Dissertation
Department of Business Administration



Building on stable ground

How sustainability accounting employs boundary infrastructure

Marcus Brogeby

UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Building on stable ground – How sustainability accounting employs boundary infrastructure

Marcus Brogeby

THESIS IN BUSINESS ADMINISTRATION

Doctoral dissertation in business administration, Department of Business Administration, School of Business, Economics and Law at University of Gothenburg, 24-11-2026.

Department of Business Administration
School of Business, Economics and Law
University of Gothenburg
PO Box 610
405 30 Göteborg
Sweden
www.fek.handels.gu.se

© Marcus Brogeby

ISBN: 978-91-88623-40-9

Printed in Sweden by
Stema Specialtryck AB, Borås, 2026

Abstract

Organisations are expected to produce an ever-growing body of reports on their sustainability work. At the same time, sustainability accounting has been criticised for creating representations that may be disconnected from organisational practice. This thesis examines how calculative practices are employed in the creation of sustainability accounts and explores the role of accounting in sustainability work. The study asks: *What is the role of accounting in sustainability work?*

The thesis is based on an ethnographic field study conducted at a large Swedish listed real estate company. Through shadowing sustainability coordinators, interviews, and the collection of organisational documents and artefacts, the study follows the everyday work involved in producing sustainability accounts. Rather than starting from completed reports, the analysis traces how sustainability information is assembled and made reportable in practice.

Drawing on the concept of boundary infrastructure, the study analyses how sustainability reporting is built upon infrastructural relationships. Particular attention is given to three areas of sustainability work: the production of consumption data, the management of environmental certifications, and the creation of sustainability reports.

The findings show that sustainability accounts are not produced in a single reporting process but emerge from the continuous maintenance and adaptation of multiple boundary infrastructures. Accounting practices play a central role in stabilising representations of sustainability by making heterogeneous activities calculable. At the same time, sustainability reporting is shaped by existing accounting infrastructures, which influence what becomes measurable, and reportable.

The thesis contributes to the sustainability accounting literature by providing a detailed account of how sustainability reports are made in practice. It further develops the concept of boundary infrastructure as a way of understanding sustainability accounting and offers an alternative perspective on debates concerning greenwashing, organised hypocrisy, and decoupling. The study shows how accounting practices can both create and reduce such gaps through the infrastructures that support sustainability work.

Keywords: sustainability accounting, sustainability reporting, boundary infrastructure, calculative practices, ethnography, real estate sector

Svensk sammanfattning

Organisationer förväntas i dag producera en allt större mängd rapporter om sitt hållbarhetsarbete. Samtidigt har hållbarhetsredovisning kritiserats för att skapa representationer som riskerar att vara frikopplade från organisationers praktik. Denna avhandling undersöker hur kalkylpraktiker används i skapandet av hållbarhetsredovisning och utforskar redovisningens roll i hållbarhetsarbete. Studien ställer frågan: *Vilken roll spelar redovisning i hållbarhetsarbete?* Avhandlingen bygger på en etnografisk fältstudie genomförd i ett svenskt börsnoterat fastighetsbolag. Genom skuggning av hållbarhetskoordinatorer, intervjuer samt insamling av organisatoriska dokument och artefakter följer studien det vardagliga arbete som ligger bakom framställningen av hållbarhetsredovisning. I stället för att utgå från färdiga rapporter följer studien hur hållbarhet sammanställs och redovisas i praktiken. Med utgångspunkt i begreppet *boundary infrastructure* analyserar studien hur hållbarhetsrapportering bygger på sammanlänkade socio-tekniska arrangemang. Särskild uppmärksamhet riktas mot tre områden av hållbarhetsarbete: framställningen av förbrukningsdata, hanteringen av miljöcertifieringar samt rapporterande av hållbarhetsredovisning. Resultaten visar att hållbarhetsredovisning inte produceras genom en enskild rapporteringsprocess utan växer fram genom kontinuerligt underhåll och anpassning av flera boundary infrastructures. Redovisningspraktiker spelar en central roll i att stabilisera representationer av hållbarhet genom att göra heterogena aktiviteter kalkylerbara. Samtidigt formas hållbarhetsrapportering av existerande redovisningsinfrastrukturer, vilka påverkar vad som blir möjligt att redovisa. Avhandlingen bidrar till litteraturen om hållbarhetsredovisning genom att ge en detaljerad redogörelse för hur hållbarhetsredovisning skapas i praktiken. Den vidareutvecklar begreppet *boundary infrastructure* och erbjuder ett alternativt perspektiv på diskussioner om *greenwashing*, *organised hypocrisy* och *decoupling*. I stället för att betrakta gapet mellan organisationers tal och handling som ett på förhand givet tillstånd visar studien hur redovisningspraktiker både kan skapa och minska sådana gap genom de infrastrukturer som stödjer hållbarhetsarbete.

Nyckelord: hållbarhetsredovisning, hållbarhetsrapportering, boundary infrastructure, calculative practices, etnografi, fastighetssektorn

Acknowledgements

This is a thesis that has been fourteen years in the making. As such, there are almost countless people who have been involved in the process. While I have physically pressed the keys on the keyboard that made the words in this book, these people have shaped both this book and me into what we are today. I would like to thank all of them, but that would make this section longer than the rest of the thesis.

However, some people need to be named. I would first like to thank my supervisors, Mikael Cäker, Lars Walter, and Tina Carlson Ingdahl. They signed up for a two-year thesis project and ended up having me around for twelve years. They never stopped believing in this project and went above and beyond in their support of me and my project. I would also like to thank Thomas Polesie and Kristina Jonäll, who supervised my licentiate thesis: without them, I would never have been in a position to start this project or even a PhD at all.

Besides my supervisors, I would like to thank everyone else who has commented on the various drafts of this work over the years. Particularly, I would like to thank Andreas Sundström, who gave thourough comments on the text during the internal final seminar and suggested the path forward that led to this thesis.

I would also like to thank everyone at the FIRE research school, both junior and senior, for their support, feedback, and inspiration while discussing the various texts I presented there. I am also grateful to my colleagues in the SOL research group in Borås for their support, and to all the colleagues with whom I have worked in both teaching and research at the University of Gothenburg and the University of Borås.

I am also indebted to all the anonymous people in the field who have allowed me to hang around them with my notebook. Without them this would be a very thin book.

Finally, I would like to thank my family – Sarah, Edmund, Hedvig and Vilhelm – for simply being you.

Marcus Brogeby, Borås, September 2026

Contents

1 Introduction **8**
1.1 Sustainability work in organisations 8
1.2 Accounting for sustainability 10
1.3 The talk/action gap 11
1.4 Research question 12
1.5 Sustainability in practice 12
1.6 Symmetry 13
1.7 Contribution 15
1.8 Disposition of the thesis 16

2 Boundary infrastructures as a theoretical point of departure **17**
2.1 Infrastructures 18
2.2 Boundary infrastructures 20
2.3 Infrastructuration 24
2.4 Pivotality 25
2.5 Uses of infrastructure as a theoretical concept 26
2.6 Accounting and boundary infrastructures 28
2.7 Using boundary infrastructure as a method theory 29

3 Previous studies **31**
3.1 On accounting 31
3.2 On sustainability accounting 34
3.3 Sustainability work 42
3.4 Summary 43

4 Method **45**
4.1 The case for fieldwork 45
4.2 Ontology 47
4.3 In the field 48
4.4 Access 49
4.5 Shadowing 51
4.6 Interviews 54
4.7 On relating to the literature 55
4.8 Interpretation and analysis 55

5 Setting **58**
5.1 The property business 58
5.2 Backstory 58

5.3 Property and its business model 59
5.4 The reorganisation and merger 60
5.5 Property and its people 61
5.6 The picture of Property 63
5.7 Organising properties 65
5.8 Sustainability work 66

6 Consumption **68**
6.1 Gathering numbers 68
6.2 Hunting anomalies 79
6.3 Refining numbers 87
6.4 Reflections on the consumption infrastructure 91

7 Certificates **94**
7.1 On certificates 94
7.2 Getting a certificate 101
7.3 Building a system 114
7.4 The certification infrastructure 121

8 Reporting **128**
8.1 Preparing the accounts 128
8.2 Reporting to an evaluator 129
8.3 Reporting to suppliers 131
8.4 Reporting to tenants 134
8.5 Using the infrastructures 141

9 Discussion **143**
9.1 Infrastructure and the creation of sustainability 144
9.2 The need for accounting in sustainability work 145
9.3 Sustainability work changing accounting 147
9.4 The role of accounting in the talk/action gap – who puts up the facade? 149
9.5 The consequences of infrastructure for accounting for sustainability 152

10 Conclusions **155**

References **159**

1 Introduction

It is generally agreed that today's society needs to move towards becoming more sustainable (United Nations General Assembly 2015). To this end, businesses need to undertake environmental and social work, to reduce emissions and other negative effects of the company's operations. This entails transforming the concept of sustainability into a material practice. As part of this practice, companies are supposed to implement environmental and social governance, or ESG, and to produce accounts of their environmental and social impact, which can be used by stakeholders to make decisions about these companies (Busco et al. 2018; Quattrone 2021).

Sustainable development is defined by the UN as meeting the needs of the present without compromising the ability of future generations to meet their own needs (United Nations World Commission on Environment and Development 1987). Because there are very few things that humans do that cannot potentially have an effect on future generations' ability to meet their needs sustainability is something that may affect every aspect of human activity on the planet. Sustainability is such an all-encompassing concept that it is often subcategorised as environmental, social, and economic sustainability, which together can cover all human activity. The concept that is being widely spread and discussed is a consequence of its potentially all-encompassing definition; it is also well established, with practically every organisation writing about sustainability in their reports.

Existing in an environment where sustainability is part of everyday discourse requires that the concept is taken into account, managed and turned into some sort of material practice. This is done at all levels, from intra-governmental bodies such as the UN and its Agenda 2030 (United Nations General Assembly 2015) to individuals deciding what type of product to buy (Fuentes 2014). The sustainability concept is not just about talk but also about action because it is in the material world that the problems that it is supposed to solve are to be found.

1.1 Sustainability work in organisations

It is generally assumed that sustainability work means that today's practices are unsustainable and that we need to change in order to become sustainable. However, moving from the Brundtland definition of not compromising future generations' ability to meet their own needs (United Nations World Commission on Environment and Development 1987), to

the totality of human activity, which may or may not be sustainable remains challenging. Social, environmental and economic work to improve the world for future generations is nothing new; even Frederick Taylor mentions de-forestation and pollution in his proposition for a more rational management (Taylor 1911), and environmentalism and workers' rights have been issues for a long time. The sustainability concept has, however, superseded many of the older discussions and work regarding environmental and social issues, and in doing so requires the attention of people who work and make decisions in vastly different circumstances.

Businesses and other organisations are a part of society and need therefore, to take sustainability into account; they play a large role in contemporary human activities. The role they play, or should play, in sustainable development is debated. There are those who argue that the profit motive of business is fundamentally incompatible with sustainable development, and that all activities therefore are carried out in order to legitimise the organisation in the eyes of the public, allowing it to keep on going as before (Campbell 2007). Elkington (2018) takes the opposite side and says that companies that implement the triple bottom line approach, an accounting approach, correctly will become sustainable. Both of these sides use sustainability accounting and its role in their arguments: one side says that the accounts are disconnected from reality or that the nature of accounting prevents a full account of an organisation's sustainability, and the other side argues that well-made sustainability accounts can usher in a sustainable future.

Businesses engagement with the concept of sustainability is perceived as mandatory today. While the reasons for this engagement are debatable, it could be because of laws, regulations, institutional pressures or an interest in preserving society and the environment in the long run that businesses need to interact with the concept in ways such as providing accounts of their sustainability. One way that businesses interact with sustainability is that they employ people to deal with sustainability issues. Some firms even have whole departments that deal with sustainability issues, and people at the top of the company with sustainability in their title (Strand 2014; Wright, Nyberg and Grant 2012). What these departments and the people that work in them do has an effect on what the organisation does and what it classifies as related to sustainability (Corvellec 2016).

1.2 Accounting for sustainability

Sustainability practice is often tied to making sustainability work visible through quantification and, in turn through accounting frameworks and concepts. Sustainability accounting is comparatively new compared with financial accounting, but it has existed in the literature for several decades (Solomons 1991; Owen 2008). As sustainability for organisations is often seen as being transparent through creating reports and accounting for the organisation's social and environmental impact (Elkington and Robins 1994; Quattrone 2021), accounting has become a part of CSR. However, the mechanisms for when sustainability becomes accounting have yet to be fully explored.

The triple bottom line was described in 1994 in the UN Environment Programme, Industry and Environment, Technical Report no. 24 (Elkington and Robins 1994). The concept of a bottom line, or result for the period, is an accounting concept that dates back to the invention of double-entry accounting (Lee 1977). The bottom line is supposed to represent, in a number, the value added by a reporting entity over a period. It is a reduction of all the period's activities into a singular number, which can be positive if the entity has created value for its owners or negative if it has lost value (Olbrich, Rapp and Follert 2020; Edwards and Bell 1961).

The triple bottom line concept was conceived as a way to incorporate an entity's impact on other things than just its profit or loss to its shareholders. By adding a social and environmental dimension, the triple bottom line sought to more wholly represent the organisation's activities and their consequences for a larger number of other entities, such as employees, the environment or society at large. The triple bottom line is just one way that accounting and reporting have been used as a way to implement sustainable development since the concept was invented (Andrew 2000). Since then other concepts, or standards, such as GRI, CSRD, Integrated reporting, GHG protocol, and the EU taxonomy have been established. Sustainability work can be framed as implementing one or more of these standards to make more of their social and environmental impact available to outside entities. Sustainability in organisations is closely linked to accounting, and there is a need for knowledge on how this link manifests in the organisation's practices.

1.3 The talk/action gap

The critical literature on sustainability accounting has shown that sustainability accounts can create a domain of talk that is separate from the organisation's actions[1] and thus enable an unsustainable business-as-usual (Cho et al. 2015). This type of sustainability reporting has been termed greenwashing (Busco et al. 2018), or 'organized hypocrisy' (Cho et al. 2015), managerial co-option (Bebbington and Gray 2001) or institutionalised decoupling (Campbell 2007; Stål and Corvellec 2018). All these concepts have in common that organisations differ between their formal reporting, which shows what they do for sustainability and their everyday actions, which are still unsustainable business-as-usual. These explanations for the gap between the current practices of sustainability accounting and a more substantial account (Birkin 1996; Bebbington and Gray 2001) stem from the fact that organisations continue their business-as-usual in order to be efficient.

It may the case that accounting can never provide a holistic account of an organisation and that the promise (Mouritsen and Kreiner 2016) of sustainability accounting being able to do this is empty. Financial accounting was never the singular representation of an organisation's financial matters, and sustainability accounts cannot be either (Quattrone 2021). Whatever views one might have on what role accounting can or cannot play with regards to sustainability, there is a lot of sustainability accounting being done in everyday organisational practice, and it is being used by decision-makers (Migliavacca 2024). If there is decoupling, greenwashing or facade building going on then this disconnect between talk and action should be seen in the everyday practices of the sustainability workers (Wright, Nyberg and Grant 2012).

In order to study the mechanisms of how this disconnect occurs, this study proposes to start with sustainability work to see what role accounting has in it. Since sustainability work involves accounting concepts, the role accounting has in facilitating a disconnect between talk and action will be explored. This will allow for a description of the mechanisms that facilitate a disconnect. Looking at the mechanisms of disconnection will allow for an explanation of concepts such as institutionalism and business-as-usual as something material instead of abstract forces. This type of explanation can further our knowledge of the talk/action gap and how it is manifested. Just having a social explanation opens the descriptions up for critique along the lines of Latour (2007), who argues that explanations where social forces are the cause of action will be unhelpful

[1] This is further elaborated in section 3.2.

since the forces are established at the outset. An explanation where a force, such as business-as-usual, is assumed from the beginning to affect the social world will have difficulty in being accepted by those it seeks to explain (Latour 1993).

Accounting is a part of what sustainability work is in practice, as Asdal (2011) and others have shown. It shapes (Georg and Justesen 2017) and enables sustainability work (MacKenzie 2009; Grisard, Annisette and Graham 2020). Even when it is not always successful in bringing about faithful numbers, it is still in use, quantifying and representing something. This something can be seen as what the sustainability workers do: they practice a form of accounting. A study starting from the sustainability workers' practices, rather than the accounts, can gain insight into how, and where, sustainability work accounting plays a role and how it is materialised. Starting from sustainability work can show where accounting is unable to play a role. It can also show how the context affects what accounting becomes and what roles accounting is able to play.

If we begin with an assumption that organisations disconnect talk from action due to a business-as-usual force that causes this behaviour then we will not know how this disconnect occurs or what role accounting plays in this disconnect. On the other hand, a material description, as this study proposes, cannot on its own explain why the disconnect occurs – these types of descriptions are complementary, and this study will seek to contribute by creating a complementary description.

1.4 Research question

Since this is a study that starts at sustainability work and seeks to describe the role of accounting within it the research question for this study is as follows: *What is the role of accounting in sustainability work?*

The purpose is to describe what accounting does in sustainability work and, by doing this, to bring about a greater understanding of both the practice of sustainability reporting and how accounting is used in everyday work in organisations.

1.5 Sustainability in practice

The sustainability employees in Strand (2014) had many different practical responsibilities, depending on the organisation's goals, industry and other factors. Despite these differences, some sort of institutionalised or standardised practice seems to be forming in today's organisations (Milne

and Gray 2013). Furthermore, the existence of trade papers[2] for sustainability workers suggests that sustainability work is becoming taken for granted as an organisational function, with sustainability employees, and sustainability work is carried out. The accounting related studies, such as those by Asdal (2011) and Mouritsen, Ernst and Jørgensen (2000) show that accounting is a part of sustainability work.

This study will start with the sustainability employee's work and from there see what role accounting plays and how this affects both accounting and sustainability work. If there is a disconnect – that is, some aspects of the organisation's operations are ignored while others are emphasised – then this study could show what role accounting has in what is emphasised, or what is discarded when bringing about a representation of the organisation. It will also give an indication of the amount of work required to produce useful sustainability accounts and how much of the work is accounting.

1.6 Symmetry

A way to explore the research question of this study is to follow the principles of symmetry, as described by Czarniawska (2017) and Callon (1986). This would mean not assuming at the outset who, or what, is capable of agency.

This type of symmetrical study can bring about knowledge of accounting in a sustainability context by not assuming *a priori* when and what role accounting plays in sustainability practices. By studying a sustainability practice instead of an accounting one, it is possible to observe what role accounting has without assuming that it has a role, as one might do if one studied an explicitly accounting practice. Defining a sustainability practice could be problematic. Even so, many companies today have a manager or even a department that specifically works with sustainability. Studying what role accounting has in the sustainability manager's or department's work can provide knowledge about the role of accounting for sustainability and add to studies such as Grisard, Annisette and Graham (2020) and Rodrigue and Picard (2022).

Not assuming agency at the outset also allows for avoiding the *a priori* classification of technology and the people that use them as separate entities. Technology shapes both accounting and sustainability work and not treating them as separate entities with their own pre-defined qualities (Latour 1993; Bowker and Star 2000; Orlikowski and Scott 2008) gives

[2]For example, in Sweden, a paper called *Aktuell Hållbarhet*.

the study an ability to see how agency is performed in sustainability work and accounting.

One study done that explores sustainability as work is Corvellec (2016). He argues that sustainability objects and their creation and use can be seen as a performative definition of sustainability. Sustainability becomes what is made of it, rather than the abstract definitions that are usually used. He shows how sustainability is put into two different objects, fertiliser and gas, both made from food waste, and how the creation of these objects requires the enrolment of a series of other actors, such as bags for collecting food waste and people who put the waste in the bags, in order to become successful and perform the role of a taken-for-granted object. This performative definition of sustainability allows for studying how things come to successfully perform as sustainable and how they sometimes to not. The objects in Corvellec (2016) were both successful. A related way of using a performative definition of sustainability is to not follow a specific product but to follow an actor in order to see what can be mobilised as sustainable.

A symmetrical study of sustainability work can use several different perspectives. Actor-network theory (ANT) is the most common symmetrical perspective in current accounting studies (Justesen and Mouritsen 2011; Lukka, Modell and Vinnari 2022). In accounting, ANT has been used to study a variety of accounting practices, from accounting for sins (Quattrone and Hopper 2001) and diseases (Frandsen 2009) to more traditional accounting topics such as the implementations of standards (Hartmann 2013), accounting systems implementation (Quattrone and Hopper 2006) or budgeting (Lowe 2001). These studies give rich empirical insights into the role of accounting in organisations and show how it acts on other things than money.

However, there are other symmetrical perspectives that have analytical advantages over ANT for this study. One such perspective that is gaining traction is the concept of the boundary infrastructure. The difference, for analytical purposes, is that the boundary infrastructure concept has some defined analytical terms which can be used to explain the field material, while ANT has its terms purposely undefined (Mol 2010; Lukka, Modell and Vinnari 2022). By having given analytical terms the boundary infrastructure approach can give a description that is not purely a description that uses the field's own terminology to describe itself. This type of description can often stop at a purely descriptive stage and offers less of a contribution to a theoretical field (Lukka and Vinnari 2014). Both of these theories are what Lukka and

Vinnari (2014) classify as *method theory*, which is theory that is used to inform the study's analytical starting point and method rather than being something that the study should test or contribute to.

Symmetrical approaches such as boundary infrastructure and ANT use terms such as accounting in the field and during analysis in non-predefined ways, so that they take their definitions from the field. This approach defies codification, as it is mainly a practice; however, there are some texts that have sought to pin it down in textual form. This approach grew out of a critique of sociological methods of the time, which would treat 'social' as a sort of material that was a thing in itself. Social could be used to explain actions or to say that something was a social construction or a social fact, and then leave it there. For those using an ANT approach these explanations are not satisfactory. Social is a relational concept rather than a thing in itself, so there cannot be any social facts, only facts that are made in relationships between actors. An ANT-explanation requires showing how and between who these actors, and the social fact, such as the gap between talk and action, can be explained as relationships, not as things in themselves (Latour 2002; Latour 2007).

Infrastructure explanations are similar, in that the role and effects of the infrastructure are undefined at the outset; however, some properties are defined, such as having a history and being taken for granted when it works. This allows for an analysis which uses these terms in order to understand the studied subject without losing the qualities of seeing the studied subject as relational. See chapter 2 for more on infrastructures.

1.7 Contribution

By having some insight into the role of accounting in sustainability work, this study can complement the more critical studies, such as Milne and Gray (2013) and others, who claim that sustainability accounting has been co-opted by managerialist interests. If one has this viewpoint then it is still useful to know how this managerialist interest has come to take over from other interests and what role, if any, accounting plays in this co-option. As Alvesson and Spicer (2012) have argued, a critical perspective without offering any practical answers is easy to dismiss. By taking a symmetrical approach to achieve a better understanding of current corporate practices of sustainability, accounting and calculation can move the debate towards something that has practical use, which in turn is necessary in order to have a material effect.

It can also contribute to the discussion on what role accounting can

play as a representation of an entity. What sustainability accounting promises (Mouritsen and Kreiner 2016) and how is this done in practice. If the critics of sustainability accounting are correct and accounting can not make an organisation transparent (Quattrone 2021), then how and why accounting plays a role in selecting what counts and what does not is useful to know. How certain numbers and calculations take precedence has been studied, as seen above; however, a study of the role of accounting in sustainability work can offer a new contribution to this discussion.

Having a description of the material relations that constitute sustainability work can allow for seeing how talk is disconnected from action without at the outset assuming that it is the business as usual, or another, institution that causes it. Instead the disconnect can appear as something that is done in material relations where agency is produced in, or by, the relations. By seeing how this disconnect occurs in a material way a contribution can be made to the literature on both the talk/action-gap and what can be done if one considers this gap to be problematic.

1.8 Disposition of the thesis

The rest of this thesis is structured as follows:

Chapter 2 presents the theoretical starting point of the study, the boundary infrastructure, and how it will be used to structure the field material.

Chapter 3 presents previous studies that are relevant to the study, both in the field of sustainability accounting, the relevant parts of accounting in general, and sustainability work.

Chapter 4 describes the method used in the study, how the field material was collected and how it was analysed.

Chapters 5 to 8 are where the empirical material is presented and analysed. The disposition of the chapters is elaborated in chapter 5.

Chapter 9 frames the findings of the study in the context of the previous studies.

Chapter 10 attempts to answer the research question and summarises the findings of the study; it also offers potential insights into its consequences for sustainability accounting in practice.

2 Boundary infrastructures as a theoretical point of departure

In this chapter, the theoretical point of departure and some key terms will be developed. These key terms will be used to analyse and draw conclusions from the field material. A starting point for this study of sustainability work is the view that this type of work can be studied as an ongoing practice. This work is something that is done continually, engaging many different actors in order to stabilise what sustainability becomes in the field.

Another starting point is that the analytical terms of infrastructure, scaling, infrastructuration and so on, are not defined here, but rather they are presented and then put to use (Mol 2010). They are used together with field material and allowed to be defined and redefined by it; the way they are presented here is as a starting point. This is elaborated in the methods chapter in section 4.8.

Using a boundary infrastructure framework, this study will follow a symmetrical tradition of research. A symmetrical (Callon 1986; Czarniawska 2017) approach is a way to capture agency without assuming where it is located at the outset. The best-known symmetrical study is Callon (1986) where there were three main actors; the fishermen, the scallops and the scientists who tried to farm the scallops. They were treated equally methodologically. This is the main feature of a symmetrical approach, of which infrastructure is one. Agency – who or what is able to do something – is needed to show how and where the talk/action gap materialises in sustainability work because, if it exists, it must be done somewhere.

A symmetrical approach has allowed accounting researchers to see accounting as performative, rather than descriptive (Skærbæk and Tryggestad 2010; Revellino and Mouritsen 2015). Accounting is not predefined by what role it has, which has allowed researchers to describe the role of accounting in practice in different cases. In Skærbæk and Tryggestad (2010) the creation of an external report also served to generate a new internal identity of a company in crisis. In Revellino and Mouritsen (2015), a symmetrical approach, in this case ANT, allowed the researchers to see how the introduction of a new accounting device changed the business model of a toll company. Without this type of approach, the role of the device itself would go unnoticed. For an overview of the ANT literature on accounting and sustainability accounting that is relevant to this study, see section 3.1.3.

The boundary infrastructure framework can be used to describe the relations and actors that make accounting work, similar to ANT studies. What infrastructure also allows for is a description of how sustainability accounting is built on older infrastructures, such as financial accounting and how this logic amd these practices affect what later becomes sustainability accounts. By doing this, it can show the role of accounting in forming sustainability accounts and the role accounting logic has in decoupling these accounts from material action performed by the organisation.

Bowker and Star (2000) is in many ways the central text of boundary infrastructures. It is where the concepts of infrastructures, standardisation and boundary infrastructures are described and elaborated and it is from this text that other authors have used the infrastructure concept to form their starting point.

2.1 Infrastructures

The notion of infrastructure comes from studies of IT systems where there was a need to describe complex and large systems which were more or less decentralised, standardised and evolving. Star (1999) uses a performative definition of infrastructure. She describes it as not being an object, but rather a relational concept. This means that the infrastructure is not a thing-in-itself, nor an effect of another's action that can be analysed by itself; instead, since it is relational, it is being made of other things that are connected in order to form the infrastructure (Star and Ruhleder 1996). In this way an infrastructure is similar to an action net (Czarniawska 2004) or an actor-network (Latour 2007). These connected things are material and immaterial, humans and non-humans and so on. The infrastructure is shaped by these and in turn the infrastructure shapes and affords the actors new work and even new ways of thinking (Star and Ruhleder 1996). Accounting, in an infrastructure framework can be seen as a set of techniques, objects, and standards that can be, and often are, parts of infrastructures (Arena, Arnaboldi and Palermo 2017). The following section will first describe infrastructures, then boundary objects, and finally boundary infrastructures as analytical devices.

When developing the concept of infrastructure, Star and Ruhleder (1996) described it as having properties that defined it as an infrastructure: Embeddedness; Transparency; Reach or scope; Learned as a part of membership; Links with conventions of practice; Embodiment of standards; Built on an installed base; Becomes visible on breakdown; and Is fixed in modular increments rather than all at once or globally. Embed-

dedness means that the infrastructure is embedded in everyday activities and routines. Transparency means that the infrastructure is predictable to the users and works in expected ways. Reach or scope means that the infrastructure is larger than a single object and also that it is built to last for longer than just one project or event. Links with conventions of practice, embodiment of standards and learned as a part of membership are all related to how the infrastructure is developed and then used. Infrastructures are what standards become in practice when they are implemented, but they also need to be built on something. Often new infrastructures are built using older infrastructures as a base, such as fibre cables following older phone lines, and learning how the infrastructure works becomes part of learning how an organisation works. Infrastructures are often taken for granted until they break down and become visible to the users. When infrastructures break and need fixing they are not torn down and rebuilt from scratch, instead they are fixed in increments, just as they are when they are constructed.

Infrastructures are taken for granted by the user, in that they are used as objects that generate predictable outputs from the user's perspective. They are also taken for granted because they are embedded in practices and organisations and not easily separable from them. Learning to a new role a work is in many ways learning to operate the infrastructure of that place. Yet infrastructure is a relational concept, which means that it is always made up of several entities, and it is not taken for granted by the actors that maintain it. Star (1999) exemplify this with a city water system. It is transparent to people who turn on their taps to get water, but for a plumber, it is a site of practice made up of many different parts that need to work together. Transparency is one of the properties of an infrastructure, as defined in Star and Ruhleder (1996). This definition of transparency differs from how it is used in the sustainability accounting literature, where transparency is often described as a state of being open and clear (Gray 1992; Roberts 2009; Quattrone 2021). Transparency in the boundary infrastructure framework is, instead, where the infrastructure itself is transparent[3] to the user in a way that can be likened to being black-boxed (Latour 1999) or taken for granted: the people that turn on the tap in Star (1999) do not need to know the details of how the water system works; they just expect it to work, and it is the infrastructure itself that is transparent.

It is in the infrastructure that standards and routines are linked with

[3]For more on how transparency in the boundary infrastructure framework is made and maintained see section 2.3.

material entities and put into practice. The standards and routines that are embedded in the infrastructure are established by relational work but also build on previous infrastructures; therefore, work done in the past to solve problems that were perceived at the time can shape current work even if the problems are completely different. The infrastructures are continually developed and not repaired or replaced all at once. Instead, components are repaired when broken or replaced to gain new functionality (Star 1999).

As described above, the infrastructure concept is fundamentally symmetrical in that it does not assume agency in any of the entities that make up the infrastructure, human or non-human. It is imperative that agency is not assumed to be in any of the entities at the outset; agency is the result of the relational or social process of building the infrastructure.

Infrastructures have been studied in terms of their material effects. The infrastructure is a collection of heterogeneous elements that come together and are sorted and sort themselves in a way that is stable. Stability here is a relative term, as infrastructures are not permanent, and they are also long enough in a temporal scope that they enable work to be routinised. One effect of infrastructure is that it both affords and restricts work. Star (1999) says that infrastructures are often supposed to be neutral and free from any type of bias, yet they often have built-in master narratives that are embedded and can be studied when the supposedly neutral infrastructure is studied as a purely relational concept (see also Bowker and Star 2000). These narratives become embedded in the routines and fixed as stable relations. Star (1999) uses examples of how supposedly neutral infrastructures affect social justice, for instance, how medical history forms can support a narrative of norms of sexuality and relationships by having fields such as 'husband's name' and 'maiden name' even if they appear to be neutral to most of their users. Master narratives can also be used to decide what types of standards, practices, or techniques get embedded and made material by the infrastructure. The effects of infrastructures are also shaped by the infrastructure's history; they are often built upon older infrastructures and can inherit the older infrastructure's biases.

2.2 Boundary infrastructures

A boundary infrastructure is a specific type of infrastructure that enables tasks to be done over boundaries. The term itself has sprung from a need to describe and analyse situations where organising is done across boundaries and the infrastructure is needed to facilitate this work (Star

2010). A boundary infrastructure has the properties of an infrastructure, as listed above. It is large and standardised, and allows work to be done that would otherwise not be possible, due to differences in practices and sensemaking (Bowker and Star 2000). It has an interpretive flexibility (Star 2010) in the same way as a boundary object (Star and Griesemer 1989) has[4].

A boundary infrastructure is like any infrastructures made of multiple entities and is not a thing in itself. Boundary objects, on the other hand can analytically be seen as things in themselves. Boundary infrastructures have boundary objects as parts of them, but also other entities such as people, routinised stable practices, and non-boundary objects.

Tuertscher, Garud and Kumaraswamy (2014) describe a process of stabilisation and the making of an infrastructure that enables work between teams of people from different disciplines in order to build a highly complicated machine: namely, the Atlas particle detector at CERN. They show how this was possible due to a boundary infrastructure that was made of things such as texts and simulation models. This stable base in turn allowed the divergent teams to argue their points in a standardised way which allowed for the production of cycles of justification and contestation that moved the process of building the detector towards something material. The boundary infrastructure constrained the way that contestation and justification could take place and put in place a mechanism that allowed for the settlement and starting of a new cycle that was recognisable to those involved.

The boundary infrastructure described in Tuertscher, Garud and Kumaraswamy (2014) had a bigger scope than an object, as it stabilised several cycles of work. It was also built upon older types of routines and objects that were recognisable to the users, such as the simulation models. These things might seem obvious and inconsequential to the users and outsiders, yet analysed through an infrastructure perspective the constitutional role of these things and arrangements to the work becomes obvious. Bowker and Star (2000) describe the process of becoming taken for granted as naturalisation. That the properties of the infrastructure are taken for granted means that any controversies that came up during the assembling of the infrastructure have been settled; however, they are still there, as the infrastructure is a relationship. The entities that make it up can become disenfranchised and stop participating as a part of it. As the entities comprise a wide variety of things, such as documents, people, concepts and pipes, the notion of disenfranchisement

[4]For a more comprehensive description of the boundary object, see the next section.

needs to be quite broad. When the infrastructure breaks down, it loses its transparency and becomes visible to those who took it for granted. The non-working part of the infrastructure then needs to be put to work again or the infrastructure needs to be reorganised to account for its absence.

2.2.1 The boundary object

The concept of the boundary object was developed in order to describe how different heterogeneous actors can work together despite having different ways of making sense of things (Star and Griesemer 1989). It is built on Callon and Latour's ideas of intressement and translation (Callon 1986), but builds on them by adding the concept of the boundary object. The boundary object can act as different things in different settings while still being the same object. This can enable different actors to work together, as the boundary object brings them together.

The boundary object is plastic enough to be used in different ways, yet rigid enough to maintain its integrity when used in different settings. These features are what enable the boundary object to allow new things to be done, things that were not possible without the object acting as a reference point for actors who have different ways of making sense of things.

It is both standardised enough to move over boundaries and still be recognised as the same object, while being adaptable enough to be used in local contexts in different ways. These local contexts can be things such as different professions or any groups where there is a different way of making sense of things. One example of a boundary object is a map, which can be used to find places to camp or to locate the fastest route from one place to another, both using the same map. The map is the same, but its use makes it different in different practices. The concept of a boundary object can describe how different communities of practice can organise themselves around the boundary object and put it to use to enable new types of work.

2.2.2 Scaling

The way boundary objects can scale up into infrastructures is a process of giving the objects structure and stability (Star 2010), and assigning categories to things (Bowker and Star 2000). Scaling from object to infrastructure means adding more entities, as infrastructure is a relational concept. Boundary objects are naturalised in their local settings. They

are, after all, objects, taken for granted as things that are predictable and useful in certain ways. Infrastructures are similarly naturalised but they are an embedded arrangement of entities and need maintenance. Therefore, for those that perform this maintenance the infrastructure is never settled or closed and the constituent parts are visible.

Bowker and Star (2000) use the phrase 'scaling up' to describe how objects become taken for granted in many places and become standards, or standards become linked to material objects. Scaling is not a one-way process. Boundary objects can become part of boundary infrastructures and boundary infrastructures can be scaled down to objects (Star 2010). Just as the word scaling implies, the difference between an boundary object and a boundary infrastructure is in scale, or size. However, for analytical purposes the main difference is in stability. The scaling process describes how infrastructures are made and kept going as relatively stable relations.

Hummel, Berends and Tuertscher (2024) developed the scaling concept into two mechanisms to describe large scale inter-organisational collaboration: scaffolding boundary objects and reconfiguring coalitions. The creation of a boundary infrastructure is a response to a boundary object that is no longer sufficient for a specific large-scale task; therefore a scaffolding of boundary objects takes place. Scaffolding involves reconfiguring the boundary objects so that they can be used together in a larger setting. It is an iterative process where they are reconfigured until they are able to function as a boundary infrastructure. Reconfiguring collaboration involves changing out the actors and objects over time so that the scaffolding process can move forward and the infrastructure can become stable. This is an iterative process, and the configuration of the actors is changed over time so that the scaffolding process can continue. This type of description enables the researcher to see both the development of a coherent boundary infrastructure and the role that the infrastructure has in shaping the work, in this case collaboration, that is done.

To sum up, scaling boundary objects into boundary infrastructures means assembling different entities, organised, or organising themselves, so that they are stable and enable routine work to be done. Boundary objects are organised in boundary infrastructures, and they enable a sort of plasticity in the otherwise rigid infrastructure; so that the infrastructure can be used by entities with different ways of making sense of things for different purposes. The boundary infrastructure is stable as an effect of the way it is organised, yet it is adaptable at the same time

in order to be useful in different settings. The boundary infrastructure concept allows for the analysis of phenomena that are composed of many entities and that stay organised over several cycles of work, yet adapt to local settings. Boundary infrastructures are large in scope and rigid, yet local and flexible; they are dual or even multiple in that they can play different roles depending on the user. This multiplicity is what allows boundary infrastructures, as an analytical tool, to provide insights into modern work,such as sustainability work, where different actors from various fields need to work together in order to produce meaningful work.

2.3 Infrastructuration

Edwards (2019) has developed a critique of infrastructure and the social dimension. He calls the social process of building infrastructures *infrastructuration*, a verb. Infrastructuration is the process of maintaining and at the same time reproducing the infrastructure. Tt has a cultural as well as technical dimension, or trajectory. Both of these trajectories create an infrastructure that is transparent to the user, but they differ in terms of what type of entities they are made up of. In the social trajectory the infrastructure is made up of people's behaviour and standardised routines, while the technical trajectory is made of things such as pipes and software.

The infrastructuration process is a deliberate process of keeping the infrastructure invisible to the user, it is deliberately hidden which facilitates the infrastructure's ability to generate reliable results. Edwards (2019) uses another term for making the infrastructure invisible, *habituation*, which is the deliberate process of making the infrastructure taken for granted and invisible. An infrastructure can over time shift from being mostly technical to mostly social, and then back again. It is always a deliberate process no matter whether it is people's routines, software or roads that are doing the habituation.

The infrastructuration concept is an extension to the framework of boundary infrastructure, it does not change the original concept in Star (2010) where infrastructures, including boundary infrastructures, need to be maintained and are invisible to the end user until they break down. Infrastructuration as a concept serves as a reminder that infrastructures are a mix of technical and social things and that they are constantly reworked. The building of infrastructure requires work in both building and maintaining the relations that make up the infrastructure and this work can be labelled infrastructuration.

2.4 Pivotality

As described above, infrastructures are made up of a relational assemblage of things that are configured as an infrastructure (Bowker and Star 2000). In this way the infrastructure is not a thing in itself, yet it is constructed and this construction has been studied in different settings. Millo, Panourgias and Zachariadis (2019) describes the process of building an infrastructure for the sake of capitalisation, that is to build an asset. The actors that could control how the infrastructure's calculative practices were shaped were positioned as obligatory points of passage (Callon 1986). The success of the infrastructure depends on the actor's *pivotality* and its related counterpart *linkability*. Pivotality is the infrastructure's (or a part of the infrastructure's) ability to position itself as a indispensable solution to a problem and therefore become an indispensable part of the infrastructure. Linkability concerns the infrastructure's ability to connect to outside actors and other infrastructures.

The concept of pivotality (Millo, Panourgias and Zachariadis 2019), like infrastructuration, come from studies of infrastructures in the making where there was a set end goal of either a new way of working or a new way of collaborating between organisations. These infrastructures were built on an installed base in the sense that some of the work they were involved with was already being done. Sustainability in organisations is a much more open ended process where the goals are more ambiguous and in some ways contradictory (Argento, Broccardo and Truant 2022). The ongoing process is more similar to the traceability described by Power (2019) where the infrastructure both delivers traceability and creates an expectation of, and a demand for even more traceability. There is not an end point where there is enough traceability, but rather an ongoing process of building out and maintaining the infrastructure in order to deliver ever more traceability. It is the infrastructure itself that enables this process of at the same time delivering and creating demand for more traceability at the same time. The infrastructure concept can be used to explain and show how both processes with a set endpoint and processes without a set endpoint work.

The pivotality concept adds to the boundary infrastructure framework in Star (2010) by adding pivotality as a property of (some of) the entities that make up a successful boundary infrastructure. Success, that the infrastructure is able to become stable and taken for granted by its users. This can be useful when describing how some parts of an infrastructure become indispensable for doing certain types of work and can be used to understand why some parts of an infrastructure are needed

for it to function.

2.4.1 Thinking infrastructures

In Kornberger et al. (2019) the authors stress the importance of the materiality and performativity of devices as a central feature of infrastructures. This emphasis serves as a reminder that infrastructures are similar to other approaches that rely on the concept of symmetry, such as ANT (Callon 1986). There is a focus on the material and on not assuming where agency is at the outset. Kornberger et al. (2019) describe a thinking infrastructure as an infrastructure that is large enough to be able to act as an infrastructure in the sense of Bowker and Star (2000) and Star (1999). The thinking part of the thinking infrastructure is distributed among the devices that make up the infrastructure and is located among their relations, it cannot be attributed to a single device.

The infrastructure can enable action over many cycles of work in various fields, for instance, in Kornberger et al. (2019). Kaniadakis and Elbanna (2019) describes how the transparency concept was implemented as a material infrastructure that could bring together actors who had not worked together previously. This was done through what they call *transparency work* rather than being a result of disclosing more information. Work is the ordering and structuring of the infrastructure that make, in this case, transparency possible. This work defined what transparency was in order for the infrastructure to be able to work and be taken for granted by other actors, in this case, market participants.

2.5 Uses of infrastructure as a theoretical concept

The infrastructure framework, when combined with an appropriate method, can be used to analyse the naturalised, invisible objects that shape everyday work. It is, however, limited in that infrastructures are static, embedding master narratives and organising work. This ignores the work that goes on in adapting the infrastructure to local conditions and what effects this has on practices and the infrastructure. By combining the infrastructure concept with the boundary object (Star and Griesemer 1989) bring in the boundary object's ability to enable actors to make sense of the object in different ways to use it and work together. The boundary object, however, is limited in that the object itself is singular, unlike an infrastructure, which has many entities. Infrastructures also have, unlike boundary objects, a history which shapes them. Boundary objects are also shaped by their constitution, but analytically the

infrastructure concept needs to take history into account, as the infrastructure is built on an installed base. This has given rise to the concept of a boundary infrastructure, which has properties from both boundary objects and infrastructures, as an analytical tool.

Clormann and Klimburg-Witjes (2022) use the boundary infrastructure concept to re-conceptualise the phenomenon of space debris. The concept allows for the analysis of space debris as something that is not just a technical problem but also a social and political issue. It follows the work of the European Space Agency as they try to manage and classify space debris for different actors. Space debris, when seen through the lens of the boundary infrastructure concept, is more than just the sum of the individual objects that are in space and on the ground: it is also a relational infrastructure that needs managing in order to have the desired effect of, for instance, accounting for the risks of space exploration with regard to the debris already there and the effects of further launches. By seeing the debris as a boundary infrastructure, the taken-for-granted and transparent nature of the infrastructure is made visible and the space debris is seen as something that is the result of both technical space launches and also more abstract things such as the promises and dreams of the space age.

Larkin (2013) says that we need to consider that infrastructures are both a thing and a relationship between things. The infrastructural way of thinking is a part of modern life. Infrastructures shape people or are designed to shape people. Larkin questions the idea in Star (1999) that infrastructures are invisible until they break down. Instead, they exist on a continuum of visibility, and the totally invisible infrastructure is an ideal that is seldom seen in practice. The building of infrastructures is seen as a modernising process while for the people who use the infrastructure, it is clearly visible until they are accustomed to it. This makes the infrastructure's boundaries fuzzy and difficult to pin down. One cannot easily say where one infrastructure ends and another begins: for example where the boundary lies between the electricity grid, one infrastructure, and the computers that do things such as accounting, another infrastructure.

While Larkin (2013) does offer an interesting critique of the infrastructure concept, as defined by Star (1999), it must be said that the infrastructure concept uses visibility as a predefined definition of infrastructure, so if it is not invisible it is less of an infrastructure. When using the concept analytically one needs to be aware of that infrastructure is an analytical device for bringing out the performative aspects of

a process and not something that is the object of study itself. Many of the examples cited by Larkin (2013) are of infrastructure projects in the developing countries, where they are imposed as a political project. This perspective is valuable as in developed countries we can lose track of the political nature of infrastructure projects, infrastructuration is often a modernist project as Edwards (2019) points out. Yet the infrastructure concept is still useful for allowing us to see how infrastructures play a role in the implementation of these projects.

2.6 Accounting and boundary infrastructures

A way in which the boundary infrastructure concept has been used in accounting is to give insights into the effects of the possibilities of new infrastructures. Power (2019) shows how the possibilities of traceability shape what types of accounting becomes desirable while also creating a dissonance between what is possible and what the infrastructure can deliver. The infrastructure makes promises of being able to trace things such as – in the article's case fish – as well as things such as electricity to their source. These promises create accountability, as the users now are expected to take the newer information from them into accounts and make the infrastructure grow, so that more things can be traced and followed. In this way the infrastructure becomes self-perpetuating, as it generates promises (Mouritsen and Kreiner 2016) of functionality. In the case of traceability, this become naturalised and therefore invisible to the everyday users.

In the accounting literature, the process of moving between boundary objects and a boundary infrastructure is called scaling by Power (2015), who brought the concept from Hopwood (1987), which precedes the definition by Star (2010). Power (2015) showed how academic impact and performance measurement became a process of accounting though the creation of a new infrastructure that enabled the measurement of academic impact and also defined what impact was. Impact started out as a boundary object, a concept that brought together different actors, such as regulations and academics despite being an ambiguous term. However, when the regulators sought to measure and use impact, the ambiguous boundary object was of little use, and a more robust accounting model was needed. It was when impact measurement moved from being an object to an infrastructure that accounting for impact went from an activity done ad hoc on one project at a time, to a practice, performed regularly with a set of norms and routines. When seen as an infrastructure in the making, this process could be described as a process where plastic

objects are given stability over time as the infrastructure grows and the objects are scaled up.

Infrastructure is used as a starting point for theorising on how accounting develops. Accounting often begins with disappointment at not being able to compare and evaluate things. The proposed solution to this is what Power (2015, pp. 48) calls a 'performance object' that can be used to evaluate these things. This object then needs to be created, and this is done by building an infrastructure that can produce these objects in a stable and predictable way for the users.

Kornberger, Pflueger and Mouritsen (2017) studied emerging digital evaluative infrastructures and the effects this has. They purport that using the infrastructure concept, or seeing accounting as an ecology of devices (Star and Ruhleder 1996; Star 1999) allows for the study of accounting for non-hierarchical types of organising, where accounting is seen not as something that brings things to a centre of calculation, reporting and control but instead it is a practice that enables the creation of things that did not exist before. It enables new ways of organising that are not necessarily hierarchical with a centre and a periphery.

Sustainability has many of the same ambiguities as the concept of impact in Power (2015), if perhaps amplified in that sustainability is a bigger and more all-encompassing concept. It is similar in that there is a developing practice of making a new type of accounting, and this probably involves creating an infrastructure in order to make sustainability into one or several performance objects that can be used to evaluate how sustainable an organisation is. It differs from the concept of impact in that sustainability is already a performance object: it is not an entirely new form of accounting in the way that impact was in Power (2015).

2.7 Using boundary infrastructure as a method theory

The boundary infrastructure concept can be used as a method theory (Lukka and Vinnari 2014), because it sheds light on an empirical phenomenon, in this case sustainability and how it is made into a practice rather than a set of ad-hoc activities. The boundary infrastructure concept has informed both the fieldwork of this thesis and the later analysis of the collected material.

When deployed to a case such as this, the boundary infrastructure point of departure shows the role of objects, routines and old infrastructures in shaping current practices (Bowker and Star 2000). It can also reveal how infrastructures are continually rebuilt and maintained in order to stay transparent and neutral to the end users (Edwards 2019). Sus-

tainability and sustainability accounts are, seen from a boundary infrastructure view, the result of a relational process and therefore a method that can capture the relations between the parts of the infrastructure. The concept can also shed light on the relationships between the different parts and the tensions that arise when plastic objects are stabilised in an infrastructure, as in Power (2015), where the infrastructure concept is used to show how an abstract concept is turned into a material practice composed of both technical and political elements and how this practice becomes stabilised over time.

The theoretical frame that is used as an analytical device in order to structure the field material is composed of the general concepts from the founding literature on infrastructure (Star 1999; Bowker and Star 2000), where the definition of infrastructure and its features are laid down. These are complemented with the boundary infrastructure concepts of scaling, stabilising boundary objects, and the use of infrastructures to work across boundaries (Star 2010). This is then combined with more specific concepts from studies which have built on the infrastructure concept. These are infrastructuration (Edwards 2019) and pivotality (Millo, Panourgias and Zachariadis 2019) and the way infrastructures can cement certain accounting practices (Kaniadakis and Elbanna 2019).

This frame allows for an analysis with both the agency of the human and non-human actors that make up the infrastructure, and the effects that the infrastructure has on the work that is done. The tensions in the boundary infrastructure framework between the rigidity of the infrastructure and the plasticity of the boundary objects that are part of it, shows how work is enabled and constrained by the infrastructure while at the same time shaping and reshaping the infrastructure.

In order to analyse sustainability work using the above terms, field material needs to be collected in such a way that the relations of entities that make up the infrastructure can be observed. How this was done in practice is described in chapter 4.

3 Previous studies

This study touches on a number of different subjects that have been studied previously, mainly accounting as a field, which encompasses both financial and management accounting and also other types of accounting, such as sustainability accounting. Sustainability accounting can also be seen as its own field, with its own literature as a subfield of accounting. The literature on sustainability accounting also intersects with other literature on sustainability more generally, such as studies of sustainable consumption and the role of sustainability workers in organisations, which in this study is classified as sustainability work.

3.1 On accounting

Accounting in practice can be described as a type of quantification, or translation (Callon 1986; Latour 1999), where events are turned into numbers. This translation enables extraction and manipulation (Callon and Muniesa 2005) and control at a distance (Robson 1992). Robson (1992) also says that it is precisely the quantification that accounting does that affords it the ability to enable action at a distance and that it is this desire to control from a distance that has driven the development of accounting. Another explanation, which can be seen in Morgan (1988), is that quantification and the production of numbers is a way of turning things into ideal representations of themselves and that this is the reason that numbers and quantification are the dominant form of accounting.

Revellino and Mouritsen (2015) shows how accounting is performative in that it drives organisational practice rather than reflecting it. This was a case of accounting for innovation. Accounting came to define what counted as innovative. The work to create the accounting system also created the category of innovation in a more distinct way than had previously been the case. Accounting for sustainability can work in a similar manner, defining what counts as sustainability. This goes back to Hines (1991) and her argument that accounting defines things in a particular way, and this particular way might not be valuable for sustainable development.

3.1.1 Quantification

Quantification in general has been studied by sociologists under the banner of the *sociology of quantification* (Berman and Hirschman 2018). In this field, researchers have studied the effects of quantification and the

processes of quantification in different settings. In their review of the field, Berman and Hirschman (2018) found that quantification can cover many different practices, from big data and algorithms the simple counting of things. The common factor in both the complicated and simple quantification is that making numbers that are useful requires a lot of work. Work, both in making the numbers themselves and also to frame them and convince others of their usefulness.

Numbers are made using calculative practices and the way these practices are shaped affects the outcome (the numbers), produced by these practices. The calculative practices which in the end produce the numbers are not always the ones that are chosen simply due to their superior calculative methods; instead, they can be chosen due to, for instance, their political power in an organisation or for institutional reasons or because there is an existing infrastructure that supports them (Giamporcaro and Gond 2016; Giovannoni et al. 2024). There is also an aesthetic dimension to what numbers are produced: numbers that are pleasing and well presented have an advantage over numbers that lack aesthetic qualities (Giovannoni et al. 2024).

The aesthetic qualities that numbers have allow them to be a functional representation of phenomena that can be used as objective values. When they are the result of a calculative practice, they are uniquely able to perform a type of meaning and create order that abstracts and categorises phenomena in a way that makes them available for further calculations. These then reshape the world into categories chosen by the calculative practice (Giovannoni et al. 2024). Here, it might be worth emphasising that just because something is constructed it is not necessarily false; as Latour (2007) says, it is precisely because a construction is constructed that it is powerful and able to affect the world.

3.1.2 Accounting and the creation of reality

Accounting is, however, not just a practice of generating reports that reflect what an organisation has done. Accounting is political and creating useful numbers that can be used for calculations and moved outside the organisation requires the cooperation of many actors (Justesen and Mouritsen 2011; MacKenzie 2009). The report is the final step in a long process and the outcome is the result of the cooperation between these actors. The result was not given at the outset (Callon and Muniesa 2005).

There are critical views of the purported role that financial accounting in general plays (Tinker 1991; Macintosh et al. 2000; Power 2011).

They focus on how accounting creates new realities instead of neutrally mediating a singular reality. However, whether accounting creates or mediates an organisation's operations does not alter the fact that in many cases it plays a role as though it were the one true representation of an organisation. Accounting, here, is an old institutionalised practice of counting money and things translated into money, and not just reporting financial statements to external actors. Accounting is also a basis for internal decisions and has a role in inter-organisational relations beyond reporting to investors and creditors (Skærbæk 2009; Mouritsen, Hansen and Hansen 2009). Accounting numbers are often trusted in the way that Strand (2014) says that sustainability employees aspire to. Likewise Quattrone (2021) argues that transparency is a mirage that gives the impression of a holistic account of an organisation and its impact on the world but is a potential perspective among others. The perspective that is chosen in the accounting process gains agency because it is selected as the account that represents the organisation.

Accounting and reporting outside the organisation can have effects on the organisation itself and its self-image. By making accounts of what the organisation does, it is forced to define itself. Accounting for external users is not just representing the organisation to outsiders because the creation of the accounts is an internal process that can become political and plays a role in, among other things, shaping strategy (Skærbæk and Tryggestad 2010).

3.1.3 STS, accounting and sustainability work

Before ANT and STS brought the concept of symmetry to accounting studies several papers were published using anti-essentialist feminist theory. Like STS, this approach seeks to see how things are constructed as objects or subjects and are given agency. This approach was seen as a promising way to study environmental accounting, as a new phenomenon. Cooper (1992) and Shearer and Arrington (1993) argue that the nature/culture dichotomy is constructed in a similar manner to the male/female dichotomy in order to show how one of them is given agency and the other denied it. Commodities are not something that have the essential property of being a commodity: they are given that status and accounting is a technique that plays a part in commodification.

These studies could have opened up for a symmetrical approach to accounting studies, but they have not had the same impact as the later approaches had. Today they are cited more by eco-feminists (see Phillips 2014) than accounting scholars. This maybe due to bad timing or due

to that STS/ANT is more of a complete package with an associated methodology.

Later studies of accounting have used ANT or STS as a starting point (Justesen and Mouritsen 2011). Callon's market studies (Callon and Muniesa 2005) describe accounting calculations as a process in three phases: detachment, manipulation and extraction. These are prerequisites for later market based collective calculations which contain more steps to achieve a price.

Detachment is where something is translated so that it can later be manipulated. It is categorised and placed together with other things that have been categorised in the same way. This enables these things to be manipulated by adding them up and performing other calculations to them. When this has happened they can be extracted, move, and perform as an account of the thing.

Accounting, in practice studies, is usually described as a practice, or device, for translating referents into a form that allows them to travel in space and time and be used for calculations (Frandsen 2009; Miller 1997). Accounting brings the referents to other places where action can be performed as if the referent was there or the actor performing the action was at the referent (Robson 1992). Referents can move in time too; accounting can bring the past and the future into the present and make them available for calculations. Accounting is an actor that can be mobilised to bring referents together from different places and times and turn them into a format that can be used for calculation.

Accounting in this sense is a more versatile device than its use in producing financial numbers would imply. Quattrone (2004) has shown how it could be used for accounting for sins. Accounting could be mobilised to account for referents that are related to an organisations environmental and social impact. One such study is by Tryggestad, Justesen and Mouritsen (2013), where frogs were mobilised to become stakeholders in a building project.

To know what role accounting has in practice would give us insights into how accounting affects environmental and social reporting and also offer a new perspective on the discussion of how social and sustainability accounting will affect the role of accounting in modern business discourse.

3.2 On sustainability accounting

The academic debate on sustainability accounting has developed over time, from empirical studies to normative or speculative works to a critique of today's practices (Owen 2008). The speculative studies include

that by Birkin (1996), who argued, in the same vein as Hines (1991), that an effective account of sustainability needs to move beyond describing what an organisation has done towards a holistic account of whether it has contributed to or counteracted the long-term survival of the planet. This type of holistic account is different from the emergent practices that have come to define what sustainability accounting is today (Milne and Gray 2013).

The critical views on sustainability accounting can broadly be categorised into two types: one that says that accounting cannot be made to represent sustainability and one that says that current practices of sustainability accounting contribute to unsustainable practices by decoupling practice, which is unsustainable, from talk, or accounts of sustainability.

One stream of research focuses on the basis that there is an assumption that an organisation's sustainability work will not affect either it or its business at a fundamental level. In some cases, even when there is a push to integrate sustainability into the organisation these assumptions can prevent sustainability from being implemented. Accounting for sustainability becomes limited by the use of tools that are oriented towards the profit-oriented business-as-usual approach (Contrafatto and Burns 2013). In the case of Bebbington and Gray (2001) the lack of tools meant accountants were unable to produce accounts that worked and could represent the organisation's footprint in a believable and useful way. The numbers did not seem to represent the operations and they were not able to make them comparable between things such as different types of emissions and over time.

Not enrolling the relevant actors in the accounting programme can either cause the accounts to not function or, as in the case described by Georg and Justesen (2017), prevent them from being completed altogether. In Georg and Justesen (2017), the accountants were tasked with accounting for a building with the goal of making it have zero emissions. However, framing what should count as the building could never be finalised. Questions such as whether they should count energy or carbon gas emissions, or whether it is possible to offset energy produced in one period for energy consumed during another were never able to be settled. Without knowing what counted as the building it was impossible to calculate its emissions.

Even if emissions are calculated in a way that works for those involved, the outcome might not be what was intended. In Asdal (2011), numbers representing pollution were calculated and distributed. Despite

that the numbers worked in the sense that they faithfully represented the emissions. They did not have the effect of making the factory accountable for the emissions. Instead, the very act of doing accounting moved the accountability from the factory to regulators and other stakeholders. These stakeholders knew about the emissions due to the accounts and therefore were seen to accept them.

However, a firms self-interest is not always a barrier to doing worthwhile sustainability work and accounting can facilitate this. Making accounts do more than than just making the organisation more 'green'. Mouritsen, Ernst and Jørgensen (2000) identify four other potential roles: making the firm more efficient, defusing potential stakeholder interests, marketing, and inter-organisational knowledge sharing. Skærbæk and Tryggestad (2010) have shown that making reports for external users also functions as identity work (Czarniawska 2008).

3.2.1 What accounting can do for sustainability

Accounting and sustainability accounting play roles in society that differ from just being a neutral form of reporting that reduces information asymmetry (Burchell et al. 1980).

The effects of quantification and translation enable action at a distance but also shape what type of action is possible. The accounting techniques used can limit what events are translated into numbers and what events are not. An account that looks like an unproblematic technical number that represents something faithfully can be the outcome of negotiations where the end result could have been different (Callon 2009; MacKenzie 2009; Jones, Solomon and Cuckston 2013). Limits, such as time, available data or technical ability and what measurements and calculations are possible, can make the resulting account unusable (Bebbington and Gray 2001). The presence of a number representing sustainability can remove accountability by having the organisation show it is unsustainable, leaving it to the reader of the accounts to act on it (Asdal 2011).

All of these standards and reports and their subsequent critique offers valuable insights into the results of all of the sustainability workers. These results are the product of what will henceforth be called sustainability work. Work done by those who somehow are labelled or declared as working with sustainability. Studying what is done can relate to how this totalised representation becomes the one true representation among a series of what can be seen as competing programmes and anti-programmes, which are concepts that explain how a seemingly neutral

end goal was instead the product of competing programmes that sought to enrol key actors to their cause (Latour 1990).

Some accounts are able to play a role as a neutral intermediary and in doing so enable other action to take place, such as the creation of markets for trading carbon equivalents (MacKenzie 2009) or biodiversity (Jones, Solomon and Cuckston 2013). Aquiring a certificate to declare that an organisation or product is 'green' makes accounting play a role in the creation of boundaries in order to be able to determine what is included on the certificate (Georg and Justesen 2017).

Accounting can also be the driver of action, rather than a passive representation of organisational events. Revellino and Mouritsen (2015) shows how accounting practices define what innovation is in an organisation and Mouritsen, Ernst and Jørgensen (2000) shows how aquiring a certificate can have effects such as bringing forward internal knowledge that can be shared in the organisation. Internal accounting puts in place the means by which to gather information that can be used for external reports.

3.2.2 Accounting as emancipatory

There is a possibility that using accounting terms and concepts allows for greater freedoms as to what action is possible for sustainability managers. Since accounting can generate powerful arguments (Burchell et al. 1980) it can be emancipatory for sustainability managers who might otherwise be constrained by not having formal power (Rodrigue and Picard 2022). Management control systems can be a device that brings sustainability into organisations' routine practices (Ligonie 2021).

The respondents in Carollo and Guerci (2018) argue that turning sustainability accounting into the sort of routinised and trusted bureaucracy that is the role accounting traditionally has played in organisations can, in turn, make sustainability work and sustainability accounting meaningful. Traditional accounting has developed into what it is today over centuries and this has given it a special role (Burchell et al. 1980). However, as seen in the next section, making sustainability accounting routinised in the same way might involve taking for granted current financial and reporting practices as actually producing meaning, which is not always the case.

In sustainability accounting, this field has been brought in by Vesty, Telgenkamp and Roscoe (2015), who looked at the creation of a monetary value for carbon emissions at a water plant. The carbon numbers become standardised after a process of negotiation and settlement. This number

was then able to travel and affect the organisation as an authoritative represenation of a carbon emission. The number, because it was settled, was able to play this role despite at the outset, having been one of many possible results of the calculative process. Despite this, the number did play a role in calculations and was an actor that affected decisions made in the organisation on things such as investments in new plants.

3.2.3 Accounting and representing sustainability

In 1991, David Solomons argued that using accounting to account for traditionally non-accounting things would undermine accounting's special role as a neutral intermediary of an organisation's work (Solomons 1991). This was replied to by Tinker (1991), who stated that a neutral view is impossible, even for financial statements and that to state that a position is neutral is in fact political, as it silences other interpretations. Having the ability to define what is a neutral view makes one very powerful, as one can then silence other interpretations by dismissing them as ideological or political. In a similar vein, Hines (1991) argued that valuing nature would ultimately lead to its demise due to monetary valuation not being able to account for other types of values than just discounted cash flow. Here, accounting is not just a quantification but also a translation into money. The translation into money, or monetary value, allows manipulation and comparison to other translated values and the qualities that are lost in the translation inevitably lead to nature being undervalued. From this perspective, it might not be possible to achieve sustainability by performing accounting; the counting and valuation instead remove the ability to be sustainable. The very nature of accounting and its way of reducing complex phenomena in to singular numbers makes it undervalue nature and its non-measurable values.

The way that accounts are said to represent an entity has been problematised for some time. For instance, if cost or replacement value offers the best represenation of a firms assets (Finley Graves 1992), or what income is and how to measure it (Edwards and Bell 1961). Accounting can be seen as a form of representation that constructs the reality it claims to represent (Hines 1988; Macintosh et al. 2000; Power 2011). Accounting is a process that takes one of many possible realities and nails down which representation is to be the one that represents an entity, that is, which one is to be the one true represenation. This multiplicity of potential representations makes the idea that accounting can provide transparency in social and environmental concerns of organisations an empty promise (Quattrone 2021).

Studies of the developing sustainability accounting practices, such as Gray (2010) critique sustainability accounting practice by saying that the realist assumptions in accounting techniques are incompatible with sustainability issues. Realist assumptions turns the accounts into a totalised and singular representation of the organisation. This may have worked for monetary accounting but sustainability requires a different form of reporting, allowing multiple different points of view to come across (Deegan 2013; Hahn et al. 2015).

Despite these issues, a practice has emerged among organisations where they make reports about sustainability and a number of standards has emerged. According to some scholars such as (Milne and Gray 2013), sustainability accounting has started to become standardised, or institutionalised, as standards such as the Global Reporting Initiative (GRI) and laws governing sustainability accounting and reporting have been effected. This work has accelerated since then and currently standards such as IFRS S1 and CSRD are being enforced in various markeds, particularly the EU. These standards and laws have solidified sustainability as having three dimensions: economic, social and environmental. Organisations create an ever greater number of reports describing their sustainability practices, or their efforts to become sustainable. These reports are also becoming more detailed (La Torre et al. 2020).

3.2.4 Accounting and disconnecting sustainability

The standards and laws that govern sustainability accounting, Milne and Gray (2013) argue, are part of the way sustainability accounting has become institutionalised and can hinder, rather than achive sustainability. Milne and Gray argue that: '...the TBL and the GRI are insufficient conditions for organizations contributing to the sustaining of the Earth's ecology. Paradoxically, they may reinforce business-as-usual and greater levels of *un*-sustainability' (Milne and Gray 2013, pp. 24). This unsustainability is created due to the, ever-increasing accounts of sustainability being decoupled from the organisation's practices, which are business as usual and unsustainable.

Despite these laws and standards businesses are often accused of various types of -washing (Busco et al. 2018), and are told that the profit motive is fundamentally incompatible with sustainable development. Greenwashing has become a common term describing when businesses redescribe their current, unsustainable, practices as green or sustainable. This can be done by selectively deciding what to report and highlighting positive impacts while ignoring negative impacts (Lyon and

Maxwell 2011). There is a body of the accounting literature that questions the ability of accounting to facilitate sustainable development as well as criticising the current practices of sustainability accounting.

By decoupling (Meyer and Rowan 1977; DiMaggio and Powell 1983; Boxenbaum and Jonsson 2017) the accounts from the business, accounting can reinforce current unsustainable practices rather than change them. Decoupling as a concept comes from institutional theory (Meyer and Rowan 1977) and can be defined as when organisations face external pressures to adapt but these pressures contradict internal ideals of efficiency then the organisation can decouple their presentation of themselves without changing their internal operations, or like Boxenbaum and Jonsson (2017, pp. 78) puts it 'decouple action from structure'.

Cho et al. (2015) have called this gap between talk and action an organisational facade, something that the organisation sets up to make itself opaque to the outside while allowing them to control their appearance. They say that there are institutional pressures that prevent organisations from deviating from their business-as-usual approach, and they instead build up a facade of sustainability. This can be seen as a decoupling process where the formal organisation is reported as sustainable, while the informal action is left unchanged. This, in turn prevents sustainability accounts from having a substantial effect on sustainability.

Another part of the sustainability accounting literature say that this gap between talk and action is due to that accounting for the organisation's sustainable development practices brings in a managerialist perspective, which is less critical and more positive than other perspectives (Gray 2010). The managerialist perspective brings in a busines-as-usual approach (Bebbington and Gray 2001; Contrafatto and Burns 2013), and this approach means that business as usual action will continue while the formal requirements of sustainability reporting will be set up yet be decoupled from the business-as-usual action. Tweedie (2024) also argues that accounting itself can hinder sustainability rather than promote it.

Roszkowska-Menkes, Aluchna and Kamiński (2024) positions transparency as the opposite of decoupling. They say that genuine transparency has not been achieved by the sustainability accounts that they studied. By using an approach called counted accounting, where they compared the accounts to outside representations of corporate scandals, they found that the current accounting practices tended towards decoupling rather than transparency. They found that this decoupling consisted of vague disclosure, avoidance and hypocrisy.

3.2.5 Sustainability accounting and markets

Sustainability accounts also enable new markets and change old ones. Accounting facilitates markets by making representations that work and thereby stand in for the referents. Accounting can also make markets more efficient by reducing information asymmetry and agency costs (Watts and Zimmerman 1986). Sustainability accounting can facilitate markets, for things such as quantified environmental impacts (Callon 2009). This type of quantification and representation can make environmental referents comparable and thus tradeable on a market. Making these accounts is a technical problem that only needs a correct technical solution but also needs to have the potential controversies in the translation settled in order to perform as a tradable device. MacKenzie (2009) shows how this is done for carbon gas emissions trading. The trading of emissions requires them to be translated into first numbers that can travel and then into equivalents so that they can be compared. MacKenzie illustrates this with a type of greenhouse gas, carbofluoride, which has a greater greenhouse effect than carbon dioxide, that needed to be translated into carbon dioxide equivalents in order to be traded on an emissions market.

Making workable numbers is not just a technical problem that needs a correct technical solution. Potential controversies in the translation need to be settled in order for the product of accounting to perform as a tradable device. This requires the orchestration of different bodies responsible for trading across different markets to calculate in the same way (MacKenzie 2009; Jones, Solomon and Cuckston 2013).

Orchestrating and aligning all of the actors to accept the calculations is a lot of work. Convincing the key actors that, for instance, carbofluoride is the equivalent of a certain amount of CO_2 (MacKenzie 2009), that replanting a forest will reduce CO_2 by a certain amount (Jones, Solomon and Cuckston 2013) or that the environment is damaged by a certain amount from the organisation's operations (Bebbington and Gray 2001) is part of the calculatory practice that determines if the accounts work and are able to represent the underlying referents.

Traditional financial markets also respond to environmental accounting. Some have argued that environmental performance can reduce a firm's cost of capital, even if the evidence is not conclusive and it can be difficult to discern whether profitable companies simply have more money to spend on ESG measures or whether it is the ESG business models that generate more money (Albertini 2013; Khan, Serafeim and Yoon 2016; Ahn, Patatoukas and Skiadopoulos 2024). This can offer a economic

argument for making sustainability accounts because then more capital can flow towards companies that are more sustainable and away from companies that are less sustainable. However, there is also evidence that companies do not disclose enough information to make an informed calculation of their environmental risks (Paananen, Runesson and Samani 2021) and therefore the value of current environmental practices could be limited.

For businesses and other organisations, relating to sustainable development often means producing reports or in other ways trying to be *transparent* (Roberts 2009; Quattrone 2021). Transparency in relation to sustainability has come to be defined as when the organisation discloses information that is relevant to its stakeholders, both economic and other types of stakeholders. And this is achieved by implementing one or several of the sustainability reporting standards that are out there today (Quattrone 2021). Accounting and reporting about sustainability seem to be important to what organisations do in the name of sustainability.

3.3 Sustainability work

The people who work in sustainability departments and with sustainability in their titles are tasked with operationalising the broad concept of sustainability into material, everyday, work. Carollo and Guerci (2018) argue that in order to function and work with sustainability, the workers need to adopt a method of thinking that accepts that there are complex paradoxes (Argento, Broccardo and Truant 2022) in the concept of sustainability and its integration into businesses with a profit motive. Unreconcilable ideals, such as business versus values, need to be simultaneously managed, and complex thinking allows sustainability workers to make decisions while taking these paradoxes into account.

The same type of complex thinking is conceptualised by Hahn et al. (2015), who argue for a more integrated approach to sustainability work, where economic, social and environmental issues are not separated but are dealt with simultaneously, even if they are contradictory and require workers to deal with the paradoxes that occur when implementing contradictory ideals. In this balance it might not be possible to solve the paradox. There might be something inherent in sustianbility work that prevents sustainabilty accounts from being able to offer a holistic representation of an organisation's sustainability issues.

Sustainability employees motivate their existence by saying that they are putting sustainability on the agenda simply by being there, but that sustainability positions should ultimately fade out as organisations in-

tegrate sustainability into their regular operations. They describe their tasks as both signalling that sustainability is to be on the agenda and doing things such as measuring sustainability and turning measurement of sustainability into a routine bureaucracy that is stable and taken seriously (Strand 2014). Grisard, Annisette and Graham (2020) show how sustainability managers can effect what they believe to be effective sustainability work by incorporating their own goals as a business case. This allows the sustainability managers to balance the inherent paradoxes of sustainability work.

Both Carollo and Guerci (2018) and Hahn et al. (2015) define sustainability activities undertaken by employees using terms that are commonly associated with accounting and reporting. Carollo and Guerci (2018) define corporate sustainability as 'the attempt of companies to manage their triple bottom line in order to balance at the same time their environmental, social and economic performances' (Carollo and Guerci 2018, pp. 250). The bottom line is an accounting concept, and the triple bottom line builds on the same accounting concept. Sustainability reporting and accounting come together in practical work as a part of what organisations and their sustainability employees do when working with sustainability. As corporate sustainability work is connected to reporting on sustainability, sustainability employees must do some accounting in order to report what the organisation does with regards to sustainability. Carollo and Guerci (2018) define sustainability work in organisations as, among other things, making reports and they show how employees manage to function despite the contradictory nature of their work.

3.4 Summary

Unlike most monetary accounting, sustainability accounting is an emerging practice. It is not as standardised or institutionalised as monetary accounting, and is often not seen as playing the same neutral role that accounting for money does. Asdal (2011) is the clearest example of where a seemingly well-constructed number was unable to fulfil the intended role.

By starting with sustainability work this study seeks both to contribute by seeing when accounting is able to play a role and when it is not and also describe the contexts in which these different roles of accounting take place. Following how the numbers are created rather than how they are used has some limitations compared with Asdal (2011), in that following the report might not show what happens to it outside the organisation, and only the feedback within the organisation will be seen.

This does not mean that this study cannot contribute to the findings of those who follow the reports outside the organisation, by showing the role that accounting plays in sustainability work. It seeks to fill a gap that adds context in which different numbers are created by the same organisation and how they come to represent it. Related to this is a contribution to the sustainability literature and the role that accounting, as a technique or practice, plays in today's organisations and what accounting does as a potentially useful technique for mediating sustainability operations and makeing them useful for both internal and external actors.

There is also a potential contribution to the literature on the role of accounting in organisations, as it can show how accounting is used by sustainability workers, and what role it has in structuring and stabilising their work.

4 Method

4.1 The case for fieldwork

The research question of this study is: what is the role of accounting in sustainability work? In order to answer this question, I need to capture sustainability work in a way that allows for analysing how accounting is used within it. This requires a method that examines sustainability work in a way that captures both sustainability work and the role of accounting in it. To do this, a case study in the field of sustainability work is needed. This also ties in with the theoretical perspective of boundary infrastructure, where there is a need to capture the relations between the actors and objects that make up the infrastructure. Boundary infrastructures are multiple and transparent. As a relational concept, there is no infrastructure material out there that can be observed. What can be observed is the relations between objects and other actors using, building and maintaining the infrastructures. The infrastructure needs to be traced, and the best way to do this is to go to the field and study the infrastructure.

Going to the field and studying the infrastructure makes this a field study. Such studies have several advantages and disadvantages, and require some general assumptions about how the world operates. Hammersley and Atkinson (2007) divided these assumptions into realist and naturalist assumptions. Realist assumptions are modelled after natural science and are based on the idea that there are universal rules out there that are independent of the researcher and that can be captured and represented faithfully. Natural assumptions on the other hand provide a nature that is in a context, and where individual rules are impossible to remove from that context. The researcher can only grasp reality by being immersed in nature and the whole context. Total immersion and unrestricted observations are not possible in practice: if one is immersed in nature, then one becomes a part of it and the context changes. Hammersley and Atkinson (2007) propose instead that it is possible to study society as something not based on rules or situated totally in a context. They argue that learning about a phenomenon involves a refinement of the everyday methods used by the actors that one studies as well as a reflexive attitude to one's own effect on society. By doing this, theory development is possible in social science (Hammersley and Atkinson 2007).

Both a realist and a naturalist assumption can be used to study sustainability work; if a realist assumption is assumed then one assumes

that reality is out there, in the field and the best way to study it is to be in the field and observe it. Otherwise, one can miss important aspects of how accounting is used in sustainability work. If one, on the other hand, assumes a naturalist assumption, then one also needs to go to the field in order to capture the context in which sustainability work is done. Both of these assumptions can be used to motivate the use of the boundary infrastructure framework, because in order to mobilise the framework fully, one needs to capture the relations between the different actors that make up the infrastructure and these might be taken for granted by the actors in the field and therefore not be captured by other methods. The boundary infrastructure framework, however, brings in its own assumptions about how the world works, namely a performative ontology, which is described in the next section.

In order to conform to the purpose of this thesis, the goal of collecting field material for this study is a 'thick' description (Geertz 1994) of sustainability work, from which the role of accounting can be described. A thick description is a description that shows the work done together with the context in which it is done. It should also be flat (Latour 2007), which means that the description should not be the result of an *a priori* assumption of where agency is located when doing the fieldwork.

Since fieldwork of some kind is required to create a thick description, the researcher needs to place him or herself in the context that is to be documented (Geertz 1994). This fieldwork in practice means doing observations or shadowing (Czarniawska 2014a) those who are in the field – in this case doing sustainability work. In order to study the role of accounting in sustainability work I needed to place myself in a practice where there is sustainability work going on. I decided that I wanted to shadow the person who was responsible for sustainability in the organisation that was closest to where the organisation's regular operations took place. This meant that I would see the parts of the regular operations that the sustainability officer also saw and place myself in the same context. I would therefore be able to document how the sustainability officer accounted for those operations.

I shadowed (Czarniawska 2007) the sustainability officer of a subsidiary of a Swedish property company (henceforth known as Property) for one day at a time over the course of one year (see table 1). These observations underlie the bulk of the resulting description, presented in the results chapters. The observations have been supplemented with interviews with other people both inside and outside the company; documents and other artefacts collected from the field; and publicly published doc-

uments from the company or others that they interacted with in some way.

A single case was selected to allow for as close a study as possible. Single cases can offer several advantages (Flyvbjerg 2006). This study cannot answer the research question in such a way that it can be statistically generalised to all sustainability work in all companies. It can, however, be used to create a thick description of a phenomenon in a specific context. Flyvbjerg cautions against summarisation and simplification and instead argues that a case should be described in a great deal of detail so that different readers interpret it in different ways. This can generate a type of knowledge that is not possible in other types of studies and that is valuable for society (Flyvbjerg 2006).

4.2 Ontology

This study's methodology assumes a performative ontology. The actors in the world are continuously trying to make sense of their surroundings, and I as a researcher am trying to make sense of their sensemaking. The social world is composed of enactments and performances that the actors within that world perform.

Multiple ontologies are possible in this type of performative view. Mol (2002) has shown how a disease, arteriosclerosis, manifests itself in several different ways at once at a hospital. They are all workable in their different contexts. There is no one arteriosclerosis, but many. Arteriosclerosis is not the same thing under a microscope as it is pain while walking, or plaque that has been removed from someone's leg. This complements previous studies of scientific work, where the production of one single reality was a requirement for doing science (Latour and Woolgar 1979). Doing medicine did not place such requirements on ontology for creating a functioning practice, so we could have multiple ontologies. Both of these studies are examples of how a performative ontology can be used to show how a practice can be formed and maintained without relying on outside forces or predefined groups of actors or categories to explain how the practice works. Instead it is the actors themselves and the relations between them that create the practice.

This study, in line with the studies Mol (2002) and Latour and Woolgar (1979), follows the STS tradition, where close fieldwork is done without assuming categories or outside forces. STS started with studies of laboratories, and many of the most well known studies were conducted there (Latour and Woolgar 1979; Law 1994). It then moved on to technology and machines (Grint and Woolgar 1997; Orr 1996). Accounting and

science are different fields, and financial accounting might be different from sustainability accounting. STS methods have proven themselves in a wide variety of fields, and the problems faced by creators of sustainability accounts might not be that different from those faced by scientists, doctors, engineers, or copier service people. Yet sustainability accounting is a practice, one that involves different actors and brings together actors from different backgrounds that need to work together in a way that makes STS methods and their ontological assumptions valuable to study.

4.3 In the field

The fieldwork of this study took place over the course of almost two years, officially starting in October 2015 and ending in September 2017. This was not the first time I had studied this company; for my licentiate thesis (Brogeby 2014), I spent six weeks at a local office of Property[5] looking at how their financial accounts were created. The question of access, therefore, became one of extending my previous access and renegotiating access for a new study. My previous contact had resigned since the time I wrote my licentiate thesis and the start of this study, but I still had the contact information of most of the people still working there and therefore could attempt to gain access.

I started the study by conducting two interviews that were purposefully made as informal as possible. The main aim was for both my potential informants and me to get to know each other to facilitate my later observations. I conducted one such interview with the head of sustainability for the whole group at the start of the study (group officer), and one interview with both the current and soon-to-be former head of sustainability (SO0) for the subsidiary where I started the study with his replacement, whom I would be following (SO1). During my time in the field, a merger was announced (see chapter 5), I did one interview with the head of sustainability for the new, merged subsidiary whom I would be shadowing for the rest of the study (SO2). To help establish an easier atmosphere these first interviews were not recorded. I started by presenting myself and my project and then asked the respondents about their job. I asked them do describe an average year and what they do, and what projects they are currently working on. I would then try to book them for full or half days of observation as soon as possible.

The material I gathered for my licentiate thesis was not used directly

[5] At a subsidiary called Delta.

in this study. Nothing in the results chapter was recorded during that time, but the 240 hours of observation that I did at Property during that time were invaluable for me to gain the most out of the shadowing that I did during this study. I had already learnt (some of) the language of the property business and the particularities of Property, which allowed me to quickly gather relatively large amounts of material. For this study, I gathered more than four times as much material as I did in my licentiate thesis, based on what was later coded and analysed, despite the fact that I spent less time in the field.

Although none of the material comes from there, my understanding of the company and the property business that I took from the fieldwork for my licentiate thesis indirectly informed some of the analysis for this study. All of the material presented in chapters 6 through 8 was gathered during the fieldwork for this study. However, I had an understanding of how costs and revenues were generated at Property, which gave me an understanding of what economic calculations were done in other departments besides the one where I was doing my shadowing. This understanding was not directly put to use anywhere in the results or the analysis, but it could have indirectly informed how I carried out some of the fieldwork and how I interpreted the material that I gathered.

I completed a total of 118 hours shadowing the two sustainability coordinators (SO1 and SO2). There was some overlap when they had meetings together; these, I have counted these as the second sustainability officer (SO2) because she was my main contact at the organisation at that time. Table 1 shows a time-line of the fieldwork.

4.4 Access

Observation requires access to the phenomenon that is to be observed; this has been discussed in the methodological literature. Hammersley and Atkinson (2007) define gatekeepers as those who can help or hinder access to the organisation. Who the gatekeeper is will often be different and the gatekeeper can affect what type of data one gathers. Hammersley and Atkinson exemplified this with a case where they had approval from top management and therefore were identified with them. People lower down in the organisation would then act towards the researcher in the same way as they acted towards management, and this resulted in a possibly different study than if the researchers had entered and identified with the lower levels of the organisation.

The merger, described in chapter 5, led to some worries on my part when it came to access. I knew that access is continually renegotiated,

Table 1: Time-line of the fieldwork

Date	**Type**	**Person(s)**	**Time**
November-December 2013	Observation	Delta	240 hours
November 2015	Access meeting	SO0 & SO1	2 hours
December 2015	Access meeting	Group Officer	2 hours
December 2015	Shadowing	SO1	4 hours
February 2016	Shadowing	SO1	6 hours
April 2016	Shadowing	SO1	5 hours
May 2016	Shadowing	SO1	7 hours
June 2016	Access meeting	SO2	1 hour
June 2016	Shadowing	SO1	8 hours
June 2016	Shadowing	SO2	4 hours
June 2016	Shadowing	SO2	6 hours
June 2016	Shadowing	SO1	3 hours
August 2016	'Interview'	Researchers	3 hours
September 2016	Shadowing	SO2	3 hours
September 2016	Shadowing	SO2	2 hours
October 2016	Shadowing	SO2	3 hours
October 2016	Interview	SO1	1.5 hours
October 2016	Shadowing	SO2	8 hours
November 2016	Shadowing	SO2	3 hours
November 2016	Shadowing	SO2	8 hours
November 2016	Shadowing	SO2	8 hours
November 2016	Shadowing	SO2	6 hours
December 2016	Shadowing	SO2	6 hours
January 2017	Shadowing	SO2	8 hours
May 2017	Shadowing	SO2	8 hours
May 2017	Shadowing	SO2	6 hours
June 2017	Interview	SO3	1 hour
August 2017	Interview	SO2	1 hour
August 2017	Shadowing	SO2	6 hours
August 2017	Interview	ENG	1 hour
August 2017	Interview	PM	1 hour
August 2017	Interview	PrjM	45 minutes
August 2017	Interview	Com	45 minutes
September 2017	Interview	SC	1 hour
September 2017	Interview	FM	40 minutes
September 2017	Interview	CEO	50 minutes

but I felt at the time as though it was not something that I had to think about. Jan (SO1), who had thus far been my main contact, told me that he might change his role and would no longer be responsible for sustainability. It seemed likely that Emma (SO2), the sustainability officer for the other subsidiary, would take over that role, as she had been a sustainability officer for over 10 years whereas Jan was still in his first year. This meant that even if I had approval from the people that I had shadowed in the past, new gatekeepers could appear and make that approval worthless.

This sort of reorganisation could provide useful material for a study like this; however, there were also pitfalls. I was worried that my access would be curtailed 'until the merger has been sorted out and things were more settled', something that could take months or even years. Luckily, that did not happen. I was also worried that there would be a new sustainability officer and that that person might not take to me, thus making data collection much more difficult. This was not the case either. Emma, the new sustainability officer, was just as open as Jan had been.

4.5 Shadowing

As stated above, the purpose of this study is to document and describe the role, if any, of accounting in a sustainability context. This requires a research method that describes and documents the context from which the role of accounting can to be identified and documented. A thick enough description (Geertz 1994) of the practice of a sustainability officer should contain enough information to analyse the role of accounting in sustainability work.

To create this description, it was not enough just to apply the ontological assumptions described above; I also needed a practical method to use in the field. Fieldwork and observation have been extensively used and written about. Most of the practical knowledge on how to act in the field, take notes and so on comes from ethnographic studies (Goffman 1974; Garfinkel 1984; Hammersley and Atkinson 2007) which can generally be categorised as a type of observation.

Observation allowed me to be in the same environment as the informants, and to observe them making sense of their surroundings. Observation is unique in the way that the researcher can access the same surroundings as the informants while they are being constructed (Garfinkel 1984). This allowed me to see the context as well as what the inform-

ants do; for instance when reading meters[6], the informants might take for granted the role of the meter itself and how it fits into the overall system. Be being there myself, I could observe and capture this contextual material. Another feature of observation is that it allowed me to later do interviews with the informants while retaining all the context. These interviews were used to get at the informant's explanations of what they though about certain situations or issues. Having been through the same experiences as the informant, I could get the interviewee to open up and also interpret what the interviewee meant from what they said (Hammersley and Atkinson 2007).

In order to apply the practical method of observation and get the type of material needed to follow in the tradition of STS and apply the boundary infrastructure framework, which requires a flat description (Latour 2007), I used what Barabara Czarniawska calls symmetrical ethnology (Czarniawska 2007) and the practical method of shadowing (Czarniawska 2014a; Czarniawska 2014b) which was developed to conduct observations in a way that is compatible with social science, especially business studies, where there is often a need to limit the scope to something specific rather than an entire culture or site.

Shadowing was used in this study as a form of observation where the researcher observes a phenomenon without participating actively in it, unlike participant observation where the researcher is a part of the phenomenon being studied (Czarniawska 2014a; Czarniawska 2014b). Shadowing allows the researcher to follow the phenomenon or thing being shadowed in space and time, unlike traditional ethnography where the researcher usually tries to understand the culture in a certain place. Sustainability work at Property was done in many different places and at different times by different actors. Shadowing can capture action as it is done by both human and non-human actors, in practice this was done in the field by recording not just what people do, such as adjusting a meter or working on a spreadsheet, but instead, following advice in Czarniawska (2007), to make as detailed a record as possible of how and what they are doing to the meter or spreadsheet. I was also able to get copies of some of the documents they used or take pictures of the screen. This allows the meter, or spreadsheet, or other object to have a role in the resulting description, which makes it possible to create both a flat (Latour 2007) and thick (Geertz 1994) description.

Shadowing allowed me to follow sustainability work as it moved through the organisation. The sustainability officers moved from the office to the

[6]Meters are described in chapter 6.

buildings, the tenants and their suppliers while performing their work, and I followed along. It also allowed me to gather material relating to non-human actors that may be involved in sustainability work. There are some downsides to shadowing, however. As an observer, rather than a participant, I did not have the same experience of the work as my informants did. I was reliant on their explanations of what they were doing. After some time in the field, combined with my experience from my licentiate work, I had learned enough about the work to understand most of it, but not at a level where I could do it myself. This limitation of shadowing was offset by the ability of the shadowing method to follow the work and to my role as a researcher allowed me to ask questions and observe the work in a way that would not have been possible if I hade been doing the work myself, as I would have been concentrated on the work rather than the practice that I was observing.

During the study, I went to three different offices to shadow the sustainability officer whom I was shadowing at the time. First, before the merger I was at Delta's[7] offices, on an industrial estate outside the city. Epsilon's offices were in a modern building in a science park in a central location, built where the city's old docks used to be. Delta's staff moved there after the merger and I shadowed both Jan and Emma in that location. Finally, I shadowed Emma at the offices of the newly merged subsidiary, located in a central area of the city. I also conducted most of my interviews with Property employees there.

The observations made during shadowing were mainly recorded using a notebook that was transferred into a field diary as soon as possible after the observation. I was generally not allowed to record sound in the field, or it was impractical to ask permission as there were lots of people at meetings and I didn't want to affect my informant's relations with others by recording them. I found that I could most often sit and take notes in a small notebook without my informants or their guests taking much offence. I attributed this to the fact that people from technical schools often complete internships for their masters thesis in the field and the people there were used to this. Transferring my field notes to the diary took almost as long as the time it took to observe the transcribed event. Meetings took longer to transfer than observations of desk work where I could also collect documents or other artefacts that were the result of the work. The field diary was a digital document in plain text, this meant that it could be opened and edited without special software, even from

[7] One of Property's subsidiaries, along with Epsilon. For more about the structure of the organisation, see chapter 5.

my phone.

All of my observations were scheduled in advance. Usually, the person I was shadowing would suggest a date where he/she thought there would be something interesting for me. As the study progressed, I became adept at articulating what type of activities or meetings I thought would be most interesting, and they also learned what I seemed to like. Sometimes I got to see their schedule and I could choose the days that I thought were most promising. I tried to stay there as much as possible so that they would consider my presence as a natural part of their lives.

Hammersley and Atkinson (2007) and Goffman and Lofland (1989) spend some time discussing how the researcher can blend in (or not) to the environment. They have slightly different advice, but the general consensus is that there are no hard rules for how to appear. I would usually arrive by bicycle and this would be remarked on by some of the people at the office. This was especially the case during the first stage of the study when the subsidiary's office was 15 km away from where I lived at the time. When they moved, the people from the old office would often comment that I had a much shorter ride now. I did not have to alter my clothes in any meaningful way; I looked similar to most of the people in the office already.

4.6 Interviews

In order to gain material from more people in the organisation and to tie up loose threads I performed 10 interviews with people from different parts of the organisation. The bulk of the interviews were done at the end of the fieldwork.

I had a list of functions or people whom I had decided to interview because they had come up in the field material from my shadowing. Where I only had a function and not a person, I asked Emma to suggest the names of people who might be willing to be interviewed. She also suggested some people whom I had not thought of.

I used a very loose guide that I prepared before each interview as a reminder to talk about certain things, like certificates, that might not come up when talking about the respondents' everyday work. The interviews varied in length from 40 minutes to 65 minutes. The variation can be attributed to how talkative the people were and also reflects the fact I did not know as much about some roles as others. For some, I relied on them explaining what their work entails in practice and their role in sustainability work in particular. This meant that my ability to ask clarifying questions was somewhat diminished compared with when

I had a more detailed picture of what the respondents' work was due to having observed some of it or something related to what they do.

There is one interview in table 1 that is marked as an 'interview' that was not recorded. This was a meeting with some researchers that was done because they and Property had a project together where they were trying to figure out a workable business model for having solar panels on the roofs of the buildings that Property owned. The researchers were from a public research institute and were interested in my thesis project, and invited me to their office. We discussed the project and talked in general about sustainability in the real estate sector. The project of putting solar panels on the roofs of buildings fizzled out during the course of the study and is not mentioned in the results chapters.

The interviews, except for the one with the researchers and the access meetings at the start, were recorded and transcribed with the permission of the respondents.

4.7 On relating to the literature

Relating to the literature in a study about practice is not a straightforward task, as evidenced by that there are many different strategies out there for doing so. Some only refer to the literature at the beginning and the end, in order to position the study. Others refer to it throughout as a lens that they look at the data through as it is being described. Or they have the interpretations as separate chapters interspersed with the data.

A radical way, as done by Mol (2002), is to have two parallel texts, one with the references and one with the data from the field. The reader is then free to swap between them or read them one at a time or even just read one of them.

In this study, I have tried to position the study in the literature and will later describe the fundamental methodological assumptions that guided the data collection. The field material is presented both as vignettes, without any referrals to the literature, and as field material that has been illuminated by the boundary infrastructure framework. The material is then positioned in the literature with the previous studies in the discussion chapter.

4.8 Interpretation and analysis

The methods literature in ethnography calls for the researcher to be more or less distant from his or her informants, not physically of course, but as

a tool to produce reflexive insights on what the natives take for granted in their everyday practices. If one comes to a culture that is totally strange then having this distance is less problematic than if one studies one's own culture. Studying one's own culture ethnographically can require some strategies to estrange the practices that one observes in order to make them seem distant and strange and allow the researcher to see what is taken for granted in that particular culture or organisation.

The material from the field was coded in several steps during the study. First a general sorting of the material was done. This was done by reading through the field material and looking for themes that could be used as categories. These categories are the ones that the results chapters are organised by, consumption, certificates and reporting. These categories were also confirmed by the interviews that I did at the end of the study.

The next step was a more theoretical coding of the material. Since the study uses a symmetrical perspective, the coding was done with the intent of finding where agency was located in the material, in both human and non-human actors. This was done in order to create a flat (Latour 2007) description of the material as a starting point for the results chapters. Agency was identified where something was being done, such as manipulating meter readings, driving somewhere or drawing on a floor plan. At first, it was the activity itself that was being coded, not the actors involved. The actors were identified in the next step, where the agency was interpreted using the boundary infrastructure framework. The agency coding was done manually by iteratively reading through the printed material, the field diary, and the transcribed interviews; marking the text with a highlighter, adding Post-It notes; and going over the material several times. This resulted in the detailed and flat description that makes up the basis for the results chapters.

Finally, the description was interpreted using the boundary infrastructure framework and, more specifically, the terms described in section 2.7. Once again, this was done by reading the text and highlighting key areas. The focus was on where the infrastructures were in the material, what actors were involved (both human and non-human, as was already coded), and how they were built and maintained. The result of this analysis is presented in the results chapters below. By conducting the analysis in this way, I was able to capture sustainability work in a symmetrical way and how it is shaped and maintained in practice by both human and non-human actors. From there I could describe the role of accounting in this practice as well as its affordances and limitations

as part of an infrastructure that is being constantly maintained.

5 Setting

This chapter describes the setting of the study. It describes, Property, the company where the fieldwork was conducted, and its history, as well as the context in which the company operated at the time of the study. This chapter is based on books that have been published about Property, stories from the field, and Property's own published material. Due to their anonymity in this study, the sources are not referenced.

5.1 The property business

At the time of the study Property was one of 12 companies listed on the Stockholm Stock Exchange that primarily own and rent out commercial property. Most of the listed companies focus on commercial premises rather than rental apartments. Homes make up the bulk of Sweden's rental properties but these are mostly owned by municipally owned companies. Besides listed companies such as Property, the other major owners of commercial properties in Sweden are pension funds and the state government.

5.2 Backstory

The story of Property begins in the early nineties when a financial crisis hit Sweden. The crisis was caused by an overheated property market, where the most overheated sector was commercial real estate, which collapsed, taking several banks with it. The financial crisis led to the nationalisation of banks and the state ended up owning a large number of properties that served as the security for non-performing loans.

The state government needed to manage all of these properties and take stock of what they had ended up with in order to start managing the properties to prevent further losses due to vacancies and damage from a lack of maintenance. A lot of these properties were mismanaged by their previous owners who were hoping to sell them without doing any maintenance. Property was formed as one of several companies in order to sort and manage these properties and eventually create value from all the properties. This involved taking stock of exactly what sort of properties that the company owned, figuring out if they could be made profitable and planning what to do with the properties. All of this had to be done while managing the properties. The tenants that were left were often displeased with the state of the properties and the lack of communication from the former owners and the company risked

an increased number of vacancies, which would diminish the value of the properties. Rebuilding the tenants' trust in order to make them stay with Property was seen as essential to making a building profitable in the long run. This work took several years, and eventually Property formed into the shape that is was when this study started. Property took over commercial real estate with potential for long-term growth and cash flow in areas with growth. It was decided that the company should be split into geographic regions with their own names and local brands. The structure that the company ended up with can be seen in figure 1.

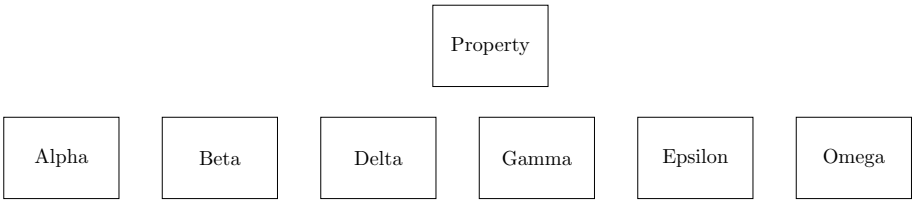


Figure 1: Structure until 2016

Property itself was a holding company and all of the properties were owned and managed by its six subsidiaries, Alpha, Beta, Delta, Gamma, Epsilon and Omega. The subsidiaries were operated independently and they had a lot of freedom in deciding their internal organisation and marketing. This structure was chosen in order to give the company local presence while at the same time enabling it to manage a large number of properties.

After a period of stabilisation Property was listed on the Stockholm Stock Exchange in the late nineties. At the time of the study, all of this was history to the people working at the company. Very few were still left from the pre-stock market era. The business model, however, was still mostly unchanged and was a result of Property's history. Several people mentioned the company's history when talking about the business model or the general trustworthiness of the company.

5.3 Property and its business model

Property's business at the time of the study was primarily owning and renting out commercial properties, that is, properties that are primarily used by companies or public sector organisations for offices, shops, industry, warehouses and similar. Their business model was based on the mistakes that were made in the commercial property bubble of the late

eighties that lead to the financial crisis and also on the need to manage a large number of properties. Property owned almost 600 properties at the start of the study. Property's business model was focused on cash flow rather than increases in the value of the properties. They had properties with relatively high yields, which means that the price, or value, of the property was low compared with the rental income. These properties were often outside the very centre of the larger cities and were considered higher risk than lower yield properties. However, they gave a higher cash flow for the same investment when they were fully rented out.

Property had an internal bank that was run from the head office. They, in turn, financed the local branches. They tried to keep their financial risk low by not using an excessive amount of loans, compared with the value of the properties, and by keeping their costs of debt servicing at a low rate compared with their cash flow from the tenants.

This strategy meant that they needed to fill somewhat cheaper buildings with tenants in order to get the needed cash flow, so they had to be good at keeping existing tenants and getting new ones. They needed to be seen as a serious, long-term, owner, in contrast to the typical owners of the boom era.

The cash flow was reinvested in new properties. In order to increase cash flow further, they would buy property and sometimes they would commission a new building, usually to accommodate an existing tenant that has expanded or otherwise needed their physical space changed in some way. The cash flow was also used for dividends to the shareholders. About half the cash flow from operations was reinvested and half used for dividends. This means that the company has had a net growth over its decades-long existence and was, at the time of the study, one of the bigger actors in Sweden.

5.4 The reorganisation and merger

This study started in one of the subsidiaries, Delta. At the time the structure of Property had been the same for 20 years. Property had a few hectic first few years, but this was seen as history, and Property was generally seen as very stable. Therefore it came as a surprise to many when it was announced that they would reorganise. The local names of the subsidiaries would disappear and instead of subsidiaries there would be divisions, all under the name of Property. Delta and Epsilon were neighbours and would merge to form Property Blue, one of four divisions.

Delta and Epsilon had been separate subsidiaries for 20 years before they were merged. They were in the same business, but in different

geographical markets and with somewhat different scopes. Epsilon had properties in the central parts of the region's main city, while Delta's were mostly on industrial estates and spread over the whole region. This meant that Delta had local offices spread over the region while Epsilon had one central office.

Delta's CEO had already announced that he would retire before the merger was announced. He was one of few people who had been with Property when it was state-owned. Epsilon's CEO was younger and a more recent hire and would become CEO of the Property Blue division.

The people from Delta would also move in to Epsilon's old headquarters. The old building that housed Delta's head office was later sold. Epsilon's office was a bit cramped for the first month after the move, so people had to share rooms. However, after some of the rental and back-office people moved to Property's main HQ the offices did no longer needed to be shared and a sort of normalcy ensued for a while. A year later, the whole division moved again to yet another building, the final move during this study.

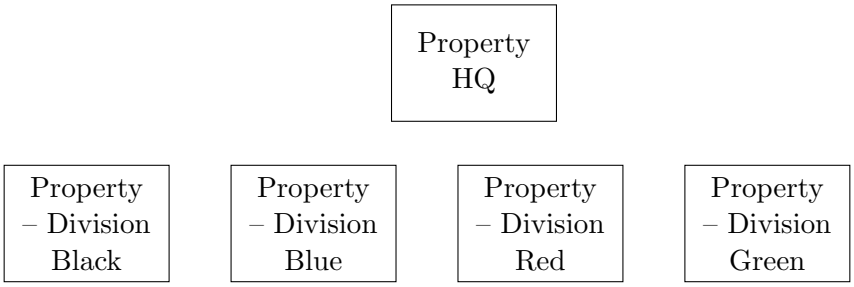


Figure 2: Structure after 2016

5.5 Property and its people

When the study started every subsidiary was run as its own independent company, except for the finance function, which was provided centrally by Property. Property's group HQ housed about 30 people. They took care of the group's annual report, stock market contacts, borrowing money for the whole group, and running the internal bank, internal compliance, central IT, support for large investments, benchmarking between subsidiaries, and other smaller functions. This was not something that a tenant would ever see.

Before the merger and at the start of the study, each subsidiary had a

CEO who was part of the group's management board together with the group's CEO, deputy CEO, and CFO. The CEO of each subsidiary was the official link between the group and the subsidiary. The CEO was responsible for managing the subsidiary and reporting upwards to the group HQ. The subsidiary CEOs later became division chiefs after the merger, except where the divisions were merged, such as between Delta and Epsilon, where the CEO of Epsilon became the division chief and the former CEO of Delta retired.

The group has a sustainability chief to whom the coordinators in the different divisions report. He originally came from one of the divisions, where he had served as a sustainability coordinator. For a while, he held both the divisional coordinator role and the position of group sustainability chief before moving to the head office.

Epsilon, unlike Delta, had for some time had a dedicated sustainability coordinator, Emma. Emma was, like Jan, an engineer, but had worked for Epsilon for about 15 years in total with sustainability work in various ways. Her title had changed from environmental coordinator to sustainability coordinator and her employment had gone from half time to full time over the past 10 years.

All of the actual property management was in the subsidiaries and later in the divisions. Every property had a facility manager[8] whom the tenants would contact if they needed anything. This was the same for all of the subsidiaries. Each property also had some sort of manager associated with it. In some subsidiaries there was just one manager who did both economic and technical management. Delta was like this. In other subsidiaries economic and technical management was split. In Epsilon, they were not split but management was done by property developers who, in turn, were managed by regional managers. In Delta, the property managers reported to the CEO, who was quite hands on in the everyday running of the company. After the merger Division Blue adopted the structure that Epsilon had. During the study the people in the new division moved in to the same office but they never fully moved away from being Epsilon or Delta people, they were still adapting to the new structure. All subsidiaries, and later divisions, had a rental department that prospective tenants would contact, and the property managers would take over once the contracts were signed. Small tenants might only ever see the facility manager and the rental department.

Besides the CEO and the people who were directly assigned to properties, there were other support functions. These included things like

[8]See figure 3 for how Property was organised.

back-office, IT management and coordination of building projects. Sustainability coordination was also one of these functions. In Delta this was done by Erik, who was also a property developer. He helped the property managers with large projects and large tenants, alongside coordinating Delta's sustainability work. Erik's role during this study was limited; however, he was replaced in the first month by Jan, who took over his sustainability-related tasks but did it full time. Jan was a recent engineering graduate and much younger than Erik.

Figure 3 shows a simplified picture of how Division Blue and the HQ are organised.

5.6 The picture of Property

One thing that I noticed when spending time with people that worked at Property was that they seemed to have a somewhat self-contradictory view of the company: that it was quite special, yet totally unremarkable. Property was boring and predictable and did nothing new without thinking a lot about it first. They were very good at what they do, but they did not stand out in any particular way – not in the type of properties they had, or the way they acted in the market.

The people at Property considered themselves to be good at sustainability work without signalling that they were good at it to the outside world. They said that they have started to talk about their sustainability work more recently, and received awards for their reporting, both from trade bodies and more general organisations. Some organisations had listed them as a green investment, so that 'green' funds could invest in their stocks. They felt as though they had always been good at environmental issues, and that other companies had caught on more recently. As explained by the sustainability coordinator of Division Black in his interview:

> We looked at the group (Property), they were like, well, a large property owner and they started talking about themselves a bit. I know that I called the group sustainability chief once when I had a question, I didn't know him then of course. Then we thought, a bit exaggerated, that we had mostly offices, in good locations, in the city and such. And in Property they had a slightly different portfolio, a bit, well, a lot of offices too of course but also a lot of warehouses and logistics, perhaps light industry and so on. (Sustainability Coordinator Division Black, talking about his picture of

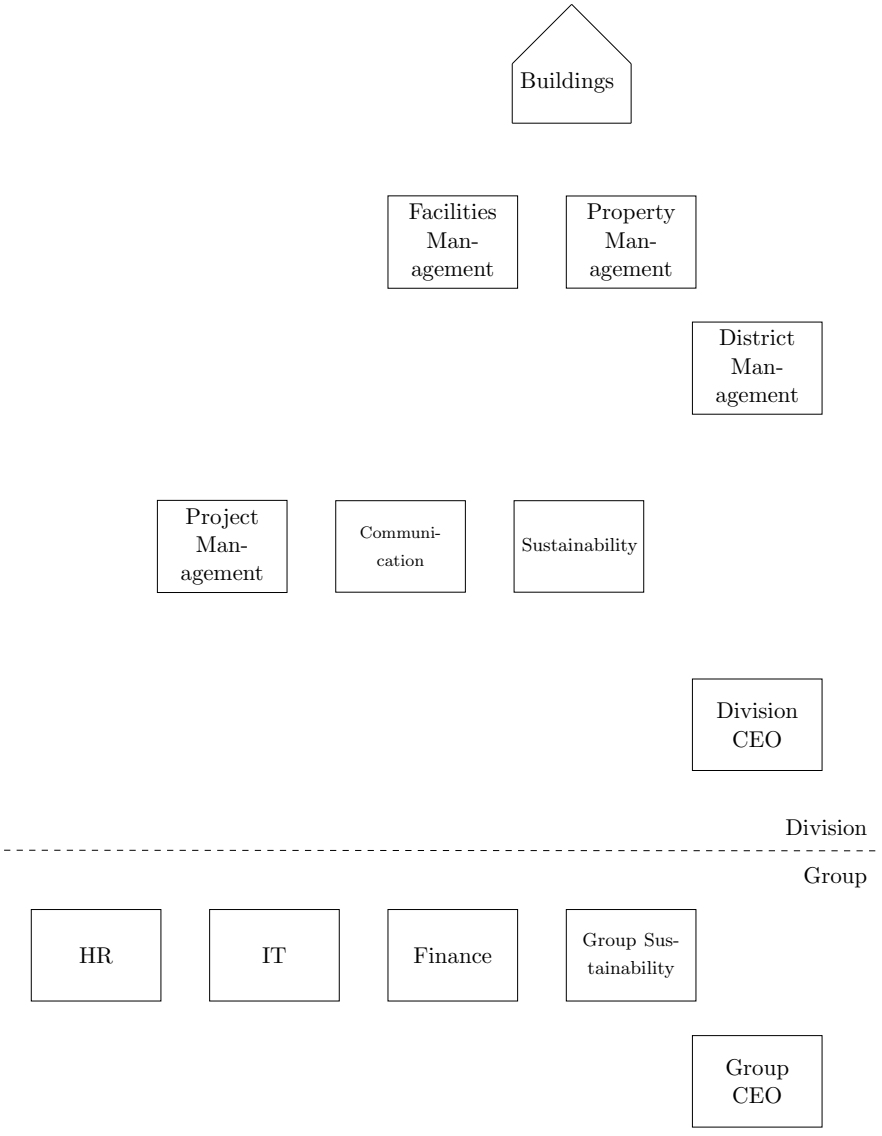


Figure 3: Formal organisation

Property before he moved there)

The coordinator of Division Black came from another company and had only worked at Property for a few months when he was interviewed. He saw Property as one of about 3 to 4 companies that he would look at for inspiration on how to write his previous company's sustainability

reports. He also says that he thought Property's portfolio was less refined than that of his previous company. He described how his company had gotten rid of the sort of warehouse and logistics buildings that still made up a lot of Property's portfolio at the time of the study.

Yet the picture was that Property was often ahead of the curve on many issues. The coordinator exemplifies this with Property's social sustainability work:

> We have a group that discusses where Property will be in 10 years and what we should focus on and what is right and wrong and so on. And that is, here I can feel like Property is much better than my old company was, I think it is because we had a lot of focus on the environment and environmental certification. Then about 3 to 4 years ago it became sustainability instead as the word we used and it expanded a lot. And we hadn't come as far as Property on social sustainability. We were thinking about what social sustainability was for us really, what we should start looking at, while Property has their projects with trainees and other projects. They have an idea about social sustainability. (Sustainability Coordinator Division Black)

He says that Property have thought out what social sustainability can mean in the property business. They have come further in this area and they keep actively thinking about the future. They have plans and goals that stretch until 2040.

5.7 Organising properties

At the start of the study, Property Blue owned about 200 properties. Properties have an official name, given to them by the Swedish National Land Survey, a government body. These names were used when communicating with external parties. Property also assigned a 6-figure number to its properties. The first two figures showed in what division it was, and the other four numbers identified the specific property. They also, when talking, referred to some properties by the name of the biggest tenant. If the building had a name that was in common use they would use it, but Property did not own many 'landmark' buildings that have names.

The National Land Survey also lists who the owner of a property is. However, it was common for commercial property to be officially owned

by a small holding company in order to facilitate transfer of the property to another owner. It was an easier and cheaper process to transfer a company than to transfer a property and have the official records changed. This meant that Property owned a lot of small companies, some of which owned one or several properties in turn. In everyday sustainability practice, this ownership structure did not affect much, except that contracts with tenants were done in the name of the holding company rather than with Property as a whole.

Property subscribed to a service that allowed them to see all of the official information about a property: its name, owner, municipality, borders, function and so on. They had an internal Excel file that was updated centrally with all of the properties that Property owned together with the internal 6-figure property number. This was where the sustainability coordinator went to see if a property had been sold recently or what number a recently acquired property had been assigned.

There was another system that had all of the contracts with tenants that a building had. The sustainability coordinator used this system in order to check if there were specific clauses in certain contracts and to see if there were any green contracts[9] with tenants in a building and if so, what clauses they had chosen to use.

There were also many other systems that were used by other people at Property, technical systems for monitoring fans and other things, project management systems and systems for financial reporting. The latter type I never saw directly, as they were only used by administrative or accounting personnel and the sustainability coordinators did not use them while being observed.

It was mostly the coordinator who used a plethora of Excel files to keep track of sustainability-related things. Some of these were shared with others, and some were only for her, even though they were available to everyone on the company network. Emma liked her Excel files to be well organised; when she received a file from someone else that she needed to use in the future she would spend some time reordering the data so that it would be searchable and can be filtered. How these files were organised and used will be shown in later chapters.

5.8 Sustainability work

The sustainability work done by the coordinator at Property consisted of many different tasks that varied in size and scope. There were, however,

[9]For more information on green contracts see vignette 8.4.2.

two major tasks that took up most of the sustainability coordinator's time. I have chosen to classify these as work with consumption and certificates.

These two major tasks will be presented in their own chapters, chapters 6 and 7. Chapter 8 shows how the sustainability work done in the previous chapters is put to use and further modified and reported up and out of the division.

These three chapters form the bulk of the empirical material and will show how boundary infrastructures are formed and maintained in the course of doing sustainability work. The chapters have a slightly different structure due to the differences in how sustainability work is done in the different tasks. Chapter 6 is free-standing as it shows how the work of generating accounts of consumption is done; this is built on other infrastructures which are explained in the chapter. Consumption is characterised by an insider centric approach where accounts are created for both internal and external use. A lot of work is making sure that the resulting numbers conform to the underlying referents. Chapter 7 also describes a boundary infrastructure, but more focused on attaching certificates to buildings and the work of doing this. Certificates have their accounts, or outputs, defined by an external party and the work consists of making sure that the underlying referents conform to what is required. This builds somewhat on the consumption infrastructure, which means that this chapter follows the chapter on consumption so that it can be understood.

Chapter 8, unlike the previous two chapters, does not describe a boundary infrastructure and the work that goes into it. Instead it shows how the infrastructures described in the previous two chapters are deployed in relation to various users both inside and outside the company. This chapter is therefore structured around the different users rather than how the infrastructure is maintained and consists of a series of vignettes that show how the infrastructures are used for reporting to different users.

6 Consumption

A large part of sustainability work is taking flows of media, measuring them, making calculations on them and packaging them in different ways so that they can be sent to others. This requires the coordinator to work with and involve many different actors, and to do different things together with them in order to produce something that is credible and useful.

In this chapter, this part of sustainability work and its related infrastructures will be described. The description will start with a referent, in this case the flow of media, and move from there to the different accounts that are made of it. Then it will move to the energy monitoring system, where the meter readings are transformed in various ways and finally extracted and transformed again in order to be reported to the central HQ. To make this process work and maintain it in a working state requires more work, both categorising new and remodelled buildings and checking for abnormal behaviour from the reporting system. Abnormal behaviour then needs to be categorised and acted upon. All of this creates a movement of the flow from a pipe or wire to part of a report which can, in turn, play a role.

The consumption infrastructure, described in this chapter, is one of the most prominent infrastructures in the material, and one on which other infrastructures are built. This infrastructure is vital for Property to function as a business, to make money and to control what is happening in its buildings. The consumption infrastructure is an assemblage that includes the meters, the energy monitoring system, the media itself, the sustainability coordinator and the other people who work with the building. It is an infrastructure in that it is embedded, which means that it is built into the everyday activities of Property; it is transparent in that it is taken for granted by the actors that use it, and it provides predictable outputs. It is learned as a part of becoming an employee at Property and is the embodiment of standards. It is built on older infrastructures such as accounting and billing which have existed for a long time.

6.1 Gathering numbers

The consumption infrastructure starts with media. Media is the industry term for things that flow into buildings and are used by the people and machines that live and work there. Media is mostly electricity, water, cooling and heat. Media for Property is things that are paid for; air, which is free, does not count as media. However, the electricity used

to power the ventilation that drives the air into the building is media. There are many types of media. The biggest one by far in terms of energy and costs for Property is heating followed by electricity and thereafter by water and cooling.

Most of the company's tenants pay for their own media, either by having their own contract with a producer or by paying for media together with their rent to Property. If they have their own contract then they have a meter which is connected to that contract. Sometimes they have a sub-meter in the building. Since the tenants pay for their own media, the rent is only for a 'cold' part of a building and the media needs to be divided up into media that is consumed by the tenant and media that is consumed by Property. The media consumed by the tenant is called operations media, and the media consumed by Property is called building media. Building media refers to media which is consumed by the building itself rather than the tenants.

Heat can be measured, but it is difficult to divide between tenants as heat, unlike other media, moves through walls. A tenant could theoretically turn down their heat to zero and then just live off the heat that has transferred through the walls of their neighbours. Therefore heat is usually paid for per rental area rather than actual consumption. This is considered to be fairer. When a building is heated by district heat or gas then measuring heat consumption is less problematic than if it is heated electrically. District heat and gas are only used for heat, while electricity is used for many things, such as lighting, ventilation, and the operations of the tenants.

6.1.1 About meters

A meter is a device for measuring media consumption at a specific place in a pipe or wire. The meters move the flows of media from the world of pipes, wires, water flows and electrons to the world of numbers; of kilowatt-hours and cubic meters.

Meters are simple devices in that they only count up. When they are installed, they read zero, and then they tick up for every unit of media that passes by them during their lifetime. They display how much has gone by on either an analogue counter or a digital screen. Reading the value with some time between allows one to calculate the amount of media that has been consumed by subtracting the older value from the newer value. Some meters have to be read manually, but the ones Epsilon used for their main meters report their values over the Internet.

Meters are installed in buildings when the building is built. The de-

mands of the building and its meters might change over time, however. Buildings change owners and tenants move in and out. Buildings are remodelled to fit new tenants, but the pipes and cables might stay the same, together with the meters. This means that the meters no longer correspond to the individual tenants. A common example of this is an industrial building that was once owned and operated as a factory or similar. A building with only one tenant usually only has a need for a meter for every type of media, installed where the media enters the building. Later, when the building is sold to a company like Delta, the original owner might stay for a while and then move out. The building might then be remodelled from a factory to having offices, shops, perhaps a small warehouse or office for the original owner, and many other things. If this happens a single meter cannot measure every tenant's consumption, and redrawing the pipes and cables is often not an option, so they need to calculate consumption somehow. This is done with calculation based on models.

Every meter has a 5-letter unique identifier printed on it. This allows it to be identified and traced in a list or system. There are also several types of meters; if it is a main meter it is associated with a contract with the supplier of the media, such as an electricity or water company. The measurements from this meter are read by the media supplier and are used as a basis for invoicing and payment and generally the identifier is printed on the invoice to link it to the meter.

Behind the main meter, seen from the perspective of the flow, other meters can be used to get extra information about where in the building the media is going, for instance between different tenants or between what is used for the building and what the tenants use. These meters are commonly known as sub-meters.

There are also completely virtual meters, set up in the energy monitoring system in order to show something where there are no physical meters. An example of this is electrically heated buildings. Heat is a different media than electricity, so a virtual meter needs to be set up that divides a portion of the electricity as heat. In some cases one main meter is shared between two different buildings. Here a virtual meter needs to be created at the building that does not have a meter. Some of the consumption from the main meter needs to be moved to this virtual meter. This can be done with a percentage of the flow, or based on area. That consumption then needs to be removed from the first building so that it is not counted twice. The physical meters set boundaries where they are placed

6.1.2 Reading meters

Meters are read at intervals. Because they count up the consumption since the last reading can be calculated, which is the consumption of the period between the intervals. If one reads the meter every month then the difference between the start of the month and the end of the month will be the consumption for that period.

Main meters are mainly read electronically and the meter data is sent from the energy provider to the provider of the energy monitoring system. Since this reading can be done by machines, it can be done at faster intervals so these readings are often done hourly. Hourly readings enable the production of graphs that show how consumption varies throughout the day. Electronic reading also means that the facilities manager does not need to enter the building and look at the meter. Some meters are hard to reach and difficult to read and other meters are in buildings where the tenants are seldom there which makes reading difficult, or the tenants require security clearance from everyone entering, including the facilities manager.

Most sub-meters are read manually. Manually read meters are read monthly. One facilities manager says that he spends about one day every month going around his buildings reading meters. Manually reading meters is seen as a source of errors by several of the people at Property, it is something that can cause anomalies in the accounts that are made later. A few manually read meters can be read remotely, meaning the facilities manager does not have to travel to the building.

It is when the meters are read that the flows of media get moved out from the building as a number. Whether it is done on a facilities manager's notebook or through an optical cable makes little difference from the point of view of a single reading. However, readings through the optical cable enable many more readings to be made, such as hourly readings, even though they measure the same thing: the flow.

6.1.3 The energy monitoring system

The data from the meters is processed by an energy reporting system. These systems not only display consumption but also aggregate, recalculate and transform the numbers in various ways. These systems are bought and subscribed to by the company. There are many such systems on the market; during the study, Property switched from having one system for every subsidiary to one system for the entire company group; the story of this switch is told in vignette 6.2.4.

The system needs to do many different things, among them mapping, categorising, transforming and reporting, as shown in the sections below.

Mapping

The energy monitoring system needs to classify consumption based on what type of media it is, what building it is used in, whether it is used by a tenant or for the building, whether it is a main meter or a sub-meter among other things. All of this information needs to be added to the system before putting it to use. See vignette 6.1.4 for a case of how this information is put in the system in practice. At the very basic level, it needs to have a list of the buildings that are owned by Property and need to be calculated. They are sorted in a tree, starting with divisions, down to districts and then individual buildings. Under each building, there are meters and under some of the meters there are sub-meters. For every building, the system knows the building's six-digit identification, its address and its area.

Raw meter readings are just numbers and a date and time when they were read. The consumption is the difference between the read dates and times. Some meters are read monthly by humans, while new(ish) digital methods allow for hourly readings. These hourly readings can then be added together by the system to form daily, monthly and yearly accounts. Monthly readings, which are done by a human, do not always conform to a calendar month, since the meters are hardly ever read at midnight on the last day of the month. All buildings cannot be read at once, and sometimes the month ends on a holiday, so they are often not even read on the last day of the month. In these cases the system needs to be able to simulate the rest of the month based on older information so that the consumption becomes comparable between years and between buildings. In the cases, where there are both manual monthly readings and hourly electric readings, the results will differ slightly due to the system's calculations.

The end result of the mapping process is that the energy monitoring system provides a map of all of Property's buildings and their meters. The meters are classified and categorised so that the system can provide numbers that are correct and useful for Property and its tenants. These numbers are not always the same as the raw meter readings, since the mapping process involves things like adding negative meters to negate the consumption of operations media, or correcting for where media flows through several meters in the same building. This map therefore represents Property's buildings and the media flows as a logical map of the

consumption in the buildings.

Categorising

The meters are categorised in the energy monitoring system. They are categorised by what media they measure, whether they are a main meter or a sub-meter and whether they measure operations or building media. If a meter is incorrectly classified then the report for a building will be incorrect. There are several types of erroneous classification which can cause different types of errors.

Some meters need to be split, for instance in a electrically heated building where there is not a sub-meter for the heater. If nothing is done here then the building would be reported as having no heat used and more building electricity than is normal. The total energy would be correct, however. For the flows to be correctly classified, a virtual heat meter needs to be set up in the energy monitoring system. A percentage of the electricity in kilowatt-hours (kWh) is then transferred to this virtual meter; it becomes subtracted from the electricity meter and instead becomes heat.

If a sub-meter is not classified as such and is instead counted as a main meter the flow will be counted twice: once from the main meter and once again from the sub-meter. This will result in a too-high total kWh reading for the building. This needs to be corrected by assigning the sub-meter to a main meter; then the totals kWh for the sub-meter will not be added to the building's total.

Meters also need to be classified as operations media if they are not for building media. If a meter that measures operations media is not classified as such, then it is counted as building media and the numbers for building media will be higher than they should be. Operations media is the responsibility of the tenant, and should not be counted as media used by Property, and therefore needs to be removed from the total for the building. This is done by classifying the meter so that it is not counted in the total for the building. In practice, this means finding the meter under the building in the system's tree and checking a box. The meter can still be seen in the system and used for other things, like invoicing, if the tenant pays for their media together with the rent. So Property needs to keep track of operations media in many cases, in order to be able to charge for it, even if they do not count it for their consumption numbers. When that is the case, it is still counted in the system, but not used for Property's consumption numbers.

This means that some sub-meters need to be classified as negative

meters in the energy monitoring system. Media that flows through a negative meter is counted in the same way as a normal meter, the difference is that the result is subtracted from the total. A normal sub-meter does not change the total consumption, it merely shows where in the building some of it has gone. So a negative meter allows Property to separate operations media from building media and only show the building media in the system when looking at a building's total consumption.

Transforming

The energy monitoring system adds up consumption numbers and also transforms them into something that is considered more useful. One of the main features of the energy monitoring system is the creation of climate-compensated consumption numbers. Climate compensation means that the consumption is corrected based on the outside temperature, so that it reflects a supposed normal period. If raw data was used, then the numbers would fluctuate based on the weather and not based on what the company or the tenants do. Climate compensated numbers are considered more fair than raw consumption numbers when comparing different time periods.

Climate compensation, sometimes called degree-day correction or normal year correction, is done in slightly different ways in different systems. They all use degree day data. This data includes geographic location together with the temperature that is used to compensate that particular location. This data is sold by the Swedish Meteorological and Hydrological Institute (SMHI) and is divided into 240 geographical locations. By using this data and knowing a building's consumption one can work out what the consumption would have been in a normal year.

Climate compensation creates consumption numbers that can be compared by year and also by geographic location. It is quite often the case that consumption has risen, but due to one region's abnormally cold weather, the normal year consumption has fallen, and the other way around, where consumption has fallen, yet this is due to warmer weather rather than anything the company or tenants have done to reduce media consumption. In these cases, there will be a difference in consumption, less or more energy used, but it is due to the weather, something that is beyond Property's control. With climate-compensated numbers, one can see the difference in consumption that represents something that is closer to what Property can control than using uncorrected numbers. Without the ability to climate compensate the numbers it would not be possible to compare different periods or locations in a useful way.

The people at the Property use both corrected and non-corrected numbers – corrected numbers when comparing and evaluating and non-corrected when they talk about costs. In Division Blue, there has been a move away from like-for-like comparisons, where a building is compared with other, similar, buildings. Instead they compare direct energy savings, where the building is compared with itself, but recalculated to reflect things beyond Property's control.

> If we say that I open a project and say that I will save 15% energy. Then it is very hard to measure, because it won't be that next year – it won't be exactly 15%. Because you have to climate compensate, you have to make sure, has someone moved in? Someone moved out? Was there construction going on for 2 months? Things like that. (Jan)

Jan explains that boundarying out the weather is not enough. The use of the building can also change, and that is much more difficult to calculate. It is not possible to create the perfect vacuum in which to put a building in order to get a like-for-like number. Even if the project saves exactly 15%, it is unlikely that there is a meter for, for instance, the lights in the parking lot or just the ventilation. So the difference that comes with doing something might not show up when looking at the entire building. Even if the project has saved the projected amount of energy the project cannot be boundaried and shown in a vacuum.

Reporting

The last of the major roles of the energy monitoring system is to generate reports: reports per building, per manager, by geographic location, business segments and so on and for various types of media and for different time periods. One can look at graphs and consumption numbers in tables in the system directly or make a report as a PDF. The most common report was bar graphs that showed the past two years, where each bar represented a month. This is done for each type of media separately.

The reports can represent different time periods: monthly, yearly or even daily if they have hourly readings. The normal report, however, is for a year with the consumption displayed per month. The report also shows the previous year so that they can be compared. The coordinator sometimes generates climate-compensated reports and sometimes not. This depends on if there whether a need for the underlying numbers or if they are going to be compared with each other. Tenants will want

to see non-adjusted numbers because these represent what they pay for and they can be added to their other non-adjusted numbers. Climate-compensated reports can be generated to specifically compare two years' consumption, this is useful when evaluating the company's efforts at energy reduction or when looking for abnormalities.

These reports are sent to tenants who request data about their energy footprint for their own reports. The sustainability coordinator receives these requests via email from the coordinators in other companies. The reports are used as a basis for reporting up in the company group (see section 6.3.4), and they are used to look for abnormal consumption in the division's buildings (see section 6.2).

6.1.4 Vignette: mapping meters

The following vignette is an illustration of how a building's meters are mapped and categorised in the energy monitoring system in practice.

> One building that Epsilon bought in 2016 came complete with tenants. It has 8 water meters installed. They can see that in the Dynamics monitoring system. One tenant uses a lot of hot water and that has its own meters; the others have to share the main meter. Emma and Henrik had to find out what the meters measured in order to get them properly classified into the Dynamics system. This was at the early stages of moving to Dynamics, and part of their overall figuring out how Dynamics works and what to do in these special, yet common, cases.
>
> Henrik goes to his office from the meeting room where we were and brings back a flowchart that he had drawn when they were discussing this building a previous time. The flowchart is reproduced in figure 4. It contains the four relevant meters for working out how to measure the water for that tenant and has lines to show how they are connected.
>
> Emma glances at the figures in Dynamics and quickly sees that something is amiss. The warm water is higher than the total water use into the building. The building has a water heater, so warm water should be made from cold water and cannot possibly be higher than cold water.

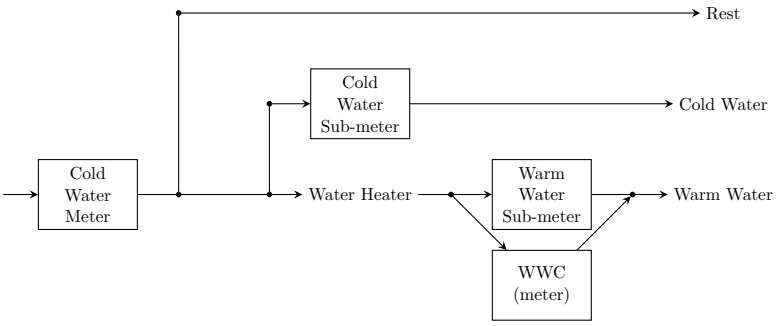


Figure 4: Henrik's chart of water meters for a tenant in a building

Henrik shows us his drawing. Warm water is higher than total water because there is a gym in the building that uses a lot of hot water. They have installed a WWC that has its own meter. The WWC is a device that circulates the warm water in the building so that when a warm water tap is turned on, there is no period of cold water coming out of the shower before the water gets warm, like there would be if the pipes were filled with water that has been cooled down. This means that water that flows into the building is recirculated and counted several times by the hot water meter. That is why the hot water is measured higher than the total water.

In order to get the correct figures, the WWC meter needs to be subtracted from the warm water meter. This will give the correct warm water use by the tenant. The water that is not measured by the sub-meters in the figure is for the other tenants. They do not have separate meters. Henrik makes a note with a formula to work out the warm water and says that the Dynamics people will have to work out how to make a virtual meter that incorporates the formula. Emma remarks that they are just guessing at what reality looks like.

At the outset, there was a higher number for warm water than for cold water. For Emma, this is obviously an error, as warm water is made from cold water, so it is impossible that more warm water is consumed. Subtracting the number from the WWC from the warm water meter gives a more believable figure. Emma's final remark, that they are guessing at what reality looks like, shows a frustration at not being able to really know how the meters are placed. They have the drawing and can get something that looks reasonable and works, but cannot be sure that it is correctly represents the meters in the building. This is a typical case of the work that needs to be done for the consumption infrastructure to work and be habituated (Edwards 2019), and it is just one of Property's

thousands of tenants. By making it look reasonable and usable, they make the infrastructure habituated, and therefore transparent to the users of the infrastructure, but the infrastructure needs constant upkeep such as this in order to maintain this transparency.

The boundaries set up in the consumption system allow for the division of costs between the tenants and Property and for the comparison of buildings over time. These boundaries are neither new nor originally part of sustainability work; they were a part of the old economic infrastructure and were a requirement for Property's business model to function. The tenants pay for their consumption, and Property pays for the consumption of the building itself. These boundaries are made by the infrastructure due to the requirements of the company to be able to separate the costs of running the building from the costs that the tenants incur from their operations. The boundaries of things such as the weather are from a need both to evaluate investments in energy-saving equipment and to be able to compare buildings in different locations and over time in order to see which buildings are the most profitable and also to calculate if investments made in buildings are profitable. These boundaries are not made for sustainability work, but they are used for sustainability reporting and the sustainability coordinator has taken over a lot of the maintenance of the boundary generating parts of the consumption infrastructure, when doing things like searching for and fixing anomalies.

The consumption infrastructure is a boundary infrastructure in the sense that it allows work to be done in different domains. It brings together the tenants, the building itself and the media with the infrastructure needed to measure and divide the media between tenants and Property. With this infrastructure come the technical requirements of measuring and controlling the media, which involves things like running the ventilation only when there are people in the building. It is used by the company for making quarterly and annual reports where the media is converted to costs. These different uses all rely on the infrastructure being stable and reliable. The infrastructure works in cycles and the meters, the energy monitoring system and the work of hunting anomalies are parts of the infrastructure. The meters can be seen as boundary objects (Star and Griesemer 1989) in the sense that they are a central part of the infrastructure and are used by different actors in different ways. The supplier uses them for billing, and the facilities manager reads them as part of their work. The sustainability coordinator uses them to get reliable numbers that can be used as a basis for sustainability reporting

and control.

The coordinator spends time infrastructurising (Edwards 2019) the consumption infrastructure when maintaining the consumption infrastructure. It can be seen as a distinct infrastructure with the properties described in Star and Ruhleder (1996). Key components of infrastructures are that they are built on older infrastructures and learned as a part of becoming a member of the organisation. The consumption infrastructure is a key part of how the organisation makes money. Tenants pay rent in order to use the space they rent, and they also pay for the media they use, heat, water, electricity and so on. These media are not produced by Property; instead they are bought from utility companies, and Property then passes the costs on to the tenants or the tenants have their own contracts with the utility company. In order to charge for the media used, the utility company has meters to measure how much the customer uses. These meters are typically installed where the media enters a building. If the meter corresponds to the tenant's rented area then they can have their own contract with the utility company; if not, then Property has to have the contract with the utility company and charge the tenant for their share of the media used.

6.2 Hunting anomalies

A large part of media measurement, and thus of sustainability work, is looking for anomalies. An anomaly is something that the coordinator sees as abnormal in the graphs, or tables of numbers, and acts on in order to find out why it is there. Tracking down the causes of these anomalies takes a lot of the sustainability coordinator's time. Anomalies have different causes and different consequences and the coordinator needs to track down the cause of the anomaly in order to fix the anomaly.

There are two different causes of an anomaly appearing in the graph that the coordinator looks at. The first cause is where the media flow for some reason is not correctly represented in the graph. And the other is where the media flow has changed which is reflected in the graph. These are elaborated below.

6.2.1 Identifying an anomaly

The sustainability coordinator spends a few days every month going over the graphs in the energy reporting system and looking for these anomalies.

The usual way the coordinator looks for anomalies is by bringing up

bar graphs that show the climate-corrected monthly consumption for the past two years for one building at a time. This is three or four graphs per building, representing different media. There are also tables showing the consumption in numbers. Sometimes these anomalies stick out so that even a shadowing researcher can spot them, but most of the time they are more subtle. The coordinator will scroll through the list of graphs and use her experience of what a normal graph of a type of media should look like and what is a reasonable consumption of a type of building, or by having an idea of how much change between the same month in two different years is normal.

If the coordinator finds something that looks strange, she needs to find out if it is the underlying consumption that has changed or if it is a measurement error. If it is the underlying consumption, she needs to figure out if the anomaly is a reporting error or a change in the underlying flow. These anomalies are handled in different ways, so it is important to know what type of anomaly she is dealing with.

6.2.2 Fault in the reporting

In many cases, the numbers in the bar graph or the table do not represent the flow of media that has gone into the building. These problems can either be with the energy monitoring system, which the coordinator can fix herself, or with the readings, where she would need help from a facilities manager.

If the anomaly is caused because the energy monitoring system has the wrong information about the meters the coordinator can usually fix this herself. These types were quite common in Division Blue due to the fact they had swapped systems[10], which resulted in a lot of anomalies transferring over. These anomalies are defined by that the number reported by the meter itself reflects the actual flow, but the total consumption for the building is erroneous. These anomalies are caused by the meters being classified incorrectly in the system.

One of the classifications that needs to be done is called a factor. Meters often have some sort of factor when they count media to prevent them from counting too fast and rolling over. This can be 10, or 60, or 100 or something else. If the factor is 60, then when the meter counts up 1 it represents 60 units of media. This factor needs to be input into the system so that it can calculate the correct number; if the factor is wrong, it will show a much too low or too high consumption. These will

[10] see vignette 6.2.4.

often be spotted as they are off by quite a large amount from what a building of a certain size should have. These errors can be corrected by the sustainability coordinator if she has overlapping data from several systems, one of which she knows has the correct factor.

Another anomaly that occurs because of erroneous classification in the energy reporting system is if a meter that should be classified as operations media is not and is therefore counted as building media. These can be more difficult to spot, depending on the size of the anomaly that they cause. It requires knowing how the physical meters are connected and to whom. The sustainability coordinator cannot usually find this information herself and needs the help of the facilities manager to get a correct map of which meters are for operations and which are for the building. Here the flow is still correctly counted, but consumption that is not the responsibility of Property gets counted erroneously.

The other type of reporting error is caused before the numbers enter the energy reporting system. These errors can stem from the meters themselves or be caused by a faulty reading of a meter. One of the common sources of this type of error is that the facility manager, or the supplier, has replaced the meter. If the meter is replaced without properly notifying the system then the meter reading for the next month will be lower than the previous month. The meters all start at zero and count up for their lifetime, so the flow for a period is the difference between the meter at the beginning and the end of the period. If the meter is replaced without notifying the system, then the system will assume that the meter has reached maximum and then started over from zero again. This will result in a very large number, so large that it is the only bar visible on the graph. The sustainability coordinator can see that it is obviously wrong, compared with what a normal graph should look like. When this happens she has to go in to a sub-menu and see the faulty entry and can tick a box and fill in the correct figure for the final reading of the old meter. The graph should look normal again when the report is refreshed. The final reading will have to come from the facilities manager, who also has to confirm that the meter has been replaced. Therefore, this type of error cannot be fixed by the coordinator alone without involving other people.

Other anomalies of this type are more difficult to spot. Sometimes a meter is read by a facilities manager that does not usually read the meters in that building. They might read the wrong meter or the wrong value from the meters. This will often result in one reading, that is one month in the graph, being very different from what it should be.

The sustainability coordinator has some ways of checking the underlying flow to see if there is an anomaly in the reporting or if it is the underlying consumption that has changed. Some media suppliers provide their own energy monitoring systems where their customers can log in and see their consumption. If these numbers are the same, or very similar, the coordinator can assume that the underlying referent is correctly translated in their energy monitoring system. She can also look at invoices where the flow is specified to get this information. The coordinator can use this to check if the energy monitoring system is reporting correctly. If it is then she can assume that the anomaly is due to a change in the flow.

6.2.3 Fault in the flow

Some of the anomalies are caused by changes in the flow of media rather than an error in the reporting system. In these cases the sustainability coordinator also needs to find out what the cause is. There are two types of changes in the flow, ones that are due to some error and ones that are due to changes in the building's use. There could, for instance, be a building in which there is an error in the programming of the ventilation. It has been the case that the feature that automatically turns the airflow down during the night has been disabled. There is a lot less need for fresh air during the night when the building is empty than in buildings that are only used during the day. This anomaly is usually clearly visible in the graphs after the fact, compared with the previous year and adjusted for outside temperature. But it takes a few months for there to be enough data to make it clearly visible compared with the previous year. The sustainability coordinator then needs to get the facility manager to track down whether there is a problem and what it is and correct it. These types are quite rare. The most common issue of this type is something leaking or a faulty tap that is running and needs to be replaced. These are easier to see for a facilities manager once the sustainability officer has notified them that there is something abnormal in a building. These types are the ones that they want to avoid most of all. Here, media is used without benefit. It is wasted. This both raises the consumption numbers for the building and the monetary costs of running the building.

The last type is where there is an anomaly that is caused by the underlying consumption changing because the tenants' use of the building has increased, or it is used a different way, perhaps with a new tenant. This is not an error like the others, but a change into a new norm.

One example was of a building where a popular Thai restaurant had

opened six months before. They used so much water that it could be seen in the facility manager's aggregate charts in the tree. The tenant could also have employed many more people which would cause more hot water consumption because they need to shower after work. Or they could have started a night shift and needed the ventilation to run at full capacity all the time during the work week. Again, it is the facilities manager who can help in differentiating between this type of anomaly, which is not really an anomaly at all, and the previous types. There is little that can be done about this type of change. It is a new norm. There is more, or less, media flow, but it is used by the tenants and not wasted as it would be if there was an error.

6.2.4 Vignette: swapping systems

The reorganisation of the company meant that they swapped from using different energy monitoring systems to using just one for all of the divisions. This created a lot of work for Emma and Jan, who had worked at Delta and Epsilon with different systems and would need to merge them in the new system.

All of the subsidiaries had their own systems before the merger. Delta used Webview while Epsilon used eMeasure.

In the Webview system facilities managers were supposed to read and input the number on a media metering device into the system every month. Meters are installed in every building and for every media. These are read manually by the facility manager that then puts the number into the system. The system can then compute how much media was used since the last reading. The meters themselves are often connected to a computer network, and the company that delivers the media can monitor how much is measured on an hourly basis. So the company that produces the media knows a lot more than the company that owns the building, unless they manually read the meter every hour. eMeasure is a system that is owned by the local provider that Epsilon buys its district heating and electricity from; they did not need to manually read meters since the provider of media also provided a consumption system for them. Delta's buildings were much more spread out and they had several different suppliers of heat, so they needed their own system and used Webview.

The entire company group switched to the Dynamics system,

which gets its figures from the providers instead of manual readings of the meters. This means that Property can see the same hourly information as the providers can for the entire group.

Emma, Henrik and Jan had biweekly telephone meetings with Dynamics. They made an ever-growing list of things that needed to be done before the system could be used and who was responsible, either Dynamics or Property. The items that have to do with setting up the system are marked as Dynamics, while those that need knowledge of the buildings and meters are marked as Property. The new system needs to reflect the meters, and all of the special adjustments that were in the old system need to be done in new ways in the Dynamics system.

The merger actualised the underlying anomalies in the different subsidiaries' measurement practices and systems. They needed to report together and also merge their measurement into a new system that the whole group was to use. When they did, they found that some of the numbers differed because of how the system presented the raw data. Epsilon's old system had taken into account electricity use when doing normal year calculations, while Delta's had not. Since electricity that is consumed in a building heats it up when it is consumed, running machines or lights or anything else, this can be compensated for when doing corrections. The new system did normal year calculations in another, slightly different, way. This meant that the numbers they had used for comparison had not been as comparable between the subsidiaries as those used inside the subsidiaries.

There were also differences between the monthly numbers in the new Dynamics system and the old system that Epsilon used. They could see this for the months where the systems overlapped. The numbers in the new Dynamics system were lower than in the old eMeasure system by a similar but not predictable amount. Both numbers were reasonable, so they wondered if it had anything to do with how compensation worked, or if one of the systems corrected for something. This anomaly was put on Henrik's to-do list and brought up during telephone meetings with Dynamics.

The Dynamics people were puzzled by this and said that the problem might be with the data from the supplier. Henrik told them that they need to check with the supplier as it was probably a technical problem that he couldn't solve. He put Dynamics as responsible for fixing it in the to-do list.

After several weeks Dynamics together with the supplier had found the problem. Apparently the system truncated the hourly metering numbers. So everything behind the decimal of the reported figure was taken away. This explained the random but always lower difference.

6.2.5 The role of anomaly hunting

Anomaly hunting fixes accounting problems, sustainability problems and economic problems. When an anomaly appears, the coordinator needs to first figure out if the problem is because of a change in the flow or if it is due to an error in reporting.

The coordinator continually checks that the process of taking the media flows from a meter to a report works. And anomaly hunting is the primary way this is done. Without all of this work, the accounts that are created would not be credible. Anomaly hunting is not only something that needs to be done in order to maintain the energy reporting process; it also has waste and economic implications. It is something that would need to be done in order to reduce costs and waste even if Property did not do anything further with the numbers. It is the coordinator who, at first, identifies anomalies, and then a facilities manager might be enrolled in categorising and fixing the anomaly. This means that anomaly hunting by the coordinator also affects facilities management work by bringing anomalies to the facility manager's attention.

Anomaly hunting is part of the system for doing all of these things, reporting, reducing costs, and facilities management and is a part of the infrastructuration that the coordinator does. Infrastructuration is the simultaneous process of both maintaining and using infrastructures (Edwards 2019). This process is evident in the way that the infrastructures are continually remade and maintained. The elimination of anomalies, which takes up a large amount of the coordinator's time, can be seen as part of a habituation (Edwards 2019) process. If there are anomalies the infrastructure cannot be transparent as it would be questioned both as a source for sustainability numbers as well as a source for economic numbers, such as bills for consumption.

The meters are built into the building when it is constructed, and it is often not possible, for cost or practical reasons, to move them if the building goes from having a single tenant to having several tenants or its use is changed in other ways. In this way, the infrastructure is stabilised, and changes need to be taken into account by the energy monitoring system rather than the meters themselves. Consequently, the infrastructure

becomes built on previous infrastructures. Learning how to fit the meters to the monitoring system is a large part of learning how to do sustainability work, exemplified in section 6.2. The consumption infrastructure has incorporated the old infrastructure for charging tenants for their media use, which uses meters and the concepts of operations and building media. For the facilities managers and the tenants the consumption infrastructure is completely recognisable as the old economic infrastructure. The sustainability coordinator brings together the old economic infrastructure and adds more entities, such as the large spreadsheet (see section 6.3.4) which brings in things like CO_2 equivalents in order to form the consumption infrastructure.

This work of infrastructurating the consumption infrastructure is necessary for the infrastructure to produce numbers that are considered to represent the building's or the tenant's consumption. The numbers are considered as representations by the users of the numbers, such as those who receive consumption numbers from the coordinator, users of the large spreadsheet or the certificate authorities. The work has made the infrastructure that produces the numbers transparent for these actors, but for the coordinator, the infrastructuration work is always ongoing.

6.2.6 Anomaly hunting and accounting

Accounting can be seen as a process of repetitive cycles that reproduce themselves more or less similarly (Palermo, Power and Ashby 2022; Power 2015). This is linked to the process of infrastructuration in that the stabilisation of the infrastructure is done by creating routines and practices that are repeated, learned and turned into a practice within the organisation. The economic infrastructure is already in place, sometimes as routines and learned practices but also as meters and the routines for reading the meters, manually or digitally and calculating the consumption into usable numbers.

The boundaries between things such as the building and the weather, the building and the tenants, and so on are not always set at the outset, but the infrastructuration process makes them stable and acceptable as representations of the building and its consumption. They are able to function as representations because the boundary infrastructure is considered as an infrastructure. It is transparent and able to produce numbers that work for different purposes, and the infrastructure that makes these boundaries can therefore function as a boundary infrastructure, bringing together different actors around the same numbers.

When hunting anomalies the coordinator is working to make the in-

frastructure habituated for its users and the buildings and so on, so that it is to be taken for granted and not thought about (Edwards 2019). The end goal for the infrastructure, of being completely transparent and yet still producing representative numbers does not happen on its own; it is built on the older economic infrastructure but through the infrastructuration and habituation process it becomes adapted to enable sustainability work.

The consumption infrastructure moves media from flows in the buildings via the consumption system to reports and invoices. This infrastructure organises the tenants, buildings, media, money, routines, managers and the sustainability coordinator. The certification infrastructure brings together builders, certificate authorities, the consumption system and the coordinator. The coordinator also needs to account for other infrastructures, like the builder's infrastructure and the electricity grid.

The infrastructure for consumption creates boundaries between things such as buildings and tenants. In Georg and Justesen (2017), limitations on how these boundaries were drawn made the accounts unworkable. The boundaries are not always clear from the outset. However, where the boundaries can be drawn with the help of the older economic infrastructure that was used for deciding who should pay for heat and electricity and so on, the boundaries become accepted by the actors and can be used for sustainability accounting.

6.3 Refining numbers

All of the divisions need to report their sustainability information up to the head office every year. This is done in an Excel sheet that is on the company network. The file, officially named 'energy follow-up 2016', is central to a lot of the work that the sustainability coordinator does throughout the year. The name implies that it was once focused on energy. It has since expanded to include water and waste. The spreadsheet serves as a device for reporting data up to the sustainability chief but also as a central reference for the group's environmental work that the coordinators access regularly; it also serves as a device that enables different types of calculations, both inside the spreadsheet and outside it. The spreadsheet also allows the accounts to travel outside of the division.

6.3.1 Reporting up

The sheet is updated every year by the group's sustainability chief. It has pre-filled information about the buildings that the company owns, updated from the current registry, their numbers, leaseable area and so on. Then the sustainability coordinators from the different divisions have to fill in the information in columns with labels. New labels are added every year, and the spreadsheet becomes ever larger.

The 2015[11] version of the spreadsheet has 99 columns, and with a row for every building. With over 200 rows just for Division Blue the spreadsheet quickly becomes too large to view at a glance. Not all of these columns have to be filled in, though. Some information is brought from the central property list, some represents last year's figures, and a lot can be easily set to zero. There is for example a column for oil heat kWh. Only two buildings in Division Blue are heated with oil and for the rest of the buildings, that column is zero; the same applies for natural gas.

6.3.2 Categories

The sheet is divided into 7 categories: Information, Heating & Cooling, Electricity, Water, Waste, Intensity, and Greenhouse Gas. The last two categories are calculated by the spreadsheet when other figures have been filled in.

Information has identifiers like the property's number, its address and so on, as well as sustainability information, such as whether the property is certified[12] when the building was last inspected for dangerous chemicals and when the ventilation was checked and by what date these inspections need to be redone. There is also information about whether there have been major investments in energy efficiency for a building during the year and whether the tenants themselves are responsible for having a contract to provide electricity, water, heat or cooling. If the contract is with the tenant, then Property will not know the consumption the way they do when they have the contract and then bill the tenants in turn.

Heating and Cooling has the most columns; that is because there are many types of heat. Most of Property's buildings use district heating[13],

[11] I received an unlocked digital copy of the 2015 version as part of my material collection; the 2016 version that the coordinator worked with during the study was largely the same.

[12] See chapter 7 for more on certification.

[13] District heat is pumped as hot water into a building and is generated in a plant, often owned by the municipality.

but some use electric heat and gas, and a few use oil. Heating is by far the largest energy use in Property. All of the types have their own column and the unit of measure for all of them is kWh. Electricity is divided into building electricity and operational electricity. Water is reported in cubic meters and waste in tonnes. Waste is divided into hazardous, recycled and burned.

All of this needs to be calculated by the sustainability coordinators and transferred to the file. The file can then calculate other values based on these numbers and other numbers that the sustainability chief adds to the file.

6.3.3 Calculation

The spreadsheet can calculate intensity. This is a number that enables comparison. It is a number that is calculated so that different buildings can be compared and buildings can be compared over time. This is done by calculating consumption per square meter, allowing buildings of different sizes to be compared. Consumption per square meter is used for every type of media, from water to heat. Comparison between buildings is also done by using climate-compensated energy numbers so that buildings in different geographic locations can be compared. Climate compensation also allows comparison over different time periods and the spreadsheet will calculate a percentage change in energy intensity between the current and previous year. As they use these intensity numbers for evaluating the whole company group, or whole divisions, the effect of individual buildings or projects should not affect the overall trends. Having many more buildings means that a method can be used for comparison that could not be used for just one building.

Greenhouse gas is measured in CO_2 equivalents, abbreviated as CO_2e. This is calculated by multiplying the kWh of energy consumed by a factor that is supplied by the energy provider. For district heat there is a spreadsheet that has environmental figures for all the Swedish district heating companies. For the district where most of Division Blue's buildings are, the figure is 8 grams of CO_2e for every kWh when environmentally certified district heat is used. All of the current figures are put in the spreadsheet for the district heat providers that Property uses. The figure for CO_2e for every kWh of electricity that is used is also in the spreadsheet; Property uses only one electricity provider for the entire company group.

There is a tab in the spreadsheet that then summarises and displays figures for the group. For greenhouse gas there are three 'scopes'; this is

the standard way of reporting greenhouse emissions. Scope 1 is directly burned fuel in the company. This includes company-owned cars and buildings where oil or gas is burned at the building for heat. Scope 2 is indirectly burned fuel; this is the vast majority of Property's emissions. Indirectly burned fuel is fuel that is burned as a result of purchased energy, so electricity and district heat are classified as scope 2. Scope 3 is fuel that is burned by someone else as a result of Property's operations, this is things like business trips and is very small in Property's case. It means that the sustainability chief needs to keep track of all the trips that the company pays for and add them to the spreadsheet.

Greenhouse gas reporting mean yet another translation. The numbers change their unit from climate-corrected kWh to CO_2 equivalents. This requires the energy producers to provide numbers of how much CO_2e they produce per kWh, that can be used to translate Property's kWh. These calculations are all quite simple for Property as long as the energy is correctly classified by type and supplier in the spreadsheet and the supplier has the correct data available.

6.3.4 The role of the large spreadsheet

The large spreadsheet is the final form of the numbers for reporting that the Division's sustainability coordinator works with. These numbers are then used by the head office is various ways, one of which is the annual report. Another use is for reporting to third parties that evaluate Property. How this works can be seen in section 8.2. It has detailed information about all the buildings that Property owns and takes some time to parse and has many more details than most external people want or need. The summarising numbers, however, are the ones that eventually go into in the annual report.

The spreadsheet calculates intensity numbers. These numbers which are mostly kWh per square meter are the ones that are most abstracted from the flow of media of all the numbers that the sustainability coordinator deals with. The numbers are also used to evaluate the entire group's performance as a percentage difference between different years.

The spreadsheet serves both as a device for moving all these numbers and other information about the divisions up to the sustainability chief. It also signals down to the divisions what is new for a given year; water and waste have been added recently, and they have become more detailed.

The sustainability coordinator and the group coordinator can decide how the spreadsheet functions, within the limitations of the spreadsheet software itself. The buildings decide what numbers are possible to ex-

tract from them and what windows they have, the floor plan and so on. The tenants use their own media, and this is boundaried from the building. They control their own part of the infrastructure but are in turn controlled by the other parts.

Infrastructures both allow and constrain possible activities (Star and Ruhleder 1996). They allow for agency yet do not place the agency at a single point; instead it is distributed among the actors and objects that make up the infrastructure. Control is therefore not exercised at one point; it is also distributed. The limitations on what can be reported are not within the spreadsheet; instead, it is a combination of what the buildings can provide, what is possible to calculate in the spreadsheet and how much work the coordinator can do to get the numbers to put in the spreadsheet.

6.4 Reflections on the consumption infrastructure

The meters and the energy monitoring system both allow the measurement of media and energy and simultaneously define what can be measured and in what way it can be done. They stabilise and make media flows visible, comparable and calculable. The meters and energy monitoring system create a history of data; they make the past visible and available for calculations and comparisons.

The process of accounting for media requires boundaries to be drawn. Boundaries are drawn between buildings, between tenants, between the company and its tenants, between years, between 'real' consumption and climate-compensated consumption. This is done to create comparable numbers and to put them in categories that can be accounted separately.

Boundaries can be drawn by classification, when saying that meters belong to a building or to a certain type of media or by classifying a meter as for operations media. They can also be drawn by calculations, such as when doing climate compensation or splitting meters. The result of boundarying with categorisation is many that things are turned into the same thing so that they can be categorised. They can then be aggregated and displayed or calculated together. Boundarying with calculations is different in the sense that they are created by cutting something away, whether in the case of climate compensation or another building in the case of splitting a meter.

It is only when credible and useful boundaries are drawn that the accounts become credible and useful. In the field these boundaries might be called the 'correct' ones. If there were not boundaries between the company and its tenants and all of the meter data that goes in to the

energy reporting system was included then the numbers from the meters that represent operations media would be included too. The energy reporting system cannot provide an account of all the media that is used in Property's buildings, however; most tenants have their own contracts for things like electricity, which do not show up in Property's energy monitoring system. Only the ones where Property has the contract or reads the meter show up in their energy monitoring system. So a number where operations media is not boundaried out would not be useful.

Climate-compensation boundaries and isolates the building from the local weather. The numbers represent a building without weather. Unlike the case with operations media, the non-climate-compensated numbers are useful; they show the actual consumption that Property pays for. Climate compensated numbers are, on the other hand, also useful, especially when comparing.

Boundaries are also drawn around buildings, when associating the meters with a building. Or if a meter is split between buildings, the boundary is drawn over the meter.

A lot of work is done mapping and making sure that the meters in the energy monitoring system correspond to the physical meters in the buildings. This is a classic case of representation, where the representation can be more, or less, accurate. In the case of media consumption, there needs to be a good enough translation from the physical buildings to the energy monitoring system. Without a good enough translation accounting for energy would not work. Some anomalies are ignored because their status is uncertain and some are considered insignificant. There is no exact line at where the translation goes from unacceptable to good enough, but there are tools that the sustainability coordinator can use. These include historical data, invoices and other data about the building, such as its area, that allow the coordinator to judge if the translations are good enough.

Most of the work described in this chapter is done by the sustainability coordinator, but it is work that was done by other people in other divisions and was a requirement for Property's business to function. Without a functional separation of operations media and building media, property could not pass the costs of operations media on to the tenants. Without a system to monitor media flows they could not know how much media they used as building media and, therefore, how much costs they were incurring and if these costs were increasing or decreasing over time. The climate compensation calculation also does not come from sustainability work, but rather from the need to be able to compare

buildings, both with each other and over time. It is also necessary to be able to judge how well investments in energy efficiency are doing; these investments are usually motivated by economic calculations, where the costs of the investment are compared with the savings in media costs. In order to know whether the investment was successful the media consumption before and after the investment needs to be compared, without the influence of the weather.

7 Certificates

Managing the myriad of labels and certificates that are out there is one of the coordinator's two main tasks, as well as managing and using the reporting and measurement infrastructure that was described in chapter 6. Sometimes these certificates are referred to as environmental certification systems, they are systems in the sense that they are made of, among other things, norms, books, websites, Excel-sheets, and courses.

The certification process also has the properties of a boundary infrastructure (Star and Ruhleder 1996). It uses indicators that are known in the construction industry, such as solar heat load. It is therefore built on older infrastructure. As seen in chapter 7, working with certificates requires effort and knowledge of how they function. This is not just knowledge of the indicators but also how the application process works. How to gather information for the indicators and how the different indicators affect each other are things that the coordinator needs to learn in order to use the certification infrastructure in a meaningful way. It brings together the building, the certificate authority, the tenant and the concept of sustainability. Sustainability becomes embodied and made material via the certificate.

7.1 On certificates

Property has many certificates that have different scopes. Some are for the whole company group, such as ISO 14000, and others are for individual divisions or building estates. There are also certificates for specific things such as individual building. As part of the company's overall certificate work, a large part of the Division Blue coordinator's work is managing the green certification of individual buildings, henceforth called building certificates.

Keeping on top of which certificates are available and, perhaps primarily, keeping up with developments in existing certificates, is part of the coordinator's work. The certificates are continuously being reworked, at the time of this study *Miljöbyggnad* was at version 2.2, but version 3.0 was about to be launched and the coordinators would have to get updated on this certificate, mainly by taking a course on it, reading the material provided by the issuer and talking to consultants and other coordinators.

The common way to get the certificates that are described in this chapter is to apply to the issuer of the certificate. This is done by submitting forms, usually on a website. These forms are made so that one can show the issuer that one conforms to the requirements of the certi-

ficate. The scope and size of the application vary greatly depending on the scope of the certificate itself. Then there is the application process, which varies in that some certificates are approved preliminarily and it can be years before the certificate is finally approved, as will be described below. And finally, when approved, one can use the label that is associated with the certificate. For single building certificates this usually means that the certificate, as well as the awarded grade, is printed out and displayed in the building's lobby.

7.1.1 Building certificates

During this study, individual buildings certification was the type which meant the most work for Emma, the coordinator of Division Blue. The practical way of getting a building certified is similar for all the issuers and standards. There is an on-line system that is managed by the issuer, where one applies and where different forms are uploaded. The certificates for individual buildings that the company worked with at the time of this study were broad enough to be divided into categories that were assessed individually and required their own types of forms where the coordinator had to show that the building conformed to the specific category of the certificate. The type of evidence, or proof, that the issuer required varied depending on the category and where in the process the application was and whether the building was a new one or an existing one. Evidence is the word that they use in some certificates but here it is used for all of the certificates, even if they use different terminology.

As mentioned, the certifications can be classified as more or less broad because some certificates cover a much broader scope than others. They can be more or less detailed because the issuer demands many pieces of evidence in order to certify the building. Certification can also be more or less difficult because the demands for getting a certificate are high in terms of the required performance from the building. There were three certificates that were in active use in some way in Division Blue during the study: GreenBuilding, *Miljöbyggnad* and BREEAM. There was also a type of certificate called WELL that was discussed but not actively used. Every certificate has an issuer, which is the organisation where Property applies to get a building certified. The main issuer for Property is the Swedish Green Building Council (SGBC), which issues *Miljöbyggnad*, the standard most often used in this study.

Property has a central policy, which is that all new buildings should be at least *Miljöbyggnad* Silver. Before the merger, decided on different certificates throughout the different companies. They had chosen

different strategies for choosing what certificates to use, especially for existing buildings. Delta, where Jan had worked, chose a simpler standard, GreenBuilding, which is both narrow and relatively easy to obtain. GreenBuilding was originally started by the EU in order to decrease energy use in the property sector. To get certified, one needs to show that the energy use of the building is 25% lower than if it had been built to the lowest standard of the building norms. Delta had certified quite a few buildings with this standard. Epsilon, where Emma worked, had chosen to certify their existing buildings using *Miljöbyggnad*, the same standard that they used for new buildings and this work was ongoing throughout the time of the study.

Miljöbyggnad is considered to be a much more complicated and difficult standard than GreenBuilding. It has three possible scores: Bronze, Silver, and Gold.

Property's division Blue are also constructing a new building with a BREEAM certification, it is a type that differs from *Miljöbyggnad* in that the client has more freedom to chose what is important to them. Most certification systems that have points and gradings are like this. BREEAM was developed in the United Kingdom but was translated to Swedish conditions by the SGBC and is known as BREEAM-SE here. BREEAM has five different grades: Pass, Good, Very Good, Excellent, and Outstanding. BREEAM outstanding was considered to be the most difficult grade to achieve of all the certificates at the time, but other issuers are catching up. The difficulty of getting a top grade increases for every revision of the certificate. Like *Miljöbyggnad*, the BREEAM certificate requires verification from actual data rather than simulations.

BREEAM's grade is determined by how many indicators one can fulfil out of the total. There are 51 individual indicators. Pass is 30% and Outstanding is 85%. Some indicators are mandatory, meaning one cannot compromise on something vital with lots of other indicators. The indicators are also weighted, so the percentage score is not just the sum of the indicators that one has gotten divided by the total. It is more complicated. Energy has the highest weight, followed by materials; water has the lowest weight, followed by waste. BREEAM is the broadest certificate that one can get; *Miljöbyggnad* focuses only on the building and its energy use and indoor environment; and BREEAM expands in this by also taking in the external environment, such as waste management, procurement, and access to public transportation.

Another way that BREEAM is different from *Miljöbyggnad* is that the certification requires that they have a consultant who is an accredited

Table 2: Certification standards

Name	**Scope**	**Flexibility**	**Cost**
GreenBuilding	Energy	None	Cheap
Miljöbyggnad	The Building	None	Expensive
BREEAM	The Building and its Surroundings	Some	Very Expensive
WELL	Well-being	Some	Expensive

BREEAM assessor. One becomes an assessor by taking courses that are given by the SGBC. The other certificates also have courses, and one can become accredited, but having an accredited person is not a requirement for getting a building certified.

The last type of certificate is the WELL certificate. WELL differs from the others in scope. It focuses on the well-being of the people who work in the building. WELL has no environmental targets at all but can be combined with another certificate that focuses on the environment, such as *Miljöbyggnad*. At the time of the study ,there were no WELL-certified buildings in Sweden and Property Division Blue did not have any concrete plans to build a WELL-certified building; however, other parts of Property were actively building WELL-buildings.

WELL has 101 indicators, divided into seven parts: Air, Water, Nourishment, Light, Fitness, Comfort and Mind. Air, Water and Light exist in environmental standards too, but the others are unique to WELL. Nourishment covers things such as the pots and pans available to the people need to be inert, and restaurants that operate in the building need to have a low-calorie meal option. Fitness covers things from bike storage to some desks having treadmills so people can exercise while working. Comfort includes things like adjustable desks and monitors and that the noise level is kept down and the temperature is good. Mind includes things such as privacy and the design of the indoor space using concepts inspired by nature. The last point was used as an example of how some of the indicators in WELL are a bit difficult to grasp. One indicator, for instance, says that the architectural drawing should feature, among other things, elements of 'human delight' and 'celebration of culture'. Other indicators are more specific: one says that the building should have a plant wall on every floor that covers a wall area that is 2% of the floor area.

Table 2 shows the different certification systems that Delta had at the time of the observations. The categories here are based on what different people at Property said. What is not in the table is anything about how

difficult it is to get certified or, how 'good' the building has to be. There are different opinions on this. Some say that BREEAM is more difficult than *Miljöbyggnad*. The highest level of BREEAM is more difficult in terms of the requirements, but because one can choose indicators others argue that getting a BREEAM certificate can be easier. In buildings where there are some problems with conflicting indicators *Miljöbyggnad* would be more difficult to get, as one cannot choose the indicators that do not conflict with each other.

7.1.2 Choosing a certificate

The company has many certificates; some have been left over from previous efforts and are not actively pursued any more, whereas some are the result of purchased buildings which are already certified.

At the time of the study, one focus for the group coordinator was on getting the whole company group ISO 14000-certified and on certifying new buildings, and major remodelling with *Miljöbyggnad* Silver.

The ISO 14000 certificate is something that is important to the people higher up in the company. However, the work to get ISO-certified is done by the coordinator for Division Black and by the group's sustainability chief and is mostly beyond the scope of Division Blue's sustainability coordinator's work. Therefore, ISO-certification only came up in the interviews. Getting ISO certified is quite a large undertaking. It was the main undertaking for the coordinator in Division Black in the first year he had been employed. Although it was a lot of work he felt that it was worth it.

> I also think that an ISO certification is a good thing, it doesn't have to mean more administration. It's more that there is more focus on tidiness and systematisation and structure rather than having a bunch of unnecessary binders full of papers. I think that there will be a hump in the beginning but once we get over it then it will help us. Above all it will raise our lowest level, I'm sure of that. (Sustainability Coordinator Division Black)

The ISO-process involves, among other things, documenting which environmental laws are applicable to the company's operations. They knew these before, but now they have to show that they have them documented somewhere. This is done differently in different divisions. Some of them have this documentation in binders somewhere where nobody

looks regularly. The coordinator hopes that the ISO certificate will bring them to the level of the average division in the company, although it will not affect the better division's work in the areas covered by the certificate.

> I see it as meaningful. If we take the ISO then I think it is a piece of the puzzle of working towards one Property. If we look at these eight things, then we will do it in the same way in all of Property now. We have an action plan for reaching our goals. We have the same goals of course. All of the divisions meet every month and we have the environment on the itinerary. We have common requirements for our suppliers. It is a way of uniting us. (Sustainability Coordinator Division Black)

The coordinator sees the certification process as part of creating a common identity for Property after the reorganisation. It also means that they can show that they do what they should be doing with regard to laws and norms. Certification in general also has a signalling effect, towards both potential tenants and the world at large. As the coordinator in Division Blue points out when discussing certification:

> Also, we have to report. It wouldn't work... People wouldn't have a clue about what we're doing, nobody would be interested in working here... They would think that we are completely backwards if we didn't tell them what we do. (Sustainability Coordinator Division Blue)

One of the things they report is the share of certified buildings, and their policy of certifying major projects. A building-specific certificate means that the building is examined and evaluated according to the norms of the certificate. For Property, this has several implications. One that the coordinator points out is that certification improves their existing consumption system:

> And this is also a good thing about the environmental certificates: verification. We need to have sub-meters so that we can show how much is used for cooling, how much is used for this, how much is used for that. I think a lot of measuring is good. One can see what different efforts do. I think it is good, doing follow-ups is generally good, so that we know if we are doing the right things. (Sustainability Coordinator Division Blue)

The certificate is not just about the signal. Even if the signal is important, as they describe it above, they will only get certificates that they feel improve their sustainability work. An example that several people gave was that they could certify whole areas or even the entire building portfolio as a whole with some of the certification systems which are available. This would mean that the company could signal a much larger percentage coverage of certified buildings than with the piecemeal method which they have chosen. However, they feel like this would not give them anything other than the certificate. They value the verification of every building individually, even if it means more effort.

Property has chosen to use *Miljöbyggnad* with grade silver for all of their new construction and remodelling. This is a decision formally taken by the board of directors, and so cannot be changed by the coordinators or the sustainability chief.

The people interviewed cite several, similar, reasons for choosing *Miljöbyggnad*. One is that it has been developed for Swedish norms and conditions, whereas the other systems all have features which have been translated from other areas where other things might be problematic. It also means they can use calculations that are used for other things, like the mandatory energy declaration, which are part of the Swedish building norms as a starting point for the calculations needed to do *Miljöbyggnad*. The lists of approved building materials are also based on a list which is done by a Swedish agency and is commonly used in the building industry. Property can also affect these standards by being part of industry boards who set the norms. Also, that they cannot pick which indicators to use is seen as a positive, as it forces them to increase the quality of the buildings.

Miljöbyggnad is a standard which affects mainly the building, but it affects many aspects of it, more than does a pure energy certificate or a well-being certificate. This means that it involves everyone that has anything to do with building the building to get the certificate.

At the time of the study there seemed to be a lot of hype around WELL:

> I think that it is a good extension of environmental certifications. Environmental certifications are one thing, and there is a lot of building and a lot of energy and a lot of materials and indoor environment of course. But this will be, I think, I think that people will appreciate a Well certificate over an environmental certificate. I think that this will give them more. They will notice it in their work and an employer should think

> that it is a good thing to sit in a good and wholesome space. Those that work should be more satisfied and perhaps hopefully do more work and be at their job more often rather than being home ill. Sort of. (Sustainability Coordinator Division Black)

Most of the people who talk about WELL see it as something that could be a must have in the future. Environmental certificates are something that everyone already expects from a modern building. It is, however, not something that was actively worked with in Division Blue at the time of study and so there is very little material about implementing it in practice.

A consequence of the company's decision that new buildings should be certified, thereby placing the certificate as a pivotal (Edwards 2019) actor, is that the coordinator has some degree of choice in some cases and is limited in others. When a specific certificate is used for a new building it is the result of work by the project manager and the builder who take the future tenants into account. One of their arguments is that international tenants want international certificates which can narrow the possible choices of certificates. The choice of what certificate to use becomes a function of distributed agency (Callon 1998); there is no one entity that makes the decision. The coordinator has some fixed boundaries as to which certificates are acceptable and a requirement that individual buildings rather than estates with multiple buildings are to be certified.

The next section will describe the process of *Miljöbyggnad* certification.

7.2 Getting a certificate

As the certification of existing buildings has the most direct involvement from the coordinator in the entire process, it is the type of certificate where the most complete picture of the process can be obtained from the coordinator.

The first step is choosing a building as a candidate for certification. There are no requirements from higher up in the company to certify existing buildings It is up to the coordinator to identify what, if any, possibilities they have and to do the work. With new buildings, certification to a certain level is mandatory, depending on the type of building. Even though it is not mandatory for existing buildings the coordinator feels that it can be worth the work involved as having a certificate in-

creases the total number of certified buildings in the division and also signals to the tenants and potential tenants that it is a modern and good building. Candidate buildings are those that are relatively new and well built, living up to the standards of the certificate despite not being built with certification in mind. The buildings with ongoing certifications during this study were all office buildings that looked like most new buildings do to an outsider, with large windows, open floor plans and so on.

The *Miljöbyggnad* standard for existing buildings has 14 indicators, all of which need to be met and reported on. As said, unlike other certificates where one can choose which indicators to use. For the coordinator the amount and type of work needed for each indicator vary. For grading purposes, the indicators are divided into 3 categories: energy, indoor environment, and materials.

The indicators are:

1. Energy use
2. Heat effect demand
3. Solar heat load
4. Energy type
5. Sound environment
6. Radon
7. Ventilation
8. Nitrous oxide
9. Moisture protection
10. Thermal climate winter
11. Thermal climate summer
12. Daylight
13. Legionella
14. Harmful substances

Indicators 1-4 are energy, 5-13 are indoor environment, and 14 is materials. All of these indicators are given a grade from bronze to gold, and then the entire building is given a bronze, silver or gold rating if it

passes the standard. The grades are aggregated in such a way that it is not an average score; some areas have more weight than others. Usually, a building will have scores from bronze to gold for these indicators, and the final grade depends on which indicators have the higher scores. However, usually a building with a bronze score for an indicator with will not be able to get a gold rating.

For indicators 1, 2 and 4, the information can be taken from the Excel sheet or the energy measurement system from chapter 6. But it needs to be put in a format for grading, so there is some work for the coordinator here. Indicators 6, 8, 9, 13 and 14 are mostly done by consultants, and the effort from the coordinator depends on how the consultants rate the building. If the consultant does not think the building meets the norms, then the coordinator has to do something about it, either fix the building or change the certificate and the grade they can get.

The consultant provides a report, which has a score from bronze to gold, which is used for that indicator. The report also provides documentation about the building and its potential problems with regard to, for instance, moisture: everything from cracks in the tarmac of the underground garage to inadequate silicone around a sink in an office. The consultant can also offer suggestions for improvements; some are almost free, such as putting in more silicone around a sink. The coordinator will send this report to the property manager and the facilities manager so that they can decide if they want to do any of what consultant suggests.

The standard is administered by an organisation called the SGBC. Bronze is supposed to correspond to the Swedish building norms, but it is still a lot of work to get a building certified in practice, especially and existing building, where the pieces of evidence might not be documented by the builder and someone needs to then do a lot of work to find out how the building is made.

Certifying an existing building is much more difficult than certifying a new building where one can plan everything according to the certificate. All of the evidence needs to be gathered and combined. Emma said many times that she had misjudged the amount of work that certifying an existing building entailed[14].

The indicators affect each other in practice, when building a new building they can be balanced, but for an existing one this can be a obstacle for getting certified. This is especially true for daylight and solar heat load. Certified buildings need a certain amount of sunlight at every workspace while at the same time maintaining a good energy performance

[14]See vignette 7.2.5.

by not letting in too much heat that needs to be transported out via the building's ventilation. Buildings that were not built with certification in mind might not have balanced this in a way that is compatible with certification[15].

7.2.1 Energy use

Energy use is indicator 1. It is measured in kWh/m^2 for all heated areas of a building. The grade is based on a ratio of the use and the requirements of the Swedish building norms. The SGBC provides an Excel-file that can be used to calculate what the building norms' limits for a particular building are.

The Excel sheet has fields for different zones in a building and for the climate zone that the building is in. These give a number for the highest energy use that is allowed in order to pass the building norms. The different zones in the building are classified into two types, and are based on how much airflow is allowed. More airflow means that a higher energy use is accepted. The airflow can be determined either by the number of people that are expected to use the zone or by the types of operations that it is used for. For offices, auditoriums and similar spaces the amount of people is used; for gyms, kitchens, industry, shops and so on the operations decides how much airflow is accepted.

The energy that goes into the calculation is heat, warm water, comfort cooling and property electricity. Comfort cooling is cooling that is calculated to be necessary for the operations or number of people in the different zones of a building.

The information that is needed for the energy use indicator is available from other sources. The calculation of energy use according to the building norms needs to be done for every building. These numbers can then be put in the Excel-sheet that the SGBC has provided in order to calculate what grade the building should have for energy use. This is uploaded to the green building system and submitted with the application.

Two years after the certificate is approved, it needs to be verified. This is done with actual data, collected from the energy reporting system from chapter 6. The sustainability coordinator reports the numbers in kWh per square metre and also needs to take screenshots from the system to show that they have gathered this information in a systematic way and that they have a system in place. These numbers will be compared to the ones submitted with the application, which are calculated before

[15]This issue will be further explained in 7.2.2.

the building is actually built and running and any differences will have to be explained.

7.2.2 Solar heat load

Solar heat load is the amount of heat that comes in to the building as light from the sun. This heat needs to be dealt with in order to keep the inner temperature reasonable and reduce the discomfort that can come from having the sun shine on one's workplace.

Solar heat load is measured in watts per square metre of floor. The lower the number, the higher the grade will be for the indicator. The number is supposed to represent the maximum amount of solar heat that reaches the room during one year.

This is not measured for every room in the building. The coordinator, or whoever does the application, can choose some representative rooms. There needs to be a motivation as to why these rooms have been chosen; for example, it is the ones facing south that have the largest windows and that would therefore receive the most solar heat. If these rooms are good enough, then every other room should be at least as good.

There have to be floor plans with the representative rooms marked, as well as an exterior drawing that shows the windows for these rooms. There also needs to be photos that show examples of any devices that are installed to limit the solar load, such as curtains, blinds or shades.

The solar heat load number is calculated for every representative room. This requires the coordinator to use two different numbers: a g-value and a g_{syst}-value. The g-value is an inherent property of the window, while the g_{syst}-value depends on the windows and all the other devices that are used to limit solar heat. The g-value is provided by the window's manufacturer and is a percentage (see vignette 7.2.5 for how this can be calculated). It is supposed to represent how much of the sun's energy is transmitted through the window. The g_{syst}-value can be calculated in different ways, the simplest being to use a table that is provided by the SGBC. There one can look up the window's g-value, or the type and amount of glass in the window, together with the blinds, and whether they are placed outside or inside the window and if the window has a sunshade on the outside and gets a g_{syst}-value.

These are then calculated with a formula for each room. The formula is $800 \times g_{syst} \times \frac{A_{win}}{A_{floor}}$. The number 800 is in watts and is supposed to represent the maximum energy from the sun in Sweden. g_{syst} is a fraction and will reduce this number. A_{win} is the glass area of the windows, without frames or other parts that do not let in light. A_{floor} is the floor

area of the room. Therefore, if the room has more floor area than glass area the number will be further reduced. If the resulting number is lower than 32 it will receive a gold grade, and if it is over 48 it will not pass. Between these are bronze and silver grades. Every room gets a grade. These are added up per floor so that every measured floor gets a grade. The the individual floors are then added so that the entire building gets a grade for the solar heat load indicator.

This indicator plays a vital role in the work of the coordinator. These modern buildings often have large windows, while at the same time the certificate issuer wants to promote windows that do not let in heat from the sun, as it increases the load on the ventilation and might require a cooler to be installed; they can also cause discomfort for the people who have the sun shining on their workspaces. This is why it is important that the coordinator can show that they have installed windows with a low g-value, or that they have added shades, or similar, in order to lower the g_{syst}-value.

7.2.3 Daylight

Daylight is a indoor environment indicator. Unlike solar heat, which one wants as little as possible of, one wants as much daylight as possible. Daylight is measured as a daylight factor (DF) or an area factor (AF), and the building's grade depends on how high this factor is.

The methods for calculating these two different factors are very different. Normally, AF can be worked out using a simple ratio of window area to floor area. However, for buildings that have a glass atrium or something else that affects the inflow of light it is more complicated. In complicated cases they need some sort of computer simulation to calculate a DF. The coordinator cannot do this herself but needs to bring in a consultant.

How complicated the consultant's task is depends on what the coordinator can provide them with in terms of files. As it is an existing building the files on hand might be difficult to find; it may also be difficult to judge whether they are good enough. The job will be much simpler for the consultant if they have a special type of drawing, a dvg-file. The more common type of file that is usually found is a two-dimensional PDF from which doing a daylight simulation becomes a much more complicated, and expensive task. The coordinator will sometimes have to track down these files by calling architects and others who were involved in planning and constructing the building and hoping that they have saved the files.

As with solar heat, the application needs to specify representative rooms and show them on a floor layout and on a drawing of the outside where the room's windows are specified. The selection needs to be motivated, unlike solar heat it is preferable to use the rooms that can be expected to receive the least sunlight so one can assume that all of the other rooms are at least as good. AF is allowed to be used for some rooms and DF for others. If this can be motivated, like where some rooms face inwards under a glass ceiling and some face outwards then AF can be used for the outwards-facing rooms and DF for the inwards-facing ones.

The rooms are given a score, from bronze to gold, and each floor is given a score. The building then gets the score of the lowest-rated floor in the daylight indicator. All of this is added to the application.

Daylight uses many of the same data points as the Solar heat load indicator, but instead of the grade being related to as low a load as possible one wants as much daylight as possible. Solar heat affects both energy use and the indoor environment whereas daylight only affects the indoor environment. When constructing a building that is to be certified a balance needs to be struck between letting in sunlight, because the certificate requires sunlight for workspaces, and blocking the heat that comes from the sun, because it causes energy use to rise and discomfort for the people in the building. In practice, in modern buildings which have large windows this is done with glass that reflects the sun's heat while letting in light. These windows are often combined with mechanical devices such as automated curtains or shades that block the sun completely during the hottest days.

7.2.4 Application and afterwards

Acquiring a certificate, from the perspective of the sustainability coordinator, is a long process. For new buildings, and major rebuilding, Property has decided that everything should be certified. In this case the coordinator coordinates all of the actors involved in constructing the building with the purpose of getting it certified.

For an existing building, the process is different; here, it is the coordinator who drives the process. The coordinator needs to identify buildings that are candidates for certification and, in the case of Property Division Blue, drive the process forward and submit the application.

The coordinator keeps track of all the certifications in an Excel file that tracks the status of all ongoing certifications. The coordinator (Emma) also keeps folders and files with all of the certifications and their indicators where she keeps all of the different files that she has used

for them.

Emma's Excel-file has rows that read Certification, Status, Flag, Year, Type, Hangs on, Area, Address, PropertyNr for every building whose certification is ongoing or completed[16]. It also tracks the total area of certified properties so that she can follow up the percentage of area that is certified of the total area owned by Property.

Every indicator is uploaded as a separate file into the green building system together with the overall application where the grade that is wanted for the building is appended. The SGBC provides and Excel-sheet where all the indicator's grades can be input to arrive at a total grade for the building. This file is also sent in with the application.

The work of getting the indicators and verifying them involves gathering many things from the building and transforming them into something that can be put on a three-grade scale. The work of gathering all of this information and showing it to the SGBC provides a comprehensive review of the physical building, what is actually installed in it and its real-world performance in use. The work of gathering evidence for the certificate then also becomes an audit of the building and the builder's work.

All of this information is added to the application and sent in. If it is a new building, the verification process will require the coordinator to prove that the windows that have been installed are the ones that were used in the application. This can be done by looking at the codes or getting an invoice where the windows are specified. This is not always easy. As Jan says:

> And how can I prove that? Well I had to ask the SGBC, what do you want? Can't you tell me? We want an purchase order where it says that it is exactly these windows. Ok, then, but this project was done 2 years ago. But OK, I will phone the project manager who will phone the builder who will phone the subcontractor. Can I get a copy of the invoice for the windows in this house we built two years ago? Yes, but the invoice does not say exactly what windows are installed, just the price. Ok then, do you still have the purchase order from when you bought the windows? Yes. And then I had something to send to the SGBC.

[16] As seen above, with *Miljöbyggnad* one gets a score when the buildings is new, and then the score is verified 2 years later with actual measured data. Once verified, the building is certified for the rest of its life.

The verification that Jan described took place before the study. Now it is the builder's job to do the verification and to make sure that they have all the necessary documentation. The certificates have changed how the building process works. There is a greater emphasis on keeping records and there is a clearer notion of who is responsible for providing these records which can be used as evidence for the certificate. The vignette below shows a small part of the work of gathering evidence for a building which, while modern, was not built with certification in mind.

7.2.5 Vignette: Gathering evidence

This vignette shows how evidence is gathered from existing buildings.

The company has a policy to certify their buildings according to at least one of the many green standards that exist. This is a requirement for new buildings, but they also do it for existing ones. The sustainability officer (Emma) has an ongoing project to certify several of their modern, yet not certified while built, buildings. Emma wants to certify them using the same system that they have used for most of their new buildings: Miljöbyggnad. In the southern subsidiary, before they merged with the central one where Emma works, they had decided to use a simpler standard for certifying existing buildings. One of the first things Emma told me when I met her was that this certification took a lot more of her time than she had anticipated. Since then she had managed to get one existing building certified as Miljöbyggnad. A few months later, she sent in an application for the building where we were at the time of my observations, and she received a response that the application needed major revisions. She said that the person checking must have been a lot more picky than the one that checked the previous building.

For this building, the SGBC had requested revision to 11 of the 14 indicators. The whole process is done in a web tool that the SGBC has. Emma logs in there and can see all of her ongoing and finished certifications. She goes to indicator 3, where revision has been requested, it is red on the website. There is a comment from the SGBC about why it need revision. The SGBC says that the windows they have reported seem improbable. They are too good from a technical perspective, even for modern windows. They want screenshots from the online tool where Emma got the information about the window's specifications.

Emma did not save screenshots. She recorded the information

she had in an excel file. She found a code printed on the windows, measured their size, and noted where in the building they are. Figure 1 shows her photographing one of these codes with her phone.



Photograph 1: Reading and saving the code

The building has 4 types of windows, indicated by the codes: one type on almost all the windows facing east and west, and another facing north and south. There are also 2 special types: a fireproof window in a restaurant and a thin one for some strips on the façade. Emma says that the reason there is the same type on the north and south is that the building is shadowed by another building, so it gets about the same amount on sunlight from both sides. Her Excel file has codes, such as '6C-(50)-20AR-6', and a description that she has written such as '6mm sun-glass, 20mm argon, 6mm clear glass'. The file also has a light transmission

value, in percent; a U-value, that has to do with insulation, it is 1.1 for these windows; and a solar energy transmission value, in percent. She needs to open the online tool again and recreate what she did to move from the codes to the description.

The tool she has used to get the specifications of the windows is called Spectrum Online, it has been produced by a glass manufacturer. It does not seem to be designed for the purpose that Emma is using it for: one cannot just input the code and then get the window's specifications. Instead, one has to specify every glass, one at a time, and then the system will output the code and specifications. An example of the output is displayed in figure 5. This output is in Swedish. Emma looks for the U-value, which has been highlighted in red, and for the transmission values, which are visible in the figure at the top of the output. This shows how much sunlight is transmitted through the window (the yellow arrow) and how much energy is transmitted through the window (the red arrow). The product code, the one that Emma photographed on the actual window, is highlighted in blue.

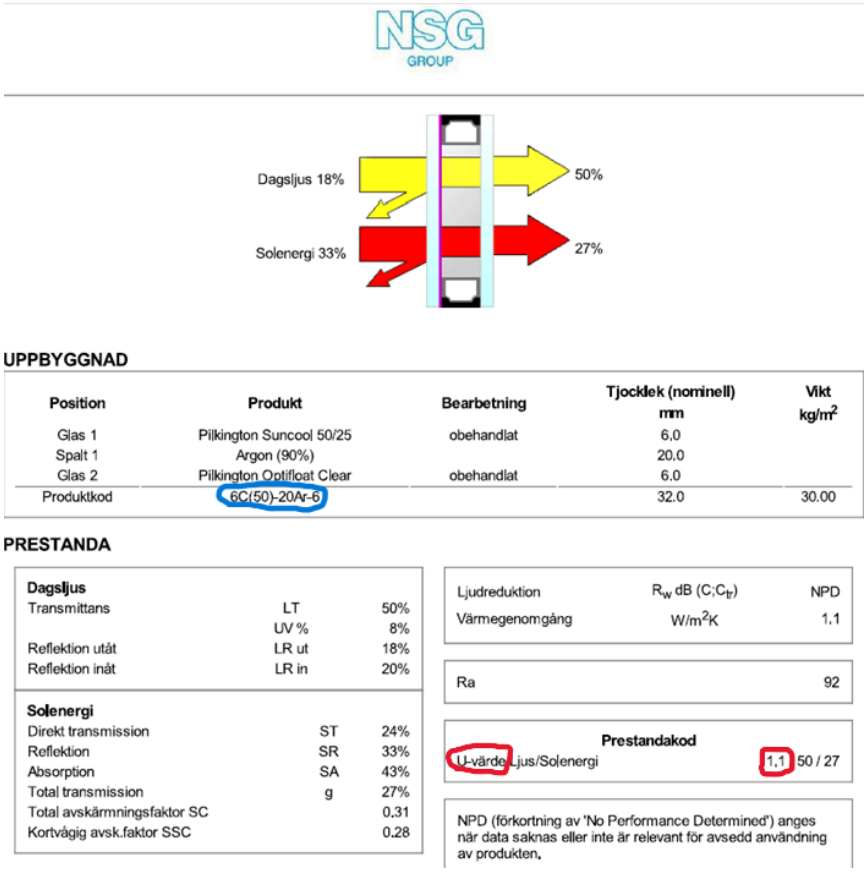


Figure 5: The output of the online window tool

Therefore, for all four glass types, Emma goes through different combinations of glass in order to find some that match the description, codes, and specifications that she has sent in. There are hundreds of types of glass to choose from, and they are categorised in the system by trade names: Suncool, Insulight, Activecool and so on. When she chooses a glass in the system it shows the thicknesses that that particular glass comes in. Often it does not come in a thickness that she wants, and the whole process needs to be started over. Emma has to find some that give the same properties for the entire window, while keeping the thicknesses the same, and not the trade name. Eventually she sees that the Suncool range seems to have the most types of thickness and gives a reasonably close specifications. The codes that she gets out do not always match exactly what is printed, perhaps the

builders ordered the windows especially for that building, or they have stopped producing those specific windows. She can now see that she must have reported light transmission incorrectly: it says 70% in her application, while the output from Spectrum Online says 50% for windows with sun-glass. So the SGBC was right in that the windows seemed too good.

Eventually she gets 4 screenshots that look like the ones in figure 5 and that match the description, but not always the code exactly. She saves them on her computer. She has a folder for every building that has ongoing certification and subfolders for the indicators. She opens the Word file for that indicator and adds the comments that the SGBC has to the Word file. She then writes in red that she has the wrong light transmission, but that light transmission does not affect indicator 3, which is the file she is working on, but only indicator 11. So the results should not change because of this. She also writes that the requested screenshots are appended to the file. She saves the file as a PDF and uploads to the SGBC system.

All of this took about 4 hours, and it only represents one, or perhaps two, of the 11 indicators that needed revision. Emma is somewhat displeased with the process. She says that she does not like the fact that the output looks so clean and has so many decimals and so on when the input is so unclear. It looks as though they are more certain of their windows than they actually are, even though there is nothing actually wrong with her methods.

This is representative of a type of work Emma does when no information is available with which to fill a form. A lot of her time is spent measuring and finding out things about the buildings that she manages and putting it together in reports and/or databases. Emma can enrol the building here, and speak for it to the SGBC, but she needs to say things that are reasonable; if she doesn't they will ask for proof, and she will have to get better arguments from the building and its windows, meters, ventilation systems, bricks and so on.

This vignette shows how the work of getting a certificate is not always straightforward; it requires both work in gathering the evidence and knowledge of where the evidence is located, in this case printed on the inside of the windows. This is a small part of gathering the evidence for two of the indicators, but it shows how much work goes into the certification process for already existing buildings, where the certificate is not something that will change the building in any material way; it will only be printed and hung up at the entrance. A modern building

like this is, to an outsider such as a visiting researcher, indistinguishable from a building that was built with certification in mind; however, for a certification process the difference is apparent. When the building was built it was done according to the infrastructure that existed at the time, which was in the process of changing to accommodate certification at the time of the study. This older building infrastructure and the emerging certification infrastructure collided here and caused a lot of work for the coordinator, work that cannot be considered infrastructuration (Edwards 2019) as it was unique to this particular building and done only once, although experiences such as this were used to form the emerging new infrastructure. The next vignette (7.3.4) will show a part of the coordinator's work with new buildings and their certificates and how the building infrastructure is merging with the certification infrastructure.

7.3 Building a system

Ordering, projecting and building a building is, in Sweden, a process that is established. However, the certification process has added and changed this in significant ways, beyond environmental improvements. Many actors are involved in building a building, such as the owner, architects, project manager, consultants, builders, subcontractors, and so on. The certification affects the work of all of these actor's in various ways and brings in new actors such as the issuer and specialised consultants. This is an ongoing process; the system for building and certifying buildings is not yet stable, but it is, according to the people at Property, a lot more predictable now than when they started certifying buildings about five years before the study took place. As the coordinator for Division Black explains:

> We didn't have an environmental building consultant, it was me that drove the project forward so to speak. As the environmental coordinator. And I had taken the courses but this was my first. I got, well, a hundred questions from consultants and builders and had to find the answers and such. (Sustainability Coordinator Division Black)

The coordinator explained his first attempt at certifying a building. None of the other actors knew what the certification meant, and they all came to him for answers. Today the builders, consultants, and coordinators have gone through the certification process a few times. They do not have to ask the coordinator about as many basic things.

During this study a lot of the early issues had been worked out and there were specialist consultants who could manage these projects and provide documents for the indicators that the coordinator cannot make, such as for moisture. Yet there were still problems, as shown in vignette 7.3.4, where unforeseen issues popped up and had to be dealt with manually in order to get acceptable data for the certificate. Whenever something like this showed up, there was often a comment about how this should have already been incorporated into the system, like the floor plan and touch down zones which were classified as workspaces by the issuer but not by the builder; the builder should have known this.

The first building that Property Blue built with a certificate was a car dealership. The car company's foreign head office had decided that all their dealerships should have a certified building. Property built it, at great expense according to a coordinator, and learned a lot about how to build a certified building in Sweden.

7.3.1 Coordinating

Getting the building companies to understand how important certification is for Property has taken some time. The tender offer that Property uses has changed over the years since they started reordering certified buildings to reflect how important certification is and to overcome some of the problems that they had in their first certifications. The tender offer that Property uses has hundreds of points in it that specify who is responsible for what. Certification is just a part of this and is a recent addition, and it is often down to the coordinator to make sure that everyone is working towards getting the building certified.

Property has had some troubles with building companies and their role in the certification process. There is no standard in the property business about how to handle problems that can occur in the certification process, such as the building failing verification. Property puts the required certificate in the tender offer and then the building company is supposed to deliver, but sometimes they don't live up to the requirements in practice. The largest ones don't have these problems because they have people who work specifically with this; it is the medium sized ones that Emma says sometimes has not taken the certificate process seriously, even acting nonchalantly throughout the entire process. And if there are problems when it comes to the building living up to the requirements there is no process for deciding who is supposed to fix problems with acquiring the certificate. They can have a situation in which they have to defend choices that the building company has made to the certi-

fication council, choices that they themselves do not agree with but that they have to defend anyway in order to try to get the building certified. Emma does not want to work in an environment where they can only use the large building companies due to the certifications; the small and medium-sized ones are better for some types of projects, and the building is the same; they just have to learn how to do the certification process.

Who should pay for the certificate is something that has been in question. When the verification i supposed to be done, the project has been finished for a year from the contractor's perspective, so unless it is specified in the tender offer then getting them to pay for the verification might be difficult. That can also put Property in an awkward position in which they might have to defend actions of the contractor that they don't agree with. It is better, from Property's perspective, for the contractor to do the verification, because then they have an incentive to not cut corners while building. The tender offer that they used in the previous year or so includes the verification as a separate paragraph so that it is clear to everyone that it is something that the builder has to do. They do have verifications now where they have to do it themselves, which is a lot of work and also not optimal. The builder, when they know how to do the certification, can keep all the documentation they need, while an external party needs to get it from the builder, who might not have sorted it with certification in mind.

During this study a car company was causing some troubles due to Property's requirements for certification. This company had a floor plan for all their dealerships worldwide, which was incompatible with certification. This was because the manager's office was supposed to be in the centre of the building, where it would not get enough sunlight. In order to get a certified building, they would have to either move the manager's office or install some sort of light duct that would bring sunlight into the centre. Both of these solutions would change the building from what the car company's head office wanted, but would allow the building to be certified. There is also the possibility of building a building that won't be certified. In this case, it is Division Blue that have to convince the head office that it is the only practical solution.

7.3.2 The issuer

The issuers of the certificates also need to be managed by both Property and all of the others involved with certification. There has been a lot of frustration about how to deal with the issuers. People are sometimes polite and say that they are unnecessarily bureaucratic while others

sometimes say that they are idiots, followed by eye-rolling.

This shows itself in different facets of the certification process – perhaps particularly in the way they communicate. There is no way to initiate a dialogue with the issuers; all communication is done with forms that are sent in and then replied to. This makes any form of discussion or compromise difficult.

In one case a coordinator had not noticed that some evidence needed to be amended to the verification application. Rather than contacting him to tell him that this was missing the issuer sent a notice stating that the certificates had been revoked. There was no way to call someone and talk to them about this; instead, the coordinator had to use forms to try to get some sort of dialogue going. Eventually, they had to reapply in order to get the certificate back. Other people have told stories of how they received no response to their questions so they go to their manager, who would get a prompt response to the same question from the certificate issuer.

Property's policy of certifying all of their new buildings can also lead to extra work for the coordinator because all buildings includes warehouses and industrial buildings, and because these types of buildings are not something that the issuer seems used to certifying. They cannot have the sort of daylight that offices have in all the places where people could work. A warehouse is often just a box of corrugated metal that for practical reasons does not have much light intake. Here the role of Property has been to convince the issuer that the whole warehouse does not constitute a workspace, even though people work there, and focus more on the offices and other areas that are made for housing people that work.

For new buildings, there is often a consultant who has the authority to submit an application for certification on Property's behalf. However, for existing buildings, the coordinators were the ones who submitted the application. Not having a consultant do the application seemed like an anomaly. Emma would often get her applications sent back for review because she had not filled in the line on the form where one is supposed to write the name of the person who is allowed to apply on behalf of the building's owner. Emma would then have to fill in a form on the issuer's website, where she points out that they do not have a consultant and asks what she should put in that field instead. After a while she would get an email saying that she has received a reply and that she should go into the system to look at it. The reply would say that she is invited to submit again and that it would go through the formality check this time.

7.3.3 The certificate's role in building

The certificate changes many parts of an already complicated system with many actors. They all need to use the certificate if it is to play a role.

The process of certifying moves the accountability for the builder and building to a third party as well as the client and eventual owner.

It has taken some years for the system around these certificates to stabilise in the way they were at the time of the study. The building company, Property, the tenants and the subcontractors and consultants have learned from their problems in the past and found routines for avoiding them in the future. They are moving towards taking certification for granted in the building process; today, it is still something that is added to the building infrastructure, but that is starting to become the norm for certain types of buildings.

This is an ongoing process, and is much more stable now than it was when they started doing certifications. Many of the people say that the current infrastructure, comprising of routines, knowledge about the certificates, and devices like the tender offer, has solved most of the problems that they used to experience, especially with new buildings. As seen in vignette 7.3.4 problems can still occur. The main issue was that the builder and the certification authority had different views on whether the touch down zones were to be classified as workspaces or not. Emma expressed disappointment that nobody had thought of this beforehand and that these workplaces should not be the way that they are.

The system today has many similar snags that were eventually overcome. When a new project is undertaken, these, and other mistakes will not repeat themselves. The coordinator and others often talk about snags that they have hit in the past and how to avoid them in current projects.

7.3.4 Vignette: Saving a certificate

The following vignette shows how different actors coordinate to save a certificate that is in trouble.

> Emma came into contact with the potential issues with certificates during meetings with the consultants that Property had employed to help with the certification of a large new office building. This meeting was held at the construction site for the new building. I

have never been to a construction site before. Because I didn't have a proper access card, I had to go though the back door while Emma could go though a turnstile after scanning her card.

There were 5 people there besides me; I had never seen any of them before, except for Emma. There was Kerstin, from Build, the builder; Bengt, who was a consultant employed by Property; and Maria and Ulla, who worked for a consultant that does certifications. Bengt was responsible for the entire construction project, including the certificate, and has set up the meeting. Maria also worked for Property, specifically with the certificate, and Ulla worked for Build, also with the certificate.

Emma wonders what we are to discuss at this meeting. Bengt says that he wants to make sure that Build are doing what they should and that we are on track to becoming certified. Maria says that a lot has happened since the summer. They have had a few meetings without Emma.

Emma says that Property has started selling green bonds. They will require BREEAM Excellent or Miljöbyggnad Silver. She does not know if that is from Property or the investors. The others seem to think that this is a bit strange. Excellent is a lot more than just Silver. Silver is not particularly special at this point. Emma repeats that she will have to figure out how it has been decided that this is the required level.

Kerstin says that Maria can start her presentation. Maria says that they have collected many pieces of evidence over the summer; they have gone from 18 to 29 finished pieces. There are also 4 to 5 pieces that need to be fixed and that won't take more than a few weeks. There are others that need to be checked against the conditions on the site. They need 54 pieces of evidence in total and about half of those that are left are not very difficult.

They then start talking about the main problem; this is something that they have gone over before. It has to do with the work areas that are designated as touch-down. These are areas that are used by visitors or people who are seldom in the office. The main problem is that a lot of them sit more than 7 metres from a window. This has escalated recently. They used to use floor 3 for calculations as a typical floor, but it was atypical in that it didn't have these touch-down areas. Now there are 727 workspaces: this has increased by 80 with touch down.

Floor 5 had touch down from the beginning, but it was not taken

into account. Maria has asked both the Swedish and international standard setters for the certification and they both gave a negative reply for them. She had hoped that one would give a positive reply and they could then use that as leverage against the other. They have the answer from the certificate issuer with them. If a workspace is designed to be used for more than 30 minutes at a time then it is a workspace and needs to conform to the requirements of one. That means that it needs to have a view and therefore it cannot be more than 7 metres from the outside wall. Maria brings up the floor plan for floor 5 on the beamer. They have circled the touch down areas in red. Maybe they can re-designate them as telephone areas or something. They joke a bit about being able to put up a sign that says that they cannot be used for more than 30 minutes – or that they should turn off the electricity after 29 minutes.

Emma wonders whose requirement it is that the building has touch-down places. It is the tenants, says Bengt.

Bengt says that moving things now will cause problems with the tenants. Emma points at one of the touchdowns and asks if it can be swapped with a meeting area that is closer to a window. Bengt says that they are probably in different departments, so they want their own touchdowns and meeting spaces.

Bengt repeats that if the problematic zones are classified as workspaces, then they would need lighting too, 500 lux. And the workers need to be able to control the lights. Kerstin says that it will be consumption of media too.

Maria says that they won't solve this today. Bengt says that the cause of the problem is the view, the lighting and the zoning. Parking is affected, but it is not a problem. There is a slight problem with bike parking. They need to build one or two extra showers if they want the points for bike parking as well as a drying room and lockers. They need two separate showers for men and women, or they need to make the showers lockable and designate them as unisex.

Emma says that it is a shame that the certification does not seem to keep pace with building types now. Someone should have known this from the beginning. All real work spaces are properly placed. The designer must have assumed that touch down areas are not workspaces.

Bengt asks how many questions they can ask BREEAM. Maria replies 6 or 8. After that it costs money, but it might be worth it because it is better to know now than after the building is done.

Maria asks if Property has any other questions. Bengt says no.

They talk about what they can do. Without a view there is nothing that can be done. It will not be an acceptable workspace. If there is something with energy then they will have to write an explanation. Emma says that the number of users cannot vary too much in the different evidence they send in. She asks again if there is a way of calculating the average use of these touch down spots. There is none says Maria, but they usually work with 70% use, but that is higher than what they have experienced in practice. They talk about visiting after the building is finished. Maria says that she cannot say when the visit will be.

Emma says that these touch down zones were a bad idea from the start. They are in bad places for doing work and they probably should never have been there. It will make the tenants unhappy.

Bengt then asks if Maria and Ulla think that Build are doing their job because it is he who is responsible to Property for getting the building certified. They say that it is on track.

The building was eventually certified by changing the floor plans so that the touch down zones were in places that were acceptable workspaces for the issuer. I was not present when this happened, Emma told me about it later. She did not know exactly how the floor plan was changed only that it was acceptable.

This vignette illustrates the work that goes into getting a certificate and how it requires the coordination of several different actors. It also shows how new actors are brought in, for instance the green bonds which are only mentioned in passing but bring finance to the building and certification process. If one of the actors does not take everything into account then the whole process could fail. In this case it was saved but it required a lot of extra work. This also shows how the certificate changes the buildings itself, they had to change the floor plan in order to get the certificate. For the tenants, who only see that the building has a certificate, this work done to get the certificate is transparent.

7.4 The certification infrastructure

Certificate work, specifically the type for individual building certificates, starts with choosing what certificate to apply for. At Property the default certificate was *Miljöbyggnad*, but they would select another certificate if there was demand for a specific certificate by a specific tenant or similar. The *Miljöbyggnad* certificate has 14 indicators and these cannot

be swapped out for other indicators. It also requires verification with data from the building two years after the certificate has been approved. Getting this data and the evidence for the indicators is a lot of work. Certificate work places requirements on many parts of the building. It is a fragile process and can fail at any single point. This requires that the certificate work not neglect any part or risk the failure of the entire certificate.

In order to produce evidence and have that evidence be good enough the actors involved with the building are required to incorporate the certificate in their work. Because the certificate work can fail at a single point, the coordinator has to make sure that there are no failures in the work. If there are no accounts, this is done by finding acceptable referents either in the building or in some documentation from the builder or one of the subcontractors. If the accounts are not good enough then the coordinator needs to change the referent in some way.

In this way the process of getting a certificate is more akin to a heterogeneous network than a chain. But it can fail at many points in the network. It is also still linked to the physical building and is attached to the building, yet it is still mobile.

The certification infrastructure needs numbers from the consumption system and, in that way, relies on the old economic infrastructure.The numbers are the same. Certification of new buildings requires coordinators from both the builder and Property, and when the infrastructure breaks down, as seen in section 7.3.4, it becomes evident that it exists and causes problems beyond not just getting a certificate. When it does not break down, it is transparent; the work done is not visible to those outside the infrastructure, such as the tenants who only see that the certificate is there.

The boundaries that come from the old economic infrastructure, such as between tenant and landlord, are still there in the separation of operations media and building media, and new boundaries are drawn such as between actual consumption and climate-compensated consumption, which boundaries out the weather. These boundaries are what allows the building to be accounted for as such, without its tenants or the weather. These calculations were originally made by the economic infrastructure, but have been adapted and used by the certification infrastructure.

7.4.1 Attaching the certificate

For existing buildings, where the coordinator has deemed it possible to get a certificate, the attachment process means attaching all of the in-

dicators to the building simultaneously. The indicators are very different and require different methods in order to attach them. Some are related to others and can be done at the same time; others use the infrastructure from chapter 6 that measures and classifies consumption. But this is not the only part of an infrastructure that is used, as *Miljöbyggnad* is based on Swedish norms for buildings. A lot of the work for the *Miljöbyggnad* system is already built in to the infrastructure required to build a building in Sweden. It is the coordinator who makes sure that these processes are all proceeding, by using Excel sheets to keep track of them or by working with a consultant. Either way, the coordinator is responsible for the attachment of the certificate to the building.

The buildings themselves and the infrastructure built into them are pivotal (Millo, Panourgias and Zachariadis 2019) actors when constructing the sustainability reporting infrastructure and the certification infrastructure. Getting a certificate requires the building to conform to the demands of the certificate, and as seen in vignette 7.3.4 and vignette 7.2.5 there is a limited scope to reframe the building as something that fits the certificate when it is already built. The infrastructure of economic boundary making and consumption measurement is also pivotal, as it is a source of numbers that are seen as representations of the building and its consumption.

The infrastructuration process that uses these objects, the meters and windows and so on, and the boundaries that are created by the economic infrastructure puts these boundaries in a position of being pivotal. Without these boundaries, the sustainability infrastructure could not be built the way that they are. Part of the infrastructuration, the building and the maintenance of the sustainability reporting infrastructure is to make the boundaries from the consumption infrastructure work for the sustainability infrastructure.

The certificate authorities are pivotal for their certificates as they are the ones that ultimately determine if a building can have a certificate or not. They run the online system where applications are sent in and processed and decide how the coordinator should communicate with them.

The picture here complements the one made by Georg and Justesen (2017) in that the type of certificates cannot be framed by the people that commission or construct the building but is defined by a third party, the SGBC. The SGBC is another actor that needs to be mobilised and doing so constrains the action that is possible by the others.

This restricts the degrees of freedom in how the building can look,

what materials can be used and even how it can be furnished. If someone goes outside these restrictions, then the whole certificate is at risk.

Scaling can also be seen in the way that the coordinator is able to turn ad hoc processes, such as getting a certificate for an existing building, where a lot of work goes into documenting the building to a more stable infrastructure where the building is built and documented at the outset. This is a much more stable process. It is still not completely rigid, however, as seen in vignette 7.3.4, where the building's floor plan was altered to accommodate the certificate without changing much of the physical building.

7.4.2 The relationship with the consumption infrastructure

The certification infrastructure is built on other older infrastructures. *Miljöbyggnad* is specifically designed to follow Swedish building norms. But certificates, and the logic behind them, are not new. Most people who work with certificates know that one sends in files to an evaluator and gets back a label to use. This is something that needs to be learned. Learning how one certificate authority works is transferable to others because the process is similar. However, the sustainability workers have to learn the specifics of the individual certificates and their corresponding issuers' specific needs. Getting the information from the building to the certificate authority's website involves the sustainability worker's knowledge of buildings, their norms and existing infrastructures as well as the infrastructure for measuring consumption.

Boundary infrastructures, like boundary objects, can act as different things in different settings, and therefore offer a sort of flexibility in possible action. They are also infrastructures which are stable and allow action to be done while at the same time constraining what is possible. The sustainability reporting infrastructure and the certification infrastructure can both be seen as boundary infrastructures as they possess these traits. The certificates can be seen as a boundary object that can play different roles for different actors. For a tenant, it can be a part of their sustainability goals or signals, while for a builder it is a problem to be solved. The building, for a tenant, is a place to do work, while for the coordinator it is a referent that needs to be represented. For a property manager it is a cost that should be kept down while still allowing tenants to do their work and be comfortable.

The sustainability infrastructure is built on the old economic infrastructure and uses it to create numbers that are useful. But it also changes the economic infrastructure. The meters for media in older

buildings are put there in order to separate who should pay for what flows of media. This is then transferred into sustainability work as the boundaries that are accepted for payment are also acceptable for accounting for sustainability. The requirement for certificates for new buildings changes the way that acceptable boundaries are drawn using meters. Newer certified buildings have more meters than older ones, allowing for both separating who should pay and calculating consumption in a more fine-grained way. As the meters are still used for both economic and sustainability calculations, the boundaries that they draw generate numbers that are able to represent consumption and enable the resulting accounts to travel outside the building.

The boundaries that the consumption infrastructure draws are used by the certificate infrastructure, in that energy use is calculated for the building and not the tenants and the weather needs to be compensated for. These boundaries affect what evidence is possible to gather and how. The certificate work also affects the consumption infrastructure by requiring the installatiob of more meters so as to measure energy use in a more granular way. The certificate infrastructure also draws its own boundaries; depending on the certificate, the certificate and its indicators define what sustainability becomes in practice. It therefore draws boundaries around what is sustainable and what is non-sustainable.

7.4.3 Infrastructuration and changing the old infrastructure

When the infrastructure for reporting is fixed in the building, it cannot be easily changed to anything else. Even if the certificate expires, the meters, windows, sunshades and so on will still be in place. They are part of both the consumption and certification infrastructures. The consumption infrastructure has its boundaries drawn more by meters in newer, certified, buildings and less so in older buildings. The certification infrastructure, and other types of sustainability reporting, in this case did not question the validity of the boundaries in older buildings, yet in newer ones have more meters for the same purpose, measuring flow in different places. One of the reasons that meters in older buildings do not represent the economic boundaries between tenants and the building or different tenants is that the building's use has changed over time and has gone from a single tenant to multiple tenants, from industry to offices and so on. The meters that were installed matched the economic boundaries at the time of installation. It remains to be seen if the newer building's use will change and how both economic and sustainability boundaries will then be drawn.

The meters and the other physical parts of the infrastructure, as well as the established boundaries used for economic calculations determine where the sustainability reporting infrastructure can draw boundaries, where the accounting entity is and whether the numbers can represent the building. The range of action for the coordinator is limited by these infrastructures and the infrastructures change slowly over time as new buildings are built. Even though the meters in older buildings do not meet the requirements for getting a certificate, they are still considered valid for the economic infrastructure, where they are the basis for costs, and therefore the sustainability infrastructure, where they are the basis for consumption of energy. It is not the technical nature of the meters that makes them function; it is that their use is accepted and taken for granted by the actors that use them.

The choice of certificate affects all of the actors involved with the building, even though the decision itself is not made in one specific place. The certificate decides what information needs to be found and what information is acceptable. Even with similar certificates there are differences in the scope and flexibility that affect how a building will look as well as how the certificate work is carried out.

The process of getting certified has become more standardised as all of the actors learn how to mobilise each other. At the time of the study, it was an emergent phenomenon and was still in flux, although it was considered to be moving towards being settled. This is particularly noticable in the procurement contract, where Property has learned that they need to make the builder responsible for getting the building certified. This is also the case with other actors, like the consultants, who learned in vignette 7.3.4 that touchdown zones are considered to be work spaces and need daylight. They had to change the floor plan to make it acceptable.

The certificate performs several roles, just as Mouritsen, Ernst and Jørgensen (2000) showed with ISO-certification, where the certificate performed different roles in different organisations, alongside the environmental role that was its intended purpose. With regards to certificates for buildings in Property, these certificates play many different roles *simultaneously* within the same organisation. The certificate is a device for controlling the builder and for making the building different from what it would be otherwise. It defines how windows, workspaces, meters, ventilation and so on have to be made and placed and how communication with tenants and potential tenants takes place.

When the certificate is in place it has brought in and stabilised a

new boundary infrastructure that contains the certificate authority, the building, the meters and other physical parts of the building as well as the coordinator and the other actors who are involved in the certificate work. The certificate is a boundary object that can be used in different ways by different actors, but it is also an infrastructure that constrains what is possible to do with the building. The certificate is placed in a pivotal (Millo, Panourgias and Zachariadis 2019) position in whivh the certificate can decide what, in practice, sustainability work is.

8 Reporting

8.1 Preparing the accounts

The production of numbers described in the previous chapters also involves the use of the numbers and the reporting to outsiders such as the SGBC. There is no clear-cut line between the categories of production and the use of accounting here, but for the sake of analysis, the use in this chapter will differ from the others in that the accounts are produced for a specific user at a specific time, sometimes cyclically and often in a specific place while the others are continually refined systems, which are always there and being used by different people continuously. Here some of these uses are presented, those done by the sustainability coordinators as part of their daily work.

The use of accounting described here uses the consumption and certification infrastructures, that move consumption out of the building and certificates into the building in different ways. The accounts are translated to be relevant and useful for from the coordinator's perspective, the end user. The end users, people who are outside the company, have different relationships with Property and different needs for accounting information. This can also vary from setting to setting for the same user.

Some users, such as energy suppliers, are part of the consumption infrastructure. The tenants, on the other hand, are ones that the consumption infrastructure and the certification in many ways are trying not to take into account, as the media they use is operations media. The consumption infrastructure in particular is designed to separate the building's consumption from the tenant's. The certificates in some cases enforce this separation and in other cases take tenants into account, for instance when judging air quality, and also other actors, such as suppliers.

Use here, then is for the coordinator the final translations from the monitoring systems and the related infrastructures, with other information added from other sources, for the external users, and how these are sent to the users and what the coordinator receives back. This differs from the processes described previously in that these are translated for very specific users at the time of production of the accounts and the production process is done in a more or less ad hoc and tailored manner to what the user is perceived as wanting. The examples below are all part of an ongoing dialogue but also examples of events where accounting is used and translated in a single time and place.

8.2 Reporting to an evaluator

Property reports its sustainability numbers not only in the annual report but also to organisations that evaluate their sustainability work. These external evaluators are much like the certificate issuer from chapter 7, and the communication works in a similar way. It differs in that the communication is only between Property and the issuer while individual building certifications draw in other actors, such as the builder, into the process.

Some of these give them a label and others evaluate whether their stock can be considered a green investment. One of the more important organisations for the sustainability chief is Green Globe (GG). This is an international evaluator that grades listed companies all over the world on their sustainability work. GG send the sustainability chief a survey every year and also request data on all of Property's buildings.

GG's survey is 95 pages long and covers a wide range of topics. The survey also shows how Property is doing in relation to other property companies. This is displayed as a percentage for each option. The sustainability chief uses this survey to see what information he thinks outsiders want and he adjusts the large spreadsheet based on the survey. He said this during a meeting and gave an example: he recently added water consumption to the large spreadsheet, something that was considered unproblematic in Sweden but since GG is an international organisation, they request it from everyone.

There are some differences in the way GG wants the data compared with how Property collects it in the spreadsheet. Energy is not classified as a type by GG as it is in the internal spreadsheet, where it is classified by type: oil, gas, district and so on. In GG it is only reported per greenhouse gas scope, so oil and gas are scope 1[17], and electricity and district heat are scope 2. The information cannot then just be copied from the internal spreadsheet to the GG spreadsheet but needs to be manually added together by scope before it represents what GG wants.

The sustainability coordinator does this by getting a special copy of the large spreadsheet which can be altered, from the sustainability chief. The official version of the file is locked down and the coordinators in the divisions cannot change it except to add their data. With the open file the coordinator is free to add new columns and can calculate the energy use by scope.

This means summing the CO_2e for all of the columns that are scope 1 and then pasting that column from the large spreadsheet to the GG

[17] Greenhouse gas scopes are explained in section 6.3.4.

spreadsheet. It includes all of the buildings for the entire group, over 500 rows, so checking that everything is exactly the same is time-consuming. The same is done for scope 2, but there, building electricity is also added, as both electricity and heat belong to scope 2.

Another difference is that GG wants area in a different way than Property calculates it. They want area in terms of data coverage; that is how much area do they have where energy use is measured compared with the total possible area that could be measured. This causes some problems for adding up the data in scope 2. Property has the data for how large an area in every building is measured for every type of energy that goes into scope 2, but these overlap. A normal office building will have electricity, district heat and, sometimes, cooling that covers the same space. So simply adding the measured areas would result in an area that is much larger than the building's area.

The coordinator solves this problem by making a column with the largest values of the areas measured in scope 2 for each building. This results in the area where they have the most coverage for scope 2. Then the coordinator makes a new column and subtracts these figures from the property's official area figure, in order to see if any of the results are negative. A negative result would indicate that the measured area is still larger than the property's total area and would mean that something is wrong with the measured areas. If there are no negative numbers, then the coordinator can paste the column with the largest areas into the Green Globe spreadsheet.

For waste, Property does not have a measured area and does not have much data at all compared with energy use. This is changing, and both Property and the companies they use for waste management are measuring and classifying waste. For waste, data coverage is in percent. Because there are not many buildings that have data for waste the coordinator can manually set all of them to 100% where there is data and then set all the rest to 0%. The data that Property has for waste is in tonnes for each category; they have three: hazardous, recycled and incinerated. GG wants tonnes for hazardous, landfill and deferred. Deferred is then split into three categories, one of which is recycled, and is reported as a percentage. Property only has recycled deferred waste, so the coordinator puts the total tonnes of recycled as deferred and then recycled at 100%.

This work changes the large spreadsheet into a new spreadsheet that is just as large as the original. It has the same information but translated so that it is useful to the Green Globe rather than Property. For Property

it is important to differentiate between different types of energy in order to manage the properties and know what suppliers they have, while for Green Globe only the impact in terms of CO_2e and scope is important. Area coverage is in a percentage for Green Globe and absolute values for Property. Percentage values are comparable to other percentage values and allow comparisons between different companies and buildings.

The translation from specific to general and comparable is, at the same time, specific to what Green Globe wants and finds useful.

8.3 Reporting to suppliers

Labels, meters and accounting come together when dealing with suppliers. Property has many suppliers and that are in many different businesses that provide them with different things. They have everything from providers of electricity or water to contractors that do everything from providing turn-key buildings to fixing broken fans and shovelling snow. The sustainability coordinator is involved in many facets of managing these suppliers, from choosing and evaluating suppliers for the whole division to contracting suppliers for sustainability work. The following vignette shows a meeting with a heat supplier where Emma joined because it concerned the use of biogas instead of natural gas, which made it a sustainability issue.

8.3.1 Vignette: meeting suppliers

The following vignette shows how different actors are brought together in order to make a decision that involves both money and sustainability.

There was a meeting between Emma, Jan, Henrik and a local gas company. The gas company is part of a municipally owned energy company that also delivers district heat and electricity, and both the subsidiaries had many dealings with them before. The meeting was ostensibly about Epsilon switching from natural gas to biogas, something that Delta had already done. There had been a meeting 2 years earlier but Epsilon had then decided that they should wait until they could be certain that the energy company had the capacity to deliver the gas. It was not felt that they could guarantee that they had enough capacity back then.

All six people sit down in a meeting room. Sven, one of the sellers from the energy company, takes out his computer and puts in on the

table and asks if he should give a presentation. Emma says no, they don't need one. 'We want to know what you have and what it costs.' Sven starts talking about their new biogas facility. 'We offer biogas made in this town.' He seems very proud of this facility. He says that it has received a lot of international and national attention; they have had over 1300 visitors and they have gotten 222 million SEK in grants from the Swedish Energy Agency. However, it is not profitable; 'the market conditions need to change' he says. The new facility makes biogas from forest industry waste; it has less than 80g of CO_2 per kWh. There is also biogas made from food waste, it has 110g of CO_2 per kWh. Emma wonders where these numbers come from; they seem quite high. Do they include transport? Everything is included, says Sven. Emma says that 'We don't want numbers that include transport.' They don't measure it that way in the property industry; they follow GHG scope 2 and only measure the CO_2 generated directly from energy generation.

Jan, who already bought biogas from the energy company and had signed an agreement 6 months earlier, also thinks these numbers seem high. He remembers something like 30g CO_2 per kWh. Sven seems confused at this number; he wonders if it was per megajoule. 'No,' says Jan. He distinctly remembers around 30g, which he could compare to other types of energy that they use.

Emma says 'Excuse me but I don't understand. How can there be CO_2 added?' The process that he describes with the use of forest waste should not add any fossil CO_2 to the atmosphere because the cycle is so short. Sven draws 3 figures on the whiteboard. They represent fossil, capture and circular. He says that the way they calculate CO_2 comes from vehicle industry norms and some of the CO_2 that is produced will be neutralised again but the norms do not take that into account and it will look like a net added amount of CO_2.

He then gives a short speech. He says that the CO_2 is not the most important part. The important part is that they have a chance to be part of the local circular economy. The gas is made locally from forest waste. Local forest owners could not survive at today's low timber prices if it wasn't for the energy company buying their waste and making gas out of it. Property is a big local actor and can play an important role here. 'You have a fantastic opportunity to be part of the local cycle.' The plant produces 160 GWh of biogas per year. The biogas from food waste is produced at another plant

150 km away: 'If we don't make biogas, then there is no reason to collect food waste.' The gas is made into a raw gas, upgraded to a standard and put onto the network. Most of it is used to power vehicles. There is no shortage today and they have ample capacity to expand into heating buildings.

Sven starts talking again. 'How do you communicate with your tenants about the environmental utility that you do?' He has a large sticker with a B on it on his computer. He points to it and says that the biogas industry has developed a symbol. 'You have probably seen it.' They don't look like they recognise it. 'The advantage of a well known symbol is that you don't have to do the marketing yourself.' The symbol is owned by and organisation called the biogas academy. You pay them and they send the printed symbols that you can use. The symbol is technically owned by a trust. Jan says that 'we want to be seen'. 'You are of course an environmental hero anyway,' says Sven.

Emma switches the subject to price. Niklas takes over again. The price for the new division is the same as Jan's old one: 0.69 SEK. Emma looks at the offer and asks what a MWhU (Under) is. It is the unit they use in the gas business. U is what the consumer sees. It can be used just like MWh. Between gas traders they use MWhO (Over). They said that they have tried to be as clear as possible but that they have instead been confusing. They don't seem to be willing to compromise on the price. Sven asks if there is any value in them having a lot of flexibility in their contract. They could probably do that without changing the price much. Emma and Henrik don't see that they need a lot of flexibility, they have flagged a few of the gas using buildings as ones that they might sell and those they need to be able to cut off at a shorter notice than the regular contract. Normally a contract is 2 years.

'We've got facts and price,' says Emma. There is no panic. Local Energy needs one month's notice before the current contract expires. That is 4 months away. Sven gets the last word, saying that it is important that it doesn't just become a question of price. And that they have 'the coolest biogas in the world'.

Vignette 8.3.1 shows how money, energy, CO_2, geography, local markets, and certificates all performed roles in the discussion of whether or not to buy biogas instead of natural gas.

Biogas is more expensive than natural gas, and the meeting revolves around whether or not it is worth it for Property despite the higher price.

The CO_2 that the energy people use is much higher than what is used by the people at Property. Apparently they use a method of calculating CO_2 per kWh that is common in the transportation industry and that differs significantly from the method used in the property industry. Emma wonders if this has to do with transport. It could be because the fuel used for transporting the raw materials that make up the gas is also accounted for. Nobody can explain exactly what the difference is, but it must have to do with issues such as this, not how much CO_2 is added by burning the biogas itself. They differ in what CO_2 Property should account for as being caused by their business. The boundaries of the consumption infrastructure are not the same for the transport industry and the property industry. This shows that the boundaries that the consumption infrastructure sets are not given but are a result of choices and negotiations built on the old economic infrastructure where potential controversies are settled.

8.4 Reporting to tenants

The sustainability coordinator also meets tenants regularly. This is because of a device known as the green rental agreement, which is an amendment to the contract between Property and the tenant. The green contract is drawn up by the Swedish property owners' association. It is entirely voluntary and has about 50 clauses that can be filled in. The main clause, for Emma's work, is that the tenant and the landlord should have a regular meeting where they discuss sustainability issues and draw up an action plan of what to do which is followed up at the next meeting.

8.4.1 Vignette: follow-up meeting

This vignette shows how the coordinator manages the complexity of what is supposed to be a routine follow-up meeting with a tenant.

> The meeting took place at the tenant's premises. The building is being rebuilt with a new glass facade. There is a lot of work underway and Sofia, the property manager, says that the heat is turned off. The offices are downstairs. Emma points out that they have electric radiators plugged in. We meet Karin and Ella, who describe themselves as working with finances as well as the environment for the tenant.
>
> Sofia starts by apologising about the building work. She says that she knows that it is quite bad. During the meeting we are in-

terrupted several times the sound of drilling coming from somewhere in the building and there is constant background noise because the ventilation is going full blast. Because the heat is off they run hot air though the ventilation instead in order to keep the temperature up. The room that we are in is quite dark. We are under the ground floor. There are windows to another room on one side but they are covered in plastic and don't let in much light.

Ella says that it is difficult to work. There is constant noise, and there is no time to go out and get a change of scene. All the people who work there are feeling bad because of it. Sofia says that she understands, and that the construction is very intense. It will be completed in a shorter time but might be more uncomfortable during that time. Most of the noisy work is done at night, but the contractor cannot foresee exactly what will be noisy, some work that they said was not noisy has propagated in the building in unexpected ways, causing noise.

Sofia has a copy of the green amendment that she uses as an itinerary. Most of the points are quickly skipped over but they discuss some of them. Both Sofia and Karin have saved their notes from last year's meeting, and they use them for reference.

Sofia has printed the output from the energy monitoring system, but the diagrams are cut off. Emma wonders how she could get such a bad output. They have to look at the numbers instead of the graphs. They start going over the green contract. They mostly have the mandatory points. They talk about the company certifications first. The tenant has Miljöbas[a] and so does Property Blue. Property are, however getting ISO 14000.

The tenant is working to reduce paper use, which is rather ironic for a computer company, they remark; however, there is a lot of paper, specifically in the finance department. They have new stores and will mostly focus on them; they have also closed two stores and bought a company with three stores. Everyone is writing in their notebooks about this.

They talk about waste. Karin and Ella wonder if there will every be a place where they can throw food waste. Now food is mixed with general waste that is supposed to be incinerated, and they wonder if they will have a bin for food waste for composting. Sofia says that the waste room, or environmental room, in their building is jointly owned and run by an association of four companies and it has been difficult to fit an extra bin there. Sofia has heard that another waste

room in a connected building has a bin for food waste; she has started discussions with them about allowing her tenants to use that bin.

Part of the itinerary is about energy, both Sofia and Karin have energy data with them. Sofia has the almost unusable prints and Karin has some invoices for their electricity bill. They decide that, due to the rebuilding, this data will soon be outdated, as the new building will hopefully be more efficient, so they do not write down any concrete goals to discuss next year.

They talk about the shop area; it has recently been remodelled. The manufacturer of the products that they sell has very strict requirements on how the shops should look; they specify everything from what tables they should use to how the lighting should be installed. So the shop does not have much freedom to influence how their decor and furniture affect sustainability. Ella has contacted the furniture manufacturer, a German company, and asked for their environmental certificates.

They have done what they can; however, they use the old furniture from the shop as their new office furniture and they have taken what they can to their new shops in other areas. They seem quite pleased with this.

Before we leave, Sofia has some more information about the rebuilding. There will be a new entrance to the parking garage around the corner of the shop. There had been some problems with youths hanging around at that corner. They had tried to address this by making it more pleasant and adding benches and plants; this did not work, however, and they have given the benches to the council. The council has moved them to a park further away. They hope that the new entrance will make more people move through the area and shift the unwanted behaviour somewhere else.

Sofia ends by again apologising for the building work and the problems that it is causing, and hopes that it will all be worthwhile in the end.

[a] A certificate given by the municipality.

While the rebuilding was not really on the agenda for the meeting, it came up as it was impossible to ignore due to the noise from the ventilation and that the windows of the meeting room were covered in paper. This was used to inform the tenant that after the rebuilding, they would have a green certificate for the building, something which seemed to be positively received by the tenant. The meeting contained both practical issues, such as the remodelling and waste management, as

well as both sides accounting for what they were doing when it comes to sustainability and how they are ensuring that the people they work with are also working with sustainability. They have a formal itinerary that was drawn up at last year's meeting but they only use it to check that they have not missed anything that they were supposed to talk about when they check it; often it turns out that they had already discussed things that were to come later.

The rebuilding also led to a refocus on what accounting made relevant, as the consumption information was considered to be irrelevant because the consumption would be different after the remodeling; therefore, comparing numbers between these periods would not be useful. The remodeling itself also caused abnormal consumption as the heat was turned off and the ventilation was used for heating.

Emma used to do this type of green amendment follow-up herself. But because the green amendment is becoming common the property managers will have to do this themselves as Emma will not have the time. Emma is there in the transition phase to support the property manager and give feedback about what to do. In the future, Emma will have less direct contact with tenants. Currently, they have over 15 green amendments, but the pace is increasing. The very first green amendment was signed in 2011; that version was a prototype of sorts for a tenant who was interested in being ahead of the curve when it came to sustainability. In 2012, the Swedish property owners' association came out with their template for a green amendment and since then more tenants have been interested. The green contract is also pushed out by Property, especially for certified buildings.

Vignette 8.4.2 shows a meeting between Emma and a tenant about signing a green amendment, as this tenant is in a certified building.

8.4.2 Vignette: Green amendment meeting

This vignette shows how the sustainability coordinator manages that the concept of sustainability can mean different things to different people.

> This meeting took place at Property Blue's headquarters. We were greeted by a man, David, who was wearing a navy suit with light brown shoes. We went to a meeting room that Emma had booked. The tenant has their head office in the building next to the one we were in. Epsilon had built it in about 2013, so it was quite new. They have a contract to move into a new building that they

are constructing on the other side of the docks. The new building will be certified and Emma wants the tenants there to have green contracts.

Emma tells David that the building has a high environmental standard. David starts off by asking what a green amendment will do for them. He says that CSR is 'super good', but you have to be practical too. He sees that Property wants green contracts so that they can communicate that they are green and so forth, but they cannot do it at the expense of practicality. He talks about parking spaces. They have built too much around there; everyone complains that there is no parking any more. They have 70 people at their head office and everyone needs a car. He uses himself as an example; he lives in a house in a southern suburb and has his kids at daycare in a neighbouring area. If he was to take the bus it would take several hours. He says that they have purposely not given all of these practical matters any thought when exploiting this area. The practicalities have to be considered when they do things like this; it is falling behind now.

Emma wonder who it is that has not thought about the practicalities. The council, says David. He says that it is up to companies such as Property to put pressure on the council so that they reduce the rate of exploitation. Emma says that she understands what he means. She says that it is a question of space. The council wants a denser city than what they have now.

David says that they have to think about what kind of tenants they want. Do they want successful companies? His company is a large company with the group's head office here. He says that their office is warm in the summer and cold in the winter and the meeting rooms get stuffy far too quickly. He says that this is because Property tries to save energy. Emma says that there is no real correlation between energy use and indoor environment. It depends on things like how many people there are. 'It is a large part of your costs though', says David. 'So are unhappy customers', says Emma.

David says that they have CSR goals to reduce their energy use by 10%. But that is CSR, not economy. He says that Property has reduced the building's energy use to save money. Emma asks whether they include heat in the rent. David wonders what the upside for him is if he signs a green agreement. Emma says that if they want to move forward with sustainability, then they need to involve the tenants. David says that this is good thinking, but they

need to see an upside for themselves. Their current solution is not satisfactory.

Emma says that she can go through the contract point by point. Most of it isn't mandatory. David looks quickly over the document and scoffs at some of the points, like the use of used furniture. Emma says that that is one of the non-mandatory points. David says that he needs to anchor this with his management. He seems to like the part about the indoor environment. There is an optional point about doing a survey of the staff. Do you measure that sort of thing? He says that energy use is your major KPI. 'We do a measurement of customer satisfactions', says Emma. 'Have you got it? It is a survey.' He does not know. David wonders whether it's available in English, Emma says that it probably isn't. It is a Swedish thing by the property owners' association.

David repeats the two problems he has: parking and indoor temperature. The green contract has a maximum value of 26c. He says that this is far too hot, especially for someone wearing a wool suit. Emma says that this is the maximum and that anything above that is extreme, and if it gets that hot, then perhaps he can take off his jacket. He says that they have a dress code at his office. He repeats that it is about what type of companies they want. Do they want successful ones that can pay a high rent? Does their group CEO really have to take off his jacket because it is too hot? He feels as though they should pressure the council to stop building to allow for more parking. They need to think practically if they want the market to follow them. They can't go ahead of the market. He mentions the area next to ours, where there are mostly apartments, and says that the council moved too quickly there and now they regret removing all the parks and greenery. Emma says that she doesn't really agree. She says that they have many successful companies as tenants and they like central locations that are even less accessible by car than this one. She says that they prefer to discuss the indoor climate rather than do a survey and that their current problem need to be addressed. David says that a survey is good, so that they can put their disappointments on paper. Emma says that they prefer to hear about it directly, rather than once a year.

He talks about parking again. He says that the market does not move as fast as the development there and that they need to slow down. The companies that pay best want cars and need to park them. David says that it costs more in the long run than the benefits

of having an image now. He says that another problem that is due to BREEAM is the floor plan. All the offices are by windows. He thinks that this has to do with energy somehow. Emma says that it has to do with the work environment, but it is not just BREEAM it is also normal Swedish building norms that they have to follow anyway. David thinks that the open floor plan that they have planned for has to do with BREEAM, and they have a new CFO from Germany who wants to change it. They will have to discuss that; it is not really Emma's job. The meeting ended with him taking a copy of the contract amendment and he was going to read it and then return with his decision.

For David the meeting was not about the green contract. The tenant seemed to use it as a way to voice his frustrations about other things and some of these he sees as by-products of sustainability work gone too far and he feels that he and his company have to pay the price for it without getting anything in return. Whenever Emma tried to talk about the contract, David used it as a vehicle to air his grievances about the current premises and their surroundings. He sees Property's sustainability work benefiting their own economic interests and lowering energy costs, and equates this with his poor indoor environment.

When they moved into the building several years ago there was plenty of space for parking. The area used to be a dilapidated shipyard that had closed down in the 1970s. These buildings had all been torn down to make space for the new developments which included both of the buildings in the vignette. There were a lot of empty lots with just gravel where parking was free. These plots were gradually fenced off and built up, reducing the free parking available. Now there was only street parking, which was not free, and garages under the new buildings, which were not free either. This was the way the area was planned from the start. He associates this with practicality and success. Successful companies can pay the high rents that these modern buildings need, but they also need the practicalities of parking spaces and an indoor climate where one, especially the group's CEO, can wear a wool suit without taking the jacket off year-round. Emma counters his view of success by saying that she knows of other successful companies that do not fit into that view of success.

The tenant links their indoor climate with Property's attempts to save media and thus costs. He uses the phrase KPI, meaning that it is what Property measures and tries to maximise. Here he references the measurement and consumption infrastructure but Emma counters him

by mentioning that media is something the tenant pays for. The tenant complained that they were too hot or cold a lot of the time and linked this to Property saving money on media. For Property on the other hand, the heat and cooling are operations media and not building media and therefore paid for by the tenant so Property cannot save money by using less media. For the tenant, this distinction might not be material; they feel like they pay a certain amount for working space in a building that is supposed to be comfortable and if it is not then Property has to make it comfortable. The boundaries between operations media and building media, which are set by the work done in chapter 6, are not taken into account by the tenant locally at this meeting.

Sustainability work is both allowed and set by the infrastructures. The infrastructure sets sustainability work in specific ways. This is sometimes challenged by others who have a different view of what sustainability work should be. In vignette 8.4.2, the tenant tries to argue that the sustainability work done at Property is just an extension of their short term business interests and that this affects him negatively.

This may be the case; however, it is also the case that because the infrastructure is built over time and many actors are involved in its upkeep, it can therefore not easily be changed into something that the tenant might prefer. The infrastructure's enabling of action also stabilises it and reduces the degrees of freedom of those who use it.

8.5 Using the infrastructures

The three types of external actors who interact with the coordinator, evaluators, tenants and suppliers, are part of and use the measurement infrastructure that is presented in chapter 6;and the environmental certificates from chapter 7, which are referenced when talking to the tenants.

They all have different uses for the different infrastructures and different uses of the buildings that Property owns. The boundaries of a building are set differently, and the same type of consumption, like district heat or electricity, means different things to a supplier, Property, Green Globe, and the tenant. The same can be said for things outside the borders of the property itself, such as public parking spaces, which Property treats very differently than parking spaces within the property, but which might not feel so different to tenants. The boundaries, created by the infrastructures, make accounts that follow these boundaries, even if the tenant might prefer a different account with other boundaries; in some cases the infrastructure cannot provide them without abandoning the existing infrastructure and the established boundaries that come with

it. For the tenant in vignette 8.4.2 the solution to his parking problem was that Property should lobby the local council not to build as densely as they were doing at the time.

The boundaries between operations media and building media are sometimes irrelevant to the tenants, as in this case in vignette 8.4.1 the tenant and the people from Property agreed that the indoor environment was poor, and Sofia apologised for it many times. This was, however, temporary as the building was being remodelled and the tenants seemed to accept the discomfort in part because they would sit in an environmentally certified building by the end of it all.

The boundaries of the building itself are different for different actors and in different settings. The building is, like the body described by Mol (2002), multiple things at once and with multiple sizes. For a tenant the green building might mean being unable to find a parking space or a workspace that is always less than 7 metres from a window. For facilities managers who work in the building it means that they might have more meters to read and that the building has been thoroughly checked for asbestos and other harmful substances. For the coordinator, it means that there are enough meters that the separation of operations and building media can be done without resorting to calculations which have assumptions in them. For a builder, it means that they need to take a third party into account and that they need to take responsibility for the amount of building media several years after construction. In cases where the infrastructure became an issue there was an effort to adapt the infrastructure so that these issues would not recur; this required infrastructuration (Edwards 2019) work to keep the infrastructure stable and useful.

In meetings with tenants and suppliers, many of the actors presented in the previous chapters are mobilised. In the supplier's meeting they discuss consumption by type and amount. When reporting to Green Globe, the consumption infrastructure, the large spreadsheet, is used, but translated so that it can be used by Green Globe. The survey and the ranking of suppliers is a type of communication with suppliers, where Property signals what it considers important.

9 Discussion

This study started with the following question: what is the role of accounting in sustainability work? To explore this question, the boundary infrastructure was used as a theoretical starting point to explore an organisation's sustainability work. The study shows that accounting is both necessary and at the same time acts as a limitation on what it is possible to do in sustainability accounting. Accounting and the infrastructures it brings in shape what sustainability work is.

In the field material, there are several different boundary infrastructures simultaneously. Of these consumption and certification are the most prominent. The consumption infrastructure uses the old economic infrastructure to create numbers where the referents are the building and the media that flows through it. It takes these flows and turns them into numbers that can function as representations of the building. It is built on the boundaries of the old economic infrastructure, and can therefore produce numbers that are accepted without further negotiation. The certificate infrastructure, on the other hand takes an abstract concept, the certificate, and turns it into something material in the building, especially in new buildings. The consumption infrastructure creates detachment while the certification infrastructure creates attachment (Callon and Muniesa 2005; Robson 1992).

Both of these boundary infrastructures require infrastructuration and habituation (Edwards 2019) in order to function. This means that the sustainability coordinator needs to do work to keep the infrastructures running and coordinated between the different actors that make up the infrastructures. For the consumption infrastructure, this work is mostly about keeping anomalies out and gathering the numbers which the infrastructure does not automatically generate. The certification infrastructure, on the other hand, requires coordination and evidence gathering to get the certificate, which is a different type of work.

There are limitations to what both these infrastructures can do. The consumption infrastructure is limited by the boundaries that the old economic infrastructure has set and therefore can only produce numbers that are as reliable as the old ones, if it still uses the old economic infrastructure. The certification infrastructure is limited by the indicators that the certificate uses and how they relate to each other, to the building, the consumption infrastructure and to how the building was, or is, constructed.

9.1 Infrastructure and the creation of sustainability

Sustainability is a concept materialised in many ways at Property and in the infrastructures where the sustainability coordinator works. There are non-material concepts that are related to sustainability, such as the idea that it is made of three parts: social, environmental and economic – as in the UN's agenda 2030 goals. These concepts are broad and abstract and moving from form to matter and using them for doing practical work has brought in many other entities in order to turn sustainability as a concept into material sustainability work.

The materialised concept is not singular. It materialises and re-materialises in different parts of sustainability work and its infrastructures. Because of the different roles of the infrastructures, as described in the previous section, sustainability also materialises differently, and this has consequences for what sustainability work is. In the case of consumption, sustainability becomes measured in consumption numbers, and the reporting system changes the numbers and not only reports the energy used, but also translates it into CO_2e.

When it comes to certificates sustainability becomes the certificate and controls how buildings are built and furnished. In this case, the existing infrastructure for constructing buildings can be seen as being superseded by the materialised sustainability concept and its infrastructure, while still existing in more or less the same configuration. The consequences of these differences are that in consumption the old economic infrastructure can work almost the same way as it always has, translating material flows into numbers and calculating them into different things. The certificate infrastructure changes how buildings are constructed and conflicts with what builders and architects have done before, such as how they placed windows and workspaces.

The infrastructures that support sustainability work allow for the old infrastructures of consumption measurement and building construction to be used in sustainability work. The consumption infrastructure measures impact and the certification infrastructure shapes the building. The actors that comprise the infrastructures make themselves an integral part of sustainability work by being positioned in a way that makes them necessary for both the consumption measurement and certification infrastructures.

The infrastructures of sustainability work are built on the older that shape and enable meaningful sustainability work. The old infrastructures, such as economic and construction, as the foundations of the newer certificate infrastructure shape how sustainability work can be done, from

how meters in the buildings are placed and how boundaries between the tenant and building are made, as shown in section 6.2. The infrastructures are necessary to turn the concept of sustainability into a practice, and this practice is, in turn, shaped by the underlying infrastructures and by how the new sustainability infrastructure is made and can operate as an intermediary between all of the actors involved in sustainability work.

Sustainability as a material practice (Corvellec 2016) is, for the actors, what the infrastructure permits. The boundary infrastructure differs for different actors. Interacting with the infrastructure becomes the way that the coordinator and other can carry out sustainability work and perform sustainability as a practice. Without the infrastructures being configured as they are sustainability work could not be done in the way that it is.

The boundary infrastructures, newer and older, shape what sustainability work is. When the consumption infrastructure uses the existing measurement infrastructure it can engage with the buildings, meters and pipes, but it is also shapes what can be done. The meters are already in place, and were not put there to measure sustainability, not in older buildings anyway. For newer buildings the certification infrastructure shapes the building and, in turn, the consumption infrastructure. These buildings, which were built from the beginning with certification in mind allow for more fine grained boundarying of tenants, by the meters rather than by the consumption measuring system.

By looking at sustainability work through an infrastructure perspective the role of the coordinator becomes one of infrastructuration (Edwards 2019); it is through this infrastructuration work that the coordinator is able to place sustainability accounting as something that can be used to motivate sustainability work from a business perspective (Grisard, Annisette and Graham 2020; Rodrigue and Picard 2022). The sustainability infrastructure's reliance on the older economic infrastructure both allows these economic arguments to be used and limits the types of arguments that can be made in the same way as the arguments that use the old economic infrastructure.

9.2 The need for accounting in sustainability work

Accounting is part of sustainability work in all three categories of sustainability work that were classified in the field material: Managing consumption, acquiring certificates and reporting to others. In the case of managing consumption, the old economic infrastructure, which generates

financial costs is the same infrastructure that decides what boundaries are drawn for sustainability purposes. When it comes to certificates, it uses numbers from the old economic infrastructure as well as accounts from when the building was constructed, such as what windows were installed. The certificate itself is also a type of account, since it represents the building as 'green' and can travel and enable action at a distance (Robson 1992), and is detached (Callon and Muniesa 2005) from the building. Another case of accounting in the field material is the reporting of numbers, sometimes aggregated, to tenants, customers and others who request them; these are often generated with the help of the old economic infrastructure.

The certificate is a sort of account of a building in that it is a reduction of the building to a certificate, a label, that can be used to represent the building. The certificate can move outside the building and signal that the building is sustainable. This integrates the certificate as an object that can be seen in different ways by different actors, and therefore turns the infrastructure it is part of into a boundary infrastructure. The certificate manages to put itself as a pivotal (Millo, Panourgias and Zachariadis 2019) actor in the infrastructure and, therefore, the sustainability work. It is in many ways not possible to do sustainability work without involving the certificate. The certificate changes the building and the reporting infrastructure and at the same time the building and the reporting infrastructure shape what can be done with the certificate.

In this pivotal (Millo, Panourgias and Zachariadis 2019) role, the certificate is able to shape what sustainability becomes in practice. When the certificate includes things like waste and sunlight, they become part of the sustainability coordinator's work. The coordinator does work measuring waste and figuring out windows because of the certificate, and this work enables the certificate to play the role of representing the building as sustainable.

Accounting representations, if seen as a type of creating reality by communicating reality (Hines 1988), are done by the infrastructures. Simply communicating sustainability is not enough to create a real representation of it; the infrastructure must support it for the representations to be free of controversial boundaries. The boundaries that the old economic infrastructure draws are considered settled, as they are used for economic calculations and are accepted by tenants as a way to calculate how much they should pay for energy. Therefore, when these boundaries are used for sustainability calculations, the same controversies can not be brought up.

In some parts of the literature on quantification, there is discussion of how numbers that are pleasing and well presented have an advantage over numbers that lack aesthetic qualities (Giovannoni et al. 2024). In the case of sustainability accounting at Property, well-made numbers are created using the boundaries of the old economic infrastructure which gives them a kind of stability and acceptance. Just being pretty is not enough here; the numbers also need to be well constructed in order to represent the referents. Aesthetics is not just about being pleasing to look at in this case, it is also how they are constructed that makes them pleasing and well made.

Sustainability work at Property requires accounts, either as numerical representations or certificates; without accounting there can not be numbers which can be used to represent things like a building's electricity use in an agreed-upon way. The large spreadsheet only has room for one number to represent a building's total electricity use, for instance. These accounts are, as in Quattrone (2021) somewhat of a mirage, in that they become representations by being put to use as representations. As Tinker (1991) says, the accounts are not a neutral representation of the referent; instead, they are constructed. However, they are not arbitrary; they are constructed using an infrastructure that is built on older infrastructures and the boundaries that they have. The infrastructure needs continual maintenance to keep producing accounts that work.

Accounting and the infrastructures it brings in are based on older infrastructures, which legitimatise the numbers but also constrain the accounts that are possible because of the boundaries that are drawn by the old economic infrastructure.

9.3 Sustainability work changing accounting

Besides the consumption and certification infrastructures, there are other infrastructures that could also be seen as such, such as the process of constructing a new building. Constructing a building is a process that involves not only the physical construction but also planning, permission, potential tenants and so on. The construction of buildings is complicated and done often enough for the actors involved to have developed routines and means of communication for working towards getting the building built. The construction of a building also needs to interface with the two infrastructures that are most prominent in the field material; the consumption and certification infrastructures.

The work involved in getting a certificate is not just about signalling. The certificate changes the building, and the way that it is accounted for.

When the certificate is involved from the start, there is documentation of what windows it has and so on. It requires changes to the building and reporting infrastructure (Mouritsen, Ernst and Jørgensen 2000; Skærbæk and Tryggestad 2010). The building infrastructure changes in that the builder needs to document all the windows and so on.

The builder also has another client to satisfy: the certificate issuer. It is Property that pay for the building and is the primary client. With the certificate as a pivotal part of the infrastructure, the builder also needs to satisfy the needs of the certificate issuer. As seen in vignette 7.3.4, at the time of the study, methods for doing so were becoming settled but there were still unresolved issues. The certificate becoming pivotal (Edwards 2019) is an ongoing process that needs work to make it function.

The certificate both changes the building process, adding a new client and the need for documents, and the resulting building itself, which has, among other things, more meters installed so that energy can be boundaried and the map in the energy monitoring system is more like the physical building. The changed building enables new accounts and changes the economic infrastructure. Accounting becomes performative, both allowing new parts of the infrastructure to be created and used (Revellino and Mouritsen 2015). This creates the need for more infrastructure (Power 2019). The changes to the economic and building infrastructure could be seen as promissory (Mouritsen and Kreiner 2016). This study shows how the promise of sustainability is embedded in material infrastructures and how the need for more infrastructure is built into the promise of sustainability accounting.

The changes to the infrastructure based on the certificate are still changes built upon an established infrastructure. Waste and water are added to the large spreadsheet and new meters are installed and put into the measuring system. It is a gradual development of the existing infrastructure rather than a new one. The boundaries from the old economic infrastructure remain, and for energy measurement they are still used as they always has been. The certificate, with its requirement for more meters turns it into a more ideal version of itself where there is less adaptation done by the coordinator when mapping the physical meters to the meters in the measuring system. This development is still limited by the boundaries of the old economic infrastructure and cannot transform sustainability reporting into something that can represent the cost of restoring the environment, as called for by Birkin (1996) and Bebbington and Gray (2001). Yet it is not entirely a facade (Cho et al. 2015) – disconnected from actual events either, as will be shown in the following

section.

This is also a study of how boundary infrastructures (Bowker and Star 2000; Star 2010) are built and maintained. This is unlike previous studies of boundary infrastructures (Clormann and Klimburg-Witjes 2022; Hummel, Berends and Tuertscher 2024) in which there was a project that had a clear goal and the boundary infrastructure was built and made pivotal to achieve that goal in order, for instance to show the importance of space debris (Clormann and Klimburg-Witjes 2022). In this case the process is ongoing and has been ongoing for some time; there is also no clear end goal where the infrastructure is finished. Instead it is continually maintained so as to keep it functioning and new actors, such as the builder, are brought in to enable it to perform new functions. There is no process of scaffolding and reconfiguration in the same way as in Hummel, Berends and Tuertscher (2024), where a new boundary infrastructure was built to perform a specific task where a boundary object was not sufficient and an iterative process of scaffolding and reconfiguration was needed to make it work as a boundary infrastructure. The boundary infrastructures in this study are built on older infrastructures and are continually maintained and reconfigured to keep them functioning and to make them perform new functions while keeping the functionality that comes from using the boundaries defined by the old economic infrastructure. It shows the importance of continual maintenance that goes into keeping a boundary infrastructure functioning; this can be seen both in reporting and in certification.

9.4 The role of accounting in the talk/action gap – who puts up the facade?

This study started with problematising the predetermined role of the business-as-usual (Bebbington and Gray 2001), or of the profit motive, in disconnecting sustainability accounts from actual events. The reporting infrastructure is maintained and continually rebuilt in what Edwards (2019) would call infrastructuration. It is built, in part on the old economic infrastructure as well as on other sources such as the building itself and its windows and workspaces, the weather and how it is measured and calculated. It outputs numbers that can be used to represent the building, its energy use and so on.

What goes into the calculations is set by the infrastructures that the coordinator uses to create the accounts. They create a monoglossic (Macintosh 2002), or single-voiced, representation of the building and its sustainability. This is due both to the consumption infrastructure used to

create the numbers and also that it is accounting itself that is being done. Infrastructuration, an attempt at creating a routine and invisible process for creating sustainability accounts, also turns sustainability work into accounting – a process of creating a representation, or a performance object (Power 2015), at the expense of other possible representations (Hines 1991).

In the field material, there is no direct example of where the severance of talk and action occurs, in the sense that potentially valuable accounts are discarded in favour of accounts that fit better with the organisation's goals. There is, however, a lot of filtering of different potential accounts that could be created. For example, when it comes to energy use, the building's performance is measured in term of energy use that is corrected for the year's weather and then translated into CO_2-equivalents. These are, in turn, aggregated for the division and then the group and other potential representations of CO_2-equivalents are discarded. The certificates bring in a different set of filters where the certificate's indicators and requirements are made to fit a building; the certificate itself leads to a pre-decided set of accounts that are attached to the building and that can be used to represent the building as sustainable.

An example of potential accounts can be seen in vignette 8.3.1, where there is a difference between how CO_2-equivalents are calculated by the supplier and what the coordinator expects. This shows that there are different ways to calculate the same thing and that the numbers that are used could be other numbers. However, because the consumption infrastructure for buildings is built on the old economic infrastructure and is well established, the numbers from the transport sector are not considered useful and the coordinator will have to use other numbers for calculations and reporting.

Where there is an established infrastructure, potential controversies such as these are already settled. In cases such as measurement of waste, where there is less of an established infrastructure, a potential controversy could cause the infrastructure to be reworked into something that works better for the actors who need to use it. Sometimes the certificate provides stability, such as for sunlight and workspaces, and these numbers can be used. Or the certificate itself can be used as a way of representing all these calculations and, in this way, provide a stable referent where the underlying calculations are not controversial.

While there is filtering in the field material, there are few overt tensions between different possible accounts that compete with one another and where one wins out and get to represent the building. When the

old economic infrastructure is used it already has its issues settled and is accepted by the tenants as workable for things such as deciding how much energy they should pay for. This gives the boundaries that the consumption infrastructure creates legitimacy and the sustainability numbers follow these boundaries. There is very little questioning of bringing in accounting numbers; conversely, the numbers from the reporting infrastructure are taken for granted as reliable and useful. Where the certificate is involved, the certificate itself can be used as a way to represent the building as sustainable; it becomes a sort of black box that can be used to represent the building as sustainable without needing to question the underlying work that goes into the certificate or how well it is attached to the building.

In vignette 8.4.2, the tenant said that Property wanted the green amendment in order to improve its own key performance indicators and that it was self-serving. The tenant talked about a dichotomy between sustainability and practicality. This is the most direct case in the field material of sustainability being questioned using business as usual as an argument. His argument was, however, that there was not enough business as usual, and that Property's sustainability work had a negative material effect on his company. The disconnect that occurs in this study does not occur by comparing sustainability and business as usual and then replacing sustainability with business as usual. Instead the infrastructure supports the construction of sustainability accounts that are based on the old economic infrastructure which was made for making business decisions.

The infrastructure's role is in many ways taken for granted; agency is then distributed in the infrastructure, being both nowhere and everywhere simultaneously, which is the end goal of an infrastructuration and habituation process (Edwards 2019). This makes it equally difficult to pin down where disconnect, or facade building, takes place. The facade-building (Cho et al. 2015) process is present in the infrastructure from the start, via the old economic infrastructure. This study offers an empirical account of why sustainability accounts can be seen as a facade, or any other facet of the talk/action gap, without either a single entity putting up the facade or an abstract force such as the business as usual to explain why it exists.

This is not a study of sustainability workers' identities and motives, such as the studies by Carollo and Guerci (2018) and Wright, Nyberg and Grant (2012), where the workers themselves expressed the need to consolidate tensions and paradoxes (Argento, Broccardo and Truant 2022)

between their identity and professional demands. This study has instead focused on the work itself and the way infrastructures determine what is possible. The paradoxes that are inherent in sustainability work seen in studies of workers, are not solely the result of sustainability work being inherently paradoxical; the infrastructures that are used to do sustainability work bring in affordances and limitations that both make sustainability accounts possible and, at the same time, limit what types of accounts are possible. These studies are not opposed; they can give complementary perspectives on sustainability work. The infrastructure perspective can show how the paradoxes that sustainability workers feel they need to navigate are part of bringing in accounting and the old economic infrastructure, which is necessary for sustainability work but also brings in limitations.

Studies of sustainability workers have also shown that accounting can be emancipatory for them because it allows them to make arguments for sustainability work (Rodrigue and Picard 2022). This study does not show the workers' perspective, but it does show how the infrastructure, with its boundaries already settled, allows for the creation of numbers that can be used for arguments. The infrastructure's ability to create numbers that can be used for arguments (Burchell et al. 1980) allows the coordinator to bring sustainability into other parts of the organisation (Ligonie 2021). The certificate and its requirements for more meters and more measurements also allows the coordinator to bring in more things into the sustainability work. In both cases the coordinator is both limited by the reporting infrastructure and the certificate, but can also use them to bring in more things and to make arguments for sustainability work.

Accounting, as a calculative practice that creates representations also shapes sustainability work into something that is routine and stable. The infrastructure that is built and rebuilt using the consumption and certification infrastructures brings in accounting and the ability to create these singular representations together with a set of routines and calculative practices.

9.5 The consequences of infrastructure for accounting for sustainability

As shown above, the reason that sustainability accounts, as they are done in this study, cannot provide a full account of the organisation's sustainability impact is not, as some argue (Busco et al. 2018; Gray 2002), a form of active managerial co-option of sustainability work. Rather, it is the use of the infrastructure that constrains what accounts are possible.

The old economic infrastructure in particular brings in numbers that are functional but also boundaries that are built into it that draw in business-as-usual. Critics of current sustainability accounting practices, such as Busco et al. (2018) and Bebbington, Unerman and O'Dwyer (2014), are correct in noting that current practices are based on the business-as-usual assumption. The old economic infrastructure is used to generate sustainability numbers, which limits the possible numbers to those that are allowed when using the boundaries set by the old economic infrastructure. The business-as-usual assumption is brought in alongside the ability to create numbers that can usefully represent the referents.

The results of this study show that sustainability accounting can function as both an objective representation (Solomons 1991) and at the same time be a constructed singular voice that is made at the expense of other possible accounts (Tinker 1991). The infrastructures make the numbers objective in the sense that they can act as representations and permit action at a distance (Robson 1992), yet they are also constructed in the sense that they are made by an assemblage of actors who make up the infrastructures. The accounts that the infrastructure makes that are built on the old economic infrastructure are able to act as representations because the old economic infrastructure makes these numbers well made (Latour 2007) and accepted.

Where the accounts are built using the old economic infrastructure, there seems to be some resistance to Solomons (1991)'s argument that bringing accounting into other domains would jeopardise accounting's special role as representing an organisation's standing. In this case, where infrastructures limit what is possible, the economic infrastructure seems to limit accounts to those that can also serve as the basis for economic calculations, such as calculations used to boundary energy costs. These economic numbers are privileged and seen as singular entities that cannot be easily changed. These numbers and boundaries then come in to the consumption infrastructure and use their role as the singular representation of, for instance, energy used in a building. This gives the later sustainability numbers the same privilege but also limits them. This limitation means that accounting for sustainability in this way can create a singular representation that can represent the organisation. But as Hines (1991) said, other things that are not calculated by the economic infrastructure or recognised as costs will not be seen in the sustainability accounts either. It seems that when using economic numbers the role that they have will be conserving the older approach that is used to create them, and that there is a built-in resistance to creating num-

bers which might jeopardise economic accounting by removing its role as a singular representation of an organisation. The upside of this, for those who do not want accounting and economic calculations to cover things that are intrinsically not possible to value (Hines 1991), is that accounting as an infrastructure seems to resist bringing these things in.

Following from this, the accounts in this study are far from what Birkin (1996) or Bebbington and Gray (2001) would advocate, where the accounts represent the cost of restoring the world to a state before the corporation did what it did during the period. This type of accounting is even further removed from an account where some things are ignored or valued at zero.

It could be that bringing in numbers from economic calculations and accounting means that sustainability work is so constrained that it can only function as an account of unsustainability (Bebbington and Gray 2001), and therefore cannot bring in what would be needed for a full account of sustainability (Birkin 1996). When using the certificates, more things are brought in, but there is still a limitation based on what numbers can be reliably produced due to the limitations in the infrastructures.

10 Conclusions

Separating sustainability work from accounting is difficult; the sustainability work in this study often entails performing calculations and reporting numbers, a form of accounting. However, the boundary infrastructure perspective used in this study allows for a view of sustainability work in which the consumption infrastructure and its baggage of the old economic infrastructure is visible as a starting point for building a sustainability infrastructure.

There are things that are outside the scope of this study. For instance in Asdal (2011) the seemingly well-produced numbers did not facilitate sustainable decisions; instead, they legitimised an unsustainable practice. In this study, how the numbers are put to use for decisions is not visible in the same way as the end users are not in the study. Market reactions are also not studied, so the firm's cost of capital might change due to the sustainability coordinator's work, as has been seen in other studies (Albertini 2013; Khan, Serafeim and Yoon 2016; Ahn, Patatoukas and Skiadopoulos 2024).

What can be seen is the role of accounting in both reducing and reinforcing the talk/action-gap that has been seen in other studies (Cho et al. 2015; Roszkowska-Menkes, Aluchna and Kamiński 2024). The numbers that are generated with the use of the consumption infrastructure include the taken for granted boundaries. And while economic numbers are full of interpretations and judgement, as Quattrone (2021) and others have argued, they often play the role of a functional account (Power 2019).

Sustainability accounting, if it is to be stabilised as a set of (more or less) repeating routines (Palermo, Power and Ashby 2022), entails making a decision or having a decision made by some pivotal actor. It might not be possible to simply transfer an economic infrastructure style of measurement to other things, as it is the case that the existence of an accepted infrastructure that makes the sustainability reporting numbers work. So decision-makers will have to choose whether to go on using the old economic infrastructure based numbers and therefore prevent a holistic account of an organisation (Hines 1991; Birkin 1996). The other option is to make a more holistic account and create an entirely new infrastructure that can measure other things that are not based on the old economic infrastructure. But since it will not have the taken-for-granted boundaries that the old economic infrastructure enforces, the accounts it creates might not be able to perform the role of a representation of an organisation.

Without the established and taken for granted boundaries of the old

economic infrastructure that gives the sustainability numbers their ability to represent the organisation, the accounts can be open to questioning and other issues that could lead to the numbers being unable to perform the role of a representation. It could be that the creation of a holistic account of sustainability will lead to a bigger disconnect between talk and action, where more and more numbers are created but they are seen as just one of many possible accounts and therefore cannot represent the organisation and its level of sustainability in the way that a monoglossic (Macintosh et al. 2000) account would.

When it comes to sustainability accounting a disconnect between talk and action is not checked by things such as markets or the outside world in the same way that financial accounting is. The timescales are often longer. Financial accounting, seen as deferred cash flows, will often be checked when the cash flows are realised, or not realised. Sustainability accounting, on the other hand, has not such mechanism that forces the numbers to be checked against the outside world. Eventually, the cash flow will not materialise and the numbers will be seen as wrong, but this is not the case for sustainability accounting where there is no such mechanism. The environment cannot check an organisation in the same way a market can. There are checks, such as the certificate, which can be withdrawn if the building is discovered not to be sustainable according to the certificate. But this has less effect on the company and its ability to operate as usual.

Both sustainability accounting and economic accounting can produce numbers that can represent an organisation (Quattrone 2021), and that sometimes do not represent the organisation, where there are controversies or the numbers are not considered to give a complete and full account. Another difference between sustainability accounting and financial accounting is that financial accounting can more often play the role of representation. Whether this is because it is based on a more established infrastructure or because sustainability is more difficult to account for is not something that this study can comment on. In this study, the sustainability reporting infrastructures that were built on the old economic infrastructure produced numbers that were not questioned even though there were multiple possible numbers. The controversies were already considered settled. So what it can say about the difference between economic numbers and sustainability is that both of them can perform the role of a representation when they are constructed in a way that is useful to the actors that use them. It is not just a technical process, where the numbers are produced in a good order by meters, cal-

culations, and so on. There also needs to be relational work in settlement of controversies and infrastructure building and upkeep for it to work.

The argument by, among others, Hines (1991), that the nature of accounting as monoglossic (Macintosh 2002) precludes a holistic approach. When only one voice is present then other potential perspectives are silenced. Whether this very nature of accounting prevents a holistic account is not a question that this study can answer. Instead what it can say is that there are also physical and relational barriers in the infrastructure, not just conceptual ones about what accounting can and cannot do. This can also offer an alternative explanation for why projects such as those described in Bebbington and Gray (2001) failed, and why the triple bottom line never materialised as a practice. The numbers need to be made by an established infrastructure in order to perform the role of representation.

A possible critique of using an infrastructure perspective, as it has been done in this study is that the results could be seen from the start when using this perspective. Infrastructures as a theoretical concept have built in affordances and limitations and these in turn affect what is possible. Applying this perspective to sustainability work will then show that there are limitations to what sustainability work can be done, and that these limitations are built into the infrastructures that are used to do sustainability work. However, the purpose of this study is not to show whether there are or are not infrastructures, the perspective is a way of illuminating the practice of sustainability work and the role of accounting in it. It offers an empirical case of how the infrastructures that are used to do sustainability work affect what sustainability accounts are possible and what limitations sustainability accounting has. Future studies could add to this by looking at other sustainability work and the infrastructures that are used to perform it, and seeing whether the boundaries and limitations that are found in this study affect other sustainability work in the same way.

The talk/action-gap that exists in sustainability accounting and its inability to fulfil its promises (Mouritsen and Kreiner 2016) is in part a result of not taking into accounting the role of the old economic infrastructure in producing numbers that are taken for granted as representations. This is not to say that the alternative, is without its issues. What can be said is that sustainability accounting, even the filtered singular representation that is done at Property, takes a lot of work.

List of Figures

1 Structure until 2016 59
2 Structure after 2016 61
3 Formal organisation 64
4 Henrik's chart of water meters for a tenant in a building . 77
5 The output of the online window tool 112

List of Photographs

1 Reading and saving the code 110

List of Tables

1 Time-line of the fieldwork 50
2 Certification standards 97

References

Ahn, Byung Hyun, Panos N. Patatoukas and George S Skiadopoulos (2024). "Material ESG Alpha: A Fundamentals-Based Perspective". In: *The Accounting Review*, pp. 1–27.

Albertini, Elisabeth (2013). "Does environmental management improve financial performance? A meta-analytical review". In: *Organization & Environment* 26.4, pp. 431–457.

Alvesson, Mats and Andrew Spicer (2012). "Critical leadership studies: The case for critical performativity". In: *Human Relations* 65.3, pp. 367–390.

Andrew, Jane (2000). "The accounting craft and the environmental crisis: reconsidering environmental ethics". In: *Accounting Forum* 24.2, pp. 197–222.

Arena, Marika, Michela Arnaboldi and Tommaso Palermo (2017). "The dynamics of (dis) integrated risk management: A comparative field study". In: *Accounting, Organizations and Society* 62, pp. 65–81.

Argento, Daniela, Laura Broccardo and Elisa Truant (2022). "The facets of the sustainability paradox". In: *Meditari Accountancy Research* 30.7, pp. 26–48.

Asdal, Kristin (2011). "The office: The weakness of numbers and the production of non-authority". In: *Accounting, Organizations and Society* 36.1, pp. 1–9.

Bebbington, Jan and Rob Gray (2001). "An account of sustainability: failure, success and a reconceptualization". In: *Critical perspectives on accounting* 12.5, pp. 557–587.

Bebbington, Jan, Jeffrey Unerman and Brendan O'Dwyer (2014). *Sustainability accounting and accountability*. Routledge.

Berman, Elizabeth Popp and Daniel Hirschman (2018). "The Sociology of Quantification: Where Are We Now?" In: *Contemporary Sociology* 47.3, pp. 257–266.

Birkin, Frank (1996). "The ecological accountant: from the cogito to thinking like a mountain". In: *Critical Perspectives on Accounting* 7.3, pp. 231–257.

Bowker, Geoffrey C. and Susan Leigh Star (2000). *Sorting Things Out: Classification and its Consequences*. MIT Press.

Boxenbaum, Eva and Stefan Jonsson (2017). "Isomorphism, diffusion and decoupling: Concept evolution and theoretical challenges". In: *The Sage handbook of organizational institutionalism*. Vol. 2. Sage London, pp. 77–101.

Brogeby, Marcus (2014). *From bricks to numbers - a study of translation*. Licentiate Thesis.

Burchell, Stuart et al. (1980). "The roles of accounting in organizations and society". In: *Accounting, Organizations and Society* 5.1, pp. 5–27.

Busco, Cristiano et al. (2018). "Making sustainability meaningful: aspirations, discourses and reporting practices". In: *Accounting, Auditing & Accountability Journal*.

Callon, Michel (1986). "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay". In: *Power, action and belief: a new sociology of knowledge?* Ed. by J. Law. London: Routledge, pp. 196–223.

Callon, Michel (1998). *The laws of the markets*. Blackwell Publishers.

Callon, Michel (2009). "Civilizing markets: Carbon trading between in vitro and in vivo experiments". In: *Accounting, Organizations and Society* 34.3, pp. 535–548.

Callon, Michel and Fabian Muniesa (2005). "Peripheral vision: Economic markets as calculative collective devices". In: *Organization studies* 26.8, pp. 1229–1250.

Campbell, John L. (2007). "Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility". In: *Academy of management Review* 32.3, pp. 946–967.

Carollo, Luca and Marco Guerci (2018). "Activists in a suit: Paradoxes and metaphors in sustainability managers' identity work". In: *Journal of Business Ethics* 148.2, pp. 249–268.

Cho, Charles H. et al. (2015). "Organized hypocrisy, organizational façades, and sustainability reporting". In: *Accounting, Organizations and Society* 40, pp. 78–94.

Clormann, Michael and Nina Klimburg-Witjes (2022). "Troubled orbits and earthly concerns: space debris as a boundary infrastructure". In: *Science, Technology, & Human Values* 47.5, pp. 960–985.

Contrafatto, Massimo and John Burns (2013). "Social and environmental accounting, organisational change and management accounting: A processual view". In: *Management Accounting Research* 24.4, pp. 349–365.

Cooper, Christine (1992). "The non and nom of accounting for (m) other nature". In: *Accounting, Auditing & Accountability Journal* 5.3.

Corvellec, Herve (2016). "Sustainability objects as performative definitions of sustainability: The case of food-waste-based biogas and biofertilizers". In: *Journal of Material Culture* 21.3, pp. 383–401.

Czarniawska, Barbara (2004). "On time, space, and action nets". In: *Organization* 11.6, pp. 773–791.

Czarniawska, Barbara (2007). *Shadowing: and other techniques for doing fieldwork in modern societies*. Copenhagen Business School Press DK.

Czarniawska, Barbara (2008). "Organizing: how to study it and how to write about it". In: *Qualitative Research in Organizations and Management: An International Journal* 3.1, pp. 4–20.

Czarniawska, Barbara (2014a). *Ute på fältet, inne vid skrivbordet*. Studentlitteratur.

Czarniawska, Barbara (Mar. 2014b). "Why I think shadowing is the best field technique in management and organization studies". In: *Qualitative Research in Organizations and Management: An International Journal* 9.1, pp. 90–93.

Czarniawska, Barbara (2017). "Organization studies as symmetrical ethnology". In: *Journal of Organizational Ethnography* 6.1.

Deegan, Craig (2013). "The accountant will have a central role in saving the planet really? A reflection on green accounting and green eyeshades twenty years later". In: *Critical Perspectives on Accounting* 24.6, pp. 448–458.

DiMaggio, Paul J. and Walter W. Powell (1983). "The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields". In: *American sociological review*, pp. 147–160.

Edwards, Edward and Philip Bell (1961). *The theory and measurement of business income*. University of California Press.

Edwards, Paul N. (2019). "Infrastructuration: On habits, norms and routines as elements of infrastructure". In: *Thinking infrastructures*. Vol. 62. Emerald Publishing Limited, pp. 355–366.

Elkington, John (2018). "25 years ago I coined the phrase triple bottom line. Here's why it's time to rethink it". In: *Harvard business review* 25, pp. 2–5.

Elkington, John and Nick Robins (1994). *Company environmental reporting: A measure of the progress of business & industry towards sustainable development (Vol. 24)*. USA: United Nations Environment Programme.

Finley Graves, O. (1992). "Dynamic theory and replacement cost accounting: TheSchmalenbach-Schmidt polemic of the 1920s". In: *Accounting, Auditing & Accountability Journal* 5.1.

Flyvbjerg, Bent (2006). "Five misunderstandings about case-study research". In: *Qualitative inquiry* 12.2, pp. 219–245.

Frandsen, Ann-Christine (2009). "From psoriasis to a number and back". In: *Information and Organization* 19.2, pp. 103–128.

Fuentes, Christian (2014). "Green materialities: Marketing and the sociomaterial construction of green products". In: *Business Strategy and the Environment* 23.2, pp. 105–116.

Garfinkel, Harold (1984). *Studies in ethnomethodology*. Polity Press.

Geertz, Clifford (1994). "Thick description: Toward an interpretive theory of culture". In: *Readings in the philosophy of social science*, pp. 213–231.

Georg, Susse and Lise Justesen (2017). "Counting to zero: accounting for a green building". In: *Accounting, Auditing & Accountability Journal* 30.5.

Giamporcaro, Stéphanie and Jean-Pascal Gond (2016). "Calculability as politics in the construction of markets: The case of socially responsible investment in France". In: *Organization Studies* 37.4, pp. 465–495.

Giovannoni, Elena et al. (2024). "Why and how counting counts: perspectives on calculative practices for organization studies". In: *Organization Studies*, p. 01708406251314597.

Goffman, Erving (1974). *Frame analysis: An essay on the organization of experience.* Harvard University Press.

Goffman, Erving and Lyn H. Lofland (1989). "On fieldwork". In: *Journal of contemporary ethnography* 18.2, p. 123.

Gray, Rob (1992). "Accounting and environmentalism: an exploration of the challenge of gently accounting for accountability, transparency and sustainability". In: *Accounting, Organizations and Society* 17.5, pp. 399–425.

Gray, Rob (2002). "The social accounting project and *Accounting Organizations and Society* Privileging engagement, imaginings, new accountings and pragmatism over critique?" In: *Accounting, organizations and society* 27.7, pp. 687–708.

Gray, Rob (2010). "Is accounting for sustainability actually accounting for sustainability and how would we know? An exploration of narratives of organisations and the planet". In: *Accounting, Organizations and Society* 35.1, pp. 47–62.

Grint, Keith and Steve Woolgar (1997). *The machine at work: Technology, work and organization*. Polity Press.

Grisard, Claudine, Marcia Annisette and Cameron Graham (2020). "Performative agency and incremental change in a CSR context". In: *Accounting, Organizations and Society* 82, p. 101092.

Hahn, Tobias et al. (2015). "Tensions in corporate sustainability: Towards an integrative framework". In: *Journal of Business Ethics* 127.2, pp. 297–316.

Hammersley, Martyn and Paul Atkinson (2007). *Ethnography: Principles in practice*. Routledge.

Hartmann, Berit (2013). *Bridging the GAAP?: IFRS in accounting practice*. Jönköping International Business School.

Hines, Ruth (1991). "On valuing nature". In: *Accounting, Auditing & Accountability Journal* 4.3, pp. 27–29.

Hines, Ruth D. (1988). "Financial accounting: in communicating reality, we construct reality". In: *Accounting, organizations and society* 13.3, pp. 251–261.

Hopwood, Anthony G. (1987). "The archeology of accounting systems". In: *Accounting, Organizations and Society* 12.3, pp. 207–234.

Hummel, Jochem T., Hans Berends and Philipp Tuertscher (2024). "From Boundary Objects to Boundary Infrastructure: A Process Study of Collaboration between Big Science and Big Business". In: *Journal of Management Studies*.

Jones, Michael, Jill Solomon and Thomas Cuckston (2013). "Bringing tropical forest biodiversity conservation into financial accounting calculation". In: *Accounting, Auditing & Accountability Journal* 26.5, pp. 688–714.

Justesen, Lise and Jan Mouritsen (2011). "Effects of actor-network theory in accounting research". In: *Accounting, Auditing & Accountability Journal* 24.2, pp. 161–193.

Kaniadakis, Antonios and Amany Elbanna (2019). "Thinking transparency in European securitization: Repurposing the Market's information infrastructures". In: *Thinking Infrastructures*. Vol. 62. Emerald Publishing Limited, pp. 183–205.

Khan, Mozaffar, George Serafeim and Aaron Yoon (2016). "Corporate sustainability: First evidence on materiality". In: *The accounting review* 91.6, pp. 1697–1724.

Kornberger, Martin, Dane Pflueger and Jan Mouritsen (2017). "Evaluative infrastructures: Accounting for platform organization". In: *Accounting, Organizations and Society* 60, pp. 79–95.

Kornberger, Martin et al. (2019). *Thinking infrastructures*. eng. Bingley, UK: Emerald Publishing Limited.

La Torre, Matteo et al. (2020). "Rebuilding trust: Sustainability and non-financial reporting and the European Union regulation". In: *Meditari Accountancy Research* 28.5, pp. 701–725.

Larkin, Brian (2013). "The politics and poetics of infrastructure". In: *Annual review of anthropology* 42.2013, pp. 327–343.

Latour, Bruno (1990). "Technology is society made durable". In: *The sociological review* 38.1, pp. 103–131.

Latour, Bruno (1993). *We have never been modern*. Harvard University Press.

Latour, Bruno (1999). *Pandora's hope: essays on the reality of science studies*. Harvard University Press.

Latour, Bruno (2002). "Gabriel Tarde and the end of the social". In: *The social in question: New bearings in history and the social sciences*, pp. 117–132.

Latour, Bruno (2007). *Reassembling The Social: An Introduction To Actor-Network-Theory*. Oxford University Press.

Latour, Bruno and Steve Woolgar (1979). *Laboratory life: The social construction of scientific facts*. Princeton University Press.

Law, John (1994). *Organizing modernity*. Blackwell Oxford.

Lee, Geoffrey A (1977). "The coming of age of double entry: the Giovanni Farolfi ledger of 1299-1300". In: *The Accounting Historians Journal*, pp. 79–95.

Ligonie, Marion (2021). "Sharing sustainability through sustainability control activities. A practice-based analysis". In: *Management Accounting Research* 50, p. 100726.

Lowe, Alan (2001). "After ANT – An illustrative discussion of the implications for qualitative accounting case research". In: *Accounting, Auditing & Accountability Journal* 14.3, pp. 327–351.

Lukka, Kari, Sven Modell and Eija Vinnari (2022). "Exploring the theory is king thesis in accounting research: the case of actor-network theory". In: *Accounting, Auditing & Accountability Journal* 35.9, pp. 136–167.

Lukka, Kari and Eija Vinnari (2014). "Domain theory and method theory in management accounting research". In: *Accounting, Auditing & Accountability Journal* 27.8, pp. 1308–1338.

Lyon, Thomas P. and John W. Maxwell (2011). "Greenwash: Corporate environmental disclosure under threat of audit". In: *Journal of Economics & Management Strategy* 20.1, pp. 3–41.

Macintosh, Norman B. (2002). *Accounting, accountants and accountability: poststructuralist positions*. Vol. 2. Routledge.

Macintosh, Norman B. et al. (2000). "Accounting as simulacrum and hyperreality: perspectives on income and capital". In: *Accounting, Organizations and Society* 25.1, pp. 13–50.

MacKenzie, Donald (2009). "Making things the same: Gases, emission rights and the politics of carbon markets". In: *Accounting, Organizations and Society* 34.3, pp. 440–455.

Meyer, John W. and Brian Rowan (1977). "Institutionalized organizations: Formal structure as myth and ceremony". In: *American journal of sociology*, pp. 340–363.

Migliavacca, Alessandro (2024). "Value relevance of accounting numbers and sustainability information in Europe: Empirical evidence from nonfinancial companies". In: *Journal of International Accounting, Auditing and Taxation* 55, p. 100620.

Miller, Peter (1997). "The multiplying machine". In: *Accounting, Organizations and Society* 22.3, pp. 355–364.

Millo, Yuval, Nikiforos S. Panourgias and Markos Zachariadis (2019). "Capitalization by certification: Creating information-based assets through the establishment of an identification infrastructure". In: *Thinking Infrastructures*. Vol. 62. Emerald Publishing Limited, pp. 131–143.

Milne, Markus J. and Rob Gray (2013). "W(h)ither ecology? The triple bottom line, the global reporting initiative, and corporate sustainability reporting". In: *Journal of business ethics* 118.1, pp. 13–29.

Mol, Annemarie (2002). *The body multiple: Ontology in medical practice*. Duke University Press.

Mol, Annemarie (2010). "Actor-network theory: sensitive terms and enduring tensions". In: *Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft* 50, pp. 253–269.

Morgan, Gareth (1988). "Accounting as reality construction: towards a new epistemology for accounting practice". In: *Accounting, organizations and society* 13.5, pp. 477–485.

Mouritsen, Jan, Jesper Ernst and Aksel Møller Jørgensen (2000). "'Green' certification as a managerial technology". In: *Scandinavian Journal of management* 16.2, pp. 167–187.

Mouritsen, Jan, Allan Hansen and Carsten Ørts Hansen (2009). "Short and long translations: Management accounting calculations and innovation management". In: *Accounting, Organizations and Society* 34.6, pp. 738–754.

Mouritsen, Jan and Kristian Kreiner (2016). "Accounting, decisions and promises". In: *Accounting, Organizations and Society* 49, pp. 21–31.

Olbrich, Michael, David J. Rapp and Florian Follert (2020). "Eugen Schmalenbach, Austrian economics, and German business economics". In: *The Review of Austrian Economics*, pp. 1–29.

Orlikowski, Wanda J. and Susan V. Scott (2008). "Sociomateriality: challenging the separation of technology, work and organization". In: *The academy of management annals* 2.1, pp. 433–474.

Orr, Julian E. (1996). *Talking about machines: An ethnography of a modern job*. Cornell University Press.

Owen, Davids (2008). "Chronicles of wasted time?: A personal reflection on the current state of, and future prospects for, social and environmental accounting research". In: *Accounting, Auditing & Accountability Journal* 21, pp. 240–267.

Paananen, Mari, Emmeli Runesson and Niuosha Samani (2021). "Time to clean up environmental liabilities reporting: disclosures, media exposure and market implications". In: *Accounting Forum* 45.1, pp. 85–116.

Palermo, Tommaso, Michael Power and Simon Ashby (2022). "How Accounting Ends: Self-Undermining Repetition in Accounting Life Cycles". In: *Contemporary Accounting Research* 39.4, pp. 2790–2824.

Phillips, Mary (2014). "Re-Writing Corporate Environmentalism: Ecofeminism, Corporeality and the Language of Feeling". In: *Gender, Work & Organization* 21.5, pp. 443–458.

Power, Michael (2011). *The audit society: rituals of verification*. Oxford University Press.

Power, Michael (2015). "How accounting begins: Object formation and the accretion of infrastructure". In: *Accounting, Organizations and Society* 47, pp. 43–55.

Power, Michael (2019). "Infrastructures of traceability". In: *Thinking infrastructures*. Emerald Publishing Limited.

Quattrone, Paolo (2004). "Accounting for God: accounting and accountability practices in the Society of Jesus (Italy, XVI–XVII centuries)". In: *Accounting, organizations and society* 29.7, pp. 647–683.

Quattrone, Paolo (2021). "Seeking transparency makes one blind: How to rethink disclosure, account for nature, and make corporations sustainable". In: *Accounting, Auditing and Accountability Journal*.

Quattrone, Paolo and Trevor Hopper (2001). "What does organizational change mean? Speculations on a taken for granted category". In: *Management Accounting Research* 12.4, pp. 403–435.

Quattrone, Paolo and Trevor Hopper (2006). "What is IT?: SAP, accounting, and visibility in a multinational organisation". In: *Information and Organization* 16.3, pp. 212–250.

Revellino, Silvana and Jan Mouritsen (2015). "Accounting as an engine: The performativity of calculative practices and the dynamics of innovation". In: *Management Accounting Research* 28, pp. 31–49.

Roberts, John (2009). "No one is perfect: The limits of transparency and an ethic for intelligent ccountability". In: *Accounting, Organizations and Society* 34.8, pp. 957–970.

Robson, Keith (1992). "Accounting numbers as "inscription": action at a distance and the development of accounting". In: *Accounting, Organizations and Society* 17.7, pp. 685–708.

Rodrigue, Michelle and Claire-France Picard (2022). "Non-accountants and Accounting: On the Emancipatory Mobilization of Accounting by Sustainability Managers". In: *European Accounting Review*, pp. 1–29.

Roszkowska-Menkes, Maria, Maria Aluchna and Bogumił Kamiński (2024). "True transparency or mere decoupling? The study of selective disclosure in sustainability reporting". In: *Critical Perspectives on Accounting* 98, p. 102700.

Shearer, Teri and Edward Arrington (1993). "Accounting in other wor(l)ds: a feminism without reserve". In: *Accounting, Organizations and Society* 18.2, pp. 253–272.

Skærbæk, Peter (2009). "Public sector auditor identities in making efficiency auditable: The National Audit Office of Denmark as independent auditor and modernizer". In: *Accounting, Organizations and Society* 34.8, pp. 971–987.

Skærbæk, Peter and Kjell Tryggestad (2010). "The role of accounting devices in performing corporate strategy". In: *Accounting, Organizations and Society* 35.1, pp. 108–124.

Solomons, David (1991). "Accounting and social change: a neutralist view". In: *Accounting, Organizations and Society* 16.3, pp. 287–295.

Stål, Herman I. and Hervé Corvellec (2018). "A decoupling perspective on circular business model implementation: Illustrations from Swedish apparel". In: *Journal of Cleaner Production* 171, pp. 630–643.

Star, Susan Leigh (1999). "The ethnography of infrastructure". In: *American behavioral scientist* 43.3, pp. 377–391.

Star, Susan Leigh (2010). "This is not a boundary object: Reflections on the origin of a concept". In: *Science, Technology, & Human Values* 35.5, pp. 601–617.

Star, Susan Leigh and James R. Griesemer (1989). "Institutional ecology,translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39". In: *Social studies of science* 19.3, pp. 387–420.

Star, Susan Leigh and Karen Ruhleder (1996). "Steps toward an ecology of infrastructure: Design and access for large information spaces". In: *Information systems research* 7.1, pp. 111–134.

Strand, Robert (2014). "Strategic leadership of corporate sustainability". In: *Journal of Business Ethics* 123.4, pp. 687–706.

Taylor, Frederick W. (1911). "The principles of scientific management". In: *New York* 202.

Tinker, Tony (1991). "The accountant as partisan". In: *Accounting, Organizations and Society* 16.3, pp. 297–310.

Tryggestad, Kjell, Lise Justesen and Jan Mouritsen (2013). "Project temporalities: how frogs can become stakeholders". In: *International journal of managing projects in business* 6.1, pp. 69–87.

Tuertscher, Philipp, Raghu Garud and Arun Kumaraswamy (2014). "Justification and interlaced knowledge at ATLAS, CERN". In: *Organization Science* 25.6, pp. 1579–1608.

Tweedie, Jonathan (2024). "Environmental accounting: In communicating reality, do we construct reality?" In: *Critical Perspectives on Accounting* 100, p. 102764.

United Nations General Assembly (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development.*

United Nations World Commission on Environment and Development (1987). *Our Common Future (The Brundtland Report).* Oxford University Press, Oxford.

Vesty, Gillian Maree, Abby Telgenkamp and Philip J Roscoe (2015). "Creating numbers: carbon and capital investment". In: *Accounting, Auditing & Accountability Journal* 28.3, pp. 302–324.

Watts, Ross and Jerold Zimmerman (1986). *Positive accounting theory.* Prentice-Hall Inc.

Wright, Christopher, Daniel Nyberg and David Grant (2012). "Hippies on the third floor: Climate change, narrative identity and the micropolitics of corporate environmentalism". In: *Organization studies* 33.11, pp. 1451–1475.

Sustainability accounting is often presented as a technical tool for measuring and reporting environmental and social performance or a device for legitimising an unsustainable status quo. Yet the production of sustainability accounts depends on far more than accounting techniques alone. Based on a longitudinal study of the Swedish property sector, this thesis examines how sustainability accounting is maintained and used in practice. Drawing on the concept of boundary infrastructure, it shows how various actors work together to produce accounts of sustainability work. The thesis contributes to research on sustainability accounting by highlighting the infrastructure that makes sustainability reporting possible and by demonstrating how accounting both shapes and is shaped by the practices through which it is produced.

Marcus Brogeby is a PhD student at the School of Business, Economics and Law at the University of Gothenburg. He has, since 2019, worked full time as a lecturer in accounting at the University of Borås.



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

ISBN 978-91-88623-40-9