DETAILING THE POLICY INTERACTIONS BETWEEN THE QUEENSLAND SOLAR BONUS SCHEME AND THE SMALL-SCALE RENEWABLE ENERGY SCHEME, INCLUDING THE SOLAR CREDITS MULTIPLIER, WHILE DETAILING THE SOCIAL, ECONOMIC AND ENVIRONMENTAL EFFECTS OF THESE SCHEMES.

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Abstract

The emergence in the need to evaluate the effectiveness of policies as a whole mix rather than evaluate the effectiveness of policies in isolation is becoming more useful as the policy environment becomes more crowded. This need is heightened considering the growing challenges of issues related to the sustainability of our energy resources. It's optimal if energy policies are not restricted to suit only economic objectives but social and environmental objectives as well, to suit emerging concept of sustainability, as energy underpins all the activity within our economy and society. The analysis of policy interactions is a relatively new approach in determining and evaluating appropriate policy mixes, rather than focusing on the effectiveness of a single policy. Sorrell (2003) has developed a systematic process for developing policy options by breaking them down into different categories for comparison. Oikonomou and Jepma (2008) have further built upon this framework in analysing policy interaction by establishing a qualitative framework as part of their methodology. The Queensland Solar Bonus Scheme (QSBS) and Small-Scale Renewable Energy Scheme (SRES) have similar objectives of increasing the implementation of small-scale renewable energy technologies. This dissertation investigates the policy interactions between the QSBS and SRES using the frameworks provided by Sorrell (2003) and Oikonomou and Jepma (2008). The results find the majority of the interactions between these policies are complementary and non-duplicative. This research recommends two policy options which support their beneficial interactions outlined in the discussion. The first policy option assumes a reduction in the tariff rate for the QSBS whilst increasing the PV system limit to 10 kW. The second policy option assumes the same system limit increase to 10 kW plus a reduction in the tariff rate for non-peak full-tariff payments during peak demand to customers who have invested in battery storage.

List of Abbreviations

RE technology – Renewable Energy Technology

RET – Renewable Energy Target

QSBS – Queensland Solar Bonus Scheme

SRES – Small Scale Renewable Energy Target

SCS – Solar Credits Scheme

FiT – Feed-in Tariff

RPS – Renewable Portfolio Standard

Solar PV – Solar Photovoltaic

eRET – enhanced Renewable Energy Target

SGUs – Small-scale generation units

GHG – Greenhouse Gas

Introduction

This research is based upon the subject of policy interactions. Two different policy mechanisms are used to discuss the issue of these interactions. These are renewable portfolio standards and feed-in tariffs. The aim of this research is to detail and investigate the policy interactions between the Small-Scale Renewable Energy Scheme and the Queensland Solar bonus scheme. This is achieved using systematic processes outlined in the following (two) journal articles titled:

Oikonomou, V. and Jepma, C. (2008). A Framework of interactions of climate and energy policy instruments. *Mitigation and Adaptation Strategies for Global Change,* 13: 131- 156.

Sorrell, S. (2003). Interaction in EU Climate Policy. Final Report. March 2001 to March 2003.

The specific objectives of this research are:

- To explore the operation of renewable portfolio standards and feed-in tariff policies whilst briefly exploring the variety of policy approaches different countries adopt around the world.
- To detail and analyse the policy interactions between the Small-scale Renewable Energy Scheme (SRES) and the Queensland Solar bonus Scheme (QSBS) incorporating the systematic process employed by Sorrell (2003) using the following criteria: scope, objectives, operation, implementation and timing.

- To detail and analyse the policy interactions between the SRES and QSBS using the following criteria as described in Oikonomou and Jepma (2008): measure/identification, objectives, scope, market arrangement, market flexibility, financing, technological parameters, timing, compliance parameters and institutional set up.

- To investigate where the interaction of these schemes have complementary effects, and where these schemes have counterproductive effects.

- Develop a basic evaluation of the impacts the SRES and QSBS have on a few similar topics described in Oikonomou and Jempa (2008).

- To discuss the social, economic and environmental impacts of these schemes in the realm of sustainability.

- Make suggestions and recommendations of how the performance of these policies can be improved based upon the findings of interaction analysis between the SRES and QSBS.

- Provide and discuss two possible integrated policy schemes.

Limitations to this research

Some of the limitations to this research include:

- It proved to be difficult to source accurate data from various Government bodies, as some data is protected and not available to the public.
- I did not have sufficient time or capacity to fulfill the full multi-criteria assessment as employed through the methodology of Oikonomou and Jepma's (2008) in order to suggest possible integrated schemes.
- As the Renewable Energy Target policy changed to the enhanced Renewable Energy Target mid-project, some of the results and data released from the Office of the Renewable Energy Regulator was indirect.
- There was a very small amount of data released about the financial aspects of the SRES since it is so young in implementation and certain data was not made available to the public.
- There was very limited statistical data for the QSBS available for the public. Most of the information I have sourced is from Mark Hazle, a policy officer from the Office in Clean Energy in Queensland and annual reports from energy retail providers such as Ergon Energy and Energex.
- As the study of policy interactions has not been sufficiently explored, there is a limitation in research papers directly

regarding policy interactions. (Some research papers were inaccessible in doc format).

Chapter One

What are policy interactions and why is the study of policy interactions important?

The analysis of policies in combination rather than single policies is starting to prove itself as a successful method in evaluating a policy's overall effectiveness and efficiency. Policy instruments are used to fulfill a variety of social, environmental and economic objectives. Considering the growing challenges of global issues relating to sustainability of our resources, the importance of careful structuring of energy related policies as a whole mix is becoming a priority. Throughout this chapter I will be discussing the different categories of policy instruments and the emergence of the analysis of policy interactions. I will also be giving a brief description of Oikonomou and Jepma's (2008) methodology for assessing different aspects of policy interaction criteria and the systematic process for investigating policy interactions employed by Sorrel (2003) with his investigations with the INTERACT project in Europe from 2001 to 2003.

Australian governments utilise a variety of policy instruments to fulfill a variety of social, environmental and economic objectives. Government bodies prescribe each policy by considering the many factors and criteria that they may need to fulfill in order to reach the particular objectives. These criteria vary, and can include cost minimisation, level of enforcement, equity and fair distribution, transparency, accountability, efficiency in administration and level of certainty to reach the specific objective. Examples of specific objectives are: increasing the efficient use of resources, internalising externalities, changing behaviour and promotion of technological innovation.

Different policy instruments are chosen to suit different needs. These include command and control instruments such as coercive regulatory policies, market-based policies with economic incentives such as taxes and tradable certificates, subsidies such as investment schemes, and finally education and awareness policies with the intent of both raising awareness and communicating information.

Oikonomou and Jepma (2008) use Figure 1 (below) to categorise the different range of government policies. In degrees of enforcement, the strongest policy is regulation (command and control), followed by certificates and taxes (market based), negotiated voluntary agreements (organisational method) and standard setting (prescriptive method). Weaker policies include labelling to increase awareness, government subsidies such as grants, loans, and tax incentives and upfront measures such as RD & D and policies for awareness and communication.

Figure 1.1 – Different categories of policies. *(Source – Oikonomou & Jepma, 2008, p. 135).*

For example, applied policies such as direct regulation (command and control) enforces a specified behaviour required of organisations or individuals (Australia. Australian Public Service Commission., 2009, pp. 4 - 5). Direct regulation policies can be efficient in some areas as they are dependable, though they may not function effectively working alongside policies such as economic instruments. On the other hand, economic instruments aim to influence and control behaviour through market price signals without the need for direct intervention (Australia. Australian Public Service Commission., 2009, p. 10).

The method by which energy-related policies are designed is crucial to reaching an optimal outcome. It's optimal if energy policies are not restricted to suit only economic objectives but include social and environmental objectives. Emerging concepts of sustainability should also be constant, as energy underpins all the activity within our economy and society.

It has become evident that rarely will one policy work effectively alone to solve all objectives. Recently, the need has risen to evaluate the effectiveness of a range of government policies as a whole mix, rather than evaluating the effectiveness of policies in isolation. In the field of policies relating to climate change and renewable energy, Fischer and Preonas (2010) highlight this issue that "less attention has been paid to how well the supporting policies work together - or whether they may work at cross purposes... As a result, the net effect of those overlapping measures is much less transparent" (p.1). Sometimes the strength of a policy instrument can be about it being part of a policy mix. Gunningham and Sinclair (1998, p.3) reinforce this by discussing how while individual instruments have both strengths and weaknesses, none is strong and effective enough to successfully meet the objectives to solve problems. To conclude, the Australian Public Service Commission (2009) describe how *"…*the best way of overcoming the deficiencies of individual instruments while taking advantage of their strengths, is by designing a combination of instruments instead of relying on a single type…" (p. 12).

An evaluation of policies as a whole mix can be a difficult task. Fischer and Preonas (2010, p.8) describe this challenge as attempting to "disentangle" different policies, especially as the range of different policies prescribed by Government bodies may overlap at different stages in the policy cycle. This can be a result in an over-crowded policy environment. The effects of these policies overlapping may be either negative or positive. The study of the effect of policies on each other can be termed as policy interactions, i.e. policies can be complementary, competitive or self –exclusive (Oikonomou & Jepma, 2008, p. 132). Fischer and Preonas (2010) discuss how the current amount of research into empirical studies related to renewable energy policies is very limited: "Such policies tend to be more recently enacted and non-technology- specific, both factors that reduce the likely availability of robust, relevant datasets suitable for statistical analysis" (Fischer & Preonas, 2010, p.9).

Rio (2010, p. 4988) believes that in general, policy analysis should be based upon the design of the whole mix of instruments, rather than the design of instruments in isolation. Rather than focusing on the effectiveness of a single policy, the analysis of policy interactions is a relatively new approach in determining and evaluating appropriate policy mixes (Sorrel, 2003, p.vi). Many policy advisors support the importance of measuring the functioning policy mixes as a whole mix and the synergies between the policies, rather than simply analysing the strengths and weaknesses of individual policies.

Oikonomou and Jepma (2008) provide an introduction to the concepts of policy interactions where they "analyse the concept of interactions between policy instruments addressing environmental, energy and climate change issues" (p. 131). They achieve this by establishing a qualitative methodology that allows for certain criteria to be investigated in order to compare the interactions between different policies. The specific criteria and parameters which Oikonomou and Jepma (2008) incorporate within their evaluation method are measure identification, objectives, scope and target groups, market arrangements, market flexibility, financing, technological parameters, timing, compliance parameters, and institutional set-up.

This methodology, which incorporates a complex multi-criteria assessment assists policy makers in choosing an optimal policy mix. Their method has been specifically developed for climate related policies and as a template to be used for other policy combinations. Table 1.1 below contains a brief description of each criteria of policy interaction incorporated by Oikonomou and Jepma (2008).

Policy interaction criteria	**Description**
Measure/identification	The policy title.
Scope and Target groups	Sectors, sites and individual emission sources that are directly or indirectly affected by the policy.
Objectives	Depicted in specific energy, emissions or other environmental targets.
Market arrangements	Administrative obligations imposed on the target group, including the functioning, monitoring and reporting and obligations of reporting parties.
Market flexibility	Borrowing and banking and methods of

	trading allowances.
Financing	Cost recovery
Technological parameters	Eligible technologies
Timing	Introduction of each policy in the mix, potential changes that might take place in the life-cycle of each instrument and the flexibility of instruments in terms of reaction of target groups.
Compliance parameters	Penalties and sanctions for effective enforcement.
Institutional set up	Different bodies and background legislations, verification procedures and registry provisions.

Table 1.1 – Criteria for the assessment of policy interactions.

(Source – Based upon Oikonomou & Jepma (2008), pp 131-156)

The methodology provided by Oikonomou and Jepma (2008) is similar to a systematic process for investigating policy interactions employed by Sorrell (2003) for the INTERACT project. This project explored the policy interactions and relationships between the European Union Emissions Trading Scheme and other climate policy instruments in Europe (Oikonomou & Jepma, 2008, p 135). Sorrel uses similar criteria as Oikonomou and Jepma (2008) through his systematic process of examining policy interactions: scope, objectives, operation, implementation and timing.

Sorrell (2003) states “policies are introduced to compensate for the problems and challenges created by other policies, rather than simply to address external problems” (p.144). Focusing on investigating and improving how policies function more effectively with one another instead of the risk of throwing more policies into an already congested policy mix seems to be of benefit. The emergence in the study of policy interactions has highlighted how important investigating the effect single policies have on each other when combined. The lack in mainstream use of methodologies for analysing policy interactions is largely due to the complex task involved with evaluating the effect of policies as whole mix. Oikonomou and Jepma’s (2008) article has provided a sound methodology through the organisation of their criteria and multi-criteria assessment method. Whilst Oikonomou and Jepma’s (2008) has provided a good design in evaluating policy interaction’s Sorrell (2003) has also provided a simple systematic process for investigating the relationships and interactions between policies.

Chapter Two

Why is there a need for efficient policies to support the deployment of renewable energy in Australia and why is solar PV significant?

There are plenty of reasons why we need efficient and effective policies to support the deployment of RE technology units in Australia. These include global warming, energy security, rising oil prices and the increasing evidence that current trends are unsustainable. Throughout this chapter I will be discussing some of these factors that contribute to the need to support the development of renewable energy technology units. These factors include: Australia's energy production and support for the growth in energy demand and Australia's GHG emissions as a result of energy production. I will also be discussing both Australia's and Queensland's response to these issues through the deployment of RETs, market barriers to this deployment and why solar PV is a reasonable choice in Australia.

There are many factors that contribute to the need to support RE technologies. These include the rise of dangerous anthropogenic greenhouse gas emissions, depleting oil resource, rising fuel prices, and energy security. The increasing acceptance of the evidence for the causal relationship between human energy consumption, GHG emissions and global warming supports an incentive to derive energy supply from renewable energy resources. Australia's level of greenhouse gas emissions (GHG) is a factor that strongly supports the need to convert to low carbon-emitting renewable energy resources. Within the scope of the Organisation for Economic Co-operation and Development

(OECD), Australia is one of the largest per-capita emitter of GHGs (The Garnaut Climate Change Review, 2008, p.153). This is a result of Australia's intense use of coal to produce electricity, in which coal accounts for 76 percent of emissions (Buckman & Diesendorf, 2010, p. 1). Australia has experienced the fastest growing source of emissions, mainly derived from GHG emissions from electricity production, between 1990 and 2007. Emissions are forecast to grow a further 40 percent between 2006 and 2020" (Buckman & Diesendorf, 2010, p.3).

Global warming is regularly referred to as one of the most comprehensive challenges facing the international community. Global warming is a result of global atmospheric concentration of carbon dioxide and other GHGs, and has increased evidently as a result of human activities since 1750; the emissions now far exceeds preindustrial values (Gupta, et al. 2007, p.748). One of the most prominent causes of global warming is the result from a build up of both natural and anthropogenic greenhouse gases (GHGs) in the atmosphere that absorb outgoing long-wave radiation (Cusack, 1999). The impacts of climate change are difficult to determine due to variables creating a range of uncertainties. The Intergovernmental Panel on Climate Change (IPCC) have published a series of climate models based on a range of possible scenarios under different conditions, which estimate impacts to varying degrees of likelihood. Some of the effects of climate change that are already noticeable include melting of glaciers and snow cover, a rise in average sea level, prolonged droughts, heavy precipitation and intensity in cyclones (Gupta et al., 2007, p.748).

The United Nations Framework Convention on Climate Change (UNFCCC) has reported that one of the highest growth rates globally in GHG emissions comes from energy supply (UNFCCC (a) 2008, para. 2). As the science of climate change and its impacts are progressively becoming clearer, policies supporting mitigation and adaptation strategies are increasing. Greenhouse gas abatement policies in the form of regulations and standards, taxes and charges, tradable permits, subsidies and incentives, and voluntary agreements are examples of strategies for reducing greenhouse gas emissions (Gupta et al., 2007, pp. 750-751).

Australia’s energy production accounts for 2.4 percent of the world’s primary energy production. It is the ninth largest energy producer in the world (Australia. Department of Energy Resources and Tourism [DERT], 2010a, p.1). Overall, energy production in Australia is dominated by coal that accounts for 76 per cent, natural gas accounting for 16 per cent, oil 1per cent and renewables 7 per cent. (DERT (a), 2010, p.21). A report by ABARES (2010) stated that during the period of 1998-2008 “energy production increased at an average rate of 3.5 per cent per year, compared with 3.2 per cent over the previous ten years” (p.7). Figure 2.1 (below) demonstrates how primary energy resources are distributed in Australia.

Figure 2.1 - Share of total primary energy in Australia. *(Data source – International Energy Agency, 2008)*

Australia's East Coast electricity network had reformed in 1998 to become the National Energy Market (NEM). The objective of the NEM, as the National Electricity Law states, is: "to promote efficient investment and efficient operation and use of electricity services for the long term interests of consumers of electricity in respect to- (a) the price, quality, safety, reliability and security of supply of electricity, and, (b) the reliability, safety and security of the National Electricity System (Australian Energy Market Operator, 2009, para.3). The liberalisation of the energy sector in Australia provided a fresh opportunity for retailers to contract with generators through the market to negotiate their own deals, thus increasing competition. On the 1st of July 1997, the electricity industry in Queensland needed to be restructured to join in the

NEM. This was achieved by separating the single government owned company into three competing generation corporations (Queensland, DEEDI, 2010, para.2). This gave the people of Queensland a choice of electricity and energy suppliers. Since 1998, the Queensland government has progressively introduced retail competition in Queensland's energy markets (Queensland, DEEDI, 2010, para.2). Bouffard and Kirschen (2008, p.4505) discuss the liberalisation of the energy market and discuss how the process of shifting one's reliance from a few centrally provided energy sources such as coal–fired electricity to many more smaller, localised sources will see improved reliability and security of supply through diversification of available sources of energy. This is beneficial as one source can act as a substitute if another energy source is in low supply.

Population growth places extra pressure on energy supply. Second to Western Australia, Queensland has one of the fastest growing populations in Australia. A *Population Projections* report in 2008 by ABS indicates that "Queensland is projected to experience the largest percentage increase in population between 2007 and 2056, more than doubling the 2007 population of 4.2 million to 8.7 million people by 2056" (Australia. ABS, 2008, p.8). This population growth will result in a greater demand for energy, and the need to continue to upgrade and expand Queensland's electricity infrastructure. This will further place pressure to increase the price of electricity.

Between 1990 to 2007 net greenhouse emissions in Queensland increased moderately by approximately 8.9 percent from 166.7 Mt CO_2 ¯to 181.9 Mt CO_2 and highlighted how Queensland's GHG emissions are still predicted to rise to approximately 250 Mt of $CO^{2\text{-}e}$ in 2050 (Queensland. Office of Climate Change, 2009, p.17). Figure 2.2 (below) shows how Queensland's CO2 compare to other countries and Australia's average. Queensland's GHG emissions per capita of 46 units grossly exceeds the average in OECD countries of 14 units and is over seven times in excess of world GHG emissions per capita (Queensland. Office of Climate Change, 2009, p.16). Queensland's average of GHG emissions is approximately 50 percent above the Australian average gives enough reason for the need to choose policies to reduce Queensland's GHG emissions per capita.

Figure 2.2 - Comparison of CO_2 emissions. *(Data source – Queensland Government, Climate Q, 2009, p 17)*

To complement Queensland's rapid population growth, Queensland became the second highest consumer of electricity in Australia by a 29 percent growth in consumption between the years 2000 and 2008 (DEEDI 2010b, para.1). This growth in energy consumption is expected to continue over the next decade at least. The Queensland Department of Employment, Economic Development and Innovation (DEEDI) have predicted that an extra 34 MW of generation capacity will be needed by as early as 2015 and an extra 394 MW of generation capacity will be needed by 2016. At the same time, Queensland has a significantly large proportion of intensive users of energy in Australia, due to farming practices in regional areas (DEEDI (b), 2010, para.3). Figure 2.3 (below) shows how energy demand is rising in areas with steady population growth, especially in Queensland and NSW.

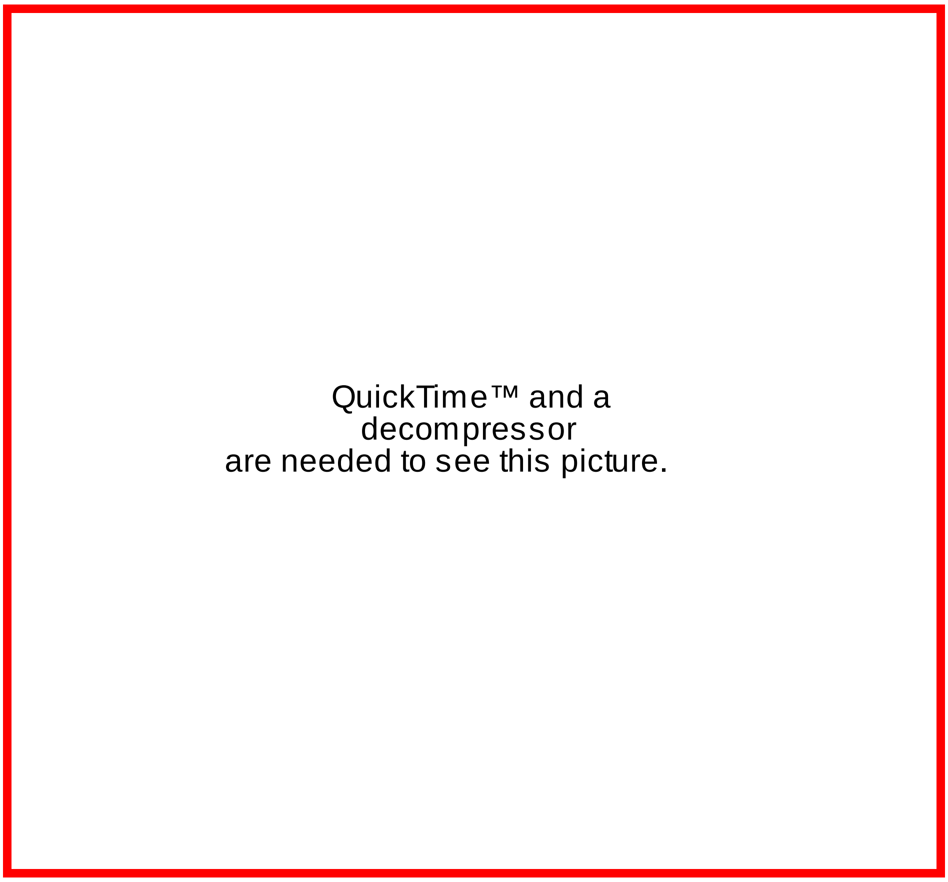

Figure 2.3 - Growth in maximum demand in the NEM – 2001/02 to 2019/2020. *(Data source – AEMC, 2010, p.7)*

The projected population growth in Queensland has created extra demand on our electricity supply. This extra demand has created incentive for the Queensland government to reduce GHG emissions, use less coal and convert to clean energy sources. The Queensland government has been forced to not only think about the amount that will need to be supplied but to think about increasing its diversity of supply, most importantly to include renewable sources **(**Queensland. Climate Smart, 2007, p 6). Most electricity in Queensland is generated by coal-fired power stations, though the number of gas-fired power stations is increasing (Queensland. DEEDI (b), 2010). Along with the liberalisation of the energy market in the nation and the development of full retail competition in Australia, the number of partial or fully privately-owned power stations in Australia is increasing.

While renewable energy technologies offer many benefits to global energy security, there exists a range of market barriers that inhibit the growth of technological development. Market barriers can be anything that can slow the rate at which the market for a technology is able to expand. Painuly (2001, pp. 79-80) discusses many market barriers that affect the uptake of renewable energy technologies in general. These include:

- Market failure/imperfection,
- Market distortions,
- High economic and financial costs,
- Institutional,
- Technical,
- Social, cultural and behavioural issues,
- Lack of infrastructure, and
- Uncertain government policies (Painuly, 2001, pp. 79-80).

The current state of the incumbent technology infrastructure gives reason to why new RET’s have difficulty entering the market; this being just one example of the many barriers of entry restricting renewables, as well as capacity, storage and upfront capital costs. Menanteau et al. (2003) explains that “by creating incentives for electricity producers to adopt renewable energy technologies, public policies, also referred to as market opening policies, are aimed at stimulating technical change and learning processes that will enable costs to be brought down to an economically competitive level" (p.800). The government is responsible for supporting the propagation of RE technologies, or else these technologies will not be implemented liberally. Considering the dominance of the fossil fuel market, the diffusion of RE technologies cannot be left to the invisible hand to achieve alone, as the government, in a democratic society, is responsible for taking care of the interests of society.

The government supports the investment of renewable energy for many reasons, as previously discussed. This includes breaking this associated cost market barrier to support technical development over a variety of different geographic areas in Australia. It also includes increase the diversity of choice of available RET systems in Australia to enhance energy security. Though the major hurdle in integrating new renewable energy technologies in the incumbent non-renewable energy supplies that Australia is dependent upon is to break the associated cost market barrier. This assists emerging RE technologies become economically competitive with other energy sources to reach grid parity.

What is technological change? CSIRO defines the process of technological change as "an experience or learning curve, where the cost of the technology decreases by a historically measured percentage (learning rate) for every doubling of cumulative capacity or output. As more capacity is installed in the future, the cost can be projected to all over time. However, recent experience of increased real power plant prices has reminded us that other drivers can at times exert a stronger influence on the price trajectory” (Hayward & Graham, 2011, p.3). There are many reasons why it is important to support technological change. These include; innovation to improve efficiency with the aim of lowering the output of emissions, improve the financial viability of energy supply, reduce the demand side effects that relate to energy sources and improve the supply side effects of mixed energy sources. The market integration and implementation of renewable energy technologies need to be supported, especially if there is reasonable potential for cost reductions for technologies with high cost barriers (Rio, 2010, p.4988)

To achieve grid parity for emerging RE technologies such as solar PV it is important the government supports both the short term and long term aspects of efficiency in technology change to provide a greater assurance of support for emerging technologies. Appropriately constructed and well thought out FiT policies assist in reducing these high cost market barriers associated with solar PV deployment by providing a long-term utility contract with a reliable method of return payment (United States of America. Department of Energy Efficiency & Renewable Energy, 2009, p.10) This assists in bridging the gap between high emitting non-renewable energy sources and low emitting renewable energy sources. A report by Green Energy Markets in 2010 has found that “the financial attractiveness of solar PV has improved significantly from the beginning of 2010. The indicative financial payback improved by around 40% (driven largely by a reduction in installed system costs) which in turn lead to a significant increase in the number of solar PV systems submitted for REC creation from May 2010 onward” (p. 15).

Renewable energy sources offer an alternative to polluting non-renewable energy sources such as oil and coal. Renewable energy has greater social and environmental benefits and are increasingly being desired as an alternative energy source. According to Berry and Jaccard (2001) “definitions of renewable electricity vary but typically include any electricity produced from a renewable fuel source such as sunlight, wind, geothermal heat, wave or tidal energy, running water and organic matter “ (p. 263).

Although Australia still faces a number of market barriers regarding deployment of RE technologies, it has still made significant and steady progress. Figure 2.4 (below) demonstrates both the percentage and rate of growth of RE technologies between 2002 and 2008. This graph shows that all RE technologies, except for hydroelectricity technologies due to drought conditions, show steady growth especially from 2004-2005 onwards.

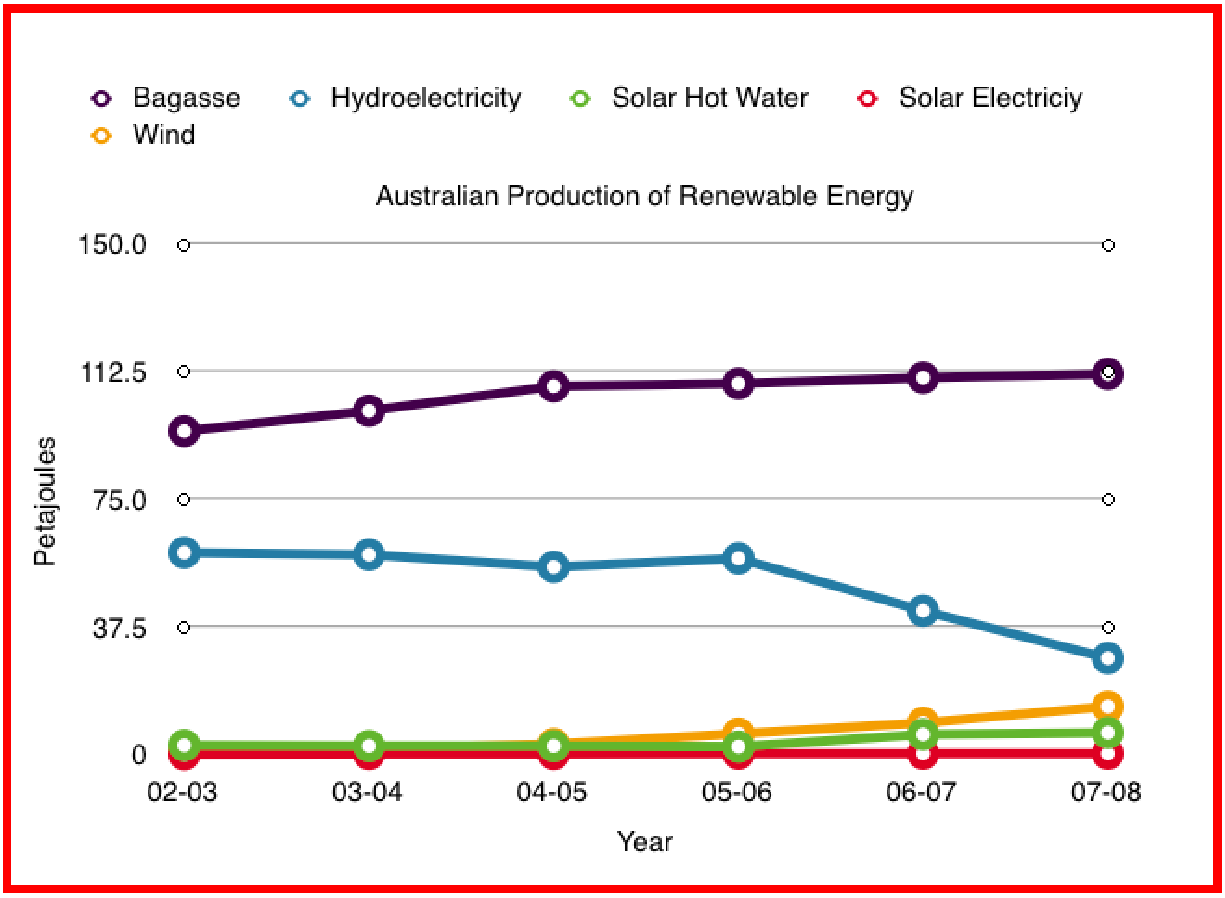

Figure 2.4 – Australian production of renewable energy - *(Data Source – Energy in Australia, 2010, p 31)*

In 2010, ABARES (2010) report found that renewable energy accounts for 5 percent of Australia's total energy consumption and contributes approximately 7 percent to Australian electricity generation (DERT, 2010, p 31). In 2008, 87 percent of Australia's renewable energy production is comprised of hydroelectricity and biomass. The remaining 13 percent consists of wind, solar and biofuels (DERT, 2010, p.31). Figure 2.5 (below) shows the percentage of renewable energy as shared in total electricity generation globally. This figure is important to show how Australia's percentage of energy derived from renewable energy technology lags behind the global average, thus reinforcing the need to support the greater deployment of renewable energy production units, as the global average shows there is great potential for improvement. The proportion of renewable energy as part of electricity generation is receding as the total of energy production is increasing so rapidly.

Figure 2.5 – Share of RE in total electricity generation. *(Data source – International Energy Agency, 2008)*

The central mechanism of photovoltaic electricity is through the photovoltaic cell that converts sunlight into electricity. PV technology consists of semiconductor diodes that process the energy in light to convert it into electric power (Rensselaer, 2009, para.1). The International Energy Agency's *PV Solar Road Map* (2011) states that annually, the PV market has grown 40 per cent on a global scale and forecasts that PV will encompass 11 per cent of electricity production by 2050, which amounts to 4500 TWh per annum. The IEA (2011) also found that the various PV applications allow for a range of different technologies to be present in the market, from low-cost, lower efficiency technologies to high-efficiency technologies at higher cost. Zahedi (2010, p.2210) claims that the current amount of installed capacity of PV in Australia has the total of 104.51 MW, which has increased about 100 percent since 2004. The majority of this increase was between 2007 and 2008 when the installed capacity of PV increased by 80 percent. The majority of this increase of 69 percent was grid-connect PV systems which indicates that the majority of PV was installed in more populated areas with grid-access. Figure 2.6 (below) shows this steady and rapid growth in solar PV in Australia.

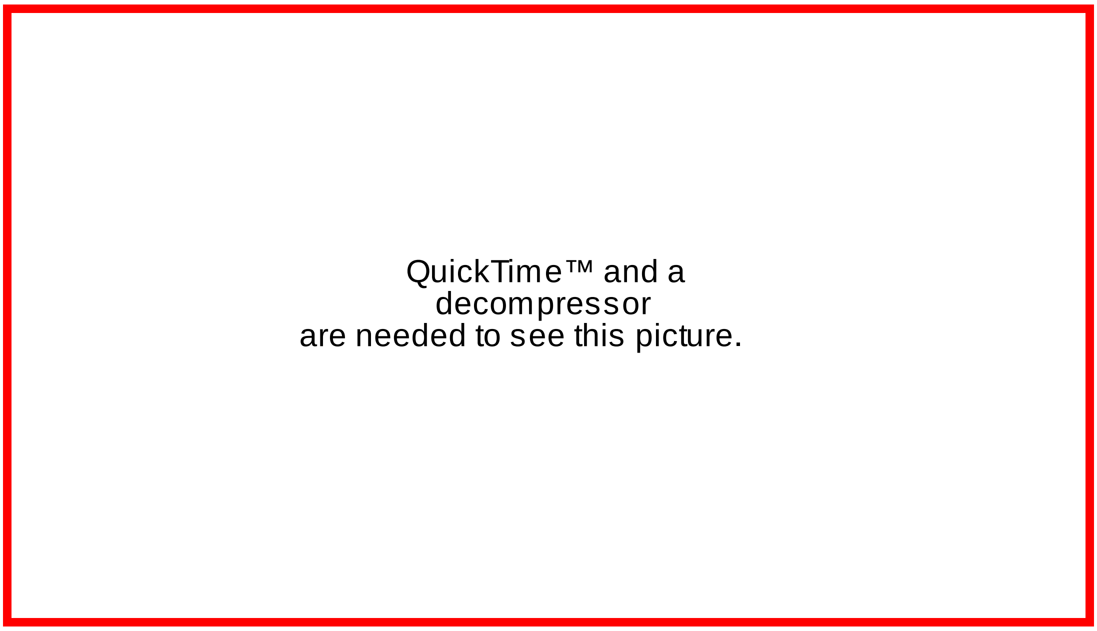

Figure 2.6 - Total installed PV capacity in Australia. *(Source – Clean Energy Council (b), 2003, p 9).*

There are many reasons why Australia chooses to support the deployment of solar PV technologies. The first is how solar energy is the most abundant energy resource on this planet (International Energy Agency, p. 5). The other reasons include: low operation costs, high reliability, non-polluting, ability to be constructed to suit different contexts, not dependent on oil, creation of industry and employment, and the long-term benefits exceed the short-term costs **(**International Energy Agency, 2010, p 5). One reason why solar PV is chosen above other RETs in Australia includes the availability of sunshine. The open-wide spaces in Australia provide an abundance of sunshine that can be utilised for renewable energy generation. Australia has an average solar radiation level of between 3 MJ (in Winter) and 30 MJ (in Summer) (Zahedi, 2009, p.871). The International Energy Agency (2010) discusses how Australia plans to utilise this abundance of solar radiation: “Australia has recently announced support for the development of 1000 MW of utility size solar generation, utilising both solar PV and solar thermal. The goal of Australia’s Solar Flagships initiative is to demonstrate the integration of utility scale solar generation into a contemporary energy network” (p. 6). This not only enhances the efficiency of renewable energy derived from solar photovoltaic systems but further confirms the support of prioritising the implementation of these systems by the government, especially in Queensland. This enhances Queensland’s potential payback from the upfront costs of investment of solar PV systems. Table 2.1 below shows the correlation between average unit costs in different parts of Australia and that there is relatively little differences between the costs of PV in Australia.

State	Annual average radiation (kWh/m^2/day)	Annual average PV electricity production (kWh)	PV production cost in $/kWh
VIC	4.44	1153	0.69
WA	5.32	1381	0.58
SA	5.25	1339	0.60
NT	6.26	1628	0.49
QLD	5.08	1321	0.60
ACT	5.20	1352	0.59
NSW	4.85	1257	0.64
TAS	4.18	1087	0.74

Table 2.1 - Average PV production cost, radiation and PV electricity production in Australia. *(Data source – Zahedi, 2010, p.3255)*

These are a few of many reasons contributing to the need to shift to low-carbon emitting renewable energy sources such as global warming and climate change, and found that current energy production derived from non-renewable energy sources is proving to be unsustainable economically, environmentally and socially. Australia, and especially Queensland, have an above average contribution to GHG emissions per capita. Queensland and Australian governments are making an attempt to mitigate this. Solar PV is RE technology currently supported in Australia due to both the success of the technologies growth in deployment globally, and the abundance in sunshine and open spaces in Australia's landscape.

Chapter Three

What are Feed-in Tariffs and Renewable Portfolio Standards?

Renewable portfolio mechanisms and feed-in tariff schemes are both popular policy mixes globally, each having their strengths and weaknesses. Feed-in Tariff (FiT) schemes are operating more predominantly and effectively in European countries, whereas RPS mandates seem to be more predominant in the United States. Fischer and Preonas (2010) support this argument by stating how "the majority of European countries have chosen to adopt FiTs as a primary RESE support policy. Outside of Europe, FiTs have been enacted in Australia, Canada and few US States, as well as in many developing nations" (p.5). RPS policies are in operation across many states in US whilst only a few countries in the European Union have RPS schemes in operation (Fischer & Preonas, 2010, p.5).

A feed-in tariff (FiT) scheme is a mechanism that provides a premium rate of payment for an amount of electricity that is fed back into a central electricity grid from a renewable electricity generation resource (Energy Matters, 2010, para.1). Most common renewable electricity generation resources using FiTs are solar, hydroelectric and wind technologies. Governments across the world are in support of FiT schemes as they are effective in providing a financial incentive to accelerate the uptake of RE technologies. The energy payment that is above market price acts creates the for renewable energy generators to produce more energy, whilst supporting an increase in market confidence (Lesser & Su, 2008, p. 983).

There are many factors why FiT policies are chosen over other renewable energy policies. Their benefits include:

- A guarantee of a long term price for renewable energy (Lesser & Su, 2008, p.985),
- A reduction in the costs and level of risk to the renewable energy producer, whilst the producer has the potential to gain a financial return from the investment (Lesser & Su, 2008, p.985),
- Effective expansion of renewable electricity capacity and increased market creation for renewable energy producers (Rowlands, 2005, p.56),
- Encouragement for smaller stakeholders to install solar PV technology (Zahedi, 2010, p.2210),
- Allowing the smaller participants in the electricity market. i.e. residential and small businesses, to create new revenue streams (Queensland. Office of Clean Energy. 2011. Para.9).
- FiTs are flexible within their design to be able to adapt to different contexts (Rowlands, 2005, p.58).

Germany and Denmark have both been global leaders of FiTs. Germany has been successful in implementing an effective and efficient FiT scheme.   Germany's scheme applies the basic fixed-priced model, which acts independently from the market and remains protected from other variables, such as inflation. Germanys FiT was introduced in its Electricity Feed-in Law in

1991, a law under which utilities are obliged to purchase renewable energy at 90 percent of the retail price of electricity, the other 10 percent being subsidised by their government (Lesser & Su, 2008, p.984). Part of the success in Germany's program is due to a digressive payment method where the tariff rates drop incrementally. This disgressive element created an incentive for people to partitcipate in the scheme sooner rather than later. This success shows in how "solar PV now requires no more subsidies in Germany" (Mendonca, 2007, p.61)

Denmark had a successful FiT program that has later been abandoned. Denmark's FiT scheme began in 1992, when it was mandatory for utilities to purchase renewable energy from private producers at a fixed price of between 70 percent and 85 percent of the retail price of electricity (Wiser et al. 2002, p 3). Denmark used FiTs during the 1990's, having a very successful result in renewable capacity development, though their scheme was put to a halt when the new conservative government entered force in early 2000. This abandonment has later proven to impede further growth of renewable energy capacity development (Rowlands, 2005, p 57).

Feed-in tariffs in Europe differ in the way that they are arranged in Australia, as they have bigger systems within their wholesale market. In Europe, the renewable energy generator is responsible for following technical standards for grid connection and operation and reporting any technical failures to the local grid operators. The local grid operator is responsible for maintaining grid operation, reporting electricity figures quarterly to the transmission grid operator and most importantly paying the tariff to the RE power plant. The transmission grid operator calculates the total generated RE electricity (based on information from the local grid operator), calculates the total feed-in tariffs based on renewable energy electricity production, breaks down the costs per kWh for the distributor, collects the money from the distributor and distributes money to the local grid operator to pay feed-in tariffs to RE operators (Mendonca et al., 2010, p xxii). The distributor is responsible for the distribution of RE electricity, as well as collection and money transfer. The consumer is responsible for getting the renewable and conventional electricity and and/or paying or receiving payment for renewable energy technology (Mendonca et al., 2010, p. xxii).

Wiser et al (2002) highlight some factors that are required for a successful feed-in tariff. These include feed-in tariffs that are;

- Designed to be as simple as possible,
- Designed to cater for a variety of renewable energy technologies,
- Designed to cater for a variety of participants,
- Designed to keep administration costs low,

Designed to remain flexible enough to capture evolving market and cost efficiencies (Wiser et al., 2002, p.1).

The target groups which FiT schemes involve include are both small businesses and the residential sector with an eligible renewable energy source, plus access to electricity grid utilities. The government is responsible for establishing the legal framework for all aspects involved with the overall distribution of electricity including both on-grid and off-grid electricity connection. The assigned Government body and Minister are responsible for determining the tariff rates. The Government does not get involved with any of the financial exchange. The electricity utilities must pay this specified rate for the specified period of time to the renewable electricity generator that are generally small business owners or homeowners.

In Australia, the amount of energy bought by the electricity utility from the renewable electricity generators may be monitored by a bi-directional meter, which connects to both the household and the grid (Queensland. Office of Clean Energy, 2011, para. 14). The electricity retailer is responsible for recording their consumption of renewable energy they buy and then providing the appropriate payment. The consumer pays for the electricity taken from the grid.

As previously discussed, under a FiT scheme the electricity utility is responsible for paying the generator for the specific price for renewable energy they purchase. There are two different sorts of metering: net arrangement and gross arrangement. The **net** arrangement is the difference between the portion of production which is used by the household and the total energy produced by the generator (Zahedi, 2010, p.3252). The **gross** arrangement is the when all of the energy produced by the renewable energy generator is bought by the electricity utility, which generally delivers higher paybacks to the generators (Zahedi, 2010, p. 3252).

For example, Australian states incorporate a variety of different schemes. The table below provides a brief summary.

STATE	MAXIMUM SIZE	RATE PAID	DURATION OF PROGRAM	MODEL
VIC	5 kW	60 c	15 years	Net
SA	30kW (10kW/phase)	44c/22c	20 years	Net
ACT	200 kW	30.16	20 years	Gross
TAS	-	20c	-	Net
NT	-	Same as consumption rate	-	Gross
WA	5 kW – 10kW	20c/kWh	10 years	Net
QLD	5 kW	44c+	20 years	Net
NSW	10 kW	60 c/kWh 20c /kWh	7 years	Gross

Table 3.1 – Feed-in tariff schemes in Australia. *(Data source - Energy Matters, 2010)*

The cost of FiTs vary in different regions around the world, depending upon different socio economic factors, though the cost of the scheme generally remains constant over the scheme's period. Kelly (2007) describes how the majority of payment levels of FiTs are normally based upon the specific generation costs. The majority of FiTs are funded by a levy which is incorporated into the electricity price. This assists with steady market growth, increases security of future cash flows and enables the generators to recover their costs of investment (Kelly, 2007, p.332). The costs of FiTs are mainly dependent on three variables: the scheme design, level of uptake, and tariff rate. In Australia, the costs for administration of feed-in tariff schemes are incorporated within each State budget, especially as it is not a State policy. The Government generally provides the initial funding for the development and administration of the FiT schemes. In Queensland, The electricity companies, such as Ergon Energy and Energex, are responsible for payments to the RE generators for electricity. The renewable energy generators are responsible for payment of their own RE technology unit, which can sometimes be subsidised through another government policy scheme.

Table 3.2 below describes some different feed-in tariff models.

FIT MODEL TYPE	**DESCRIPTION**
Fixed Price Model	Remains independent of other variables. eg. inflation.
Fixed Price Model with full or partial inflation adjustment	Allows adjustments for inflation and allows for other variables, while changes in the economy are being monitored.
Front-end loaded model	Higher level of payments in initial years of project.
Spot market gap model	Payments sit in between the spot market price and the FiT price.
Premium price model	This model offers a constant bonus above the average retail price.
Variable premium FiT model	Provides ceilings and floors to the FiT policy structure.
Percentage of retail price model	Establishes a price that is a fixed percentage of the retail price.

Table 3.2 – Different feed-in tariff model types. *(Source - Couture & Gagnon, 2010, pp.955 - 961).*

Feed-in tariff payment schemes generally operate for long periods usually between 15 and 20 years (Jacobs, 2010, p.30). This longevity in payment reduces the risk involved for investors as it increases investment security plus they can be 'designed flexibility according the framework condition of the national electricity markets and according to the specific national energy policy objectives (Jacobs, 2010, p. 30).

The institutional set-up of FiT schemes can include the government body for setting up the scheme, the body for administration of the scheme, the body for verification of the scheme and the body for registration of the scheme (Oikonomou & Jepma, 2008, p.144). FiT schemes in Australia are controlled in each state by separate legislation. Each State has a Government department that is responsible for administration of the scheme. The Minister of Energy in each State is responsible for the implementation of the regulatory arrangements.

The RPS mechanism was initially developed during the 1990's in the United States at the same time as competition in the electricity market was introduced (Rickerson & Grace, 2007, p.2**)**. A stimulus for this policy's development was the liberalisation of the electricity markets when the restructuring of the electricity systems posed uncertain effects upon market competition. At this time, non-renewable energy sources such as coal and oil restricted the emergence of renewable energy technologies. Australia was one of the world's first countries to set their RPS currently known as the enhanced Renewable Energy Target (Buckman & Diesendorf, 2010, p.4).

Renewable portfolio standards are an example of a quantity-based policy approach as they set minimum standards for regulation and/or mandate the targets that must be achieved by the specified participants. In general the main objective of RPSs is to aim to guarantee that a certain amount of electricity is generated from a renewable energy resource. RPSs are growing in popularity and have proven to display successful operations.

The Mandatory Renewable Energy Target (MRET) emerged as Australia's first RPS in 2001. The MRET scheme was adjusted in 2009 to become the Renewable Energy Target (RET). A distinction between this stage of the scheme is that the RET required 20 percent of electricity generation in Australia to be derived from renewable energy sources (ORER, 2009, p.1). The RET officially commenced in 2010, though it was not long before many concerns were raised and the Act was amended again to become the enhanced Renewable Energy Target in 2011 (Australia. Office of the Renewable Energy Regulator. [ORER], 2011). Table 4.1 (below) describes the progressive stages of the MRET to become the enhanced Renewable Energy Target (eRET).

STAGE IN POLICY	OBJECTIVES
MANDATORY RENEWABLE ENERGY TARGET (2001 - 2009)	The objective of the MRET scheme was the gradual increase in the annual target of energy derived from renewable sources reaching 9500GWh in 2010. Once 9500 GWh has been reached it will remain until 2020 resulting in approximately 3.5 percent of electricity supply derived from renewable sources (International Energy Agency, 2005, p.90).

STAGE IN POLICY	OBJECTIVES
RENEWABLE ENERGY TARGET SCHEME (2010)	The objective of the Renewable Energy Target is the same as the MRET, although the target has been increased to 20 percent. The objective is to supply an additional 45,000 GWh of renewable energy per year by 2020 whilst setting the framework for both the supply and demand of renewable energy certificates via a renewable REC market (ORER, 2010, p.4). This scheme involves a change in the shortfall charge from $40/MWh up to $65/MWh (Freehills, 2009, para.1).
ENHANCED RENEWABLE ENERGY TARGET SCHEME (2011)	The objective of the *eRET* remains similar to the former policy design target of 20%, though the scheme was split into two parts, the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). The LRET will cover large-scale renewable energy projects such as solar farms, windfarms and geothermal projects, contributing to the majority of the 20% target. The SRES encompasses smaller installations such as solar hot water, solar photovoltaic rooftop systems, small hydro and small wind systems (ORER, 2011, p.3).

Table 3.4 - History of the Australia's renewable portfolio standard.

While the implementation of solar PV dominating the implementation of small-scale generation units (SGUs)above other renewable energy SGUs offered under the SRES, an oversupply in RECs from the Solar Credits scheme has also had an adverse effect on large-scale projects. Large-scale generation projects have been stalled as a result of the oversupply. These projects include wind, bioenergy and large-scale hydro (Clean Energy

Council, 2009, p 14). This is one of the reasons as to why the Renewable Energy Target was divided into the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES).

Buckman and Diesendorf (2010) describe this counterproductive effect of the oversupply as ‘flooding’ of the market and describe these excess RECs/STCs as ‘phantom credits’ because of the important fact that these additional credits from the solar credits multiplier doesn’t have any value as they don’t substitute real units of generation. Buckman and Diesendorf (2010, p.9) describes this as counting all five RECs as contributing towards RETs target even though four of them do not represent real generation because RET’s target is expressed as a number of generation hours, and not as a future market share, and the extra RECs created under the scheme erode its target.

In February 2010, Climate Change Minister Penny Wong describes how the introduction of the excess solar credits had driven the price of RECs from $50 to $30 per certificate (Kelly & Maher, 2010). This same Ministerial speech describes how Minister Wong’s decision to divide the scheme into two meant the smaller producers would be guaranteed a stable price of $40/MWh of electricity (Kelly & Maher, 2010). Energy Minister Greg Combet commented that the need for the scaling down of this scheme was due to the falling price of RECs in conjunction with the falling cost of solar power technology (AAP, 2010).

According to the Clean Energy Council (2009, p.13) the result of this combination of policies had a counterproductive effect. This counterproductive effect resulted in a weaker price. of this combination of policies which in a weak price to be a concern as it has gone against its objectives previously stated with the renewable energy target. A recent report by ACIL Tasman in 2011 has given projections for the STC price until this imbalance is corrected (ACIL Tasman, 2011, p 18). Table 6.1 below assumes that the STC price should reach its ideal price of $40 by 1 April 2012 onwards, especially as the Solar Credits multiplier has been reduced due to this counterproductive effect.

QuickTime™ and a
decompressor
are needed to see this picture.

Table 3.4 – Small-scale certificate price assumptions between April 2011 and April 2012. *(Data source – ACIL Tasman, 2011, p.18).*

The target groups of renewable portfolio standards include associated electricity supply companies, certified renewable energy generators, wholesale customers, retail suppliers and/or consumers. Menanteau et al. (2003) describes the operation of RPSs in general. The liable entities have a few choices to reach their target including generating the required amount of electricity themselves, purchasing renewable energy through long-term contracts from a renewable energy generator or trading renewable electricity from other operators (Menanteau et al, 2003, p.803). Quota schemes such as RPSs are usually linked with RECs schemes to better equip electricity retailers meet the mandated quotas. Eligible participants are required to generate their own renewable energy or purchase certificates in equal value from eligible suppliers. This requirement is conducted through the trade of renewable energy certificates (RECs). Mendonca et al. (2010) describes some of the challenges RPSs schemes face which include the volatility of REC prices, the complexity and expense in implementing RPS schemes, plus the high administration costs involved with the trading of the RECs (Mendonca et al. 2010, p.153).

As RPSs generally couple with REC systems, RPSs use certificates to act as a commodity in the market. In general, RECs can be bought, sold or traded, depending on their current value. Renewable electricity generators can make financial profit from their own generation of electricity from renewable energy sources. In Australia, renewable electricity generators have two choices: to sell the certificates on the market where they are subject to a market price, or to surrender the certificates in a clearing house for a set price. Menanteau et al. (2003, p.800) discuss how the certificate system allows a more efficient and equitable distribution of costs where the marginal costs of production are also balanced more efficiently. REC systems can incorporate floor and ceiling prices that assist the certificate prices to remain within reasonable and acceptable limits for investors. These tradable (RECs) increase utility flexibility, reduce the cost of compliance, and enable RPS compliance tracking. Berry and Jaccard (2001, p.268) discuss how important the level of flexibility within the RPS mechanism is in achieving the target whilst reducing the costs of achieving the target. This flexibility is then transferred to increase the flexibility for trading participants in having the choice of buying credits, purchasing renewable energy from others and participants generating their own renewable energy (Mendonca et al., 2010, p.160).

Menanteau et al. (2003, p.801) RE certificates are more effective than FiTs in the promotion of technical and technological change. The eligible resources and range of renewable energy technologies utilised in a RPS will depend on both the scheme's objectives and the availability of different resource types. Different resource types will vary within different contexts plus offer different benefits. The eligible technologies will also be dependent upon what the government will support and which technologies are available in different countries. Governments make these decisions by analysing the potential and economic viability of each technology (Espey, 2000). Espey (2000, p.565) describes how the objective of REC systems is to increase flexibility and lower costs and overall how they tend to favour least-cost technologies, not a rich assortment of different renewable energy resources.

Different departments can control different segments of the functioning of RPSs. These include a body for setting up the scheme, a body for administering the scheme, a body for verifying the scheme, and a body for registering the scheme. In general, the majority of the costs of quota schemes such as RPSs are distributed across utilities and electricity customers (Berry & Jaccard, 2001, p.263). A report by the Department of Energy Efficiency and Renewable Energy (2009) in the United States of

America describes the general differences between FiTS and RPSs but also how these differences can complement each other. FiT policies focus on the support of new supply implementation by encouraging investor security, quota schemes such as renewable portfolio standards prescribe the quantity and how much customer demand must be obtained by renewable energy production (United States. Department of Energy Efficiency and Renewable Energy, 2009, p.8). Whilst FiT schemes provide the revenue streams to cover the implementation development costs to reach a fair price for the deployment of the relative technology, RPS policies focus on the amount of renewable energy that must be supplied by establishing a regulation to enforce a specific target decided by the Government body. Each scheme tackles different areas in solving a similar objective, to increase deployment of renewable energy technologies to increase production of renewable energy (p 59).

Chapter Four

Policy design of the Queensland Solar Bonus Scheme and Small-scale Renewable Energy Scheme

In order to compare and analyse policies, it is important to first organise them into different categories. As the study of policy interaction is a fairly complex task, it is vital the process is planned in an orgnaised fashion. Both Sorrell (2003) and Oikonomou and Jepma (2008) provides a good method for the first step in analysing policy interaction. Their methods are similar as the criteria which Oikonomou and Jepma (2008) used is based upon the criteria instigated by Sorrell (2003). Sorrell (2003) states that “the primary aim is to develop a systematic process for developing policy options and a framework for comparing them” (p. 9). These five different parameters are outlined below. Table 5.1, at the end of this chapter, splits the QSBS and SRES into similar categories and presents this criteria similar to Oikonomou and Jempa (2008). Throughout this next chapter the central features of the QSBS are analysed within five different parameters by.

i) Scope of the instrument

ii) The nature of the objectives

iii) The operation of the instrument

iv) The mechanics for implementation

v) The timetable of the Queensland Solar Bonus Scheme

SCOPE

Sorrell (2003) defines scope as “the target groups directly and indirectly affected by the instrument” (p. 44). There is potential that the target groups affected by two policies may overlap at some point. This point of interaction where they overlap can change as the policy changes in time, or can be modified if the overlap is resulting in a counterproductive interaction. Sorrell (2003) describes how “the first stage the process is to define the scope of each instrument and the overlaps between them” (p.44).

The target groups generally incorporated within FiT schemes include small businesses, the residential sector with eligible renewable energy sources and regional or national electricity grid utilities. The QSBS is only available for customers who live within the state of Queensland.

The Office of Clean Energy (2008) website provides criteria which citizens must meet to be eligible to participate in the scheme. Customers in Queensland must;

- Consume less than 100 MWh of electricity per year,
- Purchase and install a new solar PV system or operate an existing PV system that is connected to the Queensland electricity grid,
- Generate surplus electricity that is fed into the Queensland electricity grid,
- Have an agreement in place with either: Ergon Energy or Energex ,
- Have an appropriate meter installed,
- Have Solar PV systems with a capacity of up to 5 kilowatts,
- Have a net metering configuration,
- Submit only one scheme application per premises (QLD. Office of Clean Energy, 2011, para. 9).

The groups that the SRES targets include eligible parties such as nominated persons, agents and individuals who create RECs for eligible renewable electricity generated through the accredited renewable energy power stations (ORER, 2009, p.8).

OBJECTIVES

Sorrel (2003) describes how “the second stage of the process is to identify and compare the objectives of each instrument. Policy objectives refer to desired policy outcomes. Typically, policies will have multiple objectives and when in operation policies will have multiple outcomes“ (p.46).

The main objective of the Queensland Solar Bonus Scheme (QSBS) is to encourage the uptake of renewable energy through the implementation of solar PV rooftop systems via a feed-in-tariff scheme. The Office of Clean Energy in Queensland, who is responsible for administration of the scheme, states the scheme's objectives are: to make the provision of solar power more affordable; to stimulate the solar power industry; and, encourage energy efficiency (Queensland [QLD]. Office of Clean Energy, 2008, para. 2).

Essentially, the QSBS aims to reward customers for exporting their excess electricity which is then fed back into the grid and sold and used by other customers who may not participate in the scheme. The QSBS customers are rewarded 44c/kWh for this electricity fed back into the grid (QLD. Office of Clean Energy, 2008, para. 9). This is an example of a net FiT. "Under net metering arrangements, the electricity you generate is used to supply your own energy requirements and be payed for excess generation that is not used in the premises and exported to the grid (NSW, 2012, para. 2).

As discussed previously in Table 4.1, he objective of the *eRET* remains similar to the former policy design RET of 20%, though the scheme was split into two parts, the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). The LRET will cover large-scale renewable energy projects such as solar farms, windfarms and geothermal projects, contributing to the majority of the 20% target. The SRES encompasses smaller installations such as solar hot water, solar photovoltaic rooftop systems, small hydro and small wind systems (ORER, 2011, p.3).

Section 3 of the Renewable Energy (Electricity) Amendment Act 2009 states the three main objectives of the RET scheme:

- To encourage the additional generation of electricity from renewable sources,
- To reduce emissions of greenhouse gases in the electricity sector,
- To ensure that renewable energy sources are ecologically sustainable (ORER, 2009, p.7).

OPERATION

Operation is the third category which Sorrell (2003) incorporates into his systematic process. Sorrell (2003) describes how “For target groups that are directly afffected by two policy instruments, the obligations and incentives will overlap. In some cases, the will reinforce each other, while in other cases, they will conflict” (p. 48).

The energy distributors in Queensland are responsible for distributing the renewable energy. Ergon Energy and Energex are also responsible for administrating the finances of the QSBS, as well as the Australian Energy Market Operator. These energy distributors are responsible for paying the customers participating in the scheme 44c/kWh for their surplus electricity fed into the grid. This is over double the domestic tariff rate of 21.35c/kWh recorded 01 July 2010 (QLD. Office of Clean Energy, 2011).

The Queensland Department of Mines and Energy were initially responsible for the schemes development. Mark Hazle from the Office of Clean Energy in Queensland said that the QSBS was first announced in the year 2007 as part of the Climate Smart 2050 strategy, thus preceeding the establishment of the Office of Clean Energy. The Office of Climate Change provided data to assist with the Scheme's development. When the OCE began in October 2008, the Scheme and some of the staff responsible for its development transferred over. The Queensland government provided the initial funding for the scheme's development. Following the initial funding, the QSBS is no longer funded by the State Government. The Environment and Resource Committee (2010, p.30) discuss how the costs of the QSBS are passed through to the energy distributors onto the electricity bills of all electricity consumers in Queensland. The 44c/kWh is paid for electricity fed into the grid at times when the solar system generates more electricity than the participant uses. When the meter reader visits a customer's home or business at the end of the quarter, the total amount of surplus electricity exported to the grid and the total amount imported from the grid will be read and passed onto the retailer to calculate the bill. The customer's quarterly solar bonus payment for this excess electricity exported to the grid will be deducted from their total grid-connected electricity consumption charge on their electricity bill.

The small-scale renewable energy technology used by the generator must be eligible under the requirements of the scheme. RE technologies which can be used for FiT schemes include solar PV, solar thermal, geothermal, wind, hydroelectric, biomass, biogas, waste combustion and tidal. The QSBS specifically applies to solar PV power systems connected to the electricity grid with a combined inverter capacity of up to 5 kW. This was due to recent amendments to the scheme in 2011, which includes a rule that states one scheme per application per premise; a household or small business are both applicable (Queensland. Office of Clean Energy, 2011). The QSBS doesn't support any other small renewable generation units such as small-scale wind, hydro and solar hot water heating systems.

Implementation

Sorrell (2003) describes the fourth stage of his systematic process "is to examine how the instruments will be implemented" (p. 49).

The QSBS follows a net-metering arrangement, which utilises the difference between the portion of production that is used by the household and the total amount of energy produced by the generator. The Minister who is responsible for setting the pay back rate of 44 c/kWh hour reviews this FiT rate annually. The participants in the QSBS include voluntary household and small business owners of small rooftop PV systems using less than 5 kW, since the latest amendments in 2011. The number of participants is unlimited until the program reaches its non-compulsory target of doubling Queensland's use of solar within the next five years, equating to 500 MW of electricity capacity specifically from solar (DEEDI, 2011).

The *Electricity Act 1994* requires retail and distribution authorities to submit the required QSBS data to the Regulator at six-monthly intervals. Reporting templates are provided to assist authorities to meet their obligations. Both retail authorities and distribution authorities are responsible for providing data on the QSBS to ORER bi-annually, at the end of June and December (Queensland. Office of Clean Energy., 2011). Energex's distribution area provides approximately 64 per cent of Queensland's residential electricity services and Ergon Energy provides electricity to the remaining 36 percent (AEMC, 2010, p.18).

The QSBS is centered around upon the electricity produced from small-scale renewable energy sources. The market concentration of this is specifically based upon solar photovoltaic rooftop systems. The commodity sold is the net electricity generated from these small-scale energy systems measured per kWh. The wholesale electricity retailers are liable for paying participants in the scheme. Customers can purchase solar power systems from a solar-power system provider. Many solar power system providers offer upfront discounts in using the Federal Governments Small-Scale Renewable Energy Scheme [SRES] through the utilisation of small-scale technology certificates (STCs) (ORER, 2011, para. 4).

Figure 4.1 describes the SRES Market arrangements.

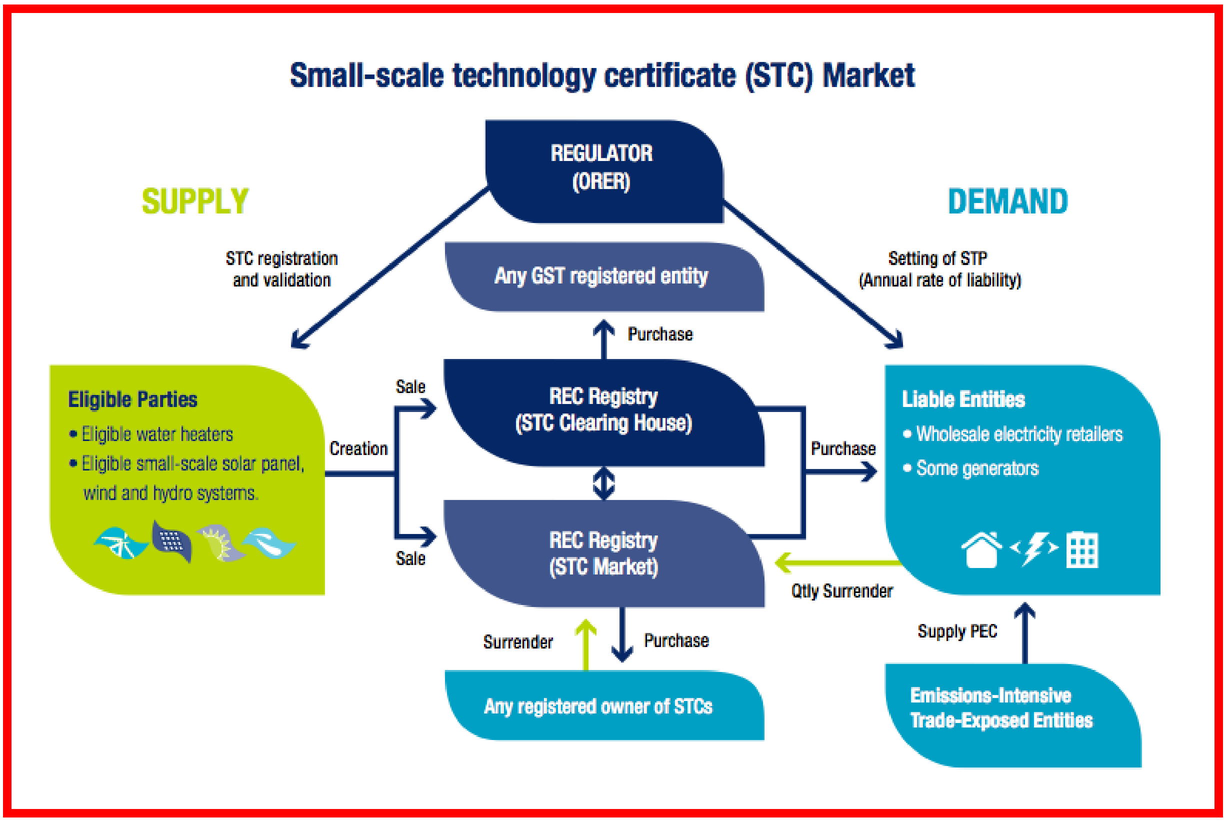

Figure 4.1 - SRES market arrangements. *(Data source – ORER, 2011, p.7)*

When the eRET came into force, the market arrangement for these certificates was altered in that the eligible parties had a choice whether to trade their certificates on the market at the current indexed price, or sell in the ‘STC Clearing House’ at a fixed un-indexed price of $40 (excl. GST). The new eRET legislation also saw a change in the solar credits multiplier scheme, allowing a multiplier to be applied to a maximum level rather than a particular level previously stipulated per year (Australia. Department of Climate Change and Energy Efficiency, 2010, para. 2).

Although the number of STCs created is not mandated, the Government hopes that by 2020, the SRES scheme supports 4,000 GWh from small-scale technologies (The Climate Institute, 2011, p.3). Rather, the Government has provided that any appropriately registered liable entity can purchase STCs from a Government-run clearing house at the price of $40, effectively fixing the price of STCs at this level. The quantity of STCs created is uncertain and will depend on the market’s response to the incentive overall (ACIL Tasman, 2010, p.1).

Timetable

The final stage of Sorrell’s systematic process is to examine the timetable of the instrument. Sorrel (2003) describes “how the timetables should specify one or more of the following: when the instrument is to be introduced, when changes are planned in the operation of the instrument, when the instrument is to be removed, how different trigger mechanisms will change the operation of the instrument, and how the instrument will respond to dynamic changes in the target group(s)" (p. 50).

The *Electricity Act 1994* legislates that the QSBS rate of 44c/kWh will remain in place until expiration in 2028. The Renewable Energy (Electricity) Amendment (Feed-in-Tariff) Bill 2008 states "the owner of the qualifying generator will receive a constant FiT for 20 years, set at the time that they register with the scheme, on all of the electricity that they produce" (ALII, 2008, para.4).

Determining the timing of the RPS scheme is particularly dependent upon both the size of the target and the type of eligible sources. One of the benefits of quota schemes such as RPSs in regards to timing is that they do not require utilities to meet the standards all at once. The policies are gradually phased in over time. Since the RPS is a quantity-based policy, the priority is made to reach the quota target, regardless of the price that remain uncertain.

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The timing of the target for the eRET follows incremental steps. Table 4.1 below shows the amount of GWh to be met each year. The legislated end date for the eRET is set for 2030.

Year	**Target (GWh)**
2011	10,400
2012	16,338
2013	18,238
2014	16,100
2015	18,000
2016	20,581
2017	25,181
2018	29,781
2019	34,381
2020 - 2030	41,000

Table 4.1 - eRET Annual Targets 2011 – 2030 *(Data Source – ORER, 2011, p. 4).*

Table 5.1 (below) is based upon the methodology developed by Oikonomou and Jepma (2008). It incorporates the five categories as Sorrell (2003) though further breaks these categories down into sub categories. This is the first step in their method of analysing policy interactions.

Measure Identification	Queensland Solar Bonus Scheme (QSBS)	Small-scale renewable energy scheme (SRES)
Measure type	Feed-in tariff scheme	Tradable certificate scheme
Mandatory or voluntary	Voluntary subsidy and incentive based scheme.	Mandatory quantity-based scheme.
Objectives		
Nature of target	Encourage the implementation of solar power renewable energy technology and encourage energy efficiency.	To encourage additional generation of electricity from renewable energy sources via the installation of small-scale renewable energy systems.
Quantitative target	Non-compulsory target to double Queensland's use of solar within the next five years equating to 500 MW of electricity generated from solar.	Small-scale technology certificates are created for these installations according to the amount of electricity they produce or displace. The SRES does not have a

		specific target and there is no cap on the amount of certificates created.
Type of target	Subsidy for renewable energy generation using a net-metering system paying 44 cents/kWh.	Tradable certificate scheme with threshold.
Threshold	Non-compulsory target to double Queensland's use of solar within the next five years equating to 500 MW of electricity generated from solar.	The SRES assists the LRET in reaching its overall target of 20% of electricity in Australia to be derived from renewable energy sources mandated by the eRET.
Emissions covered	Energy related.	Energy related.
Direct or indirect emissions	Indirect	Indirect.
Energy or other environmental goals	Energy and secondary environmental goals.	Energy and secondary environmental goals.
Reference term	Final energy.	Final energy.

Scope		
Entities bound by obligation	Participants who consume less than 100MWh per annum.	Registered agents, owners of small-scale renewable generation units.
Sectors	Energy related.	Energy related.
Sites	Voluntary households and small-business owners.	Small-scale generation units.
Market arrangements		
Non-obligated but eligible parties	Residential households and small businesses with small solar systems using less than 5 kW.	Residential households and small businesses with small systems using less than 5 kW.
Number of participants	Unlimited.	Unlimited.
Trading participants	Solar PV retailers, wholesale electricity retailers such as Ergon Energy and Energex.	Wholesale consumers of electricity and small-scale renewable energy generators.
Market concentration	Small-scale solar PV rooftop systems up to 5kWh.	Small-scale renewable energy generators such as

		hydro, wind, solar PV and solar hot water systems.
Buyer or seller liability	Liability of wholesale electricity company to pay participants in the scheme.	Legal obligation on the wholesale consumers of electricity (usually electricity retailers) to purchase and surrender STC's annually.
Market flexibility		
Market type	Electricity production.	Electricity production.
Trading commodity	Electricity generated from small-scale solar PV systems.	Small-scale generation certificates traded through the REC-Registry.
Nature of commodity	1 kWh = 44 cents	Market price paid for small-scale technology certificates (STC) or $40 to surrender each certificate in STC clearing house (1 STC = 1 kWh).
Lifetime of commodity	20 years.	1 year.

Financing		
Cost recovery	Regular payment to the household or small business for electricity generation by the electricity retailers.	Cost recovery by compliance with scheme and trade/surrender of required certificates.
Revenues raised	Revenues generated annually if renewable energy generation exceeds electricity consumption.	The financial benefit, which is generally based around the price of STCs at the time of assignment, ensures that the price of small-scale systems remains within reach of householders, and encourages the installation of more systems.
Timing		
Compliance period	QSBS contract lasts for 20 years.	Schemes current legislated end date is 2030.
Future continuation	Schemes current legislated end date is 2028.	Schemes current legislated end date is 2030.
Compliance		

parameters		
Penalty for non-compliance	None.	If a liable entity does not surrender its required number of STCs in a quarter, it will be liable to pay a shortfall charge, currently set at $65 per STC unsurrendered.
Institutional set-up		
Body for setting up the scheme	Queensland Government. Department of Mines and Energy.	ORER.
Body for administering the scheme	Queensland Government. Office of Clean Energy.	ORER.
Body for verification	Retail authorities such as Ergon Energy and Energex plus the Australian Energy Market Operator.	ORER.
Body for registration	Electricity distributors such as Ergon Energy and Energex.	REC-Registry.

Table 5.1 Areas of policy interactions between QSBS and SRES.

Discussion

Policies can be considered to be complementary if they carry over positive impacts within their policy mix and their effectiveness and efficiency will be significantly enhanced by using them in combination, irrespective of the context of the issue being addressed (Gunningham & Sinclair, 1998, p.15). Sorrel (2003) describes complementary policies as ‘policies which encourage similar changes by the target group, but the net effect of the combination of policies is considered to be greater than either instrument acting alone' (p.49). Some of the points of interactions between the QSBS and SRES can be considered to be complementary interactions, as they co-exist in a similar manner of supporting each other to reach similar objectives. In other words, they target different aspects of a similar objective (Sorrel, 2007, p. 49). In the case of the QSBS and SRES, the similar objective is the encouragement of additional generation of energy from renewable energy sources via the implementation of small-scale RE technologies. The most significant policy interaction is how the SRES provides the incentive to invest in smaller solar PV systems (1.5 kW to 2.5 kW systems) where as the QSBS provides an incentive to invest in larger systems up to 5 kW. I will discuss some of the results of these schemes in reaching their objectives, detail some of the similarities and differences, between the QSBS and SRES, detail some of the points of policy interaction and discuss how the Solar Credits policy, an important point of interaction, has increased each policy's effectiveness in the short-term.

The QSBS has proven to reach its target effectively years ahead of schedule. On July 3rd 2008, the Queensland government made the QSBS available to customers. Queensland Mines and Energy Minister Geoff Wilson reported that approximately 350 people had signed up for the scheme already by October 10, 2008 (Queensland. Ministerial Statements (b), 2008). This QSBS proved to grow at an exponential rate resulting in over 4,700 households signing up to the scheme between July 2008 and

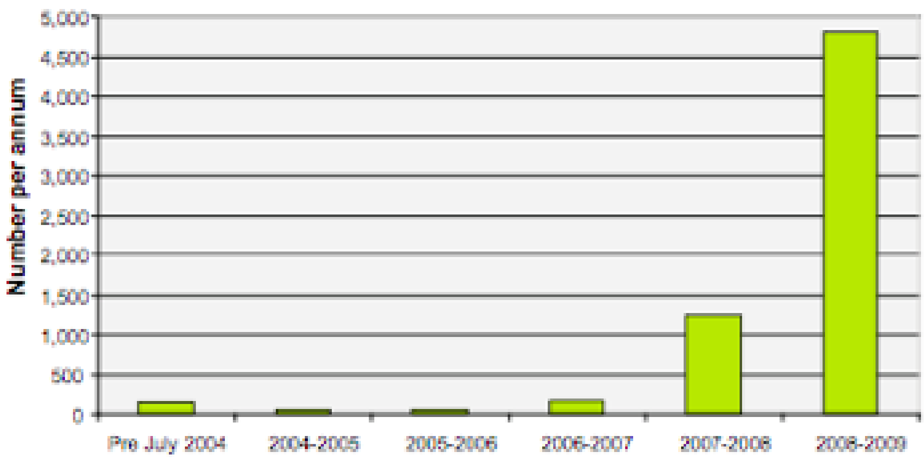
October 2010 (Queensland. Office of Clean Energy., 2010). Table 5.2 (below, the data provided by M. Hazle (personal communication, February 21, 2011) from the Office of Clean Energy In Queensland shows some figures from the 6 monthly reports gathered by this department.

PERIOD	**SYSTEMS CONNECTED IN THIS 6 MONTHLY PERIOD**	**CAPACITY CONNECTED (kW) SINCE 1 JULY 2008**
July 2008 – Dec 2008	1,893	2,819
Jan 2009 – June 2009	4,033	9,473
July 2009 – Dec 2009	9,843	24,683
Jan 2010 – June 2010	14,671	52,404
July 2010 – Dec 2010	27,213	113, 116

Table 5.2 – Bi-Annual growth in systems connected by the QSBS *(Data Source – M. Hazle, Queensland. Office of Clean Energy).*

Table 5.3 indicates how rapidly the solar uptake in QLD increased after the QSBS was implemented. Before 2008, there were only 1,200 people in Queensland supporting approximately 1.5 MW of connected solar power generating capacity in QLD

(Queensland. Ministerial Statements. (b), 2010). By December 2010, this number grown to about 113 MW with over 27,000 customers participating in the scheme, equating to an approximate growth of 1400% over 2 – 3 years. M. Hazle from the Office of Clean Energy in Queensland, commented that "as at the end of January 2011, we had 60,341 PV system owners connected to the network via the Solar Bonus Scheme with a combined total system capacity of 120,000 kilowatts" (M.Hazle, personal communication, February, 2011). By July 20th 2011, it was reported that Queensland have reached their solar energy target more than three years ahead of schedule. Minister for Energy and Water Utilities Stephen Robertson commented that "Queensland has a total of 500 megawatts of installed solar capacity**"**. (Queensland. Ministerial Statements. 2011). This 500 MW is not achieved from the QSBS alone but a combination of other policies. This attainment of 500 MW of installed solar capacity surpasses reaching their Renewable Energy Target in Queensland of 250 MW (Solar Choice, 2011).



Note 1: Figures for 2008-2009 are for 10 months ending April 2009.

Figure 5.1– Energex photovoltaic network agreements 2004 – 2009. *(Data source – Energex, 2009, p.46)*

Figure 5.4 (above) shows the rate in growth of photovoltaic agreements with Energex. During 2008 -2009, Energex's PV network agreements rose approximately four times as much as the previous year (Energex., 2009, p.47). During 2009 and 2010 there was another steep rise in the number of photovoltaic network agreements, again approximately four times as much as the previous year, "reaching a major milestone with the 20,000th solar photovoltaic connection installed in April 2010 (Energex, 2010, p.94). This rise in photovoltaic systems as part of the QSBS was at the same time the solar credits multiplier gave an attractive option by enhancing the effects of the SRES.

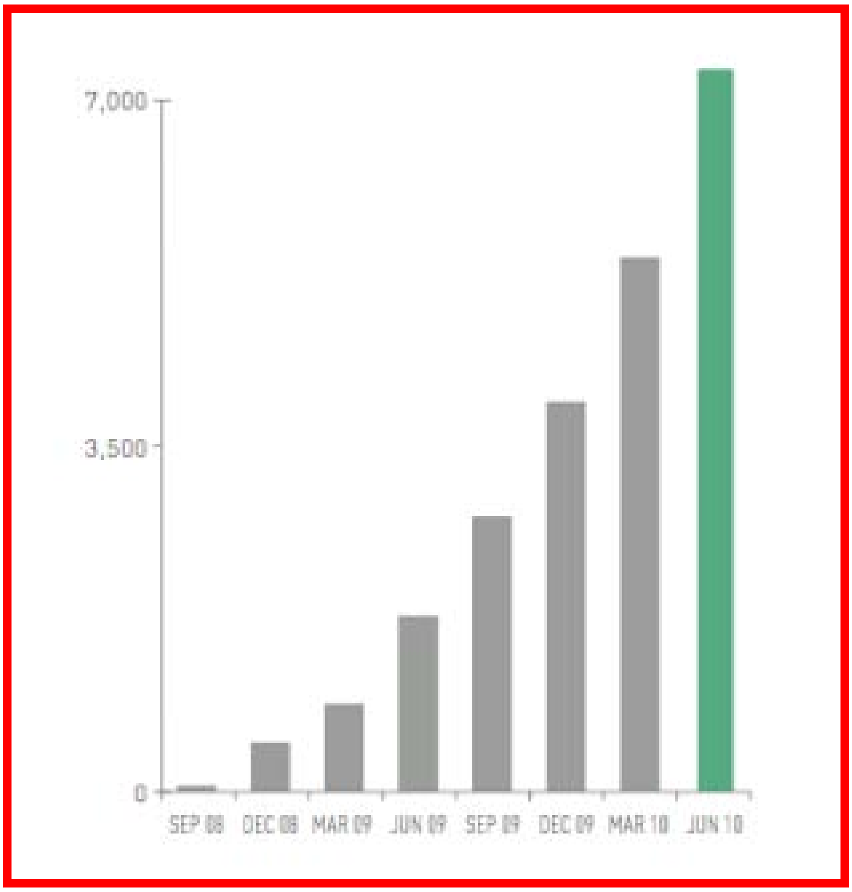


Figure 5.2– Ergon energy photovoltaic network agreements 2008 – 2010. *(Source – Ergon Energy Annual Report, 2010, p.42)*

Ergon Energy has followed a similar pattern to Energex's steep increase in photovoltaic installation around the same time the multiplier was introduced. During 2008 – 2009, Ergon Energy found that approximately 2,400 new solar photovoltaic systems were connected during that period (Ergon Energy, 2009, p. 24). During 2009 – 2010, Ergon Energy claim that they connected 5,200 customer-owned solar PV systems to their network at a rate of around 430 per month, the total number increasing by over 270 percent from the end of the previous year. All the PV systems connected to this network have a combined maximum generating capacity of more than 10,900 kW (Ergon Energy, 2010, p.42). The benefits offered by both the SRES and SBS has assisted in achieving the extra installations, supporting the objectives of both the SRES and QSBS.

Figure 5.6 (below) shows the registered installations of PV systems by state during the period of 2007 – 2010. This graph indicates there was a steady rise in all states during the 2009 – 2010 period, the largest growth of which being in NSW, closely followed by QLD, Victoria, WA and then SA, all with active FiT schemes.

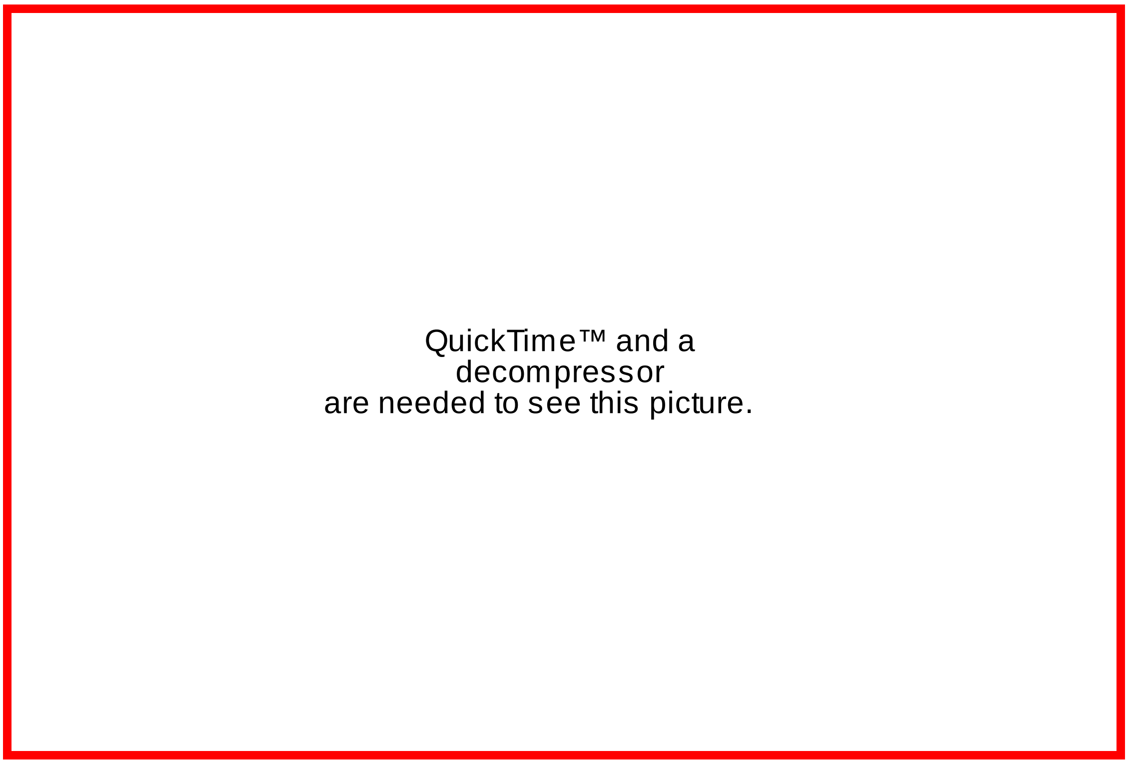


Figure 5.3 – PV installations by state in Australia 2007 – 2010.
(Data source – ORER, 2010, p.19)

Various media releases by ORER show the high level of compliance from wholesale electricity purchases and electricity retailers to the eRET that supports the high success in their results. During the years from 2008 to 2010, compliance results were all above 99 percent with only approximately three to six liable parties being assessed with a shortfall due to the failure to surrender to meet their obligation of liability (ORER, 2011(d)).

	2001-2008	**2009**	**2010**
# of registered persons applications approved	614	386	664

# of SWH & SGU installations that created RECs	311,300	240,700	275,631
# of REC's created	37,111,281	16,216,800	35,556,875

Table 5.3 - Number of RECs created between 2001 and 2010. *(Data source – ORER, 2010b, p.11) (Data source – ORER, 2009b, p.11)*

The results above from ORER have shown every stage of the RET has progressed to reach its target. Table 5.4 (above) shows the growth of the scheme. The number of RECs created and persons applications approved in 2010 is fairly similar to the number of RECs created and persons applications approved during the entire period of between 2001 and 2008. Figure 5.7 (below) demonstrates this sharp increase in solar PV installations during 2009 and 2010. This graph demonstrates the amount of installations of PV units under the RET.

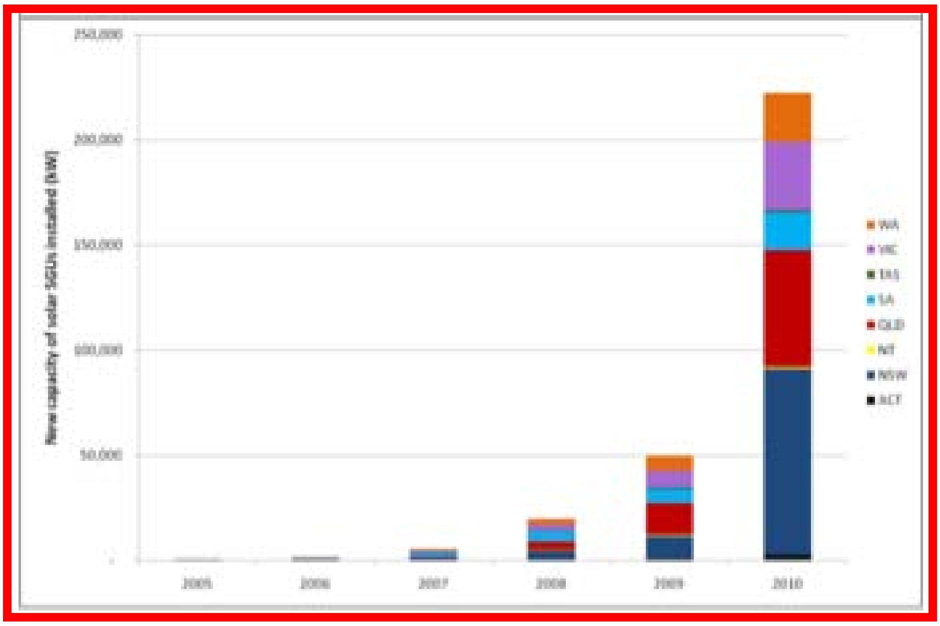


Figure 5.4 – Installation of solar photovoltaic technologies under the Renewable Energy Target *(Data source – Roam Consulting, 2011, p. 24)*

Considering the results in the previous section it is easy to see how both the QSBS and SRES have been successful in attaining their objectives and targets. Both the SRES and QSBS assist with the effective promotion, expansion and creation of markets aimed at increasing renewable energy capacity in Queensland. This is one way these schemes complement each other is how they both support the technological learning process whilst being effective in the promotion of technical and technology change (Menanteau et al. 2003, p.801). These schemes intercept again as both schemes apply to participants from households or small businesses owning a SGU that generates less than 5 kW. These schemes achieve this by fostering small-scale projects rather than supporting large-scale projects. The QSBS aims to make the provision of solar PV more affordable, to stimulate the solar PV industry and encourage energy efficiency, whilst the

SRES encourages the additional generation of electricity from renewable sources, to reduce emissions of greenhouse gases in the electricity sector and to ensure that renewable energy sources are ecologically sustainable. Both the SRES and QSBS relate to indirect energy related GHG emissions. Whilst both of these schemes have similar qualities in their target, the quantity they target differs. Their scope differs dramatically as the SRES is a nation-wide policy whilst the QSBS is a State-wide policy. Both of these schemes are uncapped, have no restriction on numbers of participants and are currently legislated to operate until a similar period (QSBS year 2028 and SRES year 2030).

Whilst the SRES and QSBS have similar objectives, they also have many differences. Firstly and most importantly is their measurement type. The QSBS as a FiT, is a subsidy and incentive-based scheme that uses money as its commodity whereas the SRES is a mandated quantity-based scheme that uses certificates to be traded for money. The second major difference between these two schemes is the scope of eligible technologies. The QSBS is restricted to supporting a small portion of the renewable technology market by fostering only solar PV rooftop systems whereas the SRES fosters a wider varuety of small- scale RE generation systems. ie. solar rooftop PV, solar hot water, small wind and small hydro SGUs consuming less than 5 kW. Another difference between these schemes is their level of enforcement. While the SRES encourages participation in the scheme via a regulatory approach (p 61), the QSBS offers a fiscal reward as an incentive for participation which greatens if participants invest in a larger system. Another difference between the QSBS and SRES is their levels of complexity within their administration processes. The administration of the QSBS is fairly simple and straight forward, providing it has been planned appropriately, whilst the administration of the SRES is fairly complex and can be a hindrance if not planned appropriately.

The QSBS and SRES intercept with one another at different points within their policy cycle. The introduction of the Solar Credits scheme (SCS), part of the eRET policy, is an important point where these two schemes intercept and interact. The SCS was introduced in late 2008 (during the RET phase) to increase the amount of RECs able to be created via the application of a ‘multiplier’ mechanism (ORER, 2011, p.8). This mechanism was added to encourage an acceleration of the uptake of small-scale RE technology units. This is achieved by increasing the financial benefit to the RE technology customer by providing an initial five-fold increase of STCs, originally known as RECs. They are successful in directing revenue towards chosen technologies. The SCS follows the market arrangements listed in the table below:

INSTALLATION PERIOD	**MULTIPLIER**
9 June 2009 – 30 June 2010	5 x (*number of eligible STCs)*
1 July 2010 – 30 June 2011	5 x *(number of eligible STCs)*
1 July 2011 – 30 June 2012	3 x *(number of eligible STCs)*
1 July 2012 – 30 June 2013	2 x *(number of eligible STCs)*
1 July 2013 - onwards	1 x *(number of eligible STCs)*

Table 5.4 – Small-scale technology certificates multiplier.
(Data Source – ORER (c), 2011)

The combination of the multiplier mechanism with the State-based FiT schemes across Australia has favoured the uptake of PV SGU's since the introduction of the SCS in 2009. An increase in the Australian dollar has also influenced this price drop as many components of the solar panels are imported from overseas (Clean Energy Council, 2009, p.4). ORER describes the SCS as "a mechanism which increases the number of STCs able to be created for eligible installations of SGUs through the use of a multiplier and applies to the first 1.5 KW of capacity installed in an eligible premises" (ORER (c), 2011). The SCS provides an incentive to encourage the acceleration the SRES and encourages implementation of solar PV systems in the QSBS by reducing the upfront costs of SGUs. The STCs are a subsidy to assist reducing the cost of the otherwise high upfront payment, which is one of the market barriers for solar PV in Australia. ACIL TASMAN (2011) describes their combination affecting each other positively in two different ways, **"**firstly, the Solar Credits policy affects the rate of STC creation for any given level of SGU installations, as it affects the number of STCs any single installation can create. Secondly, the Solar Credits policy affects the financial attractiveness of SGUs and therefore SGU installation rates" (p.15).

In combination, the QSBS and SRES schemes are complementary as they assist in promoting each other's objectives, which is to provide support for the emergence of small-scale RE technologies. In essence, they have worked hand in hand to reach their objectives faster than anticipated This benefits offered by the SRES are also be enticing for a customer interested in the QSBS. In some ways, the schemes work together as a twin subsidy. For example, the QSBS participants are required to own a solar PV SGU using less than 5 kW. The SRES and Solar Credits multiplier reduces the upfront cost of this, which means more people will be willing to participate in the QSBS whilst fulfilling the objectives of the SRES of encouraging an increase in generation of electricity from renewable energy sources via the installation of small-scale RE units (ORER, 2011).

The SRES is provides a greater incentive to encourage the investment in smaller solar PV systems between 1.5 kW as half the system size is subsidised by STCs and the SCS. Green Energy Markets (2010) project the average system size in Queensland to be purchased between 2010 and 2013 vin relation to the SRES ranges between an average of 1.76 kW and 2 kW (p.44). The QSBS provides a greater incentive for investment in larger system sizes up to 5 kW, as they provide a greater return on investment. These two schemes interact to assist each other in fulfilling each of their objectives while providing individual incentives to implement different systems. Figure 5.1 below shows the effect the STC multiplier combined with the Solar Credits multiplier has on PV solar rooftop systems of different sizes.

PV System size (kW)	System Cost ($)	STCs incl. Solar Credits	STC Reduction ($)	Final System Cost ($)	Percentage of system cost reduced by STCs (%)
1.5	5,499	93	2,883	2,616	52.4
2	6,499	103	3,193	3,306	49.1
2.5	7,499	114	3,534	3,965	47.1
3	9,499	124	3,844	5,655	40.5
3.5	11,249	132	4,154	7,095	36.9
4	11,999	145	4,495	7,504	37.4
5	14,999	165	5,285	9,714	35.2
10	29,999	269	8,339	21,660	27.8

Table 5.5 – Solar PV system costs with the SRES scheme incl. Solar Credits. *(Data source- Ingenero, 2012).*

The cost of these systems was provided by a solar supply company called Ingenero as of 6 February, 2012. This company provides solar PV rooftop systems in Queensland. The price of STCs was calculated at $31 each, which is the current market price for 1 STC on 6 February, 2012. All pricing was based upon the following criteria:

- Roof angle – 22 ^{O} (Moderate)
- Roof direction – 0^{o} (North)

- o Solar insolation – 5.22 W/m^2
- o Making a one-off 15 year payment which is the most popular.

A 1.5 kW system will accumulate 93 solar credits, as the SCS was applied for the first 1.5 kW. This resulted in a reduction of $2, 883 from the original system price cost of $5.449 down to $2,616. The combination of the SRES and SCS resulted in a 52.4% cost reduction for a customer wanting to purchase a 1.5 kW solar PV rooftop system. Figure 5.1 also shows how the percentage of system cost reduction by the certificates reduces as the PV systems increase in size. This is partly due to the omission of the Solar Credits multiplier as it is non-applicable to systems above 1.5 kW. The 3.5 kW system has a price reduction of 36.9% and the 5 kW system has a reduction of 35.2%. Therefore the saving ratio provided by the SRES incl. the Solar Credits multiplier seems to have a greater effect in smaller solar PV units. This results encouraging the additional generation of electricity from smaller-systems, which is the policy's objective. Figure 5.2 below shows how the cost reduction provided by the STC incl. Solar Credits outweighs the other half of the costs.

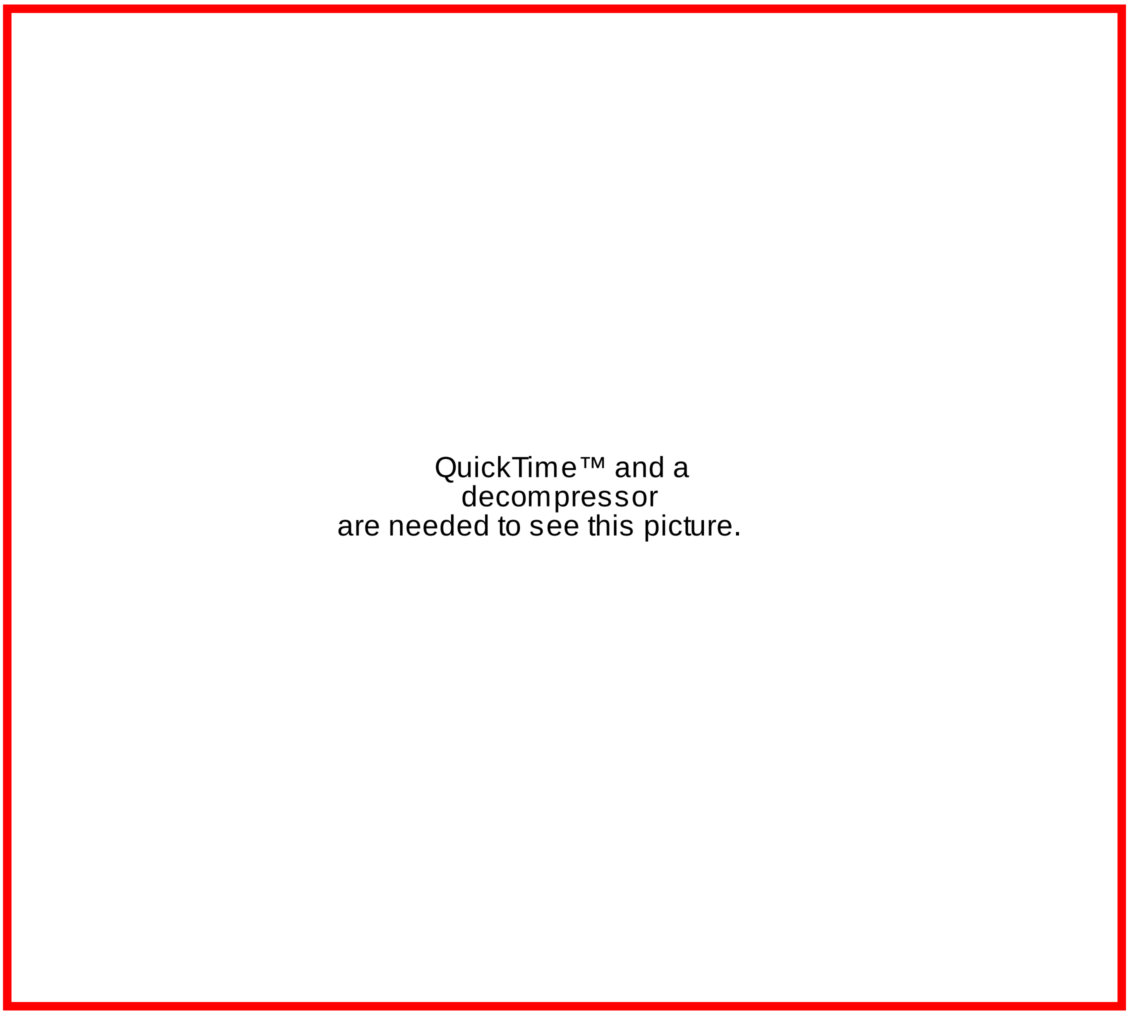


Figure 5.5 – Cost allocation when purchasing a 1.5 kW solar PV Rooftop system in Queensland 6 February, 2012. *(Data source – Ingenero, 2012)*

Table 5.6 (below) shows the return on investment for solar PV systems of various sizes. All of these calculations are based upon an annual household consumption of 7,300 kW. This averages at a consumption of 20 kW p/day.

System Size	x 4.2 kWh (QLD average)	Grid purchase kWh	2011/2012 Average price p/kWh x .22 cents	Return or cost per quarterly bill ($)	Annual cost or return ($)
1.5	6.3	13.7	-3.02	-275.6	-1,102.3
2	8.4	11.6	- 2.56	-233.60	-934.40
2.5	10.5	9.5	- 2.09	-190.71	-762.85
3	12.6	7.4	- 1.63	-148.7	-594.95
3.5	14.7	5.3	- 1.17	-106.76	-427.05
4	16.8	3.2	- 71 cents	-64.8	-259.15
5	21	- 1 kWh	+44 cents	+ 40.15	+160.60

Table 5.6 – QLD Feed-in tariff potential payback for different sizes. *(Data source – Ingenero, 2012).*

A 1.5 kW system creates an average of 6.3 kWh p/day from the rooftop system. The following 13.7 kWh needs to be bought from the grid at the average price in 2011/2012 of 22 cents p/kWh. This works out to cost $3.02 p/day on average. A 1.5 kW system in Queensland saves the customer $1.39 p/day on average. If the customer were able to purchase a 1.5 kW system with the final cost of $2,616 as displayed in Figure 5.1, then it would take approximately 1,882 days, which is approximately 5.5 years to pay the system off. This estimate is also assuming the average price of electricity in Queensland remains at .22 cents p/kWh, which is very highly unlikely.

On the other hand, investment in a 5 kW system, creates an average daily income of .44 cents. Plus the customer does not need to pay electricity bills averaging $1,606 annually, unless for unforeseen circumstances such as an extreme wet season with little sunshine. The customer of a 5 kW system would have an annual return of $160.60 from the electricity companies. Though again this estimate is not considering the increase in electricity prices. Adding the average saving on electricity bills of $1,606 and annual return of $160.60, the final system costs of $9,714 would take 5.5 years to make a return on investment also. The owner of a 5 kW system would have greater benefit long term as the system has capacity to generate more after the system is paid off.

System Size	x 4.2 kWh	Grid purchase kWh	2012/2013 Average price p/kWh 24.16	Return or cost per quarterly bill ($)	Annual cost or return ($)
1.5	6.3	13.7	-3.31	-302	-1,208
2	8.4	11.6	-2.80	-255.73	-1022.93
2.5	10.5	9.5	-2.29	-209.43	-837.74
3	12.6	7.4	-1.78	-163.15	-652.6
3.5	14.7	5.3	-1.28	-116.85	-467.37
4	16.8	3.2	-.77 cents	-70.56	-282.18
5	21	+ 1 kWh	+.44 cents	+40.15	+160.60

Table 5.7 – QLD Feed-in Tariff potential payback for different sizes 2012 – 2013. *(Data Source – Ingenero, 2012).*

Figure 5.6 (below) shows the number of RECs created for eligible SGUs between 2006 and 2010. This graph shows a gradual increase in RECs created at the same time as the start of the FiT schemes across Australia and the implementation of Solar Credits multiplier. This graph demonstrates the impact these new policies have had.

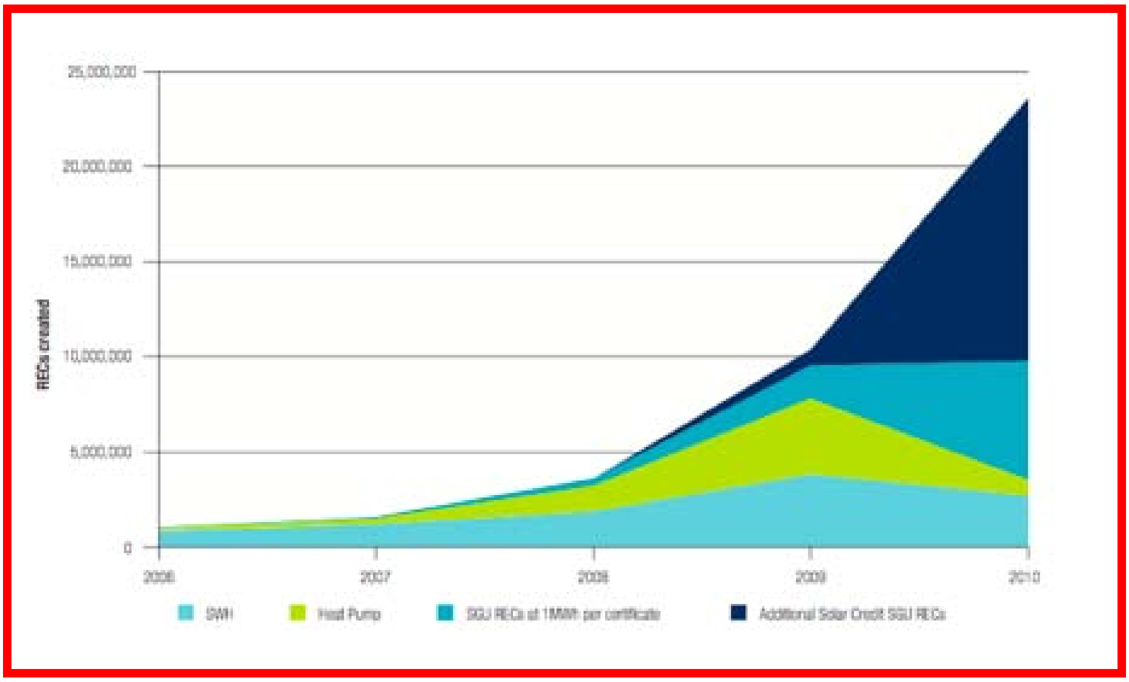


Figure 5.6 – Number of RECs created for eligible small-scale systems. *(Source – ORER, 2010, p.15)*

RPS and FiT schemes are both popular policy mixes globally, each having their strengths and weaknesses. The SRES and QSBS both assist with the effective promotion, expansion and creation of markets for increasing renewable energy capacity in Queensland and both schemes achieve this by fostering small-scale projects rather than supporting large-scale projects. The SBS and SRES share small relationships with each other at different points within their policy cycles. The introduction of the SCS, part of the eRET policy, is the peak point where these two schemes meet and interact. There is plenty of evidence that the combination of the multiplier mechanism with the state-based FiT schemes has favoured the uptake of PV SGU's since the implementation of the SCS in 2009. The QSBS has proven to effectively reach its target, years ahead of schedule.

Some interactions between different policies can be counterproductive. Counterproductive policy interactions occur when there is a noticeable reduction in the policy's effectiveness and/or efficiency (Gunningham & Sinclair, 1998, p.15). Oikonomou and Jepma (2008) discuss how "there is significant risk that different policy instruments might undermine each other's objectives and credibility"(p.132). Sorrel (2003) describes counterproductive interactions as where "the obligations and incentives created by one instrument are undermined to a greater or lesser extent by those created by a second" (p.49). Whilst most of the interactions between the SRES and QSBS have been complementary, there has also been an example of where their interception has been counterproductive.

This example of the counterproductive effect between the SRES and QSBS is the crowding-out effect that the combination of these three policies towards other RETs. The effect of crowding-out is how one policy can crowd-out and dominate the effectiveness of another policy. The QSBS and SRES differs in that the QSBS is isolated in concentration on solar photovoltaic rooftop units, whereas the scope of market concentration for SRES is broader to encompass various technologies including small-scale wind, hydro and solar hot water generation units. The oversupply of 'phantom' REC's created by the solar credits scheme has also assisted with the crowding-out effect of other policies (Buckman & Diesendorf, 2010) describes this as “when combined with the RECs earned by solar and heat pumps, it is possible there will be little room in the expanded RET for extra wind or biomass generation, at least until 2015” (p.9) The problem with this is that other renewable generators received one REC for producing the same amount of electricity as other generators who would receive five RECs. This has resulted in the emphasis on solar panels crowding out other renewables which are also included in the objectives of the SRES. This favouritism of solar PV units supported by the combination of the QSBS and SRES including Solar Credits has resulted in the crowding-out of the other RE technologies supported within the SRES policy. I.e. Micro-wind and Micro-hydro. Table 6.2 (below) emphasises this point by the amount of STCs created by solar PV above other small-scale technologies supported by the SRES.

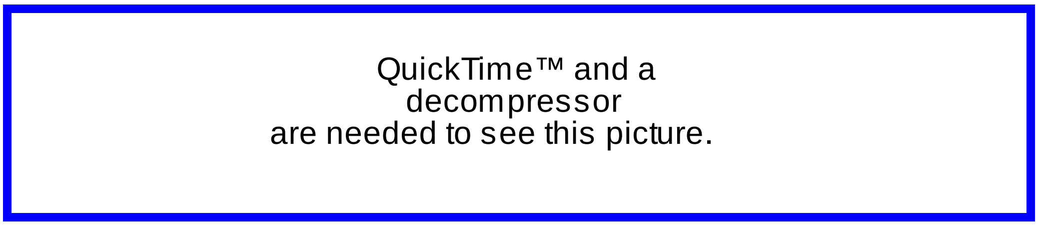


Table 5.8– Micro – wind, micro- hydro and solar PV comparison, 2001 – 2010 *(Data source – ACIL Tasman, 2011, p. 13).*

Figure 5.3 (below) displays the massive growth in solar PV from 2008 to 2010, with the largest proportion in 2010. This was at the same time the Solar Credits multiplier was at its highest magnitude in offering a five times multiplier. The Solar Credits multiplier had made the QSBS an even more attractive deal than the generous feed-in tariff model was already offering.

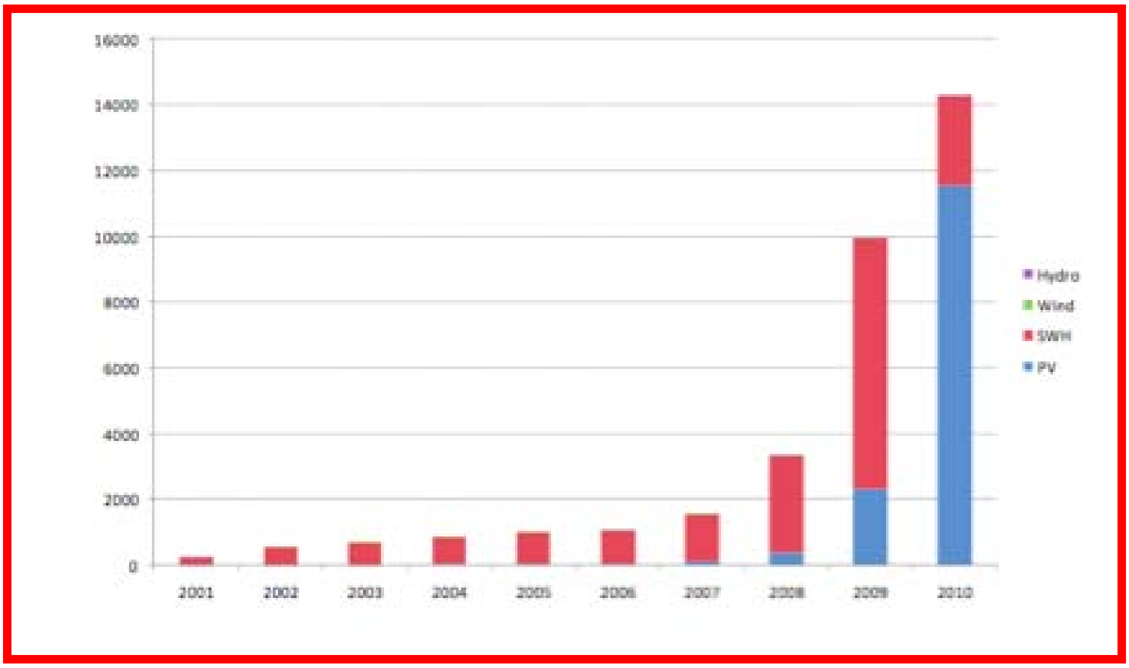


Figure 5.7 – Micro-wind, micro-hydro, solar hot water and solar PV installations 2001 – 2010 *(Source – SKM – MMA, 2010, p 7)*

Referring back to Figure 5.3, it shows how the combined solar credits and FiT subsidies have assisted solar PV installations to dominate the market share of SGUs in 2010, only a year after the SCS had commenced. In general, RECs/STCs from SWH and PV have dominated the supply of REC/STC's. The PV and SWH certificates have accounted for 70% of the total certificates (SKM MMA, 2010, p.11). An annual report by ORER (2010) found that "from 1 April 2001 to 31 December 2010 more than 853,000 deemed units from installations created REC in the REC-registry... Of the SGU installations, solar makes up 99.86 percent of installations followed by wind (0.13) and hydro (0.01)" (p.15).

A negative impact on Queensland residents imposed by the concentration and support of solar PV rooftop systems is the issue of intermittency and the dependence on the availability of solar PV. Although Australia is abundant in sunshine the constant availability of sunshine is something that cannot be depended upon. For example, Queensland may be subject to periods of lengthy rainfall and high cloud cover where there is very little solar radiation. In times of such storms and windy weather, a diversity in supply of renewable energy sources including wind sources may have been more advantageous overall.

The final negative impact the combination of the QSBS and SRES is that the influx of solar PV SGU's supported by these schemes for the QSBS to reach its goal three years early, has placed too much pressure on Queensland's electricity network as it was not yet ready for the extra energy fed back into the grid, (Solar Choice, 2011) resulting in the rejection of new applications for the scheme as of September 2011 being rejected. “In a nutshell, transformers on the electricity grid are limited in their ability to ‘absorb’ and put to use power from small-scale system; there is a solar saturation point’ after which problems could begin to develop in section of the grid” (Solar Choice, 2011,p.2). The Environment and Resources Committee (2011, p. 21) discussed the issue of the necessity of grid upgrade in certain areas in order to handle an influx in renewable energy: “The electricity grid is not a homogenous system. There are areas where you have a problem and other areas where it has been upgraded recently so there is no problem. We have that problem in the grid at the moment” (2011). The Environment and Resources Committee (2011) further discusses how this problem has the potential to become more ‘acute’ as the grid starts having about 20 percent of renewable energy on the grid, (p. 21) which is very likely considering the goals of the Queensland government included in their Renewable Energy Target.

This acceleration in uptake and implementation of solar PV units influences a drop in price for this technology as it enters the market, just as other factors support this drop in price. A report by Green Energy Markets in 2010 sees the economic case for the installation in PV. This report describes how the capital costs of solar PV systems has fallen due to variables such as; falling module prices, expansion of the market to be more competitive and the increase in strength of the Australian dollar (Green Energy Markets, 2010,p.15). Both the solar credits multiplier in the RET/SRES, and FiTs across Australia have also influenced significant reductions in installation costs through increased demand. Other variables include: “Significant reductions in installed system costs driven largely by reduced panel prices, together with the impact of the solar credits multiplier and FiTs has meant that solar PV systems have become very attractive” (Green Energy Markets, 2010, p.15). Figure 5.8 below shows the capital costs of for solar PV assumed in 2010.

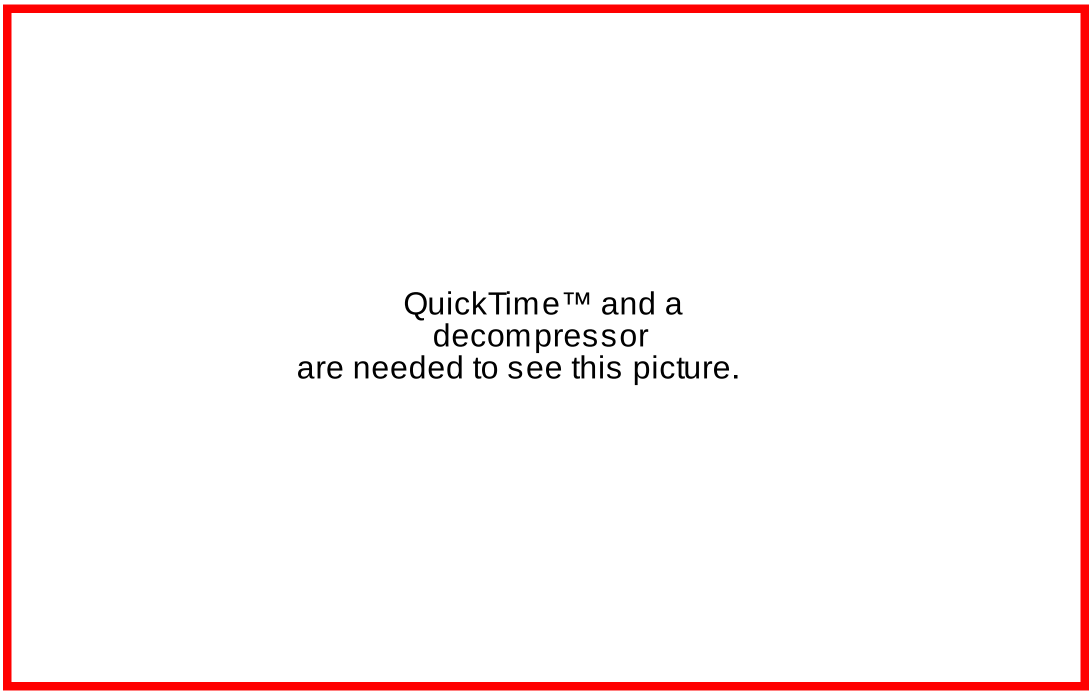


Figure 5.8 – Capital cost projections for solar PV *(Data source – SKM-MMA, 2010, p.14)*

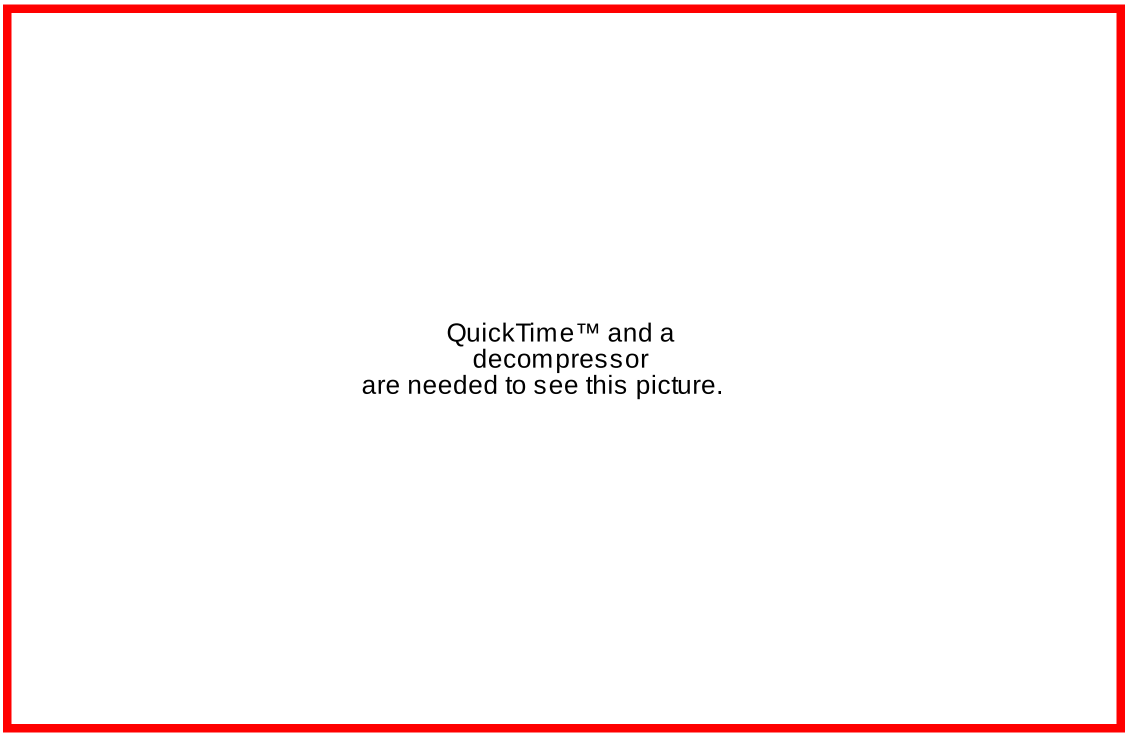


Figure 5.9 – Solar PV installation rate assumptions in Australia *(ACIL Tasman, June 2011, p. vii).*

Figure 5.9 (above) is taken from a report by ACIL Tasman released in June 2011. This report discusses how the uptake of solar PV technologies will significantly dip after mid 2011, mainly due to the reductions in the solar credits multiplier. This report explains that this dip will occur as the solar credits multiplier has ‘brought forward’ the likely sales which would have been over the next few years, as the combination of the policies posed a very attractive offer to customers to encourage immediate sale. This results in the potential reduction of future installation rates as the potential customers have already taken up the great offer and of course the sudden stop fro x 5 to x 3 makes systems more expensive again (ACIL Tasman, 2011, p.vii).

Various reports have found that the different policies across Australia have also influenced significant reductions in installation costs through increased demand across Australia. The combination of these schemes has had a greater result in static efficiency and the improvements in the dynamic efficiency cannot yet be calculated as it is assumed the installation rates will have a great reduction as the solar credits multiplier 'brought' forward many customers who may have utilised the feed-in tariff scheme at a later date. Overall, the combination of the QSBS and SRES play an important role in increasing the deployment of small-scale solar PV units, thus having a positive effect on the dynamic efficiency.

The QSBS and SRES schemes in combination assists in reducing the potential market failure associated with the negative effects in the high use of non-renewable carbon emitting energy resources. A market failure is "when prices within a market do not accurately reflect the true costs of producing goods and services. Costs which are often absent from market pricing include environmental, resources scarcity and social costs" (Queensland. Office of Climate Change. 2009. p.28). The higher costs associated with the increased deployment of solar PV can be seen as one way of correcting this market failure, as the higher costs helps to alleviate the damage which would otherwise be caused to environment and society.

Climate Q, a Queensland research paper, claims that "the introduction of the expanded national Renewable Energy Target (RET) provides Queensland with the opportunity to develop a new economic and regional development strategy around significant predicted private investment in renewable energy electricity generation" (p. 79). Growth in the renewable energy sector, as relative to growth in any other sector, will assist to drive economic growth that will have beneficial results for the economy. Expansion of the renewable energy sector and an increase in the development of export in renewable energy related products means an increase in new jobs and investment within the economy.

Overall, schemes such as the QSBS and SRES have many positive social economic and environmental effects. Sustainability is a term that has been used increasingly over the past two decades common to many fields in our society from economics, to industry development to government departments and environmentalists. This growth in the goals of sustainability has stemmed from the release of the Brundtland Report by the Brundtland Commission, formally known as World Commission on Environment and Development in 1987 which argued for the need of sound balance between the economic, environmental and social goals. The Brundtland Commission has defined the field of sustainable development as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987) As energy policy underpins all economic activity in Australia, it is optimal the goals of sustainability be kept as priority when defining the policies regarding energy policy.

Because one of major aims of policy interactions is the evaluation of the effectiveness of policies as a whole mix rather than policies in isolation, it is important to evaluate the achievement of both these policies objectives in combination in regards to their contribution to sustainability, rather than each scheme in isolation. This is especially important considering the challenges the world is facing relating to climate change, population growth and the depletion of non-renewable or limited resources. These challenges are related to policy decisions involving energy supply and management.

The combination of the QSBS and SRES policies results in many social advantages. These include enhanced energy security, building greater resilience to climate change impacts in Queensland such as security of supply and diversification of energy resources. Some of the political advantages of FiTs include the government demonstrating a commitment to increase the provision of renewable energy technologies, increasing energy security, reducing dependence upon non-renewable energy resources and support of a more decentralised energy system which is more resilient and supports emission reduction targets (Mendonca, et al. 2010, p.xxvii).

The encouragement of additional generation of electricity from renewable energy sources, especially from privately-owned SGUs such as solar PV systems, plus the others supported by the SRES scheme, assists in enhancing our energy security overall by enhancing security of supply and enhancing the diversification of energy sources overall. This enhancement in energy security is progressive in counteracting the possible negative impacts threatened by not only climate change but also helping Australia be less vulnerable to the rising costs associated with weakening fuel supplies. An increase in privately-owned SGUs encouraged by the SRES and QSBS enhances security of supply is the ability to provide electricity when conventional sources may be unavailable. Though this may not always be successful as all the SGUs supported by both of these schemes are dependent on the appropriate environmental conditions.

The combination of the QSBS and SRES policies offer many productive environmental impacts, positively contributing to the goals of sustainability. The most important factor these policies support is the mitigation of potential climate change impacts through the reduction of dangerous greenhouse gas emissions. Other environmental benefits include an overall reduction in pollution, an increase in energy efficiency and a reduced dependence on non-renewable energy resources, depending on extent of actual fossil displacement. While the Queensland's Climate Q report (2009) has found that energy production and use is the most significant contribute of Queensland's GHG emissions and that since 1990 emissions from the energy sector has grown over 94 percent (p.79). The QSBS and SRES schemes make a positive step towards the reduction of GHG emissions to assist with the mitigation of climate change. As this report has stated, global warming and climate change are regularly referred to two of the most comprehensive challenges facing the international community. While Queensland has one of the highest levels of population growth in Australia, Queensland became the second highest consumer of electricity in Australia by a 29 percent growth in consumption between the years 2000 and 2008 (DEEDI (b), 2010, para. 1). It is assumed this will result in higher amount of

GHG emissions if Queensland's energy supply remains the same. The increased deployment of no GHG emitting renewable energy technologies from policies such as the QSBS and SRES assists with reducing the adverse environmental effects associated with climate change and global warming.

Overall, the combination of the SRES and QSBS has assisted with the increased deployment of non-carbon emitting solar PV small generation units which assists in fulfilling the goals associated with sustainable development. The integration of both of these schemes offer many positive benefits economically in the longer term, socially and environmentally. The high costs and inequity in distribution of these costs can be viewed to be a negative impact, though these extra costs are one step in correcting the market failure created by the dominance of non-renewable coal and oil energy supply industry.

RECOMMENDATIONS

Table 6.1 (below) offers two integrated policy scheme options which could improve the efficiency and effectiveness of the

SRES and QSBS. These scheme options have been developed with an objective to enhance the benefits of the complementary interactions between the QSBS and SRES. These integrated scheme options has also considered some of the issues which the Queensland government and electricity companies are currently facing with an eroding distribution and transmission network in need of upgrade. These policy options also aim to assist with intermittency that is prevalent in Australia with renewable energy sources such as solar and wind technologies. Table 6.1 (below) is based upon the methodology employed by Oikonomou and Jempa (2008).

Measure Identification	Scheme Option 1 **(QSBS 2)**	Scheme Option 2 **(QSBS 3)**
Measure type	Feed-in tariff scheme	Feed-in tariff scheme
Mandatory or voluntary	Voluntary subsidy and incentive based scheme.	Voluntary subsidy and incentive based scheme.
Objectives		
Nature of target	Encourage the implementation of solar power renewable energy technology and encourage energy efficiency.	Encourage the implementation of solar power renewable energy technology and encourage energy efficiency.
Quantitative target	Further double Queensland's use of solar within next five years equating to 1000 MW of electricity generated from solar.	Further double Queensland's use of solar within next five years equating to 1000 MW of electricity generated from solar plus increase the amount of storage battery units of energy derived from renewable sources.
Type of target	Subsidy for renewable	Subsidy for renewable

	energy generation using a net-metering system paying 33 cents/kWh	energy generation using a net-metering system paying 44 cents/kWh during peak demand and 33 cents p/kWh during non peak hours.
Threshold	Further double Queensland's use of solar within next five years equating to 1000 MW of electricity generated from solar.	Further double Queensland's use of solar within next five years equating to 1000 MW of electricity generated from solar plus increase the battery storage units.
Emissions covered	Energy related	Energy related
Direct or indirect emissions.	Indirect	Indirect
Energy or other environmental goals.	Energy related	Energy related
Reference term.	Final energy	Final energy
Scope		

Entities bound by obligation.	Participants who consume less than 100 MWh per annum.	Participants who consume less than 100 MWh per annum.
Sectors.	Energy related.	Energy related.
Sites.	Voluntary households and business owners of all sizes.	Voluntary households and business owners of all sizes.
Market arrangements.		
Non-obligated but eligible parties.	Residential households and businesses with solar systems using less than 10kWh.	Residential households and businesses with solar systems using less than 10kWh.
Number of participants	Unlimited.	Unlimited.
Trading participants.	Solar PV retailers, wholesale electricity retailers such as Ergon Energy and Energex.	Solar PV and battery retailers, wholesale electricity retailers such as Ergon Energy and Energex.
Market concentration	Solar PV rooftop systems up to 5 kW	Solar PV rooftop systems up to 10 kW and battery storage systems.
Buyer or seller liability.	Liability of wholesale electricity company to pay participants 33 cents/kWh for net	Liability of wholesale electricity company to pay participants 44 cent/kWh hour for net

	electricity, plus payment of 11 cents/kWh to the development of a ‘Smart Grid’.	electricity for customers who have invested in a battery storage system also.
Market flexibility		
Market type	Electricity production	Electricity production and storage
Trading commodity.	Electricity generated from solar PV systems up to 10 kW.	Electricity generated from solar PV systems up to 10 kW.
Nature of commodity.	1 kWh = 33 cents	1 kWh = 44 cents (peak) 1 kWh = non peak
Lifetime of commodity.	20 years.	20 years
Financing.		
Cost recovery.	Regular payment to the household or business plus regular payment to upgrade the Queensland grids to implements a Smart grid. This excess of 11 cents/kWh can be subsidised by the State Government.	Regular payment to the household or business that have a battery storage system connected to the grid.
Revenues	The excess revenues	The excess revenues

raised.	are committed to the upgrade of the Queensland electricity grid to become a Smart grid.	will pay for the solar PV and battery storage system.
Timing		
Compliance period	QSBS 2 contract lasts for 20 years.	QSBS 3contract lasts for 20 years.
Future continuation.	Schemes current proposed end date is 2032.	Schemes current proposed end date is 2032.
Compliance parameters.		
Penalty for non-compliance.	Electricity companies penalised if in breach of the commitment to 11 cents p/kWh towards the development of the Smart Grid.	Electricity companies penalised if they do not pay the 44 cents p/kWh to customers who have a battery storage system with the solar PV system.
Institutional set-up.		
Body for setting up the scheme.	Queensland Government. Office of Clean Energy.	Queensland Government. Office of Clean Energy.
Body for administering the scheme.	Queensland Government. Office of Clean Energy.	Queensland Government. Office of Clean Energy.

Body for verification.	Retail authorities such as Ergon Energy and Energex plus the Australian Energy Market Operator.	Retail authorities such as Ergon Energy and Energex plus the Australian Energy Market Operator.
Body for registration.	Electricity operators such as Ergon Energy and Energex.	Electricity operators such as Ergon Energy and Energex.

Table 6.1 Integrated policy options

The most significant point of interaction between the QSBS and the SRES has been how the SRES has supported the implementation of small-scale solar PV units between 1.5 kW and 2.5 kW whilst the QSBS has provided a greater incentive to implement systems up to 5 kW. The success and early attainment of the QSBS provides an opportunity to prolong the scheme to reach a higher target.

Integrated option one suggests another policy option to the QSBS. This Integrated Option one is called Queensland Solar Bonus Scheme Two (QSBS 2). The objectives of QSBS 2 are the same as QSBS, though the quantitative target will be increased to 1000 MW. This increase of 1000 MW is based upon a potential increase in Queensland's Renewable Energy Target to 1000 MW by 2025. The type of target in QSBS 2 differs from the type of target in QSBS. Electricity retailers will pay back 33 cents p/kWh to the electricity customers, rather than the previous 44 cents p/kWh. The reason for this decision is to support a greater investment in putting costs towards upgrading the electricity grid in Queensland to a 'Smart Grid'. This excess 11 cents p/kWh which was previously invested, will be redirected towards funding for the Queensland’s Smart Grid. This will benefit all electricity consumers in Queensland as the costs of upgrading the distribution networks will not be as high.

For example, in 2008- 2009, Ergon Energy was paying approximately $45, 000 per month to customers for the energy exported to the grid (Ergon Energy, 2010). In 2009 – 2010 Ergon Energy were paying customers $150,000 per month for the renewable energy exported to the grid. In 2008 – 2009, Energex paid about $5,000,000 to customers. In 2009 – 2010, Energex paid about $3,300,000 (Energex, 2010). This cost is distributed across all of Ergon Energy and Energex’s retail bills. As Ergon Energy and Energex are paying so much money, it is beneficial if some of their money can be put towards the high costs of upgrading the Queensland grid.

The Australian Energy Market Commission (AEMC) (2011, p. 18) has found that it will cost approximately $10.5 billion for the work that is necessary to be completed over the next few years on Queensland’s distribution networks. The AEMC (2011) also described how “residential electricity prices in Queensland are forecast to increase by 32% in nominal terms between 2009/10 and 2012/13, which is an increase 5.90 c/kWh” (p.17). This decision will also provide greater equity to all electricity producers and consumers in Queensland. For example, the owners of larger PV systems of say 5 kW benefit from using the grid as the electricity retailers purchase their electricity from them. Though with the current QSBS scheme they do not contribute to certain components of the electricity bill that support the maintenance and upgrade of Queensland’s electricity distribution network. Whilst it is inevitable the QSBS will have to eventually reduce tariff rate as the target has been reached, 33 cents p/kWh seems to be a healthy compromise in supporting benefits for both customer and electricity retailers. Figure 6.1 below shows how electricity distribution costs in Australia will account for 47.4% of electricity price increases (Roam Consulting, 2011).

Figure 6.1 – Cost components of future energy price increases. *(Australian Energy Market Commission, 2010, p. 3).*

Within the costs of SRES and QSBS which are distributed amongst all electricity uses, these costs are minimal overall.

Figure 7.4 (above) displays how small these costs are in comparison to network charges and wholesale electricity. Whilst the other factors of cost assumption seem to fluctuate each year, the costs imposed by the LRET, SRES and FiTs are fairly stable, if not reduce.

Figure 6.2 below displays the various cost components in Queensland's electricity tariff.

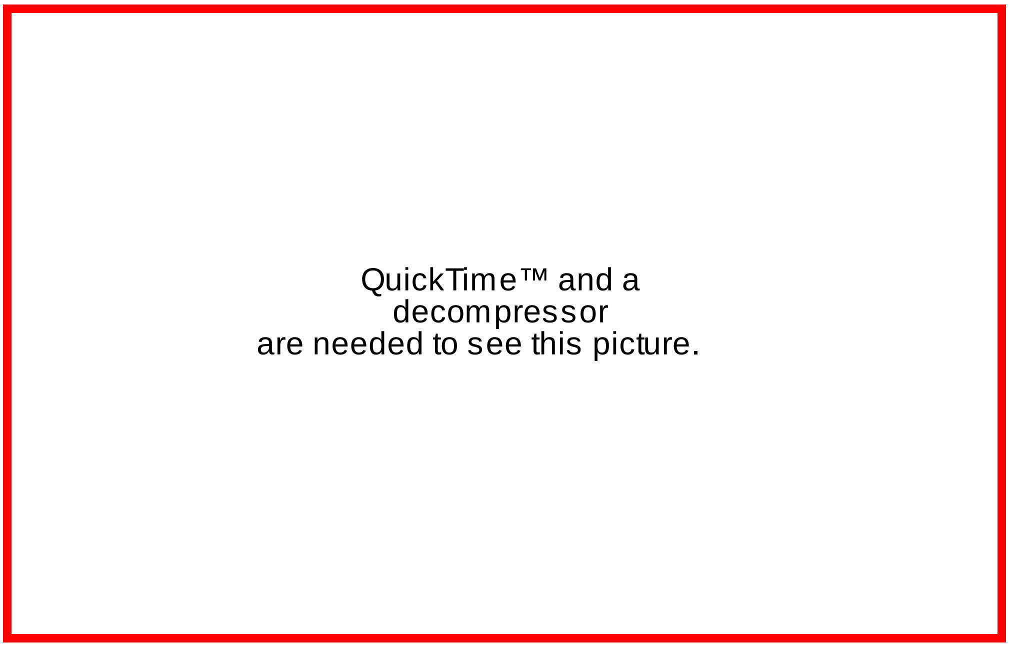


Figure 6.2 – Projected future retail prices in Queensland *(Data source – Roam Consulting, 2011, p. 49).*

The QSBS 2 scheme allows for the customer to purchase any solar PV system size up to 10 kW. This is an incentive which promotes an intake of larger system sizes, which is advantageous to the customer, as well as being advantageous to the Queensland

Government in reaching a higher Renewable Energy Target. Meanwhile, this keeps the SRES and QSBS more separate from potential duplication or overlap in outcomes for their policies. This allows the SRES to be successful in implementing systems in between 1.5 kW and 2.5 kW and the QSBS to strengthen the implementation of larger systems in between 4 kW and 10 kW. The 1.5 kW systems which are suitably subsidised by the SCS are more affordable to lower socio-economic sectors of society whereas the larger systems are affordable by the medium to high socio-economic sectors who can afford the higher upfront payments.

The second intergrated scheme option is called QSBS 3. The principle objective of this scheme is to encourage the implementation of solar power renewable energy technology and encourage energy efficiency. The quantitative target is to further double Queensland's use of solar within next five years equating to 1000 MW of electricity generated from RE technologies whilst supporting the implementation of storage battery units with solar PV systems.

Considering the state of Queensland's distribution grid and the necessesity for upgrade, another step towards the development of a Smart Grid is to support the investment of battery storage units for excess electricity. The introduction of battery storage units also assists to reducing some of the issues involved with intermittent RE technologies such as wind and solar.T his excess electricity derived from the solar PV systems can be particularly beneficial during peak demand period, which makes this electricity more valuable all parties. The electricity companies could also pay for this value during peak demand times. The customer in the QSBS 3 will be paid a higher tariff rate than QSBS 2 during the peak demand period. During the peak demand period, QSBS 3 customers would be paid 44 cents p/kWh and during non-peak hours the QSBS 3 customer will be paid 33 cents p/kWh. This tariff rate of 44 cents p/kWh during peak demand hours, equal to the current QSBS, can be justified as payment for the storage batteries that could would be incorporated into the Smart Grid costs. The investment in storage batteries will also be advantageous to support the long process involved with a electricity grid upgrade. The Government support in storage battery implementation will extend the objectives of the SRES and QSBS one step further.

The potential of these policy options could be further investigated by incorporating the full methodology which Oikonomou and Jepma (2008) used within their research, which is to conduct a multi-criteria assessment. A multi-criteria assessment places weighing factors on different elements of a policy. These include; effectiveness, efficiency, effectiveness on energy and market prices, impacts on society and innovation. This requires a large capacity of data and means in order to conduct this investigation. This was not possible to within the limitations of this research. A multi-criteria assessment can be beneficial in scrutinising policy elements, though the method poses some limitations as some policy elements are difficult to measure.

Though for the purpose of scrutinising policy option QSBS 1 and QSBS 2, I do suggest further research into the economic effects of these options. This includes economic effects on the electricity market price, economic benefits or costs to the participant and economic costs to the electricity retailer.

Conclusion

This dissertation has investigated two Australian energy policies with similar objectives of encouraging the implementation of small-scale renewable energy systems in Australia. Both these schemes favour the uptake of small-scale solar PV rooftop systems. Two different approaches to analysing the interactions between these policies were used. The first is a systematic method of categorising these policies by Sorrell (2003). These policies were then placed into further sub-categories with part of the method provided by Oikonomou and Jepma (2008). There method of categorising the different policy elements supported a similar table of integrated policy options to be produced. The integrated policy options that were created in this research, QSBS 2 and QSBS 3, were based upon extending the benefits of the complementary interactions between the QSBS and SRES. This complementary interaction is the most significant interaction discovered in this research. This is the ability of these two policies to work together to enhance the effectiveness of each other. The SRES provided support for the implementation of small-scale solar PV systems between the range of 1.5 kW and 2.5 kW whilst the QSBS provided the support for the implementation of solar PV rooftop system up to 5 kW. The SCS proved to assist the SRES to be effective.

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