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White certificate schemes – can commodification and financialisation of energy efficiency solve energy market failure, or risk just adding to it?

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Abstract

Policy measures that establish a trading market in 'energy savings', going under names including White Certificates, Energy Efficiency Targets, Energy Savings Schemes and Energy Efficiency Certificate Trading, are receiving growing policy attention and have been implemented in jurisdictions including Europe, the United States and Australia. They are often portrayed as a market-based energy efficiency solution to energy 'market failure.' This paper highlights some key challenges with such 'designer' markets that attempt to commodify a potentially wide range of 'energy savings' activities and then facilitate the financialisation of such opportunities through tradable instruments. A key challenge is that energy efficiency opportunities are highly heterogeneous, and exist within a broader energy services decision making context. Hence the genuine additionality of energy savings is generally difficult to measure and verify. This, in turn, poses particular challenges and risks when establishing financial instruments and associated markets to trade complex, interacting, uncertain and highly abstracted 'energy savings' outcomes. While at least some of the schemes implemented to date appear to be functioning well, these challenges and the role of commodification and financialisation more generally in the Global Financial Crisis suggests some measure of caution. It is concluded that considerable care is required with such approaches to energy efficiency policy lest governments' merely add yet further market failures to those already existing for energy efficiency. More importantly, progress with some key energy efficiency opportunities will require that policy makers not just frame energy efficiency within conventional economic terms of market failure within 'energy commodity' markets that can be addressed through explicit 'energy efficiency' designer markets, but also address the broader challenge of engaging energy users within a coherent and comprehensive 'energy services' context.

Introduction

The opportunities yet challenges of improving end-use energy efficiency have been widely noted and are receiving growing policy attention. A key challenge is that energy efficiency is just one 'means' to the desired 'end' of energy services, albeit almost certainly one of our best options to address our growing energy accessibility, affordability, security and environmental challenges (IEA, 2012). Nevertheless, energy efficiency decision making sits within a broader context of energy related decision making.

This broader context has changed markedly in many jurisdictions over the past two decades. In particular, a number of electricity industries around the world have undergone a process of restructuring[1] away from traditional integrated monopoly utility arrangements towards more market oriented approaches. The stated intention of these changes has typically been to increase economic efficiency and customer choice by introducing greater competition into the industry. The resulting arrangements have commonly involved competitive wholesale markets between large generators and retailers[2] with associated financial markets to facilitate risk management and investment by these participants, with monopoly network service providers to manage the poles and wires and some form of retail market between the retailers and energy consumers.

Electricity industry restructuring inherently involves some level of commodification and financialisation of electricity. Wholesale electricity markets require that electricity be treated as an homogenous and exchangeable whilst trading requires that a range of financial instruments be established around this 'commodity'.[3]

Within restructured electricity industries, energy efficiency policy, and energy policy more generally, are often framed in terms of market failure. As such, policy efforts are argued to be appropriate when the market does not provide economically efficient outcomes for society (often with the proviso that such outcomes wouldn't be made worse by 'government failure' when intervening). The energy industry certainly features every possible form of market failure including the presence of monopolies and oligopolies, energy's role as an essential public good, incomplete markets as key energy infrastructure requires high levels of centralised decision making, a range of environmental, economic and social externalities that aren't currently priced appropriately and, last but not least, information failures including often poorly informed and un-engaged energy users.

There are, however, significant concerns that this 'market failure' framework does not represent a sufficiently complete and appropriate basis for undertaking energy, or indeed any, policy efforts. For example, Kay (2007) argues that seeing government intervention and specifically policy making purely through the framework of market failure risks leading policy makers to an impoverished view of politics, democracy and collective decision-making. Bozeman (2002) argues that this framework has its uses yet important shortcomings for understanding the public value aspects of public policy and management for reasons including its failure to properly include underlying community values and their 'privatisation' of public benefits. The key role that energy plays in societal welfare would suggest particular challenges in this regard. Nevertheless, this framework is widely applied in energy policy making including for energy efficiency where impediments are often cast in more general terms of energy market failure (eg. Productivity Commission, 2005a; MacGill et al, 2013). This has proven problematic. Sorrell et al (2011) reviews the differences between barriers and market failures for energy efficiency, and a range of perspectives of what market failure might reasonably include, and omit. Beyond information failures and unpriced externalities, lie more complex questions about the nature of end-user decision making, and policy opportunities to improve its outcomes.

The role of electricity industry restructuring on market failures in energy efficiency is also vexed. While it has been argued that greater market-based, competitively driven, decision-making in the electricity sector would improve energy efficiency outcomes through more 'rational' decision making, experience to date has been mixed (European Commission, 2002; Productivity Commission, 2005b). The efficiency of a competitive industry model depends critically on informed decision-making by engaged and empowered consumers, yet also all other key stakeholders within a commercial context that appropriately prices all relevant private and societal costs and benefits. Highly abstracted and complex 'designer' electricity markets are problematic in all regards.

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[1] Other terms are also used to describe this process including reform, privatisation, liberalisation and deregulation. However, reform is generally defined to mean improvement which may or may not be the case, privatisation is not a necessary condition for restructuring as competing entities may remain state owned, liberalisation is used in diverse ways in different contexts whilst deregulation is generally a poor description of the process which often involves moving from state owned monopolies under limited direct regulation to far more complex regulatory arrangements required to direct competitive behaviour and privately owned monopoly components of the industry.

[2] These retailers are also known as suppliers or load serving entities in some industries.,

[3] In practice, of course, a range of centralised market interventions are required to address mismatches between the physical realities of electricity and associated infrastructure, and such market arrangements. These include ancillary services and network operation and investment.

The growing interest in, and deployment of, market-based[4] energy efficiency policy mechanisms and, in particular, the development of designer markets for 'energy efficiency' itself, is one outcome of this only relatively recent market oriented energy industry and policy context. Such approaches, going under names including White Certificates and Energy Efficiency Certificate Trading (EECT) fall within a broader range of schemes described by terms including Energy Efficiency Portfolio Standards, Energy Savings Schemes and Energy Efficiency Obligations (Bertoldi et al, 2009). While details vary significantly across the schemes developed to date, they all involve the measurement and commodification of some types of energy efficiency activities and the creation of demand for these commodified energy savings (often through legislated targets). These schemes may also include some form of flexibility mechanism. For White Certificates/EECT, the schemes include a 'designer market' to support trading of 'energy efficiency' certificates between liable parties and energy efficiency providers. Typically a range of financial markets have emerged to facilitate and extend such trading (Bertoldi, 2011). As such, these latter policies represent, at least in part, the commodification and financialisation of energy efficiency, to match similar earlier developments within the energy industry itself. A number of schemes including such trading have been implemented in Europe and Australia and are often portrayed as a market-based solution to energy efficiency 'market failure' in energy markets, and they form the focus of this paper.

The benefits of such approaches are argued to be many. Such schemes are compatible with restructured so-called competitive retail markets and focus cash flow through specialised participants who can assist energy users to undertake particular types of energy efficiency actions. In theory, they also allow the market to identify the cheapest way to deliver energy savings rather than relying on fallible government policy makers. Indeed, in theory, regulators can 'set and forget' the desired energy efficiency outcome and then transfer the actual decision making and risks to parties that are better 'ready, willing and able' to identify and act on energy efficiency options.

However, there are also some potential limitations to consider. Of particular interest to this paper, energy efficiency is not a natural commodity and the schemes therefore require considerable complexity and abstraction. There are, also, obvious risks with creating financial instruments around such a highly abstracted commodity within a broader designer market – a market designed and implemented by those fallible policy makers. The rest of this paper addresses some of the potential advantages and pitfalls of commodifying and financialising energy efficiency. The approach taken is exploratory in nature – the schemes are still relatively novel and designs continue to evolve as policy makers gain experience. First, the paper explores the motivation, and potential advantages and disadvantages of commodifying and financialising electricity itself. It then assesses some potential implications of commodifying and financialising energy efficiency in term. It concludes with a general discussion of the key challenges and opportunities of White Certificate/EECT schemes, and their potential contribution to addressing existing energy market 'failure' in facilitating energy efficiency.

The commodification and financialisation of electricity

Beyond the very general economic definition of a commodity as a marketable item produced to meet wants or needs, the term is commonly used to describe something of value which is of uniform quality and produced by many different producers.[5] As such, a commodity is homogenous and fungible – that is, there is no quantitative differentiation in quality or price depending on where or by whom the commodity was produced. As such, commodities represent a particular type of good – itself commonly defined as a tangible physical product that can meet a desire or need. By comparison, non-commodity goods can have very different qualities, attributes and values.

Commodification has several common meanings. One is the process by which something which traditionally doesn't have an economic value is assigned such a value and then entered into commercial relationships. An example is greenhouse gas emissions which have, in some jurisdictions and economic sectors, recently

[4] Note that in the broadest sense, market based energy efficiency policies have been defined as "aspects of laws or regulations that encourage behaviour through market signals, rather than through explicit directives regarding pollution control levels or methods' (Stavins, 2003) The particular focus here, however, is on mechanisms that establish a 'designer' market in energy efficiency by creating a tradeable fungible unit of energy savings, placing obligations on key electricity industry participants to purchase some target of these savings, and establishing a range of measures, and associated measurement methodologies for interested parties to supply these buyers.

[5] Except where specifically noted, the various definitions used here are largely derived from the general topic discussions on *wikipedia.org*.

transitioned from an unpriced waste flow to a traded 'carbon' commodity. However, it also describes the process by which distinct goods with different attributes and values end up as simple fungible commodities within undifferentiated price competition. Electricity has only recently joined the ranks of commodities which were traditionally a range of underlying agricultural and livestock products (for example, pork bellies) and metals, as well as some primary energy sources notably oil. Some other energy sources including natural gas are also undergoing a similar process to some extent, as seen with the growing international market in shipped Liquefied Natural Gas (LNG).

Financialisation also has several common meanings. More broadly, it has been described as *"..the increasing importance of financial markets, financial motives, financial institutions, and financial elites in the operation of the economy and its governing institutions, both at the national and international levels"* (Epstein, 2001). More specifically, it can used to describe *"an economic system or process that attempts to reduce all value that is exchanged (whether tangible, intangible, future or present promises, etc.) either into a financial instrument or a derivative of a financial instrument"*[6] A financial instrument itself is, according to International Accounting Standards[7], *"any contract that gives rise to a financial asset of one entity and a financial liability or equity instrument of another entity"* As such, financialisation aims to reduce any produced good or service into an exchangeable financial instrument which can be easily traded by parties that not only produce or use the product or service, but potentially any other party that might be interested in the underlying value of this product or service. Note that such instruments may be valued directly by a market, for example the wholesale spot oil price, or instead have a value which is derived from one or more underlying entities, such as for example a derivative contract settled on future spot oil prices.

A general shift towards commodification and financialisation within many economies worldwide has been noted over recent decades as part of broader micro-economic restructuring efforts across a range of sectors. A general principle of such efforts has been that markets can play a positive role in improving economic efficiency through greater competition. While it is certainly possible to have competition between differentiated goods and services, it does pose additional complexities for both buyers and sellers. Competition is inherently based on a range of factors including perceived quality and how well different offerings meet their needs, as well as price.[8] By comparison, markets for commodities generally compete largely on price.

Associated with this increasing commodification has been a process of growing financialisation. As just one example, in 2007, the U.S. financial services industry accounted for some 40% of corporate profits (The Economist, 2008) while financial sector debt had grown from one tenth of non-financial sector debt in 1980 to around half (Turner, 2010), The implications of this are also contested. As Lord Turner, Chair of the London Financial Authority, noted (2010) "*A dominant conventional wisdom of economy theory and policy – The Washington Consensus as it was labelled – has assumed and asserted that this increase in the financial intensity of the economy is beneficial, driving a more efficient allocation of capital, imposing discipline on inappropriate policies and enabling investors and users of funds to hedge risk better*."

The global financial crisis has, however, heightened concerns regarding the potentially adverse impacts of a greater reliance on such market mechanisms across the economy and, in particular, the greater financialisation that has become possible with commodification of entities as diverse as sub-prime mortgages and credit default swaps. Turner notes that the theory underling the Washington Consensus *"has shown to be severely deficient, failing to take account of the inherent potential of financial markets to be subject to self-reinforcing herd and momentum effects, with periods of irrational exuberance followed by sudden and contagious panics. Short-term capital flows can under some circumstances be harmful: and complex financial innovation in developed countries has produced few demonstrable benefits and resulted in an increased risk of financial instability*."

For the electricity industry, the success or failure of the varied restructuring efforts seen to date is still being debated. There are some clear examples of failure such as seen in California, yet other apparent 'successes' (Sioshansi, 2013). Much would seem to depend on different views of what our objectives for the electricity industry should be, particularly regarding environmental objectives (MacGill and Healy, 2013a). However, some critiques have directly addressed the issue of commodification. For example, Byrne and Mun (2003) argue

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[6] *http*://en.wikipedia.org/wiki/Financialization accessed 25 February, 2013.

[7] *IAS 39: Financial Instruments: Recognition and Measurement*, released by the International Accounting Standards Board (IASB).

[8] One example of the difference, relevant to energy efficiency is that between *Requests for Proposals* where the purchaser is typically looking for the most appropriate solution to an only partially understood problem versus a *Tender* where they are generally seeking the best price offer to deliver a precisely specified solution.

that for electricity *".. a commodity policy relies for its claim of being a distinctive source of public benefits on two premises – cornucopianism and individualism. Specifically, a commodity policy's public benefits are the result of the production of 'more,' on the logic that 'more is better' (cornucopianism); and/or the result of a greater exercise of individual choice, on the logic that individual choice is the only true expression of freedom or, at least, its principal expression (individualism). The experience with power liberalisation ... has underscored the existence of vital public values that are neither cornucopian nor individualistic. These include the value of reducing energy use in the interest of sustainability…"*

A related issue which is of particular relevance to energy efficiency is the gulf between establishing electricity as a traded commodity 'good' and the 'end' industry objective of optimal energy services delivery. A 'commodity good' differs from a differentiated 'service' in significant ways, including (Jacobs et al, 2009):

- a service is an intangible process that cannot be directly measured, whereas a good is tangible and measurable,
- a service requires at least some degree of interaction with the consumer, and
- services are, with some exceptions, inherently heterogeneous both between consumers, and within individual consumers depending on a wide range of factors from particular consumer circumstances to changing consumer interests and needs

The desired energy services delivery of electricity consumers are highly varied, context specific and changing. This doesn't, on the face of it, look well suited to commodity style electricity industry arrangements that are, largely, the result to date of restructuring efforts around the world. There is clearly a question as to whether such electricity commodification is the most efficient 'means' to energy services 'ends' given these fundamental differences – an issue of particular relevance to energy efficiency as we shall consider next.

Electricity industry restructuring has also seen the development of a range of financial instruments. They play important roles in facilitating risk management and forward looking investment decision making. While there doesn't appear to have been widespread financial crises in the electricity industry to date due to such instruments, the role of Enron – an early 'innovator' in electricity related financial instruments – in the Californian crisis provides one example of the potential risks involved.[9] As it happens, Enron was also an early 'innovator' in the commodification and financialisation of energy efficiency, as highlighted next.

Commodification of energy efficiency

White Certificate/EECT schemes are established around energy efficiency certificates (EECs) representing a measured and verified unit of energy savings from energy efficiency (eg. 1 saved MWh of electricity) undertaken by some party. A potentially wide range of energy efficiency activities is, therefore, commodified into a generic and fungible unit of energy savings.

One important question is whether energy efficiency is, in principle, better treated as a commodity or a differentiated service. Given the broad scope of energy efficiency opportunities there are circumstances where it is clearly one or the other. For example, changing out incandescent light bulbs with more efficient LED lights has a commodity aspect. However, completely redesigning and implementing lighting arrangements within a commercial building with attention to the varied and varying needs of end-users far more closely resembles a differentiated service. Commodity approaches have potential competitive efficiency and scale-up advantages whilst service approaches seem more likely to be able to deliver 'deep', coherent and comprehensive energy efficiency improvements. An intriguing aspect of energy efficiency commodification is that it is possible to design methodologies that commodify energy savings from highly differentiated service provision.

The scope of energy efficiency activities that can be undertaken by scheme participations is a design choice with a broader scope including potentially more low cost options for improving energy efficiency, and greater opportunities to include more differentiated energy efficiency services. However, energy savings arising from energy efficiency are inherently counter-factual (that is, they must be calculated from an estimate of what would have happened otherwise), creating challenges in measurement and certification, and a wider scheme scope exacerbates this problem.

[9] Note that Bushnell (2004) argues that the *lack* of long term financial instruments was a key factor in the Californian crisis.

Such measurement has the challenges of

- separating changes in energy consumption due to energy efficiency actions from all the other possible factors that might change consumption;
- identifying those energy efficiency actions that are specifically motivated by this energy efficiency policy, and hence additional to what would otherwise have happened; and
- measuring and verifying energy savings arising from these actions so that they can be appropriately rewarded.

The usual approach is to create a baseline from a 'business as usual' (BAU) view of energy efficiency decisions. Energy efficiency initiatives must then prove their additionality above and beyond this baseline, in order to be credited. The inescapable problem with proving this additionality is that it is impossible to verify what would have happened in the absence of this policy measure. Instead, policy makers have to establish a set of rules for each activity included within the scheme. More activities, particularly differentiated service activities, means more rules, hence more inherently fallible rule making. Unfortunately these tests still leave mechanisms open to gaming by participants or 'free-riding' off BAU technological progress and other changes to the decision-making context.[10]

This has proven one of the most problematic areas for the schemes implemented to date. There is considerable variation in the methodologies used to establish energy 'savings' from energy efficiency both within and between different schemes. Most include some forms of 'deemed' energy savings for particular energy efficiency activities where measurement is impossible, difficult or expensive, and there is a view that the magnitude of savings can be reasonably predicted in an average sense. Some, such as the Clean Development Mechanism[11] allow project proponents to put forward their own methodologies, whilst others have only a select list of standardised methods. Some, such as the CDM, have very formal additionality processes, whilst others don't actually mention additionality anywhere in the scheme legislation and associated regulations (e.g. the original NSW Greenhouse Gas Abatement Scheme[12]). Some schemes such as the UK require that a particular energy efficiency activity counted with an EECT scheme can't be a legislated requirement, but also shouldn't be financially rewarded by another policy. In other schemes such as that in Italy, this isn't considered and some activities may receive credit, and be counted as an outcome, of several or even numerous policies. The temptation for double counting is clear, both for scheme participants but also the governments seeking to claim credit for improved energy efficiency outcomes (Bertoldi, 2011).

Given the limited experience and high expectations placed upon White Certificate/EECT schemes it might be imagined that they would receive extensive assessment. In practice, however, there would seem to have been a surprising lack of independent assessment of the effectiveness, efficiency and equity outcomes of existing schemes. Instead, most assessments have been carried out by the body responsible for designing and/or implementing the scheme, or largely based on their analysis, or according to terms of reference set by government (Passey and MacGill, 2009). Note that this doesn't mean that meaningful assessments can't be made. For example, numerous US jurisdictions assess free-ridership for their ratepayer funded energy efficiency programs (Kushler et al, 2012). Other schemes have also included some allowance for non-additional activities when setting their targets such as that of Denmark (Staniaszek and Lees, 2012 p16). Still, a recent review of nineteen Energy Efficiency Obligation schemes around the world notes that "None of the schemes have established robust procedures to verify whether energy savings are additional" (RAP, 2012 p.104).

[10] Note that the issue of 'free riding' is a common one when new markets are introduced. For example, large generators within the EU Emissions Trading Scheme were given generous 'free permit allocations' that resulted in very significant wind-fall profits" as they charged their customers for the full price of the permits. Whilst such wind-falls may be inevitable with novel 'designer' markets, or the political price required for policy progress, such 'free riding' has potentially very large equity implications that need to be considered.

[11] The CDM is one of the flexibility mechanisms intended to facilitate the Kyoto Protocol and allows certain 'additional' abatement actions in developing countries to create certified emission reductions that can be purchased by parties in developed countries to assist meeting their targets. Energy efficiency projects have played a modest role in the scheme to date, but there are some valuable examples of the opportunities yet challenges of market-based energy efficiency.

[12] The NSW GGAS was introduced in 2003 as the world's first mandatory emission reduction trading scheme. Energy efficiency (termed demand side abatement for the purposes of the scheme) was one of the possible types of emission reduction actions within the scheme.

A particular feature of White Certificate/EECT scheme performance to date has been that in many jurisdictions, most of the energy savings have come from one dominant measure for at least some period of the time– insulation in the UK, deemed compact fluorescent light bulbs (CFLs) in Italy and heating replacements in France (Giraudet and Finon, 2011). The dominant measure in the Australian NSW GGAS and Victorian Energy Efficiency Target (VEET) has also, until recent rule changes, been deemed CFL lighting upgrades (Betz et al, 2013). It is possible that this is an outcome of a well-functioning market identifying the least-cost approach to driving energy efficiency. However, at least in part, it is likely to be an outcome of relatively modest targets and the rule making processes by which different types of activities, involving different levels of time, money and effort, are effectively made fungible through inevitably complex and occasionally flawed rules. For example, in the NSW GGAS households were still being given free CFLs to create certified energy savings after the available CFL market had been well and truly saturated and households were reportedly stock piling their 'free' globes (Passey and MacGill, 2009). Certainly, any 'additionality' lapse in the rules may quickly be taken up by fast moving, highly motivated and entrepreneurial market participants. Furthermore, it does raise the question of whether the complexity and abstraction of certificate trading is required if only a few types of activities dominate activity – why not target these actions directly?

Financialisation of energy efficiency.

Given an underlying commodity 'energy efficiency' or 'energy savings' certificate, White Certificate/EECT schemes have three key attributes:

- parties that are able to undertake energy efficiency actions that can be measured and verified in order to create certificates
- a government directed legal obligation on some group of parties that they regularly acquit some number of these certificates as part of their societal obligations; and
- trading so that parties obliged to acquit certificates can choose to buy certificates from other parties as an alternative to undertaking their own energy savings

Trading in energy efficiency is not a requirement for White Certificate/EECT schemes but can be argued to increase the economic efficiency with which an overall 'energy savings' target is met by allowing a market, albeit a highly abstracted 'designer' market, to determine which of the energy services, end-use technologies and associated decision-makers included in the scheme actually create certificates. In theory the spot price of certificates for liable parties should theoretically settle at the marginal cost of energy efficiency actions that achieve the target. Risk management and investment should see the development of forward and derivative markets for these certificates.[13] In practice, the amount of trading and associated financialisation has varied considerably across schemes and across time.

The number and nature of parties potentially supplying energy savings depends on the scope of the schemes – in particular, what types of activities are included. In practice, the number and nature of such parties depends on the scale, costs and underlying challenges of included options, and these depend in large part on the rules for how energy savings are measured. Organisational capacity is another key factor in what activities predominate. On the buy-side of the market, the obliged parties are often retailers, and large industrial and commercial loads. In many restructured electricity industries, the retail market has only a small number of large players who therefore wield significant market influence. However, the certificates represent a financial instrument that any interested party could look to trade including, of course, purely financial players whose only interest is in the potential change in value of certificates between buying and selling.

There are some well appreciated challenges with markets that seem particularly relevant for White Certificates/EECT given the potentially difficulties in verifying and certifying measurable energy savings. One is the well-known 'Market for Lemons' problem, outlined by economist George Akerlof (1970). Buyers unable to verify the quality of what they are buying will encourage sellers of poor products (lemons) to enter the market. These buyers, understandably, then won't be prepared to pay the high prices required to fund high quality products. The result is that good products are penalised even as poor products are subsidised. Akerlof illustrated this issue with the example of the market for second-hand cars. However, White Certificates/EECT

[13] One outcome is that all providers of certificates should theoretically receive the same price – the cost of the marginal (most expensive) energy efficiency activity required to achieve the target. Low cost providers may therefore achieve very high profit margins. Note, however, that standard economics holds that this represents only a distributional issue – optimal efficiency (ie. lowest overall societal cost for achieving the target) is still achieved. Still, it does have potential equity implications that need to be considered.

would seem to share some characteristics, and might even pose additional risks. For example, the buyer of a second-hand car cares about the quality of their purchase while buyers of legislated obligations may not be particularly interested in the 'quality' of what they are buying beyond ensuring that it meets 'certification'. Should they, instead, seek out the lowest available prices, the 'lemons' problem becomes even worse. For a highly abstracted commodity such as energy efficiency savings where it may be difficult for the buyer to know exactly what they are getting, and where the buyer may not particularly care as long as it is accepted by the scheme regulators , the risk of a market for lemons emerging would seem to be significant. Note that this is likely a more significant issue with schemes that include trading. Where buyers are directly acquiring energy savings, there is inherently greater engagement with the activities actually taking place and therefore greater accountability, particularly given a longer-term perspective on regulatory oversight.

In practice, trading within most schemes implemented to date has been somewhat limited. For some schemes there are only limited opportunities for market participation other than the liable energy companies. In Italy, it would seem a range of factors has supported considerable trading and participation by parties other those with obligations under the schemes (Giraudet and Finon, 2011). The NSW GGAS and Victorian VEET have also seen significant trading activity (Betz et al, 2013).

Price volatility would seem to be an inherent characteristic of White Certificate/EECT and designer trading schemes with regulated targets more generally. For example, if there is a perception in the market that there are sufficient certificates to meet the specified target into the longer term, the certificate price can be expected to fall markedly, in extreme cases to zero. There is also significant uncertainty in such markets because market participants never have perfect access to reliable information regarding current and future energy efficiency costs and demand for certificates, as well as possible future policy changes. For example, the NSW GGAS exhibited considerable spot price variability over the duration of the scheme. At times, certificate prices were trading at near the 'penalty' price for non-compliance. In later years of the scheme, certificate prices plunged to around a third of their earlier value. Note that these challenges, and the potential for some non-additional types of activities to be permitted to earn certificates creates considerable risks for parties considering taking genuine 'additional' activities that have a real financial cost and therefore require a meaningful and assured cash flow from the scheme (Passey and MacGill, 2009). By comparison, any parties that receive certificates for energy efficiency activities that they were going to do anyway, can take whatever price is available with little risk.

One final issue is how well these markets have facilitated technology, business and institutional innovation, versus just picking up the easily obtained 'low hanging fruit'. Lees (2010) highlights that White Certificate/EECT objectives include the development of energy service companies (ESCOs) *"…that they see themselves moving from being "suppliers of a commodity" to providers of sustainable energy solutions"*. Certainly, in the NSW GGAS scheme a number of highly entrepreneurial companies have been established to help energy users deliver certified energy savings. As just one example, some companies began engaging with residential energy consumers in a way that hadn't been generally seen prior to the scheme. In later years of the scheme, this involved teams of people knocking on house doors offering to change out their conventional light bulbs to CFLs. However, this activity was not sustained once the low additionality of such actions became evident. Still, the impact on the number and capabilities of local energy efficiency providers has been marked. This question of how White Certificates/EECT may facilitate innovative new business models and energy efficiency players would seem to be an important area for future work.

Discussion

The commodification of energy savings involves significant abstraction in practice. Concepts such as energy efficiency, energy savings and additionality have to be defined, and this requires assumptions, choices and trade-offs. A potentially wide range of energy efficiency activities involving very different parties; technology, process and perhaps behaviour changes; investment scales and timeframes are all reduced to some number of energy savings certificates. All of these necessary abstractions, and the process of determining them:

- add to the complexity of such schemes,
- make it more difficult to determine the real outcomes of the measure, and
- create moral hazards for both scheme designers as well as participants.

These issues have all been demonstrated in some of the schemes implemented to date although most have sought to limit the range of activities that are included, and made significant changes to scheme design as the context within which the schemes reside changes. This is not to say that such efforts aren't worth doing but, rather, that the transaction costs and efforts may be significant without careful thought on scheme design, whilst failure to address these issues may adversely impact scheme performance in delivering 'real' energy savings.

Trading of these savings adds further challenges although many of the schemes to date don't appear to have seen very significant levels of financialisation. However, high price volatility has been seen in some of them for reasons that don't represent the underlying costs of energy efficiency but, instead, changes in the rules of what counts as accredited energy savings, the scheme target, and growing policy uncertainty about the future of the scheme. This has posed problems for driving fundamental technology, business and institutional innovation although there has been promising progress in the development of energy service companies in some schemes.

It is notable that one of the first companies to look at energy services and the role of energy efficiency through the lens of standardisation, commodification and tradability was Enron (Matthew et al, 2005). This reflected in large part the nature of the Enron commodity model in, what were then, emerging electricity and gas markets.

Many energy efficiency opportunities don't appear, at first glance, likely to be a good fit with standardisation as – they are often highly diverse, non-standardised and context-specific. Standardisation, of course, lies at the heart of commodification. However, some energy efficiency opportunities do seem a reasonable fit and such standardisation in at least some aspects of energy efficiency does offer the potential for rapidly scaling up efforts. Furthermore, larger scale energy efficiency projects may warrant sophisticated measurement and verification sufficient to deliver some level of energy savings with reasonable assurance. Furthermore, some energy efficiency options are more straightforward than others and White Certificate/EECT schemes might choose to focus on these.

The involvement of Enron in pioneering such commodification and financialisation approaches for energy efficiency doesn't mean that these approaches are wrong. However, the failure of Enron's general commodification and financialisation business strategy in energy does highlight some of the risks with this approach, and its potential limitations. Commodity markets have proven troubling enough – energy efficiency commodity markets are possibly even more troubling given the higher levels of abstraction and the political nature of market design and settings.

Furthermore , there would seem to be some risks in permitting energy efficiency policy outcomes to be driven, at least in part, by the outcomes of financial markets with all of the attendant speculation, potential bubbles and crashes. Addressing these broader challenges of financial markets is proving very challenging but there appear to be ways to improve their performance. UNCTD (2011) highlights that high transparency of market participation can assist, and that "beyond this kind of "soft regulation", a number of direct commodity price stabilisation measures should be considered to address potential financial market failures. These seem highly relevant guidance for policy makers considering the use of White Certificates/EECT approaches.

With regard to the broader question of how White Certificates/EECT can assist in addressing energy market failure, there is the question of the limitations of the 'market failure' framework in assessing our energy policy needs and most appropriate means. There have also been broader critiques of commodification and financialisation in energy. Beyond this fundamental question of market based approaches, it is clear that EECT schemes intended to address energy and energy efficiency market failures may suffer from their own market failures (MacGill et al, 2013). Examples include (building upon the more general energy market failures noted earlier):

- Potential oligopolies, for example where the liable parties within EECT are the existing highly concentrated energy suppliers and these can control who does what sorts of activities within the scheme; (although note also the potential benefits of organisational scale in delivering large amounts of reasonably priced energy savings)
- Public Goods, given energy efficiency's key role in the essential public good of energy provision and the implications of EECT on this;
- Incomplete markets, as the EECT schemes are invariably limited in extent and scope, and many energy efficiency opportunities require very high levels of coordination that may well be beyond current scheme designs;
- Information failures, including generally poorly informed potential White Certificates/EECT participants;
- The "Business Cycle", a particular issue given capital intensive, long-lived investments for energy efficiency infrastructure, and the difficulty posed here by certificate market prices that have exhibited significant variability and uncertainty;
- Externalities, because whilst White Certificates/EECT offers a means to address some externalities it doesn't cover all of them, and can create new ones through impacts such as perverse equity outcomes (MacGill and Healy, 2013).

This is not to say that White Certificates/EECT can't assist in reducing energy efficiency related market failure in existing electricity industry arrangements. Energy efficiency policy is challenging and all approaches used to date have demonstrated limitations and failings. Some assessments of these types of approaches have been positive, particularly in the context of the considerable challenges policy makers face in driving improvements to energy efficiency (eg. Bertoldi et al, 2010). However, there would certainly seem to be some questions regarding the performance of White Certificates/EECT that would benefit from improved reporting and analysis of the schemes.

It can also be argued that such schemes can suffer from 'government failure' as well as market failure. The design and implementation of government policies targeting improved energy efficiency is vital yet inherently challenging. It has potentially adverse impacts on powerful incumbent power sector participants with political influence. Energy suppliers are generally large and focused on energy. Energy users, by contrast, include very large numbers of small participants with little interest and knowledge of energy beyond its vital importance in delivering their desired energy services. There are clear imbalances between the various stakeholders that may influence the decision-making process used to develop government policy in this area and this is particularly problematic for White Certificates/EECT as they are novel 'designer' markets that provide significant flexibility to policy makers working under considerable uncertainty. On the other hand, these schemes can create new constituencies with an interest in driving improved energy efficiency outcomes. Nevertheless, effective governance is almost certainly the key to successful market-based energy efficiency policies (Passey et al, 2008).

Beyond this, there are questions regarding the impact of commodification of energy, and even now energy efficiency, on the broader energy user decision making context which is framed by desired energy services. There are likely to be limitations to what can be achieved in reducing energy use without greater energy user engagement and appropriate energy efficiency within this broader context seems certain to require a services rather than commodity framing by both energy efficiency providers and policy makers.

Note that White Certificate/EECT schemes do have some promising characteristics in this regard. They create an opportunity for knowledgeable, skilled and motivated organizations to assist disengaged energy users to undertake energy efficiency actions that they would otherwise ignore. The engagement of these firms with energy users will almost always involve financial transfers of some form yet may involve a wider relationship. For example, a number of environmentally focused ESCOs emerged within the framework of the NSW GGAS. The flexibility of the schemes means that, with appropriate scheme design, they can drive focus on wider energy concerns. For example, equity concerns have been a key design imperative in some EECT schemes.

To conclude, well designed EECT schemes may be able to play a useful role in a coherent and comprehensive energy efficiency policy framework that includes a range of different policy measures. They have some attractive characteristics including their inherent measurement of policy outcomes, support for scaling up energy efficiency activities and their potential role in facilitating motivated, knowledgeable and skilled ESCOs to assist often poorly motivated, unknowledgeable and unskilled energy consumers in undertaking appropriate energy efficiency opportunities. As such, they can represent a market-based solution to some market failures in energy-related decision making. Poorly implemented schemes may, however, risk just creating further market failures to add to those that already exist. And, finally, there are challenges in energy efficiency, and engagement with energy users more generally on the sustainability of their energy services, that would seem to lie beyond the current commodity energy market, and hence 'market failure' frameworks which are currently setting the energy policy agenda in many jurisdictions.

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