CREATING NUMBERS: CARBON AND CAPITAL INVESTMENT

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Abstract

Purpose - This field study seeks to illustrate the way in which carbon emissions are given calculative agency. We contribute to actor-network theory with a specific ethnographic focus on the translation of a number in an organisation's capital investment accounts. In following an intangible gas to a physical amount and then to a dollar value, we used the sociology of quantification (Espeland and Stevens, 2008) to explore the attributes of a newly created number and the way it changed the work of actors, including the way they reacted and viewed authority.

Design/methodology/approach – An empirical fieldwork study in a large Australian water utility. In particular, this is an ethnographic study of a carbon emissions number.

Findings - The number disciplined behaviour and acted like a boundary object, while at the same time, enrolled allies through its aesthetic appeal in management accounting system designs. In this framing our empirics, we were able to highlight the non-human network effects associated with the creation of a number.

Research limitations/implications – This paper contributes with empirical research that specifically traces the attributes of an accounting number when enlisting human and non-human network allies.

Originality/value – This study contributes to the limited empirical research adopting actor-network theory. In particular, it contributes with detailed analysis of a number using the Sociology of Quantification (Espeland and Stevens, 2008).

Keywords – Actor-network theory, Sociology of Quantification, Ethnography, Carbon Emissions Number

Paper type – Empirical study

Introduction

"Hey, wouldn't it be interesting", said the accountant from a large state-owned water utility. "Now we have this new number in our NPV model, we can go back over past decisions to see if we might have done them differently." "Yes. What about the over the hill or through the hill dilemma we had last year?" explained the Environment and Technology Manager. "That would be a perfect example to test".

We were in a meeting with senior managers from the state-owned water facility. They had recently made the decision to include carbon emissions number in their accounts. The main role for this number was to be a dynamic cost function in their net present value (NPV) model. Yet it symbolised a lot more for each of the managers in the meeting. We could feel the enthusiasm of the environmental and sustainability team as they were given the authority to bring carbon emissions to life to life in the capital investment accounts. The enthusiasm of the sustainability team overflowed to others in the organisation, including the accountants, who were enlisted to the project and even us, the researchers, as we witnessed the translation of the number into a visible icon.

The aim of this paper is to use actor-network theory as a means to provide a central focus on the translation of the carbon emissions calculation in an NPV model. We further contribute to the accounting literature with empirics that draw on Espeland and Stevens (2008) sociology of quantification. We use the sociology of quantification as an analytic framing to show how a carbon number (a dollar value derived from physical units) is elevated to become an iconic representation of corporate accountability and sustainability governance.

The process of quantification can tell a lot about organisational relations and the accounting craft (Miller, 1991; Robson, 1992; Law, 1996; Quattrone, 2009). One of the primary benefits of using actor-network theory is in the way it helps to elevate the role of calculation in accounting research. As Justesen and Mouritsen point out:

> The emergence of actor-network theory in accounting research can therefore be viewed as an attempt to reposition, or even rehabilitate, accounting technologies in sociological explanation. One possible advantage derives from ANT's insistence that inscriptions and calculations are central to explaining activities and not just the effects of conditions and contexts even if the accounting entities derive their power from associations between calculations and conditions (2011, p.164).

While actor-network theory reminds us that the relations among actors are multiple (Mol, 2002; Latour, 2005) the central focus for accounting researchers is the notion that accounting numbers are non-human actors or "inscriptions", implicated in multiple modes of interaction (Quattrone and Hopper, 2001; Andon et al., 2007; van der Steen, 2010). Prior research highlights the capacity of accounting numbers to travel and mobilise action from one context to another (Miller, 1991; Robson, 1992; Quattrone and Hopper, 2005). Miller (1991) helped to demonstrate the performativity of accounting technologies, in particular, the authority discounted cash flow (DCF) techniques engendered, even from a distance. In bringing to the forefront the multiple calculative worlds that emerge over time and space, the practices of these non-human actors are central to network construction and recognised for their organising effects (Latour, 2005). Unitary goals of actors are accomplished, not as a linear process, but as an ever mobilising (and re-mobilising) path towards power; necessarily deviating and enlisting allies on its way to translation[1] (Latour, 1999; Callon, 1986; Latour, 1987; Mol, 2002). The focus for actor-network theorists when studying accounting change is not the successful translation, or otherwise, but the ability to see translation as a fragile process that is continually created and re-created (Latour, 2005).

In the case of interest, presented in this paper, it is intended that the carbon emissions number will take a place in a traditional accounting model. Actor-network theory would suggest the unitary goal of this non-human actor is to have a "voice" in accounting designs. To do so it must convince others of politics around sustainability and the important role it can play in creating societal order. The path is not a linear or passive one that accommodates the environment (Latour, 2005). Embedding sustainability in accounting designs is an active process of translation that takes actors away from predefined (linear) activities and deviates practices outside traditional comfort zones. Actor-network theory also suggests that for "sustainability" to be a reality, this ubiquitous term must take on a common meaning, before its representative, "carbon emissions", can be an accepted calculable reality (Barry, 2001). In the conversion to typical accounting transaction, the carbon number must enlist others to its goal. These network collaborations will strengthen and translate its position as a signifier of sustainability market activities (MacKenzie, 2009). Thus, to become visible in the accounts, accounting boundaries must be redefined breaking down any silos between the organisational actors (i.e. accounting, engineering, operations) (Briers and Chua, 2001; MacKenzie, 2009; see also Barry (2001) who discusses the importance of standardisation and classifications in the creation of the European Union).

In spite of the usefulness of actor-network theory in providing accounting a central role, there is minimal empirical research that specifically relates to accounting calculations and the multiple ontologies that emerge from relations between both human and non-human accounting technologies (Justensen and Mouritsen, 2011). Within the accounting literature, there is limited ethnographic studies that specifically follow the non-human actor networks and explore the way relations give agency to a *number* newly emergent in accounting system designs. Notable exceptions include case and fieldwork studying the implementation of management accounting systems (Preston et al., 1992; Briers and Chua, 2001; Quattrone and Hopper, 2005) as well as specific ethnographies of accounting calculations (Mouritsen et al., 2009). Further, MacKenzie's (2009) work on emerging carbon market contributes to our knowledge of actor-network theory through the visibility given to previously invisible objects. These empirical studies help demonstrate the benefits of following the development of accounting calculations before they become established taken-for-granted practices. Insight is given to the establishment of networks illuminating the interconnections between accounting technologies and social factors before they are black-boxed (Preston et al., 1992, p.589). Also the adaptive role of accounting is apparent as it enrols or is enrolled in networks reconfigured for other actors' interests (Briers and Chua, 2001). These studies also largely contribute to the management accounting change and practice literature and demonstrate the performative role accounting plays in shaping itself and markets (Justensen and Mouritsen, 2011).

What is missing from this literature, however, is a specific focus on the accounting number itself and the type of enlisting role it plays in the network. Justensen and Mouritsen hint at the network power accounting calculations and inscriptions hold when they state:

[1] Latour's early work explored translation as ''displacement, drift, invention, mediation, the creation of a link that did not exist before and that to a degree modifies the original [intention]'' (1999, p.179). Later, Callon (1986) follows with the sociology of translation and explores the practices of human and non-human actors to gain control and power of the network.

> Accounting provides inscriptions and visualizations that highlight and make visible certain properties. Obviously managers interpret information, but this interpretation is constrained by the accounting object that may object to some interpretations. Furthermore, it is rarely enough for a manager to be powerful. A manager has to persuade others and this will typically include drawings on a visualization. If one visualization is interpreted as wrong or inadequate, another one has to be mobilized to conquer the first one. There is more to accounting entities than being the backdrop to interpretations (2011, p.178).

In this actor-network response to sense-making and interpretation, Justensen and Mouritsen allude to a hierarchy of actors, with managers the key actor consciously enrolling others to the network with different accounting objects. In this interpretation, the central role for calculative technologies is somewhat reflexive, leading to the question: what are the persuasive attributes that non-human actors have alongside other actors in the network? We aim to take this thought further and contribute to the literature by drawing on Espeland and Stevens' (2008) sociology of quantification to highlight the influential power of numbers in enrolling other human and non-humans to the network. The sociology of quantification claims numbers hold five attributes: they make people 'work' and 'react' in certain ways. A number has 'authority', it 'disciplines' while at the same time has an 'aesthetic' appeal that cannot be ignored (Espeland and Stevens, 2008).

In order to explore our thoughts about numbers as central actors in translation, we commenced our fieldwork, like Briers and Chua, at the 'start of an accounting controversy' (2001, p.242). Organisations were gearing up for the carbon market and our ethnographic work commenced at the beginning of accounting system design change. Our findings are based on empirical data including archival data, interviews and field observations of long term capital investment models and project infrastructure decisions over a period of twelve months. The setting in which we explored the translation of the carbon number in capital investment technologies, was a government owned water utility. Our ethnographic object is the carbon number and our research role was follow the representational activities that connect with our object of concern.

We found that, firstly, work practices are controversial. In particular, when constructing the number from an invisible gas, to a measurable unit which is juxtaposed with electricity consumption, a dollar value and ultimate believable account of internalised externalities (MacKenzie, 2009). Secondly, the reactions, from organisational actors, highlights how number accomplishes credibility and also mobilise further work: "Are our carbon emissions too high?" "Is this investment a viable alternative?" Thirdly, an accounting number has authority and manages to establish relations among the heterogeneous actors (Espeland and Stevens, 2008). It disciplines by placing boundaries around acceptable limits. Finally, as a representation of corporate accountability, it has an aesthetic appeal that is certainly not ignored by the diversity of organisational experts. The aesthetics of the number reinforces the other attributes along with the performativity of accounting numbers (Quattrone, 2009). As iconic representation (Davison, 2009), the newly created number effected a unique authority within our case site. At the same time, the carbon emissions number also symbolised the means for new boundaries to be drawn and new modes of thinking about what should be considered acceptable levels of carbon emissions levels for past, existing and future capital investment projects. In the fabrication and maintenance of this accounting technology, there are multiple instances of power effects that make it, and continue to make it, exist.

In the sections that follow we first provide details of the accounting literature that connects sustainability, carbon emissions and capital investment technologies. We follow with literature from actor network theory, to highlight the performativity of calculation (Preston et al., 1992; Briers and Chua, 2001; Andon et al., 2007; MacKenzie, 2009; Quattrone, 2009; Boedker, 2010). In particular, we consider the aesthetic appeal of numbers and the ways accounting is considered a visible technique (Burchell, et al., 1980; Bloomfield and Vurdabakis, 1997; Thomson, 1998; Suzuki, 2003; Davison, 2009). As Preston et al., (1992) highlight, when we make accounting visible we are demonstrating our belief in a prescribed social order. In relation to this case, societal order in our political present is entwined with broader, sustainable notions of corporate accountability and governance (Callon et al., 2009). Next we explain the calculative appeal of numbers (Espeland and Stevens, 2008; Verran, 2001). We follow these thoughts with discussion of ethnography of a number in a water utility and its role in the construction of a capital investment decision model that would meet accountability expectations. We conclude this paper with discussion on our contributions to the literature and areas for further research.

Politics, sustainability, numbers and capital investment technologies

A sustainability-focused organisation is arguably well equipped to recognise the long run costs and benefits of balancing economic, social and environmental impacts in business processes (Mahoney & Thorn, 2006; Bebbington, 2007; Hopwood *et al*., 2010). That is, all stakeholders (such as suppliers, customers, employees and shareholders) are acknowledged in strategic and operating decisions (Norris & Innes, 2005; Artiach, Lee, Nelson & Walker 2010). In our political present, the efforts of polluting organisations to curb their greenhouse gas emissions is recognised as an effort to not only reduce costs but also making visible externalities that must be accounted for (Stern, 2006; Garnaut, 2008; MacKenzie, 2009). As MacKenzie points out:

> The goal of a carbon market is to bring emissions within the frame of economic calculation by giving them a price. In such a market, emissions bear a cost: either a direct cost (because allowances to emit greenhouse gases need to be purchased), or an opportunity cost (because allowances that are not used to cover emissions can be sold, or because credits can be earned if emissions are reduced below 'business as usual'). A carbon market is thus an attempt to change the construction of capitalism's central economic metric: profit and loss, the 'bottom line'.

Emergent accounting systems are now required to meet the demands of sustainable organisations (Hopwood, 2009; Hopwood *et al*., 2010; Gray, 2010; Artiach *et al*. 2010)[2]. Most importantly, as MacKenzie highlights, is the focus on carbon emissions (CO_2 e) and emerging carbon markets in the accounts. With an economic value that has been 'visible' in the electricity sector for some time, in accounting the true value effect is still to be determined (MacKenzie, 2009, p.450). The impact of carbon markets on investment decisions is potentially complex and waiting to be tested. MacKenzie talks of 'inherently

[2] For example, the Global Reporting Initiative (GRI) offers a list of sustainably performance measures for companies to choose from (www.GRI.org). The Prince of Wales Accounting for Sustainability (A4S) project provides internal control guidance (www.accountingforsustainability.org). Corporate governance guidelines, he Dow Jones Sustainability Index and the International Integrated Reporting Council (www.IIRC.org) also connect organisations with sustainability to make sure what they disclose is actually being embedded in practice.

flawed' carbon markets in terms of their risk – the capability of incentivising emissions reductions, the impact of allowances and tax liabilities, market pricing impacts through delayed sale of permits, passing of opportunity costs and issues associated with 'leakage' beyond the boundaries defined by the carbon market (2009, p. 450). In addition, MacKenzie claims there are the purchasers of allowances who are not just buying for compliance but to achieve carbon neutrality or other forms of offsetting for 'reputational benefits' (2009, p.452). Regardless of the underlying reason for considering carbon emissions, compliance or strategy, there are important reasons why companies will decide to include this number (or a carefully derived proxy) in their asset valuations and investment decisions. It is argued that when corporate externalities are visible in accounting designs, organisations are better positioned to respond to sustainability-related consequences (Hopwood *et al*., 2010).

Traditional techniques such as discounted cash flow (DCF) using net present value (NPV) analysis tend to be prioritised by accountants in their capital investment appraisal practices (IFAC 2008; Vesty, 2010). Little is known about the evaluation of the qualitative sustainability and risk factors as they tend to be unique to individual settings. Qualitative factors may be quantified in some way (or not) and included (or not) in appraisal designs (Verbeeten 2006). Other sustainability-related appraisal tools, such as environmental Management Accounting (EMA); full (or total) cost accounting (FCA); life-cycle analysis and life-cycle costing (LCA); material flow cost accounting (MFCA); cost-benefit analysis (CBA) are increasingly being discussed in the literature, but not widely tested with empirical data (Parker 2000; Bebbington et al. 2007b; Epstein 2010).

When uncertainty in cash flows is high – in other words, the gap between currently available information and that required to make a decision is large – DCF analysis becomes difficult and inaccurate into the future (Tyler & Chivaka, 2009). Modifications to traditional financial discounted cash flow (DCF) analyses must therefore be made so managers are equipped to make informed strategic decisions about investment values (Simons, 2000; Verbeeten, 2006). Accepting projects with positive NPV's and rejecting those with negative NPV's is a meaningless exercise when it comes to maximising shareholder wealth, particularly if sustainability impacts are not well defined (Bebbington, 2007; Epstein *et al*., 2010). The inclusion of carbon emission costs in investment appraisal designs should make energy efficient investments appear more attractive in relation to the alternative options (Kneifel, 2009).

However, as sustainability impacts are increasingly made tangible through one measure - the calculation of carbon emissions – it is not unexpected that there will be rigorous debates about how well the market price of carbon captures the true value of corporate externalities in these models (MacKenzie, 2009). Callon et al. (2009) is not so concerned, suggesting the debates over economic models is an important means to reinforce the use and continued acceptance of emerging designs being adopted in practice. By focusing on the politics and the networks that unfold, the impact of accounting and new numbers can be made clearer. When deciding to focus on accounting numbers, Latour reminds that "one never travels directly from objects to words, from the referent to the sign, but always through a risky intermediary pathway" (1999, p.40). Rather than commence with the accounting object – the carbon emissions number – we need to explore the visions of the carbon market being translated into working technologies. Then we need to consider how the new technologies can be upheld in a mess of competing interests (Law, 1999).

Accounting numbers and making carbon visible

Accounting numbers, like the carbon emissions number arguably represent a common language of society (Miller, 2005; Timmermans & Epstein, 2010). In one way, quantification will provide a form of standardisation whereby decisions can be depersonalised or distanced, thereby avoiding issues associated with representational discretion (Miller, 2005). Any harder to capture qualitative attributes can be 'quantitatively' enhanced by numerical attachment to ranks (a form of ordinal measurement) or converted to indexes (a to-and-fro relational form of measurement) where action is potentially concealed in the duality between numerator and denominator (Verran, 2011). Importantly, in an actor network, numbers have specific attributes that enable, direct, or even hide decisions (Espeland & Stevens, 2008).

In order for carbon emissions to become visible in the accounts, they must be first categorised and converted to a calculable form (MacKenzie, 2009). This act of visualisation necessarily begins with an idea which can then be traced - through theorising, debates and discussions among experts - to its gradual conversion into charts, tables, calculations, graphic and pictorial presentations (Latour and Woolgar, 1979). The visibility of the accounts helps in meaning making, of the economic situation in which we are faced and the extent to which an individual company's accounting tools can demonstrate that they draw their reference to the emerging economic requirements (Thompson, 1991). By placing carbon in the accounts, the sustainability process becomes institutionalised and the original ideas of economists who believed in accounting for externalities, is made real (Stern, 2006; Garnaut, 2008). The processes toward the visualisation of carbon in the accounts confirm accounting as a performable technique (Callon, 2009; Quattrone, 2009).

Performing the categories of sustainability requires expertise in defining the scope of the emission, whether it is a result of direct or indirect emissions from production and then converting energy consumption (electricity, gas, diesel etc.) and emitted volumes of greenhouse gases into meaningful numbers using scientifically calculated and proven emission factors.[3] Bloomfield and Vurdubakis (1997) suggest such careful data arrangements can help align the gaze. In making 'tangible the intangible' quantification a common organisational language is created. The accounting numbers effect an authority which is extremely useful in ensuring that sustainability impacts are considered in investment decisions (Espeland & Stevens, 2008; Timmermans & Epstein, 2010).

In producing and communicating numbers, there are numbers that "mark" and those that "commensurate" with the latter actually crafting relationships between objects that would otherwise be unclear (Espeland and Stevens, 2008, p 407). Numbers that mark are like icons, representing a desired reality (Verran, 2011). The number, for example a calculated carbon emission, is recognised by the collective as a model of social order. In this case, standing up to represented sustainability order. When the carbon emission calculation is recognised as a number that marks – it is recognised as a single number (or mark) on the company accounts,

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[3] Scope 1 emissions are those that arise from the generation of energy, heat, steam and electricity, including carbon dioxide and products of incomplete combustion (methane and nitrous oxide), fugitive emissions (intentional or unintentional), the transportation of materials, products, people and waste, including emissions from landfill sites. The key term is 'generation' from the source company. Scope 2 emissions are indirect emissions that are consumed by the facility but are not part of the facility's output. They are the Scope 1 emissions from another facility (such as coal burnt in a power station to produce electricity) that are transmitted to a manufacturing site to power the machinery (*National Greenhouse and Energy Reporting Act 2007* (Cwlth) s 10; Australian Government (Department of Climate Change and Energy Efficiency), *National Greenhouse Accounts Factors,* July 2011, pp 6-8).

defining its role in society in order to combat climate change. At the same time, this number represents commensurability. In this way we can see the many heterogeneous parts that come together to make this number visible. The human and non-human actors (numbers, accounting systems, accountants, sustainability managers, sustainability, government, societal stakeholders, as well as the planet) strive for power and accomplishment by enlisting others towards achieving their individual goals. To convince the collective that carbon emissions must be embedded in capital investment appraisals is an ultimate representation of power (Callon, 1986; MacKenzie, 2009). In doing so, the carbon emissions number becomes a symbol of commensurability. All the multiple values that contribute to the collective are recognised in the symbolic representation. All voices are heard and embraced in this number (Callon, 2009; Verran, 2011).

The performativity and power struggles of the carbon emissions number can be further investigated in terms of Espeland and Stevens' (2008) five analytic dimensions of quantification. In connecting this framing with the network of relations that create and make the carbon emissions number visible a series of research questions can be posed:

1. Work: What is the work performed to create a system of measurement?
2. Reactivity: How does the carbon emissions number cause individuals to think and act differently?
3. Authority: Is there evidence of the creation of a network of standardised procedures, of carbon emission calculations being embedded in techniques and routines? Does the carbon emissions calculation connect individuals within the organisation? Is there an authority being established throughout the organisation, based on the perceived trustworthiness of this number?
4. Discipline: What is the capacity of the carbon emissions number to act like a boundary control in evaluating and managing behaviour? Is there greater accountability through this visibility? Is there evidence of heightened transparency in decision-making?
5. Aesthetics: The numerical representations of social phenomenon through diagrammatic form, a performative role giving self-fulfilling agency.

Desired sustainability-related outcomes are therefore made real and reinforced through the act of quantification in organisational processes. In the act of making the carbon emissions numbers visible in the NPV calculations, actors must be enrolled and the initial 'work' dimension given certainty so that the number can be translated into a reality and participants will be enticed to join the network (Callon, 1986). The intangible becomes believable, with the number sometimes recognised for its iconic properties, representing social order, and at other times its symbolic representation reveals a number that tries to embrace all views (Verran, 2011).

In taking a Latourian approach to investigating the translation of a carbon emissions number in accounting system designs, we must recognise that the science behind this study becomes the object of our study and thereby shapes the investigation (Woolgar, 1988). This in turn, becomes the problem for the researcher, rather than the means for investigation. Quattrone and Hopper point out that:

> ANT case research avoids the object of investigation being the means of its own investigation by not purporting to empirically test whether relations between established categories of behaviour hold … instead it challenges taken-for-granted explanations with interpretations drawn from cases … Each description is an

> explanation because observers cannot be detached from their observation (2005, p.744).

Similarly this ethnographic fieldwork approach aims to gain insights into - the persuasive attributes that non-human actors have alongside other actors in the network. We consider an actor-network theory approach taken by others in accounting fieldwork is useful in following the translation of numbers (Briers and Chua, 2001; Quattrone and Hopper, 2005; Mouritsen *et al*., 2009).

In the following section we describe the research methods in more detail and then the setting in which we explore the creation of the carbon number for inclusion in capital investment appraisal. In particular we contribute with empirical interpretations of events and the number's persuasive attributes that unfold in the processes of translation.

Research methods and setting: a water utility

In order to draw on the ideas derived from actor-network theory and those that specifically focus on the attributes of a number (Espeland and Stevens, 2008; Verran, 2011) we arrived at our research site at the time they had decided to embed a carbon emissions number in their NPV model. The NPV model was used to value (and re-value) existing infrastructure assets as well as compare newly proposed, but competing assets. Our empirical data was based on conducting an ethnography of the newly created carbon emissions number over a period of twelve months.

The water utility is a large metropolitan organisation in Melbourne and part of the broader utility industry (comprising electricity, gas and other water providers) in Australia. Unique challenges for corporatized government entities working in this sector have been identified since the introduction of new public management (Hood, 1991; 1996). The utility industry is collectively recognised as the largest global emitter of greenhouse gases and associated with this is the societal expectation that they become leaders in their emission reduction activities to achieve global Kyoto Protocol goals (Department of Climate Change and Energy Efficiency, 2008).

In Australia, there is currently an oligopoly in water distribution. As decentralised government agencies, the water companies have a guaranteed customer base and one that is potentially growing with geographical dispersion. In somewhat conflicting strategies, revenue growth is impacted by water shortages and environmental best management practices, with water companies actively discouraging increased consumption by businesses and households. Along with societal expectations and political regulation and reputation, water companies have difficulty increasing prices to their 'average' consumers. As pseudo cost centres for governments a water company's costs and cost management practices are important in the efficient provision of water and sewerage services. This case setting thereby provides an interesting juxtaposition of demands associated with the management and delivery of water and sewerage services.

With sustainability impacts now a key societal measure, the utility industry faces considerable pressures. For example, in the water and sewerage service provision sector, increased water revenues can be directly attributable to negative environmental impacts though potential water shortages. Infrastructure development in the water utility industry includes new installations or the repair and replacement of old and/or damaged water and sewerage pipes. This activity can potentially disrupt ecosystems with sewerage spills a serious social and environmental health risk.

Our case site distributes water, provides sewerage services and actively promotes water saving services to households and businesses in a rapidly growing metropolitan area. As a state owned entity, the driving force is to protect the quality and quantity of the water supply. Other key stakeholders include the regulators, suppliers, employees, alliances and the community at large. They have approximately 800 employees and a customer base of over one million customers, as determined by government allocation. Employees are organised so that divisions consist of people engaged in similar work processes to enable efficiencies through specialisation. This organisation did not directly engage in outsourcing, instead alliance arrangements were in place with multiple engineering firms to facilitate the design and construction of their asset infrastructure. The express role for a government owned water utility is to maintain the required level of water distribution services now and into the future with a focus on efficiency and risk minimisation while at the same time maximising the effectiveness of service provision (Ugarelli *et al.*, 2010).

Our ethnographic approach enabled us to become immersed in the organisational practices and decision-making processes around the integration of carbon emissions in the capital investment model (Callon, 1986). It enabled us to focus directly on the area of interest – the accounting number and the type of enlisting role it plays in the network. Over a period of one year, we attended meetings and interviewed a range of actors using an adapted repertoire of questions to best represent the field of enquiry and the position the manager held within the setting (for example, accounting, sustainability, engineering perspective etc.). In the following Table 1 we highlight the key human actors followed in this study. These actors introduced us to the other accounting technologies and non-human actors that comprise the network of interest. Overall, our focus was on the accounting number and its persuasive attributes that contributed to maintaining its position in the network. We observed practices and interrelationships between human and non-human actors. Appendix 1 includes a further details of the interviews held with key actors identified in Table 1 below.

Table 1: Key human actors followed

1. Environment and Technology Manager
2. Environment Manager
3. Greenhouse and Energy Specialist
4. Project Officer (within the Environment and Technology Division)
5. Treasury and Financial Analysis Manager
6. Finance Manager
7. IT Operations Manager
8. Senior Engineer
9. Design Leader
10. Feasibility Manager

We were given access to documents and intranet sites, enabling us to review not only externally reported data, such as the annual report and legislative guidelines, but internal procedure documentation, corporate and divisional strategic plans. Most importantly we were generously provided with stories of past practices and events about how sustainability impacts are valued in this organisation's capital appraisals. All data enabled us to follow the translation of the carbon emission into practice.

More background politics: A commitment to sustainability

Notwithstanding stories of past sewerage spills, reputational impacts and future competition, the requirement for a 'robust assessment of environmental, social and financial implications' was formally documented in the organisation's strategy document. Arguably a step towards the effective embedding of sustainability within organisational operating procedures (Hopwood *et al*., 2010; Epstein *et al.*, 2010), carbon emissions were required to be made visible in this organisation's accounts. It was explained that while other similar organisations have elected to pay for 'green energy' (carbon emissions accounted for in long term purchase contracts) this company wanted increased visibility by introducing a new line item in their accounts. Instead of paying a premium on green energy, they also wanted to speculate on the costs associated with carbon emission calculations in the long run. It was pointed out by the Environment and Technology Manager that this form of visibility was necessary as: "sustainability is embedded in what we do every day". The Greenhouse and Energy specialist further explained that: "We don't have a specific sustainability strategy…we want sustainability to be embedded across the business. So the sustainability strategies and actions are within other strategies". The Environment and Technology Manager explained that without making their carbon emissions usage visible in their activities, the Water Company would not be able to explicitly communicate their commitment to employees: "Although it [sustainability] is embedded across the organisation, [at this stage] we don't have any metrics around it, so no one knows how well we are progressing in terms of sustainability."

The priority given to sustainability was evidenced in the formal organisational structure whereby a "Sustainability Division" and an "Environment and Technology Division" were created to devote their time to the environmental impacts of operations. The sustainability Division was customer focused, while the Environment and Technology Division, a relatively new division, was set up to develop and improve internal management systems. This latter Division is where we spent the majority of our time.

The Environment and Technology Division's role was to focus on the organisation's compliance with environmental regulations as well as the management of environmental objectives. Within this division, The Environment Manager (and Head of the Environment and Energy Branch) oversees the greenhouse gas and energy management. Her overall responsibility was to incorporate sustainability into internal decision making.

When the Environment and Energy Branch formalised their strategic aims for the first time they stated: "whilst the strategy was not new, it was important as consistent sustainable decision making criteria had not been explicitly formalised in the past". As an example, the division has set an emissions reduction target of: zero net greenhouse gas emissions by 2020. Appendix 2 provides an overview of their recently developed Sustainability Assessment Scorecard, a performance measurement tool to monitor key performance indicators of the company. Greenhouse gas emissions became one of these important measures. They believed that capital investment appraisal design was one way in which their zero emissions targets could be achieved.

While the inclusion of a cost on carbon emissions certainly reiterates with the top level organisational commitment to sustainability management, the process was also considered from a risk management perspective: "The reason that we're investigating putting carbon within the NPV is not necessarily just to have a more sustainable option. It's also because it's likely to be a real business cost very soon, within the coming years, because carbon emissions are actually a business risk for us." They were very concerned about the impact on their reputation (or the way they are viewed by their stakeholders). In addition to the risk associated with sewerage spills and the provision of consistently, clean water to their customers, they also believed that one day they would lose their oligopoly and government protected position. They explained that as new public management further decentralises, not unlike the telecommunications sector, more competition is being introduced to make the previously government-owned and managed utilities more efficient and accountable. The Environment Manager confirmed this discussion: "[Our organisation is] very conscious of reputation … Reputation is priceless to us as a company."

The carbon number and the NPV model

Sustainability was a key management priority however systems and processes to measure impacts were still in their infancy. They were testing a multi-stage approach to project appraisal to evaluate the viability of potential opportunities (Bebbington, 2007). That is, the decision model balanced quantitative financial analysis in the form of a customised version of the regulated NPV model with multi-criteria analysis (MCA) that further assisted by merging the quantitative with qualitative risk analysis and sustainability evaluation.

Varying components of the NPV model were regulated by Treasury (the overseeing Essential Services Commission). Firstly the NPV model is required for all capital expenditures that have an initial outlay of fifteen million dollars or more. Secondly, the financial regulator sets the mandatory government discount rate to be used in all capital project evaluations. This rate reflects the return desired by the Government and is not able to be modified or adjusted: "The discount rate is set by Treasury, so we have no scope to change it" stated the Environment and Technology Manager of our case site. Thirdly, the water companies have the authority to determine the cash flows. The cash forecasts are estimated by the Water Company engineers who determined the method of construction and the materials used when delivering new infrastructure to customers. Overtime, it was argued that their estimates were proven to be historically accurate. Finally, the time horizons of infrastructure projects were capped at twenty five years, even though the Water Company suggests existing infrastructure is, more often than not, far, far older than the twenty five years.

In addition, the projects that did not meet the regulators fifteen million threshold, the NPV model was still used formally within the company for projects with initial outlays between one hundred thousand dollars and fifteen million dollars. It was also adopted on an informal basis for all other projects valued at less than one hundred thousand dollars. Regardless of the initial outlay cost, the proposals generally originated from project managers throughout the organisation and most were construction projects.

For the projects valued at less than fifteen million dollars, the proposer decided the ultimate level of detail and precision required for cash flow analysis. Given the Infrastructure Department would frequently evaluate alternative options, the calculation either outsourced to the Finance department or performed by the proposer themselves, depending on ease of the calculation (for example, consistency with prior project analysis) and/or level of accuracy required. When the operating expenses over the life of the project were considered a small proportion of capital expenditure, they were generally not estimated outright; rather preparers of the analysis used a general rule of thumb. As the Treasury and Financial Analysis manager explained: "We use a sort of pretty simplistic approach to the way we factor in electricity costs into the NPV analysis…when we don't have accurate electricity forecasts, we just use a percentage of capital investment as the ongoing cost. … [in other words] the NPV analysis is done at a fairly high level at the moment". We were provided examples of NPV model documentation which highlighted this ad hoc approach to cash flow analysis. The absolute magnitude of the NPV calculation or level of accuracy was not deemed important by the management team. The rule of thumb was that the rigour of NPV analysis depended on the direct relationship with the level of operating expenses. As the operating expenses of the project increases, so should the requisite level of accuracy.

As highlighted above, the NPV output is only one component of analysis used to compare alternative projects. Multi-criteria analysis (they referred to as their MCA tool) is used to evaluate both the quantitative and qualitative components in terms of the calculation of risk and evaluation of potential sustainability impacts. The Sustainability Assessment Scorecard (Appendix 2) is a component of the MCA and involves an assessment of economic, environmental and social factors. The evaluation for each of the economic, environmental and social categories involves ordinal assessment (that is, ranking on a scale of 1-5) of a number of key factors. Each has a weighting which is assigned for each factor to achieve a score for each category out of 100. The majority of sustainability impacts currently incorporated into the capital investment appraisal process is evaluated using this ordinal assessment. The categories are then weighted and combined into a single measure. We noted the subjective judgment required by the user when using this component of the model.

Ultimate decision-making is based on the combined evaluation of both the NPV model and the MCA utilising the weightings included in Appendix 2. As highlighted earlier, the effort to ensure consistency and accuracy is a function of the perceived importance of the project. In cases where the project is perceived to be low in importance, the same person may prepare the analysis and make the final decision between the alternatives. In these projects decision-makers would generally only consider the total capital outlays of the competing projects ignoring cash flows, as well as additional social and environmental impacts that are required by formal MCA analysis. This approach was a concern for the Environment and Technology Manager who was involved in change to ensure sustainability was visible in all decisions. They decided to revisit a previous investment appraisal and see if their new MCA model and NPV (with carbon emissions included) would have altered the decision.

In this example, the original debate was about whether to take the infrastructure water pipes over a hill instead of the more expensive option of tunnelling them through the hill. The costs to tunnel were far higher but the long run electricity costs of pumping water up the hill mitigated this initial outlay, particularly if carbon emissions were factored into this cost. They hadn't performed this exercise but would like to know the impact on the decision if carbon was modelled into their NPV tool. In addition, the MCA provided the qualitative data required, examining the alternate impacts on the local community and ecosystem biodiversity with each proposal. The Water Company's management indicated to us that regulated infrastructure investment projects always generated negative NPV figures. As all social infrastructure providers, the decision alternatives were based on the benefits of taking 'least negative' option. Thus, the qualitative assessment should provide an important basis on which to make decisions.

The decision to include carbon emissions in the NPV tool was seen as getting closer to an accounting reality, providing better visibility through calculation, even though decisions were supposedly enhanced by the qualitative data. Management believe the quantification of carbon emissions within the NPV model will function as a form of 'sensitivity analysis' when it comes to sustainability impacts. The environmental management team tell us they are more interested in the impact of carbon emissions on the decision process (the reactivity and discipline), rather than the actual outcome of the model (the aesthetics and authority provided). The state owned Water Company that elected to pay for 'green energy' rather than calculating the greenhouse gas emission cost in electricity consumption was mentioned again. Our case site decided their approach would be more cost effective in the long-run as 'green energy' costs were currently higher than the proposed carbon emissions tax. Electricity is a dominant energy cost for them and carbon emissions is one that can easily be quantified and therefore made visible to be better managed. The Greenhouse and Energy specialist stated, "… other emissions from a utility wouldn't be easily captured in operating expenses, unlike electricity". In this way they can better promote the projects which are less energy intensive.

The water company setting, its strategies and emerging accounting system design provide the opportunity to explore the ways in which the carbon emissions number can change organisational practices. In the following section we provide further discussion, using Espeland and Steven's (2008) sociology of quantification as our research analytic.

Persuasive attributes of the carbon number: enlisting allies

Work is the effort required to create a system of measurement (Espeland and Stevens, 2008). That is, the conversion of carbon emissions (a previous externality) into a tangible number that is internalised within the company's operational activities and debated upon by all interested stakeholders. To be accepted by all, the generation of the carbon emissions number must follow a defined process as follows: determination of the electricity consumption (in megawatt hours); the use of an emissions factor (to convert electricity to in kilograms per kilowatt hours, equivalent to tonnes per megawatt hours); multiplied by the price of carbon emissions (per tonne of carbon dioxide equivalent units) as set by the mandatory market (for large Australian emitters) or the voluntary market for those wanting to offset emissions. Carbon emissions from gas, diesel and LPG are considered Scope 1 emissions, as the gases are directly emitted from the Water Company operations. Electricity is categorised as a Scope 2 emission as it is purchased from another facility. For our case site, this was the prime input for their pumping stations. The model for calculation, and for making carbon emission visible was developed as follows:

1. Calculate the number of carbon equivalent units (in tonnes) that results from the project's level of energy consumption by multiplying electricity consumption (in megawatt hours) by the state emissions factor of 1.22.
2. Calculate the cost of carbon emissions by multiplying the amount of carbon equivalent units (in tonnes) by the carbon emissions price, either a mandatory cost per tonne or a voluntary cost per tonne.
3. Insert this cost into the current NPV model as a line item categorised as a Non Deductible Operating Expense.

The work to generate a carbon emissions number is represented below in Figure 1. This was required for a 2012 commencement but given energy data from prior years were available, charting a history of energy consumption was considered useful to compare past results with planned future performance.

Figure 1: A screen capture of a Carbon Emissions Expense excel calculation

		2010	2011	2012	2013	2014	2015	2016
		1	2	3	4	5	6	7
Electricity Consumption Expense								
Electricity Price Forecast	Low	46.5153	37.32917	48.2585	79.65611	77.87707	82.16511	82.738
Derived Electricity Consumption	mWh	0	0	0	0	0	0	0
Carbon Emissions Factor	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Carbon Equivalent Units	Tonnes	0	0	0	0	0	0	0
Carbon Price	Mandatory - Low	0	0	0	20	20	20	20.8
Carbon Emissions Expense	$000's	0	0	0	0	0	0	0

The "Carbon Emissions Expense" was then inserted into the NPV tool and included as a line item for every project appraisal. The work to develop this model is shown in Figure 2 below. Originally the Environment and Technology team played around with ideas about how to best include this figure. Rather than calculate separately for every investment proposal, they wanted to build it in to their NPV template to ensure it maintained visibility and generated attention. With Figure 1 embedded within Figure 2 interface, the NPV tool became a dynamic model.

Figure 2: A screen capture of the inclusion of a Carbon Emissions Expense in the NPV model

Non Deductible Expenses											
Carbon emissions Expense				115	164	181	94	97	109	111	57
Total Non Deductible Expenses		-	-	**115**	**164**	**181**	**94**	**97**	**109**	**111**	**57**
TOTAL OUTFLOWS		**11,233**	**10,958**	**525**	**605**	**713**	**657**	**693**	**738**	**5,648**	**591**
NET FLOW BEFORE TAX		**(11,233)**	**(10,958)**	**(525)**	**(605)**	**(713)**	**(657)**	**(693)**	**(738)**	**(5,648)**	**(591)**
TAX											
Operating Income before Tax		-	(288)	(411)	(441)	(532)	(563)	(595)	(629)	(664)	(534)
Depreciation		535	898	838	783	734	689	648	611	772	733
Taxable Income		(535)	(1,186)	(1,248)	(1,225)	(1,266)	(1,252)	(1,244)	(1,240)	(1,436)	(1,268)
TAX PAYABLE		(161)	(356)	(375)	(367)	(380)	(376)	(373)	(372)	(431)	(380)
NET CASH FLOW		**(11,072)**	**(10,602)**	**(151)**	**(238)**	**(333)**	**(281)**	**(319)**	**(366)**	**(5,218)**	**(211)**
Net Present Value	(24,479.6)										

As the carbon emissions came to life we began to observe the reaction of employees (*reactivity dimension)*. The new visibility made the employees directly involved in the project, think, behave and react in different ways. For example, some managers were relieved that the company was taking sustainability impacts seriously (and this was just one example of this generated visibility). Others made further suggestions about current practice, how they might be improved further. Others began to tell stories about what was being done in other companies. For example, we were given information from the network of managers about similar activities and decisions being made at other water retailers (and other non-related companies) on how they included carbon emissions in capital investment appraisal. In addition, the design and application of the new model was compared to a number of NPV examples provided by management to make sure that the calculation work was not too different from other peers in the network. Comments included: "This [the NPV carbon emission modification] will force them to do a lot more analysis of the operating expenditure, and we'll get some consistency there."

Others explained how this visibility might change management decision making. For example, the IT Operations manager thought about his own role and considered the potential use of this model while looking at the newly generated spread sheet (Figures 1 and 2 above) on his computer screen: "A lot of the time people get a second screen because it's easier…but if you then looked, this is going to be X amount of tonnes of greenhouse gas emissions, then later on down the track if we had to start paying out of your department to offset those carbon emissions…we may end up making different decisions."

Espeland and Stevens (2008) further point to the *authority* a number can hold. In our setting we saw the creation of a network of standardised procedures and the carbon emission number being embedded in techniques and routines as emerging authority. We saw the way the carbon emissions number connected individuals, from sustainability departments to finance. We also recognised the growing levels of trust placed in the number that appeared in their spreadsheets. It provided an authority in which to better make investment choices. Some managers explained how this process is helping them get closer to the true cost. One manager explained how useful it would be to review all investment appraisals through this model in order to provide increased consistency and transparency in decision-making throughout the organisation: "If we can take the next step and get a bit more detail to get it more a reflection of what the true cost is, that will make it a better analysis… we would like to get a bit more rigour around those, particularly the operating costs." (Treasury and Financial Analysis Manager). Discussion was referred back to the example of pumping the water over the hill or cutting through the hill. With the new model, they could revisit this decision and see if they had made an optimal choice at the time.

The next component of the sociology of quantification is *discipline*, or the capacity of the number to act like a boundary in evaluating and controlling behaviour. We found how the numbers in the spread sheet presented above began to generate a trail of accountability, one that would help control behaviour and future decisions: *"*We'll go through the financials, make sure they're ok [and] put forward our recommendation. The business case will sit on top of that and all the work papers will be behind there, so the NPV spreadsheets will be there and they can see all the costs of inputs and things like that which form the final NPV result.*"* (Treasury and Financial Analysis Manager).

Finally, the *aesthetic* appeal of number refers to numerical representations and pleasing social phenomenon associated with the diagrammatic form, such as the delight of graphs. The aesthetic appeal the carbon emission number provides in in its tangible and concrete representation achieved through quantification (Miller, 2005). When pointing to the diagrammatic representation the Greenhouse and Energy Specialist explained this spread sheet as a way to help reveal the importance of carbon and communicate more broadly how the carbon emissions impact is measured:

> "For people that don't really understand sustainability that much, seeing the price of carbon as a business risk [pointing to the line in the model], like any other pollution that we emit, there is a risk to the business with that. If they can sort of price that, and see it as a tangible, realistic thing, it's going to be an extra risk to the business that needs to be managed."

When evaluating the final model the carbon emissions number is given agency. It is made real for the employees at the Water Company. The Environment and Technology Manager was delighted with the profile the model was receiving within the organisation. The spreadsheet was emailed, opened, viewed and commented upon. She pointed to the emerging performativity:

> *"*We don't have a good visibility for sustainability and what it means within the organisation. You ask anyone in the organisation, well what have you done in the areas of sustainability in the last couple of years, and people would struggle. They might say a few minor projects, but they would struggle to actually tell you what sustainability is for us, and how it works, cause that's not visible. So that's gotta be changed ….. That's what we're trying to work on [with this model], to develop better metrics and some clear communications what is a sustainable decision, these are the types of things we are doing sustainably.…. we are trying to stimulate by embedding this in the standard operating procedures. So when you go and design at the precinct level or even at the strategic level, and you are forced to consider sustainability, and you are forced to have shown that you've looked at all these different options. And if you haven't, you've got to justify why not. That really starts to change the thinking.*"*

The management team believed this NPV project would contribute to the visibility of sustainability practices throughout the organisation, even though they pointed out that this legislated number was just one representational form.

Sustainability accountability: representational practices

The combined use of models that both quantify carbon emissions and qualify data in a ranked format, provide two distinct means of assessing sustainability factors. Firstly, the NPV model included the new carbon emissions number and the MCA tool provided an assessment of the other sustainability factors deemed important, but not necessarily quantifiable. A Design Leader explained: "Our main concern at the end of the process is that what we're chasing is a process that's well-defined and that is consistent…we'd like to think the process stands on its own two feet, and we just plug the projects into the process and the process doesn't flip flop around depending on who's actually checking things out, etcetera. If the process is consistent, then we're basically happy". Enquired about the potential for debates between the qualitative and quantitative models? The Greenhouse and Energy Division Manager, pointed out that the best way to sure senior management considered sustainability is to account for it in the cash flows: "When it comes down to the bottom line figure, everyone suddenly becomes interested*"*. Nevertheless, the Treasury and Financial Analysis Manager further explained when examining competing investments: "One will stick out as being the most positive NPV, and we'll look at it and say that's the best one. But we don't always go for the best one; it depends on these other factors as well. Probably more often than not we would, it just tends to work out that way that there's got to be some sort of strong or compelling environmental or social factors that we go for a more expensive option."

The MCA model provided a different form of sustainability representation. Rather than the objective viewpoint provided by the NPV model, a modelled viewpoint that was largely believed in by all – the MCA opened, rather than narrowed the sustainability viewpoint. That is, rather than closing discussion, the MCA model motivated performativity by encouraging debate and contribution, so that closure could be effected. The Environment and Technology Manager recognised the performativity of this model: "The main objective of using multi-criteria analysis is to stimulate thinking because it is subjective". While management are required to formally acknowledge and weight the economic, social and environmental impacts in their MCA tools (and accept projects with balanced ordinal weightings of 32%, 34% and 34% for each of the categories respectively) they explained how they preferred the quantification of carbon in the NPV tool, as it provided them with better consistency in communication. The manager of Treasury and Financial analysis argued that the number provided the authority for making the best social and environmental decisions: "It's got to be quantified in some way…the old fashion NPV model; you gotta look at cash flows. Unless you can quantify it and put a cash flow against it and know what year it's gonna hit. It's very difficult and very subjective."

"Being the nature of what it is, which is a qualitative assessment, is never going to be able to get that very firm, because it's not quantifiable things, but we're trying to get at least a little bit more rigour around it. So if different people are performing the same assessment, hopefully they would come up with the same answer, instead of being able to manipulate it as easily as we could." (Greenhouse and Energy specialist)

The extent to which the model was believed depended on the trust in the measurement, as reflected by the Greenhouse and Energy specialist: "The inconsistency within the tools and also how easy they can be manipulated probably meant I don't know if the outcome would necessarily be based on them. In future I think that's where we're trying to get. So we'll have a tool that is trusted enough and robust enough that it will affect our decisions on which project we go on."

Trust in the ordinal ranking of qualitative data was also important. Many managers in the organisation suggested their qualitative information was easy to manipulate. The Greenhouse and Energy specialist describes: "Most of these tools, because they are qualitative, there's not any amount of rigour to them. They're easy to make the tool pop out the answer you want it to pop out. So there isn't a level of trust across the business. And being the nature of what it is, which is a qualitative assessment, it's never going to be able to get that very firm".

The power of the regulator created a challenge for the Water Company. There is certain reluctance to introduce change into business processes, unless driven by regulation: "So we've got some other things where we don't even look at collecting the carbon. But arguably we won't, because we don't have the regulatory driver. We're a fairly conservative organisation, well industry. So you'd need a specific driver". (Environment and Technology manager). The Greenhouse and Energy Specialist confirmed this view:

> "We can incorporate environmental concepts into our decision-making as much as we like, but unless that's acceptable to the [regulator], there's not much point. So if we, for example, just comparing the financial to environmental, if we selected something that was vastly more expensive, but it were much better for the environment, we'd need a very good case behind why that was acceptable, passing that cost onto our customers. Normally they'd want to see you go for the least cost option." Likewise, "Energy efficiency is something people are happy to have if it doesn't cost any more. If you have to pay a premium, people will generally go with the cheaper option, but most of our decisions are usually made around price with not a lot of consideration to the environment". (IT Operations manager)

Performativity

As highlighted in the comments above, there was an interesting perception that quantitative analysis, on its own, was unable to accurately account for sustainability impacts. Whilst the qualitative data was not perceived to hold the same objectivity, and potential trust, as the quantitative NPV measurement, the qualitative data a unique capability of opening conversation and changing behaviour. In the hierarchy of data arrays, the quantitative measurement is preferred. Yet qualitative measurement provides the necessary comfort in believing the measurement. This two-pronged NPV/MCA approach offers a means to provide a complete the circle of representational processes. The number is given further *authority* only when the sustainability experts within the organisation, debate NPV results or provide particular specifics that the capital investment appraisal calculation process does not reveal. When quantification fails to accurately capture the impacts of sustainability, the organisation can rely upon individual experts to maintain decision consistency with sustainable objectives.

The IT operations manager claimed his technical experience with the assets under consideration would assist in decisions to override the NPV financial analysis: *"It wasn't criteria in the NPV calculations, but more a recommendation in our business case, reflecting back on the five most expensive purchases that we've made in the last three and a half years. Using the history that we've always extended that, so we weighted that. So we had the NPV calculations which definitely said lease, but we decided, based on track record, the equipment that we're buying, it's designed in such a way that it's modular, we can upgrade components of it to increase the life….we're now in the process of purchasing rather than leasing."*

The Environment and Technology Manager confirmed our view that the value the quantification process is based on the continual interplay and juxtaposing of the quantitative icons with the qualitative narrative by well-informed experts: *"A lot of these decisions are based on finance, but they're also based on the people. And so if you've got people that are aware of environmental issues who are willing to consider alternate options, then they will…that very much influences the outcome….The way to improve the resolution is to have a number of people in the room making the decisions, so it's by consensus. That's generally what we do, if we have a committee, we'll get together."* The value of quantification lies in the production of knowledge which is commonly understood by all organisational participants (Espeland & Stevens, 2008). Thus, efforts to make carbon emission visible through NPV and MCA models means the overall sustainability strategies and operational agendas can be communicated more effectively through the quantified accounts.

Conclusion and further discussion

In this ethnography of a number we contributed to the actor-network theory literature with a specific focus on the carbon emissions number as it enlisted others into the network. In exploring the attributes of a number in a case setting, using Espeland and Stevens (2008) sociology of quantification, we found the broader political sustainability goals certainly benefited from the act of quantification. The attributess: *work*, *reactivity*, *authority*, *discipline* and *aesthetics* all play role in ensuring the carbon emissions number holds meaning in an organisational context. The carbon number generated work to create systems of measurement, with its inclusion in objective investment appraisal signifying its authority. Individuals reacted to the NPV number, changing their decisions about how to best reflect the carbon number. The discipline provided by the number was sometimes made possible (with decisions made in agreement with the measurement). The work to generate the NPV models helped to provide a basis on which the carbon emissions became visible and aesthetically pleasing.

In enlisting actors to the network, the carbon number was supported by other non-actors, the MCA tools and the Sustainability Assessment Scorecard. The qualitative attributes of the other models contributed to the usefulness of carbon emissions number. The number provided a certain comfort through a form of visibility and surprisingly, was accepted because of the rigorous effort of the local expertise involved in making the model credible. Nevertheless, while numbers placed boundaries and objectified a form of accountability, the qualitative attributes that could not be included in the model, multiplied and engendered further debate. Both in their own way captured the effect of carbon emissions on society, and served to embed this externality into organisational operating procedures. At times, debates, qualitative ranking practices and people certainly questioned the value of the number. This was not always bad – as the power the number held in the network was not one of perfect reality. In some the attributes helped make visible the limitations associated with striving for objectivity. It enlisted the other actors and they saw the number for its indexical contribution. That is, the number was recognised for its ability to operate in the interplay between a perfectly predefined numerator and denominator, and not as transparent singularity that it could never represent.

Representation of the underlying sustainability condition is therefore a function of the iconic representation of number, combined with the symbolic, and necessarily ordinal properties, afforded qualitative data (Verran, 2011). The activities of the employees in Water's network provide the necessary connections and offer a third form of performative representation (Verran, 2011). We argue our use of the sociology of quantification framework within an ethnographic setting provides an opportunity to recognise representational practices as performative. When following the carbon number creation we can observe the generative organisational practices that effect a commitment to sustainability.

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Appendix 1: Summary of Research Participants

	Interviewee Position	Type of Participation	Duration of Participation
1.	Environment and Technology Manager	Interview	36 mins
2.	Environment Manager	Introductory	2 hours
		Meeting	2.5 hours
		Meeting	0.5 hour
		Meeting	0.5 hour
3.	Greenhouse and Energy Specialist	Introductory	2 hours
		Meeting	1.5 hours
		Meeting	0.5 hours
		Meeting	0.5 hours
		Meeting	1 hour
		Meeting	50 mins
		Interview	36 mins
4.	Project Officer (within the Environment and Technology division)	Introductory	2 hours
		Meeting	2.5 hours
		Meeting	50 mins
5.	Treasury and Financial Analysis Manager	Meeting	40 mins
		Interview	18 mins
6.	Finance Manager	Introductory	2.5 hours
		Meeting	40 mins
		Meeting	50 mins
7.	IT Operations Manager	Interview	20 mins
8.	Senior Engineer	Interview	18 mins
9.	Design Leader	Interview	30 mins
10.	Feasibility Manager	Interview	30 mins

Appendix 2: Summary of the Sustainability Assessment Scorecard

	Business objective	Factors
Economic **Weighting = 32%**	Ensure long term economic viability	Net Present Value Contribution to business growth Adaptability Local economic benefit
Social Factors **Weighting = 34%**	Provide value to customers	Customer expectations during construction Customer expectations during operation
	Community responsibility	Public health, safety and amenity during construction Public health, safety and amenity during operation Cultural heritage Community outcomes
	Grow our people	Build capacity and well being Occupational health and safety
Environmental **Weighting = 34%**	Protect the environment	Air quality (excluding greenhouse gas emissions) Greenhouse gas emissions Land and soil Watercourse quality
	Manage our natural resources	Water consumption Energy consumption Material use and waste production Biodiversity