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Examining the use of Concept Analysis and Mapping Software for Renewable Energy Feed-In Tariff Design

Abstract

The Australian Government's installation of the now defunct carbon price in July 2012, triggered a review of the Renewable Energy (RE) Feed-In Tariff (FiT) policies in the state of Victoria. In this article, concept analysis techniques and mapping software have been used to examine RE FiT design elements and priorities proposed by eighty-six RE investors and FiT stakeholders during the course of the review. The results show that concept analysis and mapping can be used to analyse FiT designs enabling identification of combinations of discrete elements including fixed and variable payment rates, differing levels of market regulation and competition, varying tariff operating periods, and eligibility rules for RE system sizes, development sites and low emissions technologies. In addition, while the economic elements of FiT designs were afforded the highest priority by stakeholders, broader contemporary analysis shows that policy makers and regulators should continue to combine economic, technology, system and administration elements into tariffs that can deliver new RE supplies. Also, the results show that governments may elect to change the combinations of these design elements, introduce other ancillary policy instruments and regulatory mechanisms, and reshape the FiT schemes in order to accommodate significant shifts in public policies.

Keywords: electricity; energy; feed-in; renewable; stakeholders; tariff.

Nomenclature

Technical

FiT	Feed-in Tariff, cents per kilowatt hour
LCOE	Levelized Cost of Energy, dollars per megawatt hour
PFiT	Premium Feed-in Tariff, cents per kilowatt hour
RET	Renewable Energy Target, per cent or Gigawatt hours
RPS	Renewable Portfolio Standard, per cent
SFiT	Standard Feed-in Tariff, cents per kilowatt hour
TFiT	Transitional Feed-in Tariff, cents per kilowatt hour

General

CAaM	Concept Analysis and Mapping
GO	Government Organization
NGO	Non-Government Organization
PV	Photo-voltaic
RE	Renewable Energy
VCEC	Victorian Competition and Efficiency Commission

1 Introduction

Feed-in Tariffs for distributed RE sources is the dominant clean energy policy that has been credited with enabling RE developments and investment, while building energy security and addressing climate change [1,2,3,4,5,6,7,8,9]. Leading studies of FiT design assert that combinations of instrument elements (e.g. program length, fixed payment rates) must provide focused and sustained support for specific RE technologies in order to reduce costs, build energy diversity, and garner individual and business investment [1,10,11,12]. In addition, tariff design has been positioned as essential for balancing investor risks and consumer costs, including providing equitable tariff payment adjustment and program cap mechanisms [10,13]. Other contemporary studies have highlighted the importance of governments leading robust tariff design and implementation [14], including streamlining tariff administration and grid connection processes [15]; designing tariffs jointly for environmental outcomes and harsh economic realities [16]; using design philosophies that stimulate increased self-consumption of RE [17]; and, promoting designs that take account of tariff digression and impacts on future RE growth [18]. Collectively, these studies support the argument that FiT design factors are of critical importance [1,10,12,19]. Relevantly, there are internationally recognized examples where deficient FiT designs have resulted in poor RE product manufacturing and employment outcomes, and spiralling public costs [20,21]. Accordingly, it can be argued that a FiT must be purposefully designed to meet RE supply and emissions reduction targets, and avoid systemic failures [22,23].

Foundation studies show that FiT policies provide contractually binding payments for RE outputs for fixed periods, determined through the LCOE plus an investor rate of return (regulated), or the value of the RE generated using utility cost avoidance or external sustainability cost methodologies [12]. While investor returns can be paid at fixed (independent of market pricing) or premium rates (the spot market rate plus a fixed or variable premium payment) [12], the policies can also deliver broader economic benefits [4,5,6,7], including advancing industry development and innovative product research [24,25,26,27,28,29]. Importantly, RE research has determined that FiT schemes can stimulate rapid investment responses, while reducing perceptions of investment risk and improving energy costs transparency [25,29,30,31,32,33]. Also, studies conducted at national and industry levels illustrate the value of well-designed FiT schemes for controlling electricity price rises; improving energy security; and, enabling electricity markets expansion [1,21,25,34,35]. Further inquiries support the use of FiT policies for addressing RE supply targets under RPS regimes; developing non-dispatchable energy supplies; and, stimulating small scale RE systems growth [3,28,31,36,37,38,39].

However, FiT policies also possess some disadvantages. Studies of FiT implementation show that tariffs can drive higher public costs and taxes; increase capital equipment costs, installation fees and maintenance charges; limit returns on RE investments, and deliver windfall profits for electricity retailers [22,24,28,40,41,42]. Unsurprisingly, some researchers are openly critical of FiT instruments asserting that few sustainability benefits have resulted at the national level (e.g. Germany) [22]. Notwithstanding these reservations, it is difficult to design FiT policies that collectively take account of electricity costs and price factors, legislated RE quotas, and mandatory RE targets [1,2,3,30]. Unfortunately, tariff designers often have to contend with little, or no, change in energy use and demand management behaviours [43], poorly constructed RE dispatch, transmission and distribution processes and regulations [42,44], and government-mandated suboptimal geographic locations for RE development [29,35]. Hence, these factors present challenges for tariff design.

Further examination of the literature also highlights that FiT instruments do not operate in policy or program isolation. As an example, FiT policies can be coupled with RPS policies (i.e. prescription of energy demand to be met by RE) to grow new RE supply [12,39]. Tariff policies can also form part of larger innovation frameworks and programs that offer incentives to grow RE supplies, overcome policy voids and systemic failures, and advance the penetration of RE technologies into communities and business [45]. In addition, contemporary studies explicate how grid-connected residential RE systems, based on innovative business models, can support optimal bidding of energy supply volumes into the market by prosumers to secure feed-in payments, subject to timing, electricity pricing and prevailing risk appetite factors [46]. Hence, these streams of research show that FiT policies work within composite policy and regulatory arrangements to deliver new RE supplies.

This study supports the extant literature that advocates high quality FiT designs [1,2,3,10,19,47] with elements such as equitable access to electricity grids; robust and resilient transmission and distribution networks; a combination of tariff rates, RE quotas or program caps; tariff rate and participation adjustment protocols; and, efficient administration [1,2,3,4,5,36,47]. Studies also show that successful designs may allow for commercial (own and lease) and off grid system investments; gross tariffs for securing early investment returns; allowances for shifts in energy demand; and, energy production costs recovery [2,32,44,48,49,50]. In sum, robust FiT designs must be economically and socially sustainable, with the capacity to promote energy supply chain collaborations [26,33].

The motivation for this study was based on analysing and explicating FiT design elements in the context of Australia's RET of 23.5 per cent by 2020 (i.e. approximately 33,000 GWh of RE sourced electricity) [51,52], including the installation and removal a carbon price regime in 2011 and 2014, respectively [53]. A challenge for state and territory governments is the design of FiT policies that can grow RE investments and meet the RET, taking account of changing energy policies, economic conditions and electricity markets [51,54]. Hence, the site selected for analysis is Australia's second largest state, Victoria, where the state government was looking to design future RE FiT instruments that would rationalize existing FiT instruments; take account of carbon price policy shifts; and, support continued RE investment [54,55].

Given this motivation, the objectives for the research were clustered into two main areas as follows. First, given the directions of leading studies in FiT design [1,10,12,19], the identification and analysis of a combination of design elements (e.g. net/gross tariffs; capacity caps; system size ranges; public funding) with overlaid stakeholder priorities (e.g. economic, environmental, administrative) provide further theoretical insights and precision to extant benchmark research. The results also offer instructive direction for policy makers and regulators involved in tariff design and implementation. Second, through the application of a dedicated CAaM policy analysis technique [56,57], the research also provided a holistic composite analysis of tariff design elements, perceived benefits and potential RE growth barriers. Importantly, this enabled closer examination of additional and ancillary policy instruments (e.g. RE reverse auctions) [13] that can complement and adjust tariff designs and assist in growing RE stocks.

In meeting these objectives, the research makes useful and diverse contributions in the theory, practitioner, and research method disciplines. In the theory space, the study advances the examination and explication of combinations of tariff design elements, an area previously identified by leading scholars as important for future research [1,10,12,19]. Also, in the context of policy making and regulatory practice, the research offers alternate insights of how tariff design elements might be developed and adapted, and incorporated into broader and potentially more volatile energy policy regimes. As a further contribution, in applying CAaM techniques to the study, the research has resourcefully expanded the use of this multiple stakeholder analysis tool into the RE sector and energy policy design and development.

The balance of the article is developed as follows. The next section will discuss the background to the study and outline the research setting. Next, the article will describe the research method, including the CAaM technique, data collection and analysis procedures, followed by a discussion of the results. The concluding statements highlight the importance of implementing robust tariff designs, outline how Victorian FiT schemes benefit from adopting and/or adjusting combinations of design elements, and offer directions for ongoing research.

2 Background - RE FiTs in Victoria, Australia

Recent data from the Australian government shows RE sourced electricity generation equates to approximately 15 per cent (approximately 8.5 per cent short of the RET), with Australia's primary energy coming from fossil fuels [58]. The latest electricity generation trends from 2016 show that Victoria has approximately 4,200MW of renewable electricity generation capacity, with a Victorian government report showing that only 14 per cent of the state's electricity is generated using RE sources [59]. Hence, in order to meet its pro-rata 23.5 per cent obligations under the national RET, Victoria must continue to develop new RE supplies with FiT instruments forming a cornerstone of its energy policy mix.

In developing RE, Victoria has designed and instituted four FiT policies under the Electricity Industry Act (2000) Victoria [54,60]. The SFiT, PFiT and TFiT were designed as regulated, publicly funded, fixed rate and fixed period instruments. The SFiT scheme commenced in 2008 and was available to small RE generators with capacity up to 100kW. The scheme provided a 'one for one' payment dependent on the investor's consumption tariff rate and ended on 31 December 2016. The SFiT was instituted to develop the state's wind resources; improve grid connection for wind energy; and aid Victorian wind turbine industry development.

The PFiT scheme commenced operation in November 2009 and will end on 31 December 2024 (note, the scheme is now closed to investors). PFiT provides 60 cents per kWh net tariff payments to investors and was aimed at small scale RE generation up to 5kW capacity per site. The PFiT was designed to grow and bring certainty to solar PV investment; reduce emissions; and, support Victorian solar industry development.

The TFiT was launched in January 2012 and guaranteed a minimum rate of 25 cents per kWh for excess electricity fed back to the grid. This solar tariff required a system of up to 5kW capacity per site, consumption of 100MWh or less electricity per annum, and a bi-directional smart meter installed. The TFiT scheme was capped at 75MW capacity and ended on 31 December 2016. The TFiT was installed to ensure equitable support for solar PV investors; address climate change; take account of falling solar PV unit costs; and, support the state's solar industry.

On 1 January 2014, the VFiT was introduced as a mandatory ongoing tariff design, with the minimum variable payment rate regulated by Victoria's Essential Services Commission (i.e. currently 5 cents per kWh, moving to 11.3 cents per kWh on 1 July 2017), and the scheme funded by electricity retailers (5,000 customers minimum). The VFiT was installed to assure fair and reasonable payments for new RE investors, and current investors transferring from closed tariff programs.

Hence, given this cumulative policy approach, the future design and adjustment of FiT instruments will be crucial in meeting RET obligations [51], and realizing long term sustainability [60]. It should be noted that following the legislated reduction of the RET from 41,000 to 33,000 GWh in June 2015 [51,52] and subsequent slowing of new RE investments across Australia, the Victorian government has set new state RE targets of 25 per cent by 2020 (+1,500MW) and 40 per cent by 2040 (+5,400MW) to be augmented by reverse auction enabled FiT payment schemes [59].

3 Methodology

3.1 Concept analysis and mapping research technique

The CAaM is defined as "a structured process, focused on a topic or construct of interest, involving input from one or more participants, that produces an interpretable pictorial view (concept map) of their ideas and concepts and how these are interrelated", and is a proven research technique that allows analysis and description of a topic of interest (e.g. policy) [56,57]. This technique is applicable to stakeholder investigations where statements are collectively analysed using the following six step process [61].

First, the CAaM project is prepared by developing the focus of the investigation (i.e., current and future FiT designs and barriers associated with RE generation) and identifying the stakeholders that provide inputs. Second, inputs that address the investigatory focus are drafted and submitted by stakeholders (up to 200 participants may be involved). Third, the stakeholder inputs are structured by groups (i.e., investors, GOs, NGOs, public firms, private firms). Once in groups, inputs may be ranked in levels of importance (note, in the interest of equity, all inputs were assigned equal importance). Fourth, specialist CAaM software process inputs into concept statistics, clustering and multidimensional scaling analyses (Leximancer CAaM software was used in this study). Fifth, the analyses and maps are interpreted for their aggregate outcomes and outputs (i.e., collective views/issues raised by the stakeholders). Finally, the analyses and maps are utilised in management or design processes.

CAaM techniques have been used to deliver significant benefits and results in several settings, including medical education and training [62], psychiatric neurological therapies [63], health policy design [64], firm and industry level analyses [65], and tertiary level education [66]. Accordingly, it is argued that CAaM can also be applied to FiT design, and assessing barriers associated with RE developments. However, it is acknowledged that CAaM techniques possess established weaknesses, including requiring sufficient inputs for analysis and pattern building; competent interpretation of complex results; and, the clear definition of conceptual priorities [65,67]. In order to avoid interpretive difficulties, a member of the research team was recruited on the basis of their significant expertise in using CAaM techniques and supporting software tools.

3.2 Data sources, collection and processing

The data was collected on 15 June 2012 from the state government web pages established for the inquiry into Feed-in Tariffs and Barriers to Distributed Electricity Generation, conducted by the VCEC [68]. The VCEC was tasked with investigating current and future RE FiT (including state tariff termination options); and barriers that may impede RE growth and meeting RET obligations [68]. Hence, the data collected by VCEC was consistent with the scope of this tariff design investigation and analytical techniques (i.e. open-ended stakeholder responses that can be analysed and mapped), with stakeholder submissions providing ‘open and uninhibited’ views for concept analysis (i.e. a key requirement for CAaM).

Data in the form of written submissions from investors, energy users and representatives, managers and executives in private and public firms, and GOs and NGOs were collected and catalogued in separate Electronic Storage Folders (ESF) [68]. Each data file has a FiT inquiry identifier code (FT) and participant number (1 to 86). Also, the VCEC provided assistance with the reconstruction and provision of some electronic data files that had become corrupted and unreadable during the course of their inquiry. A total of 86 separate submissions were analysed with a summary of the ESF and stakeholders presented in Table 1.

Table 1 here

3.3 Concept analysis and mapping software

The Leximancer CAaM software enabled classification and documentation of concepts and themes, characterising and sorting of statements, identification of concept terms and document themes relationships, and removal of asymmetric information (i.e. statements unrelated to issues under analysis) [69,70]. Also, the software provided integrated CAaM and automatic text coding functions that supported the study’s analytical processes [56,57,71].

The software tool used a seven step analytical process to: (i) select and load the written content files (i.e. .doc and .pdf files); (ii) remove stop words with limited semantic meaning (such as ‘and’), and insert text and ESF markers; (iii) automatically extract the high level concept themes (large circles on the map) and fine detail terms (dots on the map) from the analysed text; (iv) edit the discovered concepts prior to reprocessing, including merging similar concepts (e.g. tariff and tariffs); (v) establish the text block processing and software learning parameters (i.e. number of concept (terms) integral to each concept theme, number of sentences in the text block, and the mapping of concept terms relationships); (vi) undertake the automatic location and coding of concept terms within the text block (i.e. the automated equivalent of the 'manual coding process' in content analysis) [71]; and, (vii) construct concept maps and statistics profiles.

Three primary information artefacts are created by the software [70] including a frequency distribution and statistical summary of discovered concept terms; associative behaviours between the concept terms (i.e. conceptual co-occurrence, with the central concepts being those that most frequently co-occur within the aggregate written submissions); and conceptual similarity and specific attraction (i.e. conceptual clustering, where groups of concept terms appearing in comparable or semantically similar contexts will cluster in close proximity on the map, representing an issue/set of issues). The software set points for the analysis were in accordance with procedures established in the Leximancer User Manual [70]. The software linear mapping mode was used to create stable concept map structures.

3.4 The two-stage analytical process

The analysis was executed through a two-stage process. First, the number of concept terms (points on the map) and the concept theme/s (high level theme of the aggregate written submissions) size was maximised (i.e. set to 100 per cent). This allowed all the concept terms and the primary concept themes for the aggregate written submissions to be identified (i.e. the major RE FiT issues and associated concept terms) [56,57,70]. Second, the software's Multi-Dimensional Scaling (MDS) feature was used to steadily reduce the concept theme size in order to develop a set of workable RE FiT concept clusters and associated terms. As shown in other studies, the MDS feature enabled the determination of the concept clusters within the aggregate written submissions by rescaling the primary concept themes, and enabling the secondary concept themes, associative relationships and key participant issues to emerge [65]. The software's concept co-occurrence mapping feature was also activated to record the strongest relationships between concept terms and deploy the automated text coding function (i.e., related concept terms are displayed in a table with the coded text logs in the adjacent columns) [70]. Each piece of coded text is codified with a three digit identifier number (e.g., s1_123) [69,70]. This enabled confirmatory comparisons of the coded text from the written submissions with mapped concept clusters and terms [70].

4 Results and Discussion

4.1 The concept analysis and mapping results

The consolidated results from the CAaM analysis are presented in Table 2. The results show that the 86 stakeholder inputs were focused on the primary theme of RE generation.

Table 2 here

The analysis also uncovered approximately 100 to 400 concept terms within each stakeholder category, with 'energy' the dominant concept term across the four ESF inputs. The determination of the central concept terms within each stakeholder category illustrated that the use of FiT for growing RE systems investment and distributed electricity generation was the pivotal concern in the framing of inputs.

Importantly, the cluster analysis determined that the use of RE FiT was an important driver of investment decisions, and that some future fair and reasonable FiT (either regulated-fixed or market-based variable rates) would support RE systems development. The clusters also exposed several benefits related to RE systems development (e.g. deferred grid infrastructure upgrades, energy costs savings, reduced emissions), while highlighting potential barriers to RE developments (e.g. onerous industry regulation, network and grid connection problems). An example concept map and cluster group for ESF1 is shown in Fig. 1.

In addition, 410 coded participant statements were extracted using the CAaM software, and separated into RE tariff design (192) and associated benefits (169), and distributed generation development barriers (49). The content analysis results, summaries and coded text examples are presented in the following sections.

Fig. 1 here

4.2 RE FiT design elements and associated benefits

The analysis of coded statements showed a strong level of support for a tariff design that is based on a regulated net or gross metered tariff at rates between 15 and 60 cents per kWh (i.e. 47% of participant statements) (see Fig. 2). As a typical example, the environment focused LIVE NGO (FT-55) [68] stated that gross FiT were necessary to drive RE developments:

> "As previously stated, with the adoption of renewable energy as a much greater proportion of our energy mix—in addition to mitigating catastrophic global warming—there will be the added benefit of a boost to our local economies and new, more secure and sustainable 'green collar' jobs in Victoria. Arguably the most effective policy tool to achieve a rapid, widespread uptake of solar energy in Victoria would be to offer gross metered Feed-in Tariffs of around 60c/kWh to reward generators for the safe, secure, zero emission energy they produce." (s1_52, LIVE NGO, 19 March 2012).

Comparatively, approximately 13% of participant statements (primarily from energy firms and the electricity supply NGO) presented that regulated FiT are unnecessary and that payments for net exports of electricity to the state power grid should be based on open market competition and pricing. As an example, integrated energy firm Origin Energy (FT-81) [68] stated that competitive market processes should guide electricity export payments:

> "Origin does not believe a regulated FIT is required. There is no evidence that the market has failed given the voluntary FITs offered by electricity retailers. Origin believes rivalry between retailers (which seems to be sufficient for the determination of competitive retail supply prices) is the most efficient and equitable means of determining unregulated FITs" (s1_117, Origin Energy, 26 March 2012).

This diversity of participant views highlights the priority placed on the economic elements of FiT designs, and the differences between community and more commercial perspectives with respect to RE supply development using FiT schemes.

Fig. 2 here

The results also illustrate that tariff designs can be extremely complex with the opportunity to exercise different combinations of elements (see Fig. 2), subject to the tariff's objectives and scope. In this respect, the analysis uncovered other important FiT design elements, including applying tariffs to a wider range of technologies; setting stable and long term tariff periods; establishing tariffs for varying RE systems size ranges; applying tariffs to larger scale regional community, commercial and leased RE systems; and, integrated tariff transaction procedures that combines retail consumption tariff and FiT payments and contracts, service fees, government charges and RE (green) certificate transactions.

As part of a new tariff design, a number of participants considered that any future RE FiT should allow a wide range of RE, hybrid and low emissions technologies (e.g. solar-natural gas energy systems) to qualify for entry into the scheme (14% of participant statements), while a further group of participants argued for higher levels of investment and income certainty through the application of long term FiT ranging from 10 to 25 years (8% of participant statements). As examples, low emissions technology manufacturer Ceramic Fuel Cells Limited (FT-41) [68] argued that tariffs should be technology neutral:

> "We suggest the Commission should take into account the following factors when designing feed-in tariffs. Technology Neutral – Any technology which is small scale and lower emission achieves the same valid policy objective and should qualify for a feed-in tariff." (s1_171, Ceramic Fuel Cells Limited, 19 March 2012).

while RE consulting and engineering firm Ironbark Sustainability (FT-50) [68] argued for a long term stable tariff structure:

> "A strong feed-in-tariff would be fixed for 20 years, providing a guarantee on investment and offering financial certainty for Distributed Generation. The current uncertainty hurts investment. For example, council's cannot accurately develop a business case and payback period models for rolling out solar PV because they are unsure if they will still be covered by the feed-in-tariff" (s1_39, Ironbark Sustainability, 19 March 2012).

These types of statements show that tariff designs might be expanded to include several technologies, while also reinforcing the need to assure investors that tariff operating periods will be honoured. Other aspects of tariff design raised by participants assert that all RE systems sizes (i.e. micro generation <5kW, small scale 5kW to 100kW, medium scale 100kW to 5MW, large scale 5MW to 30MW) (see Enviromate, FT-60), community-based RE systems, and RE systems deployed on commercial and leased sites should be eligible for inclusion in FiT (see Mildura Development Corporation, FT-49) [68]; and that streamlined tariff administration would be beneficial (see Exigency, FT-04) [68].

Also, the automated analysis allowed extraction of 169 coded participant statements that were related to four major benefits of establishing a new FiT. First, participants considered that new RE FiT would support environmental and climate change mitigation objectives through the introduction of increased RE capacity (29% of statements). This was observed as the most critical issue in arguing for the continuation of FiT in Victoria [51]. Second, the continued development of the state RE industry sector and sustainable regional communities was seen as an important outcome from retention of the Victorian FiT schemes (25% of statements). In this respect, the tariffs were seen as enablers of economic and social growth in the state [72,73]. Third, participants espoused the reduced financial risks and increased benefits that would flow to RE systems investors and state electricity consumers should FiT schemes be retained (24% of statements). In this context, adequate returns on RE systems investment and any associated household electricity cost savings were presented as important benefits [74]. Fourth, electricity generation and supply infrastructure, including improvements in state energy security, were identified as tariff beneficiaries by participants (22% of statements). Reduced dependency and transition away from fossil fuelled electricity generation assets were considered as benefits that would flow from continued FiT schemes [75,76]. The statement from RE engineering firm Regional Cleantech Solutions Limited (FT-53) [68] offers a consolidated view of benefits:

> "A feed in tariff for community based projects is easy to understand, supports regional development, and is politically a winner. A community renewable energy project can deliver economic, environmental and social benefit simultaneously. These include retention of income locally from energy revenues distributed to local owners/shareholders, creation of local employment in construction, operation and maintenance; reduced costs of energy for households and businesses, a reduction in the

local carbon footprint, and engagement of the broader population in the issues of sustainability and climate change" (s1_17, Regional Cleantech Solutions Limited, 19 March 2012).

In summary, the results from the analysis expose the importance of combining the economic, technology, system size, development and administration elements in the FiT design [1,10,12,19]. Importantly, these elements reflect the design priorities assigned by the FiT stakeholders under analysis. Also, the identification and documentation of these FiT design elements and associated benefits demonstrates the utility and value of CAaM techniques for analysing and developing these RE policy instruments.

4.3 Barriers to distributed renewable energy generation

Participants identified three major and two minor barriers to distributed RE generation in Victoria as noted in Table 3. The three major barriers are consistent with the RE literature [77].

Table 3 here

The highest rated barrier by participants was the overly onerous levels of government regulation including inefficient and uncoordinated administration, multiple levels of development approval, and sudden changes in government policy. As an example, RE engineering firm Neilson Electrical Systems Pty Ltd (FT-84) [68] offered a candid view on the 'clumsy' regulatory arrangements:

> "The approval and connection process can be complex and overly bureaucratic with many technical and contractual issues. Some retailers and system suppliers address this by offering a "one stop shop" service But being a relatively new process for the energy industry, it is still rather clumsy" (s1_42, Neilson Electrical Systems Pty Ltd, 19 March 2012).

The other two major barriers focus on problems associated with higher rates of RE systems investment and stable financial returns, and establishing timely and reliable grid connections. Participants presented concerns related to the high capital costs of RE supply systems, especially where larger commercially based systems in the 100kW to 30MW capacity range might be considered, and the difficulties associated with securing profitable multi-year PPAs with public firms and private power companies [78,79]. At the time, the implementation of the national carbon pricing regime was also seen as an added complication in the process of tariff design and RE development (i.e. limited incentives to invest in high cost RE capacity projects) [53,80]. The issue of assuring timely and reliable RE systems connections to the power grid, through the distribution network service provider, was also promoted as a barrier that must be overcome as part of any future FiT (the administrative forms and paperwork were seen as cumbersome, time consuming and inefficient) [1,2,3,4,5,8]. The two minor barriers to enhanced distributed generation highlighted the difficulties of building RE supply systems when political agendas interfered with the policy development processes (e.g. public expenditure reduction agenda, anti-regulation advocacy) [81], and incumbency advantage enjoyed by Victoria's coal fired electricity plants [82].

On balance, well-structured administration and development elements of the FiT design would go some way to addressing and overcoming some of these barriers. Certainly, a settled tariff policy that provided income security for investors and assured timely and reliable grid connection would present as a positive complementary policy instrument that integrates with other federal, state and local RE strategies [83].

5 Conclusions

In this study, we have examined a range of design elements that may be applied to FiT. However, the study has some specific and important limitations. First, individual investors and energy users made up over half the sample used in the CAaM activity (i.e. 53% of the sample), while GOs were a very small part of the sample (i.e. 4% of the sample). Accordingly, this skewed the results towards economic design elements that might be considered more important by individuals in the community (e.g. fixed and regulated tariff payment rates). This effect was offset to some extent by statements from ten electricity supply firms and one electricity supply NGO. Second, Victoria has abundant low cost brown coal resources, coupled with sizeable wind and solar resources. This confluence of different resource types, and their associated development economics, may make the results less applicable to some country and regional settings. However, despite these limitations, this study has made a contribution to cumulative FiT design research [1,10,12,19].

First, the results show a priority for economic elements of FiT designs [10,84,85] with specific emphasis on payment rates and regulatory (or open market) structures. The stakeholder analysis also presented that tariff designs should integrate additional elements, including more progressive eligibility rules for different renewable and low emissions technologies, various individual and commercial (lease and ownership business models) RE systems ranging from <5kW to 30MW capacity, and streamlined tariff contract and transaction administration. Notably, while the state government has retained a mix of FiT designs and elements (PFiT, VFiT), it has elected to exclude low emissions technologies in tariff schemes in the near term.

In late 2015, Victoria instituted its RE Roadmap protocols to enhance elements of its FiT designs, including improving PV investor and energy retailer business transactions; and examining different tariff enabled business models to grow RE supply, such as leasing of solar PV systems (i.e. avoiding high capital costs) and ‘roof registers’ (i.e. matching investors with parties possessing sufficient roof space to enable PV system installation) [86]. The protocols are also targeted at overcoming barriers to RE growth, such as inefficient grid connection processes and technical constraints on RE deployment. In further examples, the VFiT will be redesigned in the future as a multi-rate FiT to cover time variations in generation (peak, shoulder and off-peak) [87], while large utility scale generators (+30MW) will tender in lowest cost reverse auctions to secure a fixed term FiT contract (valued at the difference between the tendered strike price and a reference market price of electricity) [88]. Hence, this shows that while the state maintains a firm base of elements through the PFiT and VFiT, Victoria has the capability to tactically reshape its current and introduce new FiT instruments, using different combinations of design elements and ancillary policies, in order to grow RE supplies.

Second, the results show that the six identified design elements may not only sit in combination within a FiT policy, but could also form part of a strategic framework of national and state policies and programs. In this way, the PFiT, VFiT and future large utility scale tariff designs are integrated into complementary policy frames that can include multilayer RPS targets, tradeable RE certificates, and climate change and carbon emissions reduction policies. In this context, the overarching benefit for Victoria is the ability to strategically modify and adapt its FiT designs to accommodate high impact changes in national policies. As an example, the state has signalled its intent to use reverse auction enabled large utility scale FiT designs [59,88] to counter the downturn in domestic RE investment due to the steep national RET reduction in mid-2015 (–8,000GWh) [52]. This is particularly important given some of the volatile shifts in climate change and RE policies experienced in Australia during 2011-2015 [52,53].

Third, the analysis illustrates that CAaM can be used for FiT design, implementation and review. The results successfully demonstrate the ability to extract and document combinations of critical FiT design elements and associated tariff structure benefits using the CAaM technique and software. Importantly, the analysis provides a unique 360 degree view of the policy design incorporating community, business and government perspectives. This result complements the policy analysis outcomes achieved in other disciplines [62,63] and further extends the use of CAaM into the RE sector. Hence, the use of CAaM is commended as a valuable technique for RE policy design and development.

In closing, given the emergence of energy storage as a closely coupled technology to RE systems [86], it is expected that different markets (e.g. energy storage, energy capacity) will give rise to new energy supply chain stakeholders, coupled with varying levels of supply and demand and price fluctuations, over time. Accordingly, any commensurate variations in FiT design elements and policies should provide future opportunities to advance tariff design research.

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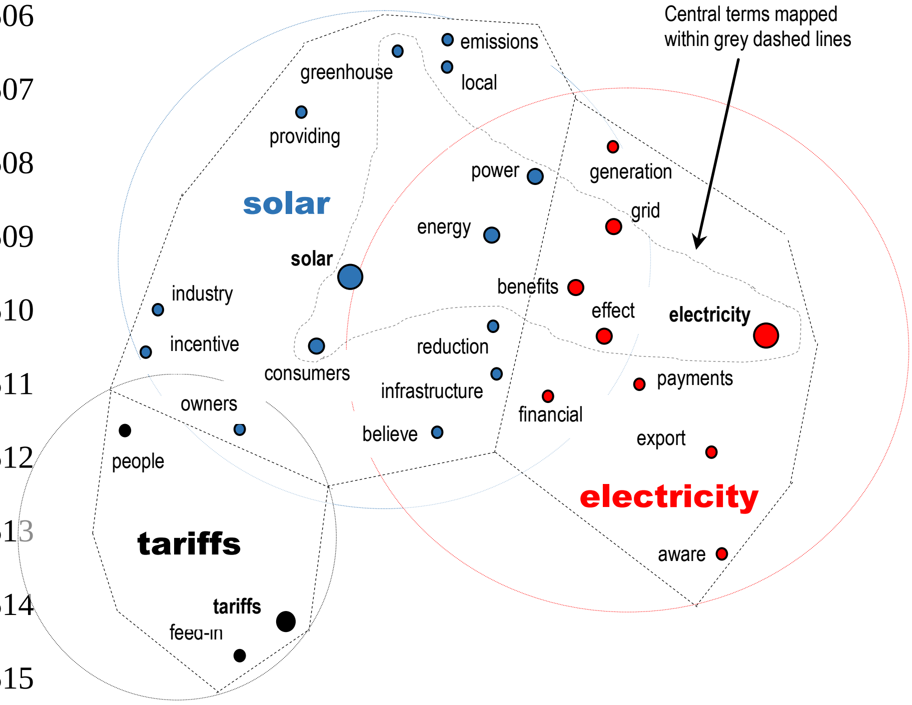

Fig 1. Example Concept Map for ESF1 Cluster

Tariff Type (n=121)
(i) Net or Gross, Government Regulated, Fixed Payment Rate, 15–60 cents/kWh (97)
(ii) Net, Unregulated, Market-based Variable Payment Rate (24)

Technology Deployment (n=25)
Technology Neutral. In addition to solar and wind RE, allow hybrid and low emissions technologies

Tariff Period of Operation (n=15)
Long term tariff operating period, 10–25 years

System Sizes (n=11)
Multiple RE systems sizes are eligible under the tariff: micro generation <5kW, small scale 5–100kW, medium scale 100kW–5MW, large scale 5–30MW

Development Type (n=10)
Community ownership, larger commercial, and leased developments

Tariff Administration (n=10)
Integrate electricity consumption and feed-in supply contracts, electricity retailer service fees, government charges, and RE certificate transactions into tariff administration processes and procedures

Fig 2. Stacking Diagram of FiT design elements (total coded statements, n = 192)

Table 1

Summary of Individual RE Investors, Energy Users and Stakeholder Organizations

Individuals or Stakeholder Organization
ESF1: Individual RE Investors and Energy Users (45)
Forty-five individual investors and energy users in Victoria. Investors and users have installed solar PV systems up to 5kW in size.
ESF2: Private and Public Firms (23)
Advance Solar Electrical - Small Medium Enterprise. RE engineering and installation.
BRT Consulting - Small Medium Enterprise. RE engineering and consulting.
Comfortid - Small Medium Enterprise. Solar PV and wind turbine systems.
Enviromate - Small Medium Enterprise. Solar engineering and installation.
Exigency - Small Medium Enterprise. Carbon market and RE advisory.
Ironbark Sustainability - Small Medium Enterprise. RE engineering and consulting.
Neilson Electrical Systems Pty Ltd. - Small Medium Enterprise. RE engineering and consulting.
Noonan Farms - Small Medium Enterprise. Farm and grazier business.
Regional Cleantech Solutions - Small Medium Enterprise. RE engineering and consulting.
Saturn Corporate Resources Pty Ltd. - Small Medium Enterprise. Economic analysis and consulting.
Ceramic Fuel Cells Ltd. - Low emissions fuel cell manufacture. A$280 Million Assets; 100 emp.
RE Solutions Aust. Holdings - Silent wind turbine manufacturing firm. 100 emp.
Warburton Community Hydro Project - Community owned company. RE community projects.
Loy Yang Marketing Management Co. - Energy dispatch and trading firm. 2,200MW capacity.
Union Fenosa Wind Australia - International RE development firm. 503 turbines; 1,200MW capacity.
Simply Energy - Large electricity and gas retail firm. 300,000 customer accounts.
Citipower/PowerCor - Electricity Distribution firm. 1,100,000 customers; 82,000km net.
Jemena - Electricity Distribution firm. 319,000 customers; 11,000km network
Lumo Energy - Electricity Distribution firm. 400,000 customers; 13,000km network
United Energy - Electricity Distribution firm. 400,000 customers; 12,000km network.
APA Group - Gas transmission business. A$9 Billion Assets; 12,700km pipeline.
AGL Energy - Large integrated energy firm. A$7 Billion Revenue; 2,100 emp.
Origin Energy - Large integrated energy firm. A$11 Billion Revenue; 5,600 emp.
ESF3: GO (4)
Darebin City Council - Municipal government. Pop. – 137,000; 59,000 dwellings.
South-East Councils Climate Change Alliance - Eight large municipal gov. Pop. – 833,000; 487,000 dwellings.
Moreland Energy Foundation - Local government business. NFP consulting and education.
Energy and Water Ombudsman Victoria - State utilities ombudsman for Victoria.
ESF4: NGO (14)
Australian PV Association - Australian solar PV industry – peak representative body.
Australian Solar Round Table - Six large Australian solar RE firms – CEO rep. board.
Alternative Technology Association - Sustainable technology and practice NFP advocate.
Beyond Zero Emissions - Sustainable energy research and education. 200 active groups.
Clean Energy Council - Clean Energy Industry (Australia).
Climarte - Small climate change and arts advocacy org. 3 employees.
Dandenong Ranges RE Association - City based climate change action group. 130 members.
Emerald for Sustainability - Environmental action group. 50 members.
Energy Supply Association Australia - Energy supply firms (Australia). 114 firms in Australia / NZ.
Environment Victoria - Environmental action group for Victoria. 416 members.
Grattan Institute - NFP Public Policy Think Tank and Advocate.
Locals into Victoria’s Environment (LIVE) - Environmental action group for Victoria. 3,000 members.
Mildura Development Corporation - Mildura region (Vic.) business development body.
Nat. Electrical & Communications Assoc. - 1,250 Electrical, voice and data businesses – peak rep. body.

Source: Victorian Competition and Efficiency Commission, 15 June 2012.

Table 2

Summary of Concept Analysis and Mapping – Participant Responses

Concept Mapping Artefact	**ESF1**	**ESF2**	**ESF3**	**ESF4**
Primary Concept Theme	Electricity	Energy	Energy	Energy
Number of Concept Terms	26	40	29	40
Highest Ranked Term	electricity (406)	energy (325)	energy (98)	energy (327)
Lowest Ranked Term	payments (39)	trading (22)	time (8)	sources (25)
Central Concept Terms (links)	[solar] [energy] [electricity] [power] [grid] [greenhouse] [effect] [consumers] [benefits] (1,570)	[renewable] [energy] [tariff] [distributed] [electricity] [generation] (1,560)	[energy] [feed-in] [tariffs] [distributed] [electricity] [generation] (297)	[renewable] [solar] [energy] [tariff] [distributed] [electricity] [generation] [panels] [cost] (816)
Concept Clusters (No.)	[*Electricity*]: A key benefit is the financial payments for generating and exporting electricity to the grid that would otherwise go unrewarded. [*Solar*]: Owners believe that the incentives to invest in solar PV systems include reduced energy costs, deferred upgrades to grid infrastructure, and reduced greenhouse gas emissions. [*Tariffs*]: Feed-in tariffs should be maintained at between 35 and 60 cents per kWh. (3)	[*Energy*]: Develop small scale embedded RE systems for distributed power generation. Timely distribution network connections and low emissions technology projects are important for RE development. A carbon price and market trading will impact RE development. [*Tariffs*]: The need for fair and reasonable solar PV Feed-in Tariffs under customer-retailer electricity supply contracts. (2)	[*Energy*]: Feed-in Tariffs are an important aspect of developing RE supplies under distributed electricity generation schemes. RE enables greenhouse gas emissions reductions. Reducing barriers and maintaining the benefits of feeding RE to the electricity grid are important. [*Solar*]: The process of integrating solar PV systems with retail networks should be smooth. (2)	[*Energy*]: Feed-in Tariffs support investment in solar panels and industry development. RE offer governments a clean alternative to polluting coal fired electricity. [*Generation*]: Investment in distributed electricity generation systems will be shaped by energy regulations and markets. A carbon price and availability of low greenhouse gas emissions technologies will also impact investment. [*Community*]: Community investment in sources of RE can assist in reducing the impacts of global climate change. (3)
Coded Participant Statements	180	132	17	81

Table 3

Barriers and Impediments to Distributed RE Generation

Barriers (coded statements) (n=49)
1 Regulation, Policy and Administration (22)
– Inefficient and uncoordinated administration
– Convoluted development approvals process
– Sudden shifts and changes in public policy
2 Investment Costs and Returns (10)
– High project capital costs
– Insufficient investment returns
– Profitable power purchase agreements (PPA)
– Carbon price policy shifts
3 Power Grid Connection (10)
– Timely grid connection
– Unreliable grid connections and installation
– Inefficient grid connection process
4 Political Agendas and Interference (4)
– Public expenditure reduction agenda
– Energy industry lobbying for free markets
– Anti-regulation advocacy
5 Fuel Source Parity (3)
– Abundant brown and black fossil fuel resources
– Cheap coal fired power

Examining the use of Concept Analysis and Mapping Software for Renewable Energy Feed-In Tariff Design

Abstract

The Australian Government's installation of the now defunct carbon price in July 2012, triggered a review of the Renewable Energy (RE) Feed-In Tariff (FiT) policies in the state of Victoria. In this article, concept analysis techniques and mapping software have been used to examine RE FiT design elements and priorities proposed by eighty-six RE investors and FiT stakeholders during the course of the review. The results show that concept analysis and mapping can be used to analyse FiT designs enabling identification of combinations of discrete elements including fixed and variable payment rates, differing levels of market regulation and competition, varying tariff operating periods, and eligibility rules for RE system sizes, development sites and low emissions technologies. In addition, while the economic elements of FiT designs were afforded the highest priority by stakeholders, broader contemporary analysis shows that policy makers and regulators should continue to combine economic, technology, system and administration elements into tariffs that can deliver new RE supplies. Also, the results show that governments may elect to change the combinations of these design elements, introduce other ancillary policy instruments and regulatory mechanisms, and reshape the FiT schemes in order to accommodate significant shifts in public policies.

Keywords: electricity; energy; feed-in; renewable; stakeholders; tariff.

Nomenclature

Technical

FiT	Feed-in Tariff, cents per kilowatt hour
LCOE	Levelized Cost of Energy, dollars per megawatt hour
PFiT	Premium Feed-in Tariff, cents per kilowatt hour
RET	Renewable Energy Target, per cent or Gigawatt hours
RPS	Renewable Portfolio Standard, per cent
SFiT	Standard Feed-in Tariff, cents per kilowatt hour
TFiT	Transitional Feed-in Tariff, cents per kilowatt hour

General

CAaM	Concept Analysis and Mapping
GO	Government Organization
NGO	Non-Government Organization
PV	Photo-voltaic
RE	Renewable Energy
VCEC	Victorian Competition and Efficiency Commission

1 Introduction

Feed-in Tariffs for distributed RE sources is the dominant clean energy policy that has been credited with enabling RE developments and investment, while building energy security and addressing climate change [1,2,3,4,5,6,7,8,9]. Leading studies of FiT design assert that combinations of instrument elements (e.g. program length, fixed payment rates) must provide focused and sustained support for specific RE technologies in order to reduce costs, build energy diversity, and garner individual and business investment [1,10,11,12]. In addition, tariff design has been positioned as essential for balancing investor risks and consumer costs, including providing equitable tariff payment adjustment and program cap mechanisms [10,13]. Other contemporary studies have highlighted the importance of governments leading robust tariff design and implementation [14], including streamlining tariff administration and grid connection processes [15]; designing tariffs jointly for environmental outcomes and harsh economic realities [16]; using design philosophies that stimulate increased self-consumption of RE [17]; and, promoting designs that take account of tariff digression and impacts on future RE growth [18]. Collectively, these studies support the argument that FiT design factors are of critical importance [1,10,12,19]. Relevantly, there are internationally recognized examples where deficient FiT designs have resulted in poor RE product manufacturing and employment outcomes, and spiralling public costs [20,21]. Accordingly, it can be argued that a FiT must be purposefully designed to meet RE supply and emissions reduction targets, and avoid systemic failures [22,23].

Foundation studies show that FiT policies provide contractually binding payments for RE outputs for fixed periods, determined through the LCOE plus an investor rate of return (regulated), or the value of the RE generated using utility cost avoidance or external sustainability cost methodologies [12]. While investor returns can be paid at fixed (independent of market pricing) or premium rates (the spot market rate plus a fixed or variable premium payment) [12], the policies can also deliver broader economic benefits [4,5,6,7], including advancing industry development and innovative product research [24,25,26,27,28,29]. Importantly, RE research has determined that FiT schemes can stimulate rapid investment responses, while reducing perceptions of investment risk and improving energy costs transparency [25,29,30,31,32,33]. Also, studies conducted at national and industry levels illustrate the value of well-designed FiT schemes for controlling electricity price rises; improving energy security; and, enabling electricity markets expansion [1,21,25,34,35]. Further inquiries support the use of FiT policies for addressing RE supply targets under RPS regimes; developing non-dispatchable energy supplies; and, stimulating small scale RE systems growth [3,28,31,36,37,38,39].

However, FiT policies also possess some disadvantages. Studies of FiT implementation show that tariffs can drive higher public costs and taxes; increase capital equipment costs, installation fees and maintenance charges; limit returns on RE investments, and deliver windfall profits for electricity retailers [22,24,28,40,41,42]. Unsurprisingly, some researchers are openly critical of FiT instruments asserting that few sustainability benefits have resulted at the national level (e.g. Germany) [22]. Notwithstanding these reservations, it is difficult to design FiT policies that collectively take account of electricity costs and price factors, legislated RE quotas, and mandatory RE targets [1,2,3,30]. Unfortunately, tariff designers often have to contend with little, or no, change in energy use and demand management behaviours [43], poorly constructed RE dispatch, transmission and distribution processes and regulations [42,44], and government-mandated suboptimal geographic locations for RE development [29,35]. Hence, these factors present challenges for tariff design.

Further examination of the literature also highlights that FiT instruments do not operate in policy or program isolation. As an example, FiT policies can be coupled with RPS policies (i.e. prescription of energy demand to be met by RE) to grow new RE supply [12,39]. Tariff policies can also form part of larger innovation frameworks and programs that offer incentives to grow RE supplies, overcome policy voids and systemic failures, and advance the penetration of RE technologies into communities and business [45]. In addition, contemporary studies explicate how grid-connected residential RE systems, based on innovative business models, can support optimal bidding of energy supply volumes into the market by prosumers to secure feed-in payments, subject to timing, electricity pricing and prevailing risk appetite factors [46]. Hence, these streams of research show that FiT policies work within composite policy and regulatory arrangements to deliver new RE supplies.

This study supports the extant literature that advocates high quality FiT designs [1,2,3,10,19,47] with elements such as equitable access to electricity grids; robust and resilient transmission and distribution networks; a combination of tariff rates, RE quotas or program caps; tariff rate and participation adjustment protocols; and, efficient administration [1,2,3,4,5,36,47]. Studies also show that successful designs may allow for commercial (own and lease) and off grid system investments; gross tariffs for securing early investment returns; allowances for shifts in energy demand; and, energy production costs recovery [2,32,44,48,49,50]. In sum, robust FiT designs must be economically and socially sustainable, with the capacity to promote energy supply chain collaborations [26,33].

The motivation for this study was based on analysing and explicating FiT design elements in the context of Australia's RET of 23.5 per cent by 2020 (i.e. approximately 33,000 GWh of RE sourced electricity) [51,52], including the installation and removal a carbon price regime in 2011 and 2014, respectively [53]. A challenge for state and territory governments is the design of FiT policies that can grow RE investments and meet the RET, taking account of changing energy policies, economic conditions and electricity markets [51,54]. Hence, the site selected for analysis is Australia's second largest state, Victoria, where the state government was looking to design future RE FiT instruments that would rationalize existing FiT instruments; take account of carbon price policy shifts; and, support continued RE investment [54,55].

Given this motivation, the objectives for the research were clustered into two main areas as follows. First, given the directions of leading studies in FiT design [1,10,12,19], the identification and analysis of a combination of design elements (e.g. net/gross tariffs; capacity caps; system size ranges; public funding) with overlaid stakeholder priorities (e.g. economic, environmental, administrative) provide further theoretical insights and precision to extant benchmark research. The results also offer instructive direction for policy makers and regulators involved in tariff design and implementation. Second, through the application of a dedicated CAaM policy analysis technique [56,57], the research also provided a holistic composite analysis of tariff design elements, perceived benefits and potential RE growth barriers. Importantly, this enabled closer examination of additional and ancillary policy instruments (e.g. RE reverse auctions) [13] that can complement and adjust tariff designs and assist in growing RE stocks.

In meeting these objectives, the research makes useful and diverse contributions in the theory, practitioner, and research method disciplines. In the theory space, the study advances the examination and explication of combinations of tariff design elements, an area previously identified by leading scholars as important for future research [1,10,12,19]. Also, in the context of policy making and regulatory practice, the research offers alternate insights of how tariff design elements might be developed and adapted, and incorporated into broader and potentially more volatile energy policy regimes. As a further contribution, in applying CAaM techniques to the study, the research has resourcefully expanded the use of this multiple stakeholder analysis tool into the RE sector and energy policy design and development.

The balance of the article is developed as follows. The next section will discuss the background to the study and outline the research setting. Next, the article will describe the research method, including the CAaM technique, data collection and analysis procedures, followed by a discussion of the results. The concluding statements highlight the importance of implementing robust tariff designs, outline how Victorian FiT schemes benefit from adopting and/or adjusting combinations of design elements, and offer directions for ongoing research.

2 Background - RE FiTs in Victoria, Australia

Recent data from the Australian government shows RE sourced electricity generation equates to approximately 15 per cent (approximately 8.5 per cent short of the RET), with Australia's primary energy coming from fossil fuels [58]. The latest electricity generation trends from 2016 show that Victoria has approximately 4,200MW of renewable electricity generation capacity, with a Victorian government report showing that only 14 per cent of the state's electricity is generated using RE sources [59]. Hence, in order to meet its pro-rata 23.5 per cent obligations under the national RET, Victoria must continue to develop new RE supplies with FiT instruments forming a cornerstone of its energy policy mix.

In developing RE, Victoria has designed and instituted four FiT policies under the Electricity Industry Act (2000) Victoria [54,60]. The SFiT, PFiT and TFiT were designed as regulated, publicly funded, fixed rate and fixed period instruments. The SFiT scheme commenced in 2008 and was available to small RE generators with capacity up to 100kW. The scheme provided a 'one for one' payment dependent on the investor's consumption tariff rate and ended on 31 December 2016. The SFiT was instituted to develop the state's wind resources; improve grid connection for wind energy; and aid Victorian wind turbine industry development.

The PFiT scheme commenced operation in November 2009 and will end on 31 December 2024 (note, the scheme is now closed to investors). PFiT provides 60 cents per kWh net tariff payments to investors and was aimed at small scale RE generation up to 5kW capacity per site. The PFiT was designed to grow and bring certainty to solar PV investment; reduce emissions; and, support Victorian solar industry development.

The TFiT was launched in January 2012 and guaranteed a minimum rate of 25 cents per kWh for excess electricity fed back to the grid. This solar tariff required a system of up to 5kW capacity per site, consumption of 100MWh or less electricity per annum, and a bi-directional smart meter installed. The TFiT scheme was capped at 75MW capacity and ended on 31 December 2016. The TFiT was installed to ensure equitable support for solar PV investors; address climate change; take account of falling solar PV unit costs; and, support the state's solar industry.

On 1 January 2014, the VFiT was introduced as a mandatory ongoing tariff design, with the minimum variable payment rate regulated by Victoria's Essential Services Commission (i.e. currently 5 cents per kWh, moving to 11.3 cents per kWh on 1 July 2017), and the scheme funded by electricity retailers (5,000 customers minimum). The VFiT was installed to assure fair and reasonable payments for new RE investors, and current investors transferring from closed tariff programs.

Hence, given this cumulative policy approach, the future design and adjustment of FiT instruments will be crucial in meeting RET obligations [51], and realizing long term sustainability [60]. It should be noted that following the legislated reduction of the RET from 41,000 to 33,000 GWh in June 2015 [51,52] and subsequent slowing of new RE investments across Australia, the Victorian government has set new state RE targets of 25 per cent by 2020 (+1,500MW) and 40 per cent by 2040 (+5,400MW) to be augmented by reverse auction enabled FiT payment schemes [59].

3 Methodology

3.1 Concept analysis and mapping research technique

The CAaM is defined as "a structured process, focused on a topic or construct of interest, involving input from one or more participants, that produces an interpretable pictorial view (concept map) of their ideas and concepts and how these are interrelated", and is a proven research technique that allows analysis and description of a topic of interest (e.g. policy) [56,57]. This technique is applicable to stakeholder investigations where statements are collectively analysed using the following six step process [61].

First, the CAaM project is prepared by developing the focus of the investigation (i.e., current and future FiT designs and barriers associated with RE generation) and identifying the stakeholders that provide inputs. Second, inputs that address the investigatory focus are drafted and submitted by stakeholders (up to 200 participants may be involved). Third, the stakeholder inputs are structured by groups (i.e., investors, GOs, NGOs, public firms, private firms). Once in groups, inputs may be ranked in levels of importance (note, in the interest of equity, all inputs were assigned equal importance). Fourth, specialist CAaM software process inputs into concept statistics, clustering and multidimensional scaling analyses (Leximancer CAaM software was used in this study). Fifth, the analyses and maps are interpreted for their aggregate outcomes and outputs (i.e., collective views/issues raised by the stakeholders). Finally, the analyses and maps are utilised in management or design processes.

CAaM techniques have been used to deliver significant benefits and results in several settings, including medical education and training [62], psychiatric neurological therapies [63], health policy design [64], firm and industry level analyses [65], and tertiary level education [66]. Accordingly, it is argued that CAaM can also be applied to FiT design, and assessing barriers associated with RE developments. However, it is acknowledged that CAaM techniques possess established weaknesses, including requiring sufficient inputs for analysis and pattern building; competent interpretation of complex results; and, the clear definition of conceptual priorities [65,67]. In order to avoid interpretive difficulties, a member of the research team was recruited on the basis of their significant expertise in using CAaM techniques and supporting software tools.

3.2 Data sources, collection and processing

The data was collected on 15 June 2012 from the state government web pages established for the inquiry into Feed-in Tariffs and Barriers to Distributed Electricity Generation, conducted by the VCEC [68]. The VCEC was tasked with investigating current and future RE FiT (including state tariff termination options); and barriers that may impede RE growth and meeting RET obligations [68]. Hence, the data collected by VCEC was consistent with the scope of this tariff design investigation and analytical techniques (i.e. open-ended stakeholder responses that can be analysed and mapped), with stakeholder submissions providing 'open and uninhibited' views for concept analysis (i.e. a key requirement for CAaM).

Data in the form of written submissions from investors, energy users and representatives, managers and executives in private and public firms, and GOs and NGOs were collected and catalogued in separate Electronic Storage Folders (ESF) [68]. Each data file has a FiT inquiry identifier code (FT) and participant number (1 to 86). Also, the VCEC provided assistance with the reconstruction and provision of some electronic data files that had become corrupted and unreadable during the course of their inquiry. A total of 86 separate submissions were analysed with a summary of the ESF and stakeholders presented in Table 1.

Table 1 here

3.3 Concept analysis and mapping software

The Leximancer CAaM software enabled classification and documentation of concepts and themes, characterising and sorting of statements, identification of concept terms and document themes relationships, and removal of asymmetric information (i.e. statements unrelated to issues under analysis) [69,70]. Also, the software provided integrated CAaM and automatic text coding functions that supported the study's analytical processes [56,57,71].

The software tool used a seven step analytical process to: (i) select and load the written content files (i.e. .doc and .pdf files); (ii) remove stop words with limited semantic meaning (such as 'and'), and insert text and ESF markers; (iii) automatically extract the high level concept themes (large circles on the map) and fine detail terms (dots on the map) from the analysed text; (iv) edit the discovered concepts prior to reprocessing, including merging similar concepts (e.g. tariff and tariffs); (v) establish the text block processing and software learning parameters (i.e. number of concept (terms) integral to each concept theme, number of sentences in the text block, and the mapping of concept terms relationships); (vi) undertake the automatic location and coding of concept terms within the text block (i.e. the automated equivalent of the ‘manual coding process’ in content analysis) [71]; and, (vii) construct concept maps and statistics profiles.

Three primary information artefacts are created by the software [70] including a frequency distribution and statistical summary of discovered concept terms; associative behaviours between the concept terms (i.e. conceptual co-occurrence, with the central concepts being those that most frequently co-occur within the aggregate written submissions); and conceptual similarity and specific attraction (i.e. conceptual clustering, where groups of concept terms appearing in comparable or semantically similar contexts will cluster in close proximity on the map, representing an issue/set of issues). The software set points for the analysis were in accordance with procedures established in the Leximancer User Manual [70]. The software linear mapping mode was used to create stable concept map structures.

3.4 The two-stage analytical process

The analysis was executed through a two-stage process. First, the number of concept terms (points on the map) and the concept theme/s (high level theme of the aggregate written submissions) size was maximised (i.e. set to 100 per cent). This allowed all the concept terms and the primary concept themes for the aggregate written submissions to be identified (i.e. the major RE FiT issues and associated concept terms) [56,57,70]. Second, the software’s Multi-Dimensional Scaling (MDS) feature was used to steadily reduce the concept theme size in order to develop a set of workable RE FiT concept clusters and associated terms. As shown in other studies, the MDS feature enabled the determination of the concept clusters within the aggregate written submissions by rescaling the primary concept themes, and enabling the secondary concept themes, associative relationships and key participant issues to emerge [65]. The software's concept co-occurrence mapping feature was also activated to record the strongest relationships between concept terms and deploy the automated text coding function (i.e., related concept terms are displayed in a table with the coded text logs in the adjacent columns) [70]. Each piece of coded text is codified with a three digit identifier number (e.g., s1_123) [69,70]. This enabled confirmatory comparisons of the coded text from the written submissions with mapped concept clusters and terms [70].

4 Results and Discussion

4.1 The concept analysis and mapping results

The consolidated results from the CAaM analysis are presented in Table 2. The results show that the 86 stakeholder inputs were focused on the primary theme of RE generation.

Table 2 here

The analysis also uncovered approximately 100 to 400 concept terms within each stakeholder category, with 'energy' the dominant concept term across the four ESF inputs. The determination of the central concept terms within each stakeholder category illustrated that the use of FiT for growing RE systems investment and distributed electricity generation was the pivotal concern in the framing of inputs.

Importantly, the cluster analysis determined that the use of RE FiT was an important driver of investment decisions, and that some future fair and reasonable FiT (either regulated-fixed or market-based variable rates) would support RE systems development. The clusters also exposed several benefits related to RE systems development (e.g. deferred grid infrastructure upgrades, energy costs savings, reduced emissions), while highlighting potential barriers to RE developments (e.g. onerous industry regulation, network and grid connection problems). An example concept map and cluster group for ESF1 is shown in Fig. 1.

In addition, 410 coded participant statements were extracted using the CAaM software, and separated into RE tariff design (192) and associated benefits (169), and distributed generation development barriers (49). The content analysis results, summaries and coded text examples are presented in the following sections.

Fig. 1 here

4.2 RE FiT design elements and associated benefits

The analysis of coded statements showed a strong level of support for a tariff design that is based on a regulated net or gross metered tariff at rates between 15 and 60 cents per kWh (i.e. 47% of participant statements) (see Fig. 2). As a typical example, the environment focused LIVE NGO (FT-55) [68] stated that gross FiT were necessary to drive RE developments:

> "As previously stated, with the adoption of renewable energy as a much greater proportion of our energy mix—in addition to mitigating catastrophic global warming—there will be the added benefit of a boost to our local economies and new, more secure and sustainable 'green collar' jobs in Victoria. Arguably the most effective policy tool to achieve a rapid, widespread uptake of solar energy in Victoria would be to offer gross metered Feed-in Tariffs of around 60c/kWh to reward generators for the safe, secure, zero emission energy they produce." (s1_52, LIVE NGO, 19 March 2012).

Comparatively, approximately 13% of participant statements (primarily from energy firms and the electricity supply NGO) presented that regulated FiT are unnecessary and that payments for net exports of electricity to the state power grid should be based on open market competition and pricing. As an example, integrated energy firm Origin Energy (FT-81) [68] stated that competitive market processes should guide electricity export payments:

> "Origin does not believe a regulated FIT is required. There is no evidence that the market has failed given the voluntary FITs offered by electricity retailers. Origin believes rivalry between retailers (which seems to be sufficient for the determination of competitive retail supply prices) is the most efficient and equitable means of determining unregulated FITs" (s1_117, Origin Energy, 26 March 2012).

This diversity of participant views highlights the priority placed on the economic elements of FiT designs, and the differences between community and more commercial perspectives with respect to RE supply development using FiT schemes.

Fig. 2 here

The results also illustrate that tariff designs can be extremely complex with the opportunity to exercise different combinations of elements (see Fig. 2), subject to the tariff's objectives and scope. In this respect, the analysis uncovered other important FiT design elements, including applying tariffs to a wider range of technologies; setting stable and long term tariff periods; establishing tariffs for varying RE systems size ranges; applying tariffs to larger scale regional community, commercial and leased RE systems; and, integrated tariff transaction procedures that combines retail consumption tariff and FiT payments and contracts, service fees, government charges and RE (green) certificate transactions.

As part of a new tariff design, a number of participants considered that any future RE FiT should allow a wide range of RE, hybrid and low emissions technologies (e.g. solar-natural gas energy systems) to qualify for entry into the scheme (14% of participant statements), while a further group of participants argued for higher levels of investment and income certainty through the application of long term FiT ranging from 10 to 25 years (8% of participant statements). As examples, low emissions technology manufacturer Ceramic Fuel Cells Limited (FT-41) [68] argued that tariffs should be technology neutral:

> "We suggest the Commission should take into account the following factors when designing feed-in tariffs. Technology Neutral – Any technology which is small scale and lower emission achieves the same valid policy objective and should qualify for a feed-in tariff." (s1_171, Ceramic Fuel Cells Limited, 19 March 2012).

while RE consulting and engineering firm Ironbark Sustainability (FT-50) [68] argued for a long term stable tariff structure:

> "A strong feed-in-tariff would be fixed for 20 years, providing a guarantee on investment and offering financial certainty for Distributed Generation. The current uncertainty hurts investment. For example, council's cannot accurately develop a business case and payback period models for rolling out solar PV because they are unsure if they will still be covered by the feed-in-tariff" (s1_39, Ironbark Sustainability, 19 March 2012).

These types of statements show that tariff designs might be expanded to include several technologies, while also reinforcing the need to assure investors that tariff operating periods will be honoured. Other aspects of tariff design raised by participants assert that all RE systems sizes (i.e. micro generation <5kW, small scale 5kW to 100kW, medium scale 100kW to 5MW, large scale 5MW to 30MW) (see Enviromate, FT-60), community-based RE systems, and RE systems deployed on commercial and leased sites should be eligible for inclusion in FiT (see Mildura Development Corporation, FT-49) [68]; and that streamlined tariff administration would be beneficial (see Exigency, FT-04) [68].

Also, the automated analysis allowed extraction of 169 coded participant statements that were related to four major benefits of establishing a new FiT. First, participants considered that new RE FiT would support environmental and climate change mitigation objectives through the introduction of increased RE capacity (29% of statements). This was observed as the most critical issue in arguing for the continuation of FiT in Victoria [51]. Second, the continued development of the state RE industry sector and sustainable regional communities was seen as an important outcome from retention of the Victorian FiT schemes (25% of statements). In this respect, the tariffs were seen as enablers of economic and social growth in the state [72,73]. Third, participants espoused the reduced financial risks and increased benefits that would flow to RE systems investors and state electricity consumers should FiT schemes be retained (24% of statements). In this context, adequate returns on RE systems investment and any associated household electricity cost savings were presented as important benefits [74]. Fourth, electricity generation and supply infrastructure, including improvements in state energy security, were identified as tariff beneficiaries by participants (22% of statements). Reduced dependency and transition away from fossil fuelled electricity generation assets were considered as benefits that would flow from continued FiT schemes [75,76]. The statement from RE engineering firm Regional Cleantech Solutions Limited (FT-53) [68] offers a consolidated view of benefits:

> “A feed in tariff for community based projects is easy to understand, supports regional development, and is politically a winner. A community renewable energy project can deliver economic, environmental and social benefit simultaneously. These include retention of income locally from energy revenues distributed to local owners/shareholders, creation of local employment in construction, operation and maintenance; reduced costs of energy for households and businesses, a reduction in the

> local carbon footprint, and engagement of the broader population in the issues of sustainability and climate change” (s1_17, Regional Cleantech Solutions Limited, 19 March 2012).

In summary, the results from the analysis expose the importance of combining the economic, technology, system size, development and administration elements in the FiT design [1,10,12,19]. Importantly, these elements reflect the design priorities assigned by the FiT stakeholders under analysis. Also, the identification and documentation of these FiT design elements and associated benefits demonstrates the utility and value of CAaM techniques for analysing and developing these RE policy instruments.

4.3 Barriers to distributed renewable energy generation

Participants identified three major and two minor barriers to distributed RE generation in Victoria as noted in Table 3. The three major barriers are consistent with the RE literature [77].

Table 3 here

The highest rated barrier by participants was the overly onerous levels of government regulation including inefficient and uncoordinated administration, multiple levels of development approval, and sudden changes in government policy. As an example, RE engineering firm Neilson Electrical Systems Pty Ltd (FT-84) [68] offered a candid view on the ‘clumsy’ regulatory arrangements:

> “The approval and connection process can be complex and overly bureaucratic with many technical and contractual issues. Some retailers and system suppliers address this by offering a “one stop shop” service But being a relatively new process for the energy industry, it is still rather clumsy” (s1_42, Neilson Electrical Systems Pty Ltd, 19 March 2012).

The other two major barriers focus on problems associated with higher rates of RE systems investment and stable financial returns, and establishing timely and reliable grid connections. Participants presented concerns related to the high capital costs of RE supply systems, especially where larger commercially based systems in the 100kW to 30MW capacity range might be considered, and the difficulties associated with securing profitable multi-year PPAs with public firms and private power companies [78,79]. At the time, the implementation of the national carbon pricing regime was also seen as an added complication in the process of tariff design and RE development (i.e. limited incentives to invest in high cost RE capacity projects) [53,80]. The issue of assuring timely and reliable RE systems connections to the power grid, through the distribution network service provider, was also promoted as a barrier that must be overcome as part of any future FiT (the administrative forms and paperwork were seen as cumbersome, time consuming and inefficient) [1,2,3,4,5,8]. The two minor barriers to enhanced distributed generation highlighted the difficulties of building RE supply systems when political agendas interfered with the policy development processes (e.g. public expenditure reduction agenda, anti-regulation advocacy) [81], and incumbency advantage enjoyed by Victoria's coal fired electricity plants [82].

On balance, well-structured administration and development elements of the FiT design would go some way to addressing and overcoming some of these barriers. Certainly, a settled tariff policy that provided income security for investors and assured timely and reliable grid connection would present as a positive complementary policy instrument that integrates with other federal, state and local RE strategies [83].

5 Conclusions

In this study, we have examined a range of design elements that may be applied to FiT. However, the study has some specific and important limitations. First, individual investors and energy users made up over half the sample used in the CAaM activity (i.e. 53% of the sample), while GOs were a very small part of the sample (i.e. 4% of the sample). Accordingly, this skewed the results towards economic design elements that might be considered more important by individuals in the community (e.g. fixed and regulated tariff payment rates). This effect was offset to some extent by statements from ten electricity supply firms and one electricity supply NGO. Second, Victoria has abundant low cost brown coal resources, coupled with sizeable wind and solar resources. This confluence of different resource types, and their associated development economics, may make the results less applicable to some country and regional settings. However, despite these limitations, this study has made a contribution to cumulative FiT design research [1,10,12,19].

First, the results show a priority for economic elements of FiT designs [10,84,85] with specific emphasis on payment rates and regulatory (or open market) structures. The stakeholder analysis also presented that tariff designs should integrate additional elements, including more progressive eligibility rules for different renewable and low emissions technologies, various individual and commercial (lease and ownership business models) RE systems ranging from <5kW to 30MW capacity, and streamlined tariff contract and transaction administration. Notably, while the state government has retained a mix of FiT designs and elements (PFiT, VFiT), it has elected to exclude low emissions technologies in tariff schemes in the near term.

In late 2015, Victoria instituted its RE Roadmap protocols to enhance elements of its FiT designs, including improving PV investor and energy retailer business transactions; and examining different tariff enabled business models to grow RE supply, such as leasing of solar PV systems (i.e. avoiding high capital costs) and ‘roof registers’ (i.e. matching investors with parties possessing sufficient roof space to enable PV system installation) [86]. The protocols are also targeted at overcoming barriers to RE growth, such as inefficient grid connection processes and technical constraints on RE deployment. In further examples, the VFiT will be redesigned in the future as a multi-rate FiT to cover time variations in generation (peak, shoulder and off-peak) [87], while large utility scale generators (+30MW) will tender in lowest cost reverse auctions to secure a fixed term FiT contract (valued at the difference between the tendered strike price and a reference market price of electricity) [88]. Hence, this shows that while the state maintains a firm base of elements through the PFiT and VFiT, Victoria has the capability to tactically reshape its current and introduce new FiT instruments, using different combinations of design elements and ancillary policies, in order to grow RE supplies.

Second, the results show that the six identified design elements may not only sit in combination within a FiT policy, but could also form part of a strategic framework of national and state policies and programs. In this way, the PFiT, VFiT and future large utility scale tariff designs are integrated into complementary policy frames that can include multilayer RPS targets, tradeable RE certificates, and climate change and carbon emissions reduction policies. In this context, the overarching benefit for Victoria is the ability to strategically modify and adapt its FiT designs to accommodate high impact changes in national policies. As an example, the state has signalled its intent to use reverse auction enabled large utility scale FiT designs [59,88] to counter the downturn in domestic RE investment due to the steep national RET reduction in mid-2015 (–8,000GWh) [52]. This is particularly important given some of the volatile shifts in climate change and RE policies experienced in Australia during 2011-2015 [52,53].

Third, the analysis illustrates that CAaM can be used for FiT design, implementation and review. The results successfully demonstrate the ability to extract and document combinations of critical FiT design elements and associated tariff structure benefits using the CAaM technique and software. Importantly, the analysis provides a unique 360 degree view of the policy design incorporating community, business and government perspectives. This result complements the policy analysis outcomes achieved in other disciplines [62,63] and further extends the use of CAaM into the RE sector. Hence, the use of CAaM is commended as a valuable technique for RE policy design and development.

In closing, given the emergence of energy storage as a closely coupled technology to RE systems [86], it is expected that different markets (e.g. energy storage, energy capacity) will give rise to new energy supply chain stakeholders, coupled with varying levels of supply and demand and price fluctuations, over time. Accordingly, any commensurate variations in FiT design elements and policies should provide future opportunities to advance tariff design research.

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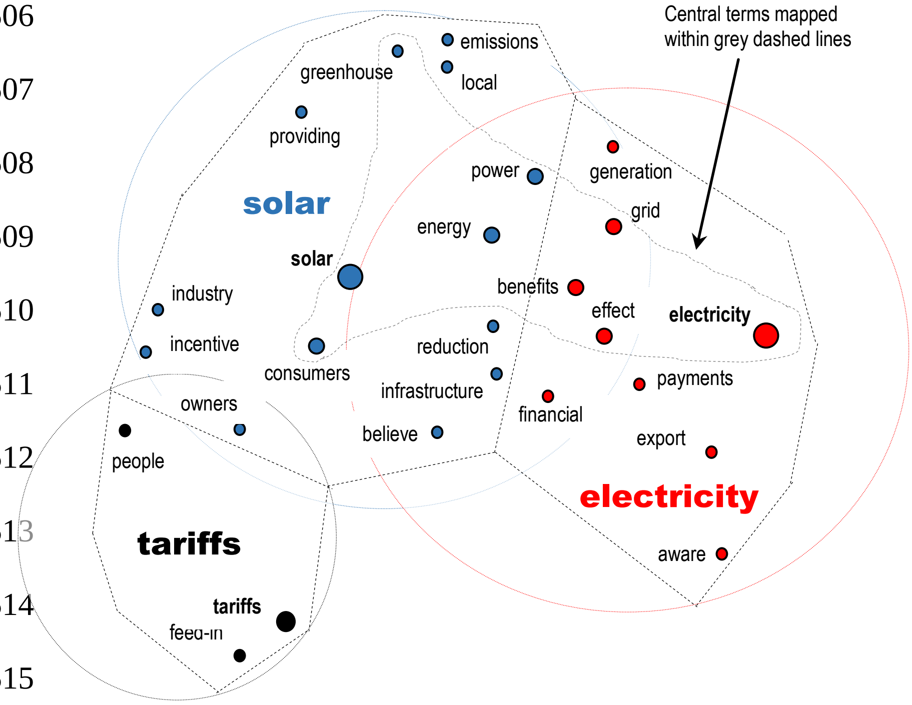

Fig 1. Example Concept Map for ESF1 Cluster

Tariff Type (n=121)
(i) Net or Gross, Government Regulated, Fixed Payment Rate, 15–60 cents/kWh (97)
(ii) Net, Unregulated, Market-based Variable Payment Rate (24)

Technology Deployment (n=25)
Technology Neutral. In addition to solar and wind RE, allow hybrid and low emissions technologies

Tariff Period of Operation (n=15)
Long term tariff operating period, 10–25 years

System Sizes (n=11)
Multiple RE systems sizes are eligible under the tariff: micro generation <5kW, small scale 5–100kW, medium scale 100kW–5MW, large scale 5–30MW

Development Type (n=10)
Community ownership, larger commercial, and leased developments

Tariff Administration (n=10)
Integrate electricity consumption and feed-in supply contracts, electricity retailer service fees, government charges, and RE certificate transactions into tariff administration processes and procedures

Fig 2. Stacking Diagram of FiT design elements (total coded statements, n = 192)

Table 1

Summary of Individual RE Investors, Energy Users and Stakeholder Organizations

Individuals or Stakeholder Organization
ESF1: Individual RE Investors and Energy Users (45)
Forty-five individual investors and energy users in Victoria. Investors and users have installed solar PV systems up to 5kW in size.
ESF2: Private and Public Firms (23)
Advance Solar Electrical - Small Medium Enterprise. RE engineering and installation.
BRT Consulting - Small Medium Enterprise. RE engineering and consulting.
Comfortid - Small Medium Enterprise. Solar PV and wind turbine systems.
Enviromate - Small Medium Enterprise. Solar engineering and installation.
Exigency - Small Medium Enterprise. Carbon market and RE advisory.
Ironbark Sustainability - Small Medium Enterprise. RE engineering and consulting.
Neilson Electrical Systems Pty Ltd. - Small Medium Enterprise. RE engineering and consulting.
Noonan Farms - Small Medium Enterprise. Farm and grazier business.
Regional Cleantech Solutions - Small Medium Enterprise. RE engineering and consulting.
Saturn Corporate Resources Pty Ltd. - Small Medium Enterprise. Economic analysis and consulting.
Ceramic Fuel Cells Ltd. - Low emissions fuel cell manufacture. A$280 Million Assets; 100 emp.
RE Solutions Aust. Holdings - Silent wind turbine manufacturing firm. 100 emp.
Warburton Community Hydro Project - Community owned company. RE community projects.
Loy Yang Marketing Management Co. - Energy dispatch and trading firm. 2,200MW capacity.
Union Fenosa Wind Australia - International RE development firm. 503 turbines; 1,200MW capacity.
Simply Energy - Large electricity and gas retail firm. 300,000 customer accounts.
Citipower/PowerCor - Electricity Distribution firm. 1,100,000 customers; 82,000km net.
Jemena - Electricity Distribution firm. 319,000 customers; 11,000km network
Lumo Energy - Electricity Distribution firm. 400,000 customers; 13,000km network
United Energy - Electricity Distribution firm. 400,000 customers; 12,000km network.
APA Group - Gas transmission business. A$9 Billion Assets; 12,700km pipeline.
AGL Energy - Large integrated energy firm. A$7 Billion Revenue; 2,100 emp.
Origin Energy - Large integrated energy firm. A$11 Billion Revenue; 5,600 emp.
ESF3: GO (4)
Darebin City Council - Municipal government. Pop. – 137,000; 59,000 dwellings.
South-East Councils Climate Change Alliance - Eight large municipal gov. Pop. – 833,000; 487,000 dwellings.
Moreland Energy Foundation - Local government business. NFP consulting and education.
Energy and Water Ombudsman Victoria - State utilities ombudsman for Victoria.
ESF4: NGO (14)
Australian PV Association - Australian solar PV industry – peak representative body.
Australian Solar Round Table - Six large Australian solar RE firms – CEO rep. board.
Alternative Technology Association - Sustainable technology and practice NFP advocate.
Beyond Zero Emissions - Sustainable energy research and education. 200 active groups.
Clean Energy Council - Clean Energy Industry (Australia).
Climarte - Small climate change and arts advocacy org. 3 employees.
Dandenong Ranges RE Association - City based climate change action group. 130 members.
Emerald for Sustainability - Environmental action group. 50 members.
Energy Supply Association Australia - Energy supply firms (Australia). 114 firms in Australia / NZ.
Environment Victoria - Environmental action group for Victoria. 416 members.
Grattan Institute - NFP Public Policy Think Tank and Advocate.
Locals into Victoria's Environment (LIVE) - Environmental action group for Victoria. 3,000 members.
Mildura Development Corporation - Mildura region (Vic.) business development body.
Nat. Electrical & Communications Assoc. - 1,250 Electrical, voice and data businesses – peak rep. body.

Source: Victorian Competition and Efficiency Commission, 15 June 2012.

Table 2

Summary of Concept Analysis and Mapping – Participant Responses

Concept Mapping Artefact	**ESF1**	**ESF2**	**ESF3**	**ESF4**
Primary Concept Theme	Electricity	Energy	Energy	Energy
Number of Concept Terms Highest Ranked Term Lowest Ranked Term	26 electricity (406) payments (39)	40 energy (325) trading (22)	29 energy (98) time (8)	40 energy (327) sources (25)
Central Concept Terms (links)	[solar] [energy] [electricity] [power] [grid] [greenhouse] [effect] [consumers] [benefits] (1,570)	[renewable] [energy] [tariff] [distributed] [electricity] [generation] (1,560)	[energy] [feed-in] [tariffs] [distributed] [electricity] [generation] (297)	[renewable] [solar] [energy] [tariff] [distributed] [electricity] [generation] [panels] [cost] (816)
Concept Clusters (No.)	[*Electricity*]: A key benefit is the financial payments for generating and exporting electricity to the grid that would otherwise go unrewarded. [*Solar*]: Owners believe that the incentives to invest in solar PV systems include reduced energy costs, deferred upgrades to grid infrastructure, and reduced greenhouse gas emissions. [*Tariffs*]: Feed-in tariffs should be maintained at between 35 and 60 cents per kWh. (3)	[*Energy*]: Develop small scale embedded RE systems for distributed power generation. Timely distribution network connections and low emissions technology projects are important for RE development. A carbon price and market trading will impact RE development. [*Tariffs*]: The need for fair and reasonable solar PV Feed-in Tariffs under customer-retailer electricity supply contracts. (2)	[*Energy*]: Feed-in Tariffs are an important aspect of developing RE supplies under distributed electricity generation schemes. RE enables greenhouse gas emissions reductions. Reducing barriers and maintaining the benefits of feeding RE to the electricity grid are important. [*Solar*]: The process of integrating solar PV systems with retail networks should be smooth. (2)	[*Energy*]: Feed-in Tariffs support investment in solar panels and industry development. RE offer governments a clean alternative to polluting coal fired electricity. [*Generation*]: Investment in distributed electricity generation systems will be shaped by energy regulations and markets. A carbon price and availability of low greenhouse gas emissions technologies will also impact investment. [*Community*]: Community investment in sources of RE can assist in reducing the impacts of global climate change. (3)
Coded Participant Statements	180	132	17	81

Table 3

Barriers and Impediments to Distributed RE Generation

Barriers (coded statements) (n=49)
1 Regulation, Policy and Administration (22)
– Inefficient and uncoordinated administration
– Convoluted development approvals process
– Sudden shifts and changes in public policy
2 Investment Costs and Returns (10)
– High project capital costs
– Insufficient investment returns
– Profitable power purchase agreements (PPA)
– Carbon price policy shifts
3 Power Grid Connection (10)
– Timely grid connection
– Unreliable grid connections and installation
– Inefficient grid connection process
4 Political Agendas and Interference (4)
– Public expenditure reduction agenda
– Energy industry lobbying for free markets
– Anti-regulation advocacy
5 Fuel Source Parity (3)
– Abundant brown and black fossil fuel resources
– Cheap coal fired power