Driving the energy transition at Maastricht University? Analysing the transformative potential on energy efficiency of the student-driven and staff-supported Maastricht University Green Office

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Abstract
Strategies on how to radically improve energy efficiency at universities as part of the global energy transition are barely understood. This study aims to contribute to this body of knowledge, by investigating the energy efficiency transition at Maastricht University. Using the Multi-Level Perspective of transition studies, this research investigates the landscape trends in relation to energy efficiency at Dutch universities, the energy efficiency regime of Maastricht University and the impact of the student-driven and staff-supported Green Office, conceptualized as organizational niche, on this regime. 29 interviews with 24 interviewees were conducted and dozens of documents as part of the analysis.

The results suggest that the landscape did not provide for an external push to radically advance energy efficiency at Maastricht University, so that any stimulus for change must come from within the institution. However, before the Green Office was established, Maastricht University was trapped in a lock-in, allowing only incremental, technology-driven improvements of energy efficiency in buildings. After successful lobbying of students, the university introduced the Green Office which ran three project series on energy efficiency in IT, buildings and sustainability strategy. The results suggest that the Green Office influenced all dimensions of the energy efficiency regime, thus breaking the regime’s lock-in.

The study makes an important contribution to the field of transition studies, by applying the Multi-Level Perspective to an organizational context and by providing an additional case study within the under-researched field of energy efficiency transitions in public universities. Based on the findings, a model of change is developed to provide an idealized representation of how a student-driven Green Office should influence energy efficiency at a university. In addition, the project hopes to make practical contributions, by providing eleven recommendations to the Green Office on how to improve its impact.

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Introduction
The global energy system is trapped in a trilemma of problems around energy security, social equity and environmental impact. Energy security is compromised as fossil fuel reserves are depleting, the environmental impact of fossil fuel combustion promotes climate change, and social equity is decreased as finite energy sources become more expensive (World Energy Council 2012; World Bank 2012). If common practices continue, this trilemma is expected to worsen, as the global energy demand is projected to surge ‘by more than one-third’ between 2010 and 2035 (International Energy Agency 2012: 1). One necessary step to resolve this trilemma is an energy transition in form of a long-term, multi-actor and multi-dimensional process that transforms the current fossil-fuel based energy system to one based on renewable energies and energy efficiency (Markard, Raven & Truffer 2012; Scheer 2012; Verbong & Loorbach 2012). Though the transition to renewable energies is already underway in some countries, the promotion of energy efficiency experiences a ‘disappointingly slow progress’ (International Energy Agency 2012: 2).

Radically advancing energy efficiency as part of the energy transition is an enormous challenge. It requires a socio-technical re-organization of the energy system: Changes in the physical infrastructure need to be accompanied by changes in laws, economic models, worldviews, political alliances, subsidies etc. (Verbong & Loorbach 2012). The challenges of this energy transition occur on multiple dimensions - legal, political, infrastructural, technological, cultural and economic - and levels ranging from countries, regions, institutions, to households and individuals (De Haan 2010). Until this point, research has mainly focused on energy issues at the household and country level, with little focus on commercial or institutional sectors (Kahn, Kok & Quigley 2013).

Higher education is an interesting institutional sector to study. Universities\(^1\) feature diverse communities and are highly decentralized organizations. Similar to other public service organizations, universities have relatively limited workforce, money and knowledge available to actively improve energy efficiency (DECC 2012). Nonetheless, improving energy efficiency is especially important at universities, as it can generate unique insights into transition processes if

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\(^1\) All institutions of higher education – colleges, universities of applied sciences, universities, evening schools, etc. - are in this study referred to as ‘universities’ for matters of simplicity.
universities are used as 'living laboratories' for experimentation and learning around different ways to promote energy efficiency (Schneidewind & Brodowski 2013). Despite this importance, case studies on the energy efficiency transition at universities are rare.

This study examines Maastricht University as a living laboratory in which students are actively involved through the Maastricht University Green Office to advance sustainability at the university. After successful lobbying by a student initiative, the Green Office was established in 2010, as the student-driven and staff-supported sustainability office, run by a team of eight student employees, the environmental advisor and several volunteers. The university provides the Green Office with an official mandate and an annual budget of 135 000 Euro to pay for salaries, office space and project expenses. The Green Office reports to its own seven member strong supervisory board. Since 2010, the Green Office has implemented several energy efficiency projects. With the Green Office, Maastricht University thus provides a unique and interesting example to study the impact of a student-driven sustainability unit on the energy efficiency transition of a university.

The Multi-Level Perspective serves as the analytical framework to conceptualize the impact of the Green Office. The Multi-Level Perspective originates from transition studies, an academic field examining energy and sustainability transitions (Geels & Schot 2007). In a review of 500 academic articles, Markard, Raven and Truffer (2012) found that the Multi-Level Perspective was applied to the national level in one third of all studies. Organizational case studies represented less than 3% of the sample. By applying the Multi-Level Perspective to a university setting, this study has the potential to develop new academic insights.

The Multi-Level Perspective consists of three levels – the landscape, regime and niche - that have been adapted to Maastricht University. The landscape represents broad and long-term developments affecting energy efficiency at Dutch universities. The regime is defined as the complex set of socio-economic and technological practices that constrain and enable energy efficiency at the university. The Green Office is defined as an organizational niche, a relatively unconstrained place in which experimentation with new practices can take place (Kemp Schot & Hoogma 1998; Raven 2012). Regimes are embedded within landscapes and niches within regimes and it is the interaction between these three levels that brings about sustainability transitions (Grin, Rotmans & Schot 2010).
Four research questions have been developed to understand the Green Office case and learn from it. The research questions towards understanding ask: (1) *What have been major landscape trends and dimensions of the energy efficiency regime at Maastricht University before the Green Office was established in September 2010?* (2) *How has the Green Office impacted the energy efficiency regime between September 2010 and July 2013?* The research questions towards learning ask: (1) *What lessons can be drawn from this case study to support theory development in relation to the Multi-Level Perspective?* (2) *How can the impact of the Green Office on energy efficiency be improved?* These questions illustrate that the relevance of the research aims to be both academic, and practical.

Participatory Action Research presents the methodological approach. A qualitative research design has been chosen to answer the research questions, as they require the in-depth analysis of a specific case, rather than insights regarding a generalizable phenomenon. 29 interviews were conducted with 24 interviewees and dozens of documents were analysed. The data was grouped into categories following a grounded theory approach. Selected interviewees were invited to provide feedback on interim research outputs. This co-production, reflection and direct sharing of the knowledge allowed for a thick generation of data and mutual learning between the researcher and the Green Office team.

The presentation of findings unfolds in the following way. The first chapter contains the literature review which describes the findings on energy efficiency at universities within the academic literature and the Multi-Level Perspective. The first chapter also outlines the analytical framework for this study, applying the Multi-Level Perspective to the case study. The methodology part describes the Participatory Research Approach and how the data was gathered and analysed. The second chapter presents the main findings with regards to landscape trends, regime characteristics and niche activities. In the third chapter, these findings are discussed, lessons for theory development and recommendations for the Green Office developed, as well as limitations of the study and directions for future research emphasized.
CHAPTER I

Literature review

The role of energy efficiency at universities

Energy efficiency is an important topic in the literature on sustainability, environmental management and climate change mitigation at universities. With regards to sustainability, energy efficiency has been identified as a key component of sustainability audits for universities (Beyer et al. 2008; Cleaves et al. 2009; Mitchell 2011). In addition, it has an important role in how students and facility management directors define a sustainable university (Nejati & Nejati 2012; Wright & Wilton 2012). In the literature on environmental management at universities, energy consumption is regarded as a major environmental impact that needs to be measured, controlled and reduced (Jain & Pant 2010; Bero et al. 2011; Disterheft et al. 2012). Finally, energy efficiency – alongside renewable energies - features as a major theme in climate action planning to reduce greenhouse gas emissions at universities (Pasinella, Andrews & Wake 2008; Rauch & Newman 2009). Despite this importance of energy efficiency, the literature suggests that the energy savings potential of most universities has not been fully exploited yet.

The potential for energy efficiency improvements is high. At German universities, the reduction potential of behaviour change measures was estimated to range from 9%-20% for heating and constitute 18% for electricity at some institutions (Kattenstein, Unger & Wagner 2002; Gillen et al. 2002; Matthies et al. 2011; Starzynski 2012). A scan of the ICT infrastructure at eight Dutch institutions of higher education suggests that an energy savings potential of 44% exists for data centres and desktop computers (Ter Hofte 2012). Though not directly focused at universities, a recent analysis of the energy consumption of different sectors in the USA found that buildings have a 60% (!) higher energy consumption, if they are occupied by a government tenant compared to a commercial one (Kahn, Kok & Quigley 2013). This failure of universities and other public service organizations to exploit these energy and costs savings is referred to as the ‘energy efficiency paradox’ (DECC 2012).

The barriers that lead to this ‘efficiency paradox’ are numerous and complex (DECC 2012). Among the common factors enabling or constraining energy efficiency at universities are campus size, incentive structures, power relationships, data quality, competence and knowledge of employees, risk perceptions, awareness, building status, funding, cost-calculation...
methodologies, geography and leadership (Levy & Dilwali 2000; Sorrell et al. 2000; Dahle & Neumayer 2001; Pearce & Miller 2006; Ward 2008; Altan 2010; Ghosh 2011; Lo 2013). These barriers have been identified and understood, and a wide range of academic and grey literature exists on how to address them.

Best practices on improving energy efficiency can be divided into recommendations on the one side for the university itself and on the other side for policy makers. Organizational best practices include among others, revolving loan funds, partnerships with energy service companies, and energy savings in laboratories, student dorms and offices through technical and behavioural measures, such as community-based social marketing campaigns (Levy & Dilwali 2000; Kahler 2003; Marcell, Agyeman & Rappaport 2004; Woolliams, Lloyd & Spengler 2005; Pearce & Miller 2006; Petersen et al. 2007; Wesolowski et al. 2010; Feder, Robinson & Wakefield 2012; Liers & Person 2012). Recommendations for governmental policy makers include measures that would also benefit energy efficiency at other organizations, such as the provision of subsidies, information sharing, and compulsory energy commitments (Sorrell 2000). Despite these specific and project-based best practices no literature could be identified on how to instigate a deep and structural transition to radically boost energy efficiency at a university. For this reason, I turned to transition studies as another body of research that aims to both understand and practically influence energy transitions.

**Transition studies: Multi-Level Perspective**

Compared to existing studies on energy efficiency at universities, transition studies provide the required analytical perspective that is process, long-term and system oriented. Transition scholars have developed several concepts to study transition processes, among which the Multi-Level Perspective is one of the most prominent. The Multi-Level Perspective provides insights into how transition processes unfold between and within three levels of analysis (see Figure 1).
Figure 1 illustrates the three levels of the Multi-Level Perspective. They present a ‘nested hierarchy’, meaning that regimes are embedded within landscapes and niches within regimes’ (Geels & Schot 2010: 18). The landscape constitutes the meso-level, such as privatization, demographics and globalization, describing long-term and global trends that actors cannot influence in the short run (Grin, Rotmans and Schot 2010). Socio-technical regimes are nested within these landscapes. As illustrated in Figure 1 Geels (2002) defines regimes with regards to seven dimensions, including among others technology, markets, infrastructure, culture and symbolic meaning. These elements weave into a complex and stable web of interdependencies, which constrain and enable certain practices and lock the regimes into a specific development pathway (Van der Vleuten & Högselius 2012). Niches are conceptualized as relatively unconstrained and ‘protected spaces’ in which experimentation with new practices can occur (Kemp Schot & Hoogma 1998; Ieromonachou 2004; Monaghan 2009; Raven 2012). It is the scaling of niche innovations into the regime, after the regime has been destabilization through landscape or regime pressures, that bring about energy transitions (Geels & Schot 2007).

Niche scaling can focus on making the niche better conform with regime requirements and on engaging in structural change to alter the regime itself (Markard, Raven and Truffer 2012). Transition scholars have identified several factors that support either of these processes. Among those are the development of a growing network of powerful supporters that share...
similar expectations, visions and trust (Schot & Geels 2008; Leenders 2009; Grinn 2010; Raven et al. 2011; Smith & Raven 2012). Learning about the niche innovation through experimentation is another important factor to continuously improve its design and verify expectations (Bos & Grin 2008; Schot & Geels 2008). Power struggles also play an important role in the interaction between niche and regime actors (Jorgenson 2012; Raven 2012). A lack of knowledge persists about the study of agency in transition processes and how different niche activities need to be linked into sequences of activities to influence the regime (Schot & Geels 2008; Markard, Raven & Truffer 2012). The realization of these necessary conditions provides crucial support to scale niche innovations to the regime.

The Multi-Level Perspective is highly applicable as an analytical framework for this case study. Maastricht University, as an innovative research and teaching organisation, is decentralized and provides considerable freedom to faculties and departments. This autonomy allows for the emergence of 'organizational niches', that I define here as unstructured spaces of experimentation within an institution. The Green Office was created as such a space, which would sit slightly outside of the normal structures, making to more independent and flexible (Supervisory Board Member 2 2013, pers. comm. 3 July). The Multi-Level Perspective provides the concepts to study the interaction between these autonomous and flexible organizational units with the organisation as a whole.

The Multi-Level Perspective was adapted to Maastricht University. In most studies, transition scholars position the landscape at the global level, the regime at the level of nation-states, and the niche at the regional or local level (Markard, Raven & Truffer 2012). However, considerable flexibility exists in terms of defining the borders of the three levels of the Multi-Level Perspective (Shove 2012). In this study, the landscape represents all developments within the Netherlands that influence energy efficiency at Dutch universities. A fourth level of analysis could be introduced, which would represent global and long-term trends that respectively influence the energy transition within the Netherlands. However, for matters of simplicity, this fourth level of analysis is not applied. The energy efficiency regime is defined as all aspects of the university that constrain or enable energy efficiency. The Green Office is defined as the organizational niche that promotes innovative energy efficiency practices at Maastricht University through specific projects. The energy efficiency projects of the Green Office are thus of special interest to this study and explained in the following section.
Case description
The Green Office divides its work into five areas, namely education, research, operations, community and governance (See Figure 2). Internally, these five areas are divided into four portfolios: Education & Research, Operations, Community, and Organization. Governance projects are jointly organized, with one portfolio taking the lead. Each portfolio is managed by two to three student employees who are supported by several student volunteers. Most activities of the Operations portfolio and joint governance projects are of interest to this study, as this team has implemented several energy efficiency projects.

The energy efficiency projects of the Green Office can be clustered into three project series (see Figure 3). The Green IT project series is the overarching category for five projects to improve energy efficiency in the IT infrastructure. First, in partnership with ICTS – Maastricht University’s central IT department - , the Green Office developed the Ctrl-Alt-Delete Emissions business case, examining the energy efficiency potential of eight IT measures. Based on this business case, three more detailed business cases have been developed. One of these measures, PC Power Management, is now being implemented. (See Appendix ‘Green IT timeline’ for references and a detailed historical overview).
The project series *energy efficient buildings* is a mixture of student research projects and a business case. Since January 2011, six student research projects on energy efficiency in real estate have been developed by students through their course work. The first tangible real estate project of the Green Office was the University College Maastricht (UCM) Business Case. This project examined the energy efficiency potential of LED lighting, PC Power Management and the adjustment of opening times in the building in which University College Maastricht is located (Green Office 2012a). (See Appendix ‘Energy efficient buildings timeline’ for references and a detailed historical overview.)

The project series on *sustainability strategy* contains all governance projects in which energy efficiency plays an important element. The series starts with the Climate Action Report, the first sustainability baseline analysis on sustainability at Maastricht University. Based this report, the Green Office wrote the Maastricht University Sustainability Policy 2012-14, Sustainability Vision 2030 and Roadmap, as well as two Sustainability Progress Reports. In all of these strategic documents, energy features as the most prominent operational issue. (See Appendix ‘Sustainability strategy timeline’ for references and a detailed historical overview).

As a student at Maastricht University, I co-founded the Green Office and worked in its Operations portfolio for 21 months from September 2010 until May 2012. I coordinated the writing of the Climate Action Report, the first five months of the UCM Business Case, co-designed the tasks for three of the six student research projects and coordinated the writing of the Sustainability Policy 2012-14 with regards to its operational objectives. Currently, I am also setting up a non-profit social enterprise to bring the Green Office concept to other European universities. The implications of my involvement will be discussed in the section on limitations.
### Green Office projects under investigation

| Green IT | - Ctrl-Alt-Delete Emissions Business Case (Jan-June ‘11)  
- Policy proposal on PC Power Management (Oct ‘11 – June ’12)  
- Policy proposal on server virtualization (Oct ‘11 – May ‘12)  
- Policy proposal on data centres (Oct ‘11 – ongoing)  
- Implementation of PC Power Management (Sept ’12 – June ’13) |
| Energy efficient buildings | - Six student research projects on energy efficiency with regards to Maastricht University buildings (Different times between Jan ’11 – May ’13)  
- UCM Business Case (Oct ’11 – June ’12)  
- Partial implementation UCM Business Case (Dec ’12 – June ’13) |
| Sustainability strategy | - Climate Action Report (Feb ’11 – Nov ’11)  
- Sustainability Policy 2012-14 (Aug ’11 – March ’12)  
- Sustainability Progress Report 2011 (Jan – Nov ’13)  
- Sustainability Progress Report 2012 (Jan – July ’13)  
- Sustainability Vision 2030 (Feb ’12 – Sept ’12)  
- Sustainability Roadmap (Sept 2012 – ongoing) |

**Figure 3 - Green Office projects under investigation**

### Methodology

As the research questions and analytical framework suggest, a qualitative research design best suits this study to generate an in-depth understanding of the organizational case and support the development of theory (Jenkin et al. 2011). In line with the principles of Participatory Action Research the study is participatory, as Green Office student employees, volunteers and Maastricht University employees were invited to provide feedback on research results and the process. It is action-oriented as the results provide recommendations for the Green Office on how to improve its work. Exploration and reflexivity are maintained, as the research process was kept open and continuously adjusted while analysing interviews and document (Burns 2007). These characteristics of the research approach are in line with other approaches to study energy transitions (Loorbach 2010). The data was gathered through interviews and documents.

### Data gathering

**Interviews**

Interviewees have been selected through purposive sampling based on people’s engagement with the Green Office projects, and snowball sampling through the recommendation of interviewees (Burns 2007). Figure 4 displays the 29 semi-structured and open ended interviews that were conducted with 23 participants. The sample included current and former Green Office student employees, volunteers and Maastricht University employees. Two external experts on Green IT and monumental buildings at Dutch universities were also interviewed. Six participants were
interviewed at least twice and 14 provided feedback on research results either via email or in follow-up interviews (see Figure 4). The interviews were conducted in person between May and July 2013 at Maastricht University or online via Skype and lasted between 25 and 90 minutes (see Appendix 5 for the interview schedule). Most interviews were recorded – some interviewees did not want to be recorded - and handwritten notes were also made. Interviews were conducted in English, German or Dutch. This diverse sample of interviewees enabled the generation of a thick web of data that included positive and critical perspectives on the activities of the Green Office (Burton 2000). Ultimately, the most relevant stakeholders have been interviewed who worked on or were affected by the energy efficiency projects of the Green Office within the last three years.

The interviews were conducted in three phases, which allowed for an evolutionary development of the current research focus. First, former and current Green Office student employees and one volunteer were interviewed to develop detailed timelines for the three project series (see Appendices 1, 2 and 3). These interviews were furthermore used to gather first data on the Maastricht University energy regime and landscape trends. In a second phase, five interviews with employees were conducted to gather more data on the energy regime, landscape and impacts of the project series. These interviews helped to test and refine the first research focus. After the final research focus had been determined, all other interviews were conducted. Depending on their knowledge, these interviewees were asked questions relating to the landscape, energy regime or Green Office project series. A generic interview guide was developed for these interviews and adapted accordingly (See Appendix 4).
Documents were obtained through online research or by recommendations from interviewees in order to identify landscape trends, regime characteristics and niche activities. Figure 5 depicts the documents that were gathered and analysed, including publications of external organizations, internal Green Office working documents, publications and policies. The insights gained from these documents were used to support or contrast the findings from the interviews. In the end, the documents were mainly used to develop the timelines of the project series and understand the niche activities (see Appendices 1, 2 and 3 for the timelines).
<table>
<thead>
<tr>
<th>Landscape</th>
<th>Agreement Dutch universities joining third Multiple-Year Agreement on Energy Efficiency (MJA3); MJA-bedrijfs- en brancherapportage 2009; MJA-Sectorrapport 2012 Wetenschappelijk onderwijs; ICT energy efficiency in higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niche</td>
<td>Green IT; Ctrl-Alt-Delete Business Case; Green IT meeting notes; Project descriptions by ICTS about data centre, server virtualization and PC PowerManagement; Presentations about SURF ICT Scan 2012 and PC Power Management Energy efficient buildings: UCM Business Case; UCM Business Case meeting notes; UCM Business Case Evaluation Report Sustainability strategy: Climate Action Report; Sustainability Strategy 2012-14; Sustainability Vision 2030; Sustainability Progress Report 2012 and 2013; Final draft version Sustainability Roadmap; Sustainability Roadmap meeting notes, planning documents and drafts</td>
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</tbody>
</table>

**Figure 5 - Overview of documents gathered and analysed**

**Data analysis**
The interviews and documents were analysed inductively following a Grounded Theory (GT) approach (Strauss & Corbin 1998). EMIC codes were developed from the interview transcriptions and the documents with regards to landscape trends, regime characteristics and impact of niche activities. These EMIC codes were grouped into higher level ETIC codes where possible (Silverman 2010). Following this clustering, their qualitative relationships and relative importance of these codes towards each other was examined.
CHAPTER II

Results

The analysis results are presented in this chapter, in order to answer the first two research questions: (1) What have been major landscape trends and dimensions of the energy efficiency regime at Maastricht University before the Green Office was established in September 2010? (2) How has the Green Office impacted the energy efficiency regime between September 2010 and July 2013? The answers to these questions provide a better understanding of the impact of the Green Office.

Landscape

The analysis suggests that landscape trends are mainly constraining energy efficiency at Dutch universities (see Figure 6). Seven constraining trends were identified: The usage intensity of medical and natural science research, Information-Communication Technologies and buildings has been increasing over the years at Dutch universities (ter Hofte 2011; AgentschapNL 2010 & 2012; Ehnert 2012; Environmental advisor 2013, pers. comm. 10 June; Green IT researcher 2013, pers. comm. 12 July). Also procurement regulations prevent universities from making ambitious demands for energy efficiency in appliances (Environmental advisor 2013, pers. comm. 10 June). In addition to these long-term trends, the financial crisis reduces the financial flexibility of universities (GO student coordinator 3 2013, pers. comm. 26 June; Energy coordinator 2013, pers. comm. 10 June). Decreasing energy prices also rise the payback periods of energy efficiency measures. Finally, the lack of attention that is paid to energy efficiency in university rankings and accreditations reduces the incentives for executive boards to address this issue (Environmental advisor 2013, pers. comm. 10 June). Overall these trends provide a powerful constraint to improve energy efficiency in the university sector.

Only four trends were found that enable energy efficiency. All interviewees identified the third Multiple-Year Agreement on Energy Efficiency (MJA3) as the major enabling trend. Under the MJA3, Dutch universities commit themselves to improve energy efficiency by 30% between 2005 and 2020. Every four years, universities develop an Energy Efficiency Plan (EEP) to outline their plans to achieve this agreement (VSNU 2008; AgentschapNL 2010). A downside of this regulation is its soft-policy approach: it is voluntary and provides no financial subsidies,
incentives or punishments for universities to reach the targets. In addition to the MJA3, interviewees mentioned an increase in knowledge, services and technologies that could help universities to promote energy efficiency. However, as a major downside, the financial crisis limits the ability of universities to purchase those (Environmental advisor 2013, pers. comm. 10 June). Furthermore, one interviewee mentioned that societal awareness of energy efficiency was increasing, which might prompt stakeholders to take action on it (Facility manager 2013, pers. comm. 11 June). However, no official data could be found to support the observation around increasing societal awareness of energy efficiency, which is why this observation should be taken carefully. Overall, the strength of government policy, service and technological improvements and societal awareness is judged as too low to provide a strong external push for energy efficiency at Dutch universities.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Landscape trends</th>
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<tbody>
<tr>
<td>Enabling</td>
<td>Tightening building and energy regulations, agreements and government policy</td>
</tr>
<tr>
<td></td>
<td>Increasing societal awareness around energy, climate change and sustainability</td>
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<tr>
<td></td>
<td>Efficiency improvements of equipment, technology and building materials</td>
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<tr>
<td></td>
<td>More services and understanding to improve energy efficiency within organizations</td>
</tr>
<tr>
<td>Constraining</td>
<td>Increasing energy intensity of natural science and medical research</td>
</tr>
<tr>
<td></td>
<td>Intensification of ICT usage</td>
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<tr>
<td></td>
<td>Intensification of building usage through longer opening hours of libraries and teaching facilities</td>
</tr>
<tr>
<td></td>
<td>Budget cuts following the financial crisis</td>
</tr>
<tr>
<td></td>
<td>Energy efficiency is not addressed in rankings, accreditation or other performance evaluations of universities</td>
</tr>
<tr>
<td></td>
<td>Procurement regulations</td>
</tr>
<tr>
<td></td>
<td>Decreasing energy prices</td>
</tr>
</tbody>
</table>

Figure 6 – Landscape trends constraining or enabling energy efficiency at Dutch universities

All of these landscape trends have been found to affect Maastricht University. The university’s accession to the MJA3 was the most important enabling landscape trends that influenced Maastricht University (Green Office 2011). As the findings on the energy regime illustrate, the intensification of research and IT usage are among the two most important long-term trends that continue to constrain energy efficiency at Maastricht University. The university also benefits from decreasing energy prices, which however make energy efficiency less attractive by prolonging payback periods (Environmental advisor 2013, pers. comm. 10 June). Governmental
budget cuts were a shock that affected Maastricht University in the short-term, but could be resolved again in the long-term (Project Manager FD 1 2013, pers. comm. 10 June). The exact impacts of these landscape trends on the energy regime at Maastricht University were difficult to quantify. Still the analysis suggests that no external push could be expected to drive the institution’s energy efficiency transition, so that the force of change must come from within the institution.

**Regime**

Having mapped the energy efficiency landscape, the analysis now zooms into Maastricht University as one of the 14 Dutch universities that are part of this landscape to analyse its energy efficiency regime in details. This section discusses the most important regime characteristics before the establishment of the Green Office in September 2010. Five dimensions were developed inductively: First to be discussed are three factors that have been found to directly determine energy usage, namely *infrastructure, technology and behaviour*. Having introduced those, all relevant *actors and networks* with regards to energy efficiency are outlined. The dimension of *awareness and acceptance* describes the awareness among the university community about the importance of energy efficiency, the acceptance of measures and the wider organizational culture sustaining this awareness and acceptance. The *strategy and policy* dimension describes the policies and goals towards energy efficiency. The final dimension describes the available *data, knowledge and understanding* on energy efficiency issues. The interaction between these dimensions creates stability within the energy efficiency regime which makes radical change from within difficult.
The main finding with regards to infrastructure, technology and behaviour is that energy consumption at Maastricht University is directly determined by a diversity of four factors that have been grouped into buildings, ICT, research equipment and user behaviour (see Figure 7 for a summary of the findings). These factors further exhibit a high-level of diversity and complexity. With regards to buildings, the 30 buildings vary by size, age, quality of equipment and usage (Maastricht University 2011). This accounts for their different gas and electricity consumptions (Hawkins et al. 2012; Kahn, Kok & Quigley 2013). The building stock has been growing and will continue to grow in the future to accommodate an increasing number of students and staff. With regards to ICT, Figure 7 illustrates the diversity and magnitude of devices that consume energy. In line with the IT intensification of the Dutch higher education sector, the size of the IT infrastructure has also been increasing at Maastricht University (GO
The two research faculties host a plurality of devices. The biggest of the two had 5322 individual research apparatuses in 2012. In line with the research intensification at other universities, the research equipment at Maastricht University has been growing: the value of research equipment increased by 41% between 2004 and 2012 (Research equipment engineer 2013, pers. comm. 3 July). The exact contribution of research equipment to the university’s energy consumption could not be determined. Nonetheless, it is expected to be relatively high, given the fact that the electricity consumption of the two research faculties is 70% and the adjusted gas consumption 22% higher per square metre than in non-research faculty buildings (Maastricht University 2011). User behaviour is a key determinant influencing the usage intensity of buildings, ICT and research equipment. The exact influence of user behaviour on energy consumption is very complex, as it depends among others on equipment and buildings characteristics, season and user group (Kahn, Kok & Quigley 2013). Overall this diversity of user behaviours, alongside the diversity in building types, ICT devices and research equipment illustrates the complexity of energy determinants.
The diversity of energy determinants is further complicated through a diversity of actors that influence usage, maintenance and investment decisions on these determinants (see Figure 8). As a major organizing principle, these actors are divided into centralized actors providing services to the whole university and de-centralized ones working on a faculty level. Facility Services formally manages the obligations of Maastricht University under the MJA3. In 2010, an energy group comprising six Facility Services staff met every six weeks to discuss progress on the Energy Efficiency Plan (Project Manager FD 1 2013, pers. comm. 10 June). On an operational level, the two energy coordinators are responsible for building optimization, monitoring energy consumption and maintenance of the basic infrastructure (Energy coordinator 2013, pers. comm. 10 June). On a decentralized level, facility managers and managing directors were involved in
daily maintenance work. As a result of the explicit responsibility of Facility Services for energy efficiency, strategic efforts had a strong focus on buildings.

With regards to ICT, the central department provides the basic infrastructure, whereas the IT departments of the six faculties provide more specialized services (Manager operations ICTS 2013, pers. comm. 4 July). With regards to research equipment, research faculties are organized into schools that are subsequently divided into research groups that control the purchase and usage of equipment and laboratories. Each of the two research faculties has their own service department to build, maintain and purchase research equipment (Research equipment engineer 2013, pers. comm. 3 July). In 2010, none of these actors had an official responsibility with regards to energy efficiency and conducted any explicit efforts to improve it.

With regards to higher management, the meeting of all directors (CBB) and the Executive Board – president, vice-president and rector – decide on large-scale infrastructure investments. The formal role of the CBB is the annual monitoring and discussion of energy usage with regards to costs. One member within the Executive Board holds a portfolio for finance and operations, meaning that energy is one of many topics he deals with (Supervisory Board member 1 2013, pers. comm. 3 July). Higher management does not have a direct influence on energy efficiency, but an indirect one through decisions on large-scale investments.

The role of users is complex. Researchers as direct users of research equipment have a stake in the decision on what equipment to procure. In general, however, users have no formal authority or resources to influence decisions regarding building construction or ICT equipment, apart from individual and small-scale actions such as switching off lights and computers. As one dean mentioned:

‘I don’t feel any control over the energy consumption of this building. I don’t think my director feels any control. We are in this building, but this is not our building. This is a university building where we are guests in a certain way.’ (Supervisory Board Member 2 2013, pers. comm. 3 July).

Users are still a very important group, as their behaviours influence the intensity of building and equipment usage and they can also resist or accept energy efficiency measures.
Awareness and acceptance

Apart from a group of employees within Facility Services, overall awareness of the importance of energy efficiency for Maastricht University and acceptance of change seem to have been relatively low among students, staff, researchers, ICT departments and higher management (see Figure 9). Unfortunately, no empirical evidence can be provided to support this finding apart from individual experiences of employees. For instance, one Facility Service project manager explained:

‘The culture of the average university employee does not accept these issues - that is my experience. [...] At Facility Services it might work because here we have people you might say that are supportive of energy efficiency measures. But as soon as you roll something out at a faculty, the only things that you get are complaints.’
The lack of direct incentives for energy efficiency measures is one reason to explain the perceived low levels of awareness and acceptance. Energy costs are divided by the amount of square meters and then factored into the price that faculties must pay when renting office space (Carranza et al. 2013). This leads to the situation that energy efficiency projects save money on a central level and potentially lead to reductions in the energy price per square meter that are divided among all users. Faculties themselves do not experience any direct returns. On the contrary, they might even need to invest time and experience discomfort (Faculty IT manager 2013, pers. comm. 4 July). This leads to a Not in My Backyard (NIMB) phenomenon throughout the organization, where students and staff might be supportive of energy efficiency measures in general, as long as they are not conducted in their faculty.

The invisibility of energy consumption is a second factor to explain the low levels of awareness and acceptance. The energy coordinator explained that Facility Services develops monthly and annual monitoring reports for the energy and water consumption of each building. These results however are not communicated to users (Energy coordinator 2013, pers. comm. 10 June). As a result, users do not understand the consumption of their building and what could be done about it. As one interviewee explained:

‘The energy usage is very obscure, because we just pay it in the square meters. There is no reporting or whatsoever to managing directors on how much energy is used. The fact that energy usage is so obscure leads to non-behaviour on my side, because I have no clue how much the usage is, if people use too much, if it could be less’ (Supervisory Board Member 2 2013, pers. comm. 3 July).

Finally, one of the main characteristics of the university’s organizational culture is that faculties should focus on education and research and not be preoccupied with operational issues. In the words of the research equipment engineer: ‘researchers must focus on their research to become or stay excellent, everything else is secondary’ (Research equipment engineer 2013, pers. comm. 3 July). Energy is a service that should be supplied by Facility Services in a reliable way with minimal disturbances to the clients, i.e. the faculties. This service orientation is well-expressed in the self-understanding of the two project managers of Facility Services: ‘We are here to support research and education, and when a researcher or educators says that we need or do not need this and that, then we cannot say no’. As a result, before the establishment of the Green Office,
Facility Services lacked power and confidence relative to students, academics and other employees to push for radical energy efficiency changes that might disrupt the primary process.

**Strategy and policy**

![Diagram](image)

*Figure 10 - Energy efficiency strategy and policy focused on technological fixes in buildings*

In 2010, the major focus of Maastricht University’s energy efficiency strategy was adherence to the MJA3 (Maastricht University 2010). Technological fixes, such as building optimization and automation, that are largely invisible to students and staff, have been the strategic focus of the Energy Efficiency Plan 2009-2013. The efforts outlined in this Energy Efficiency Plan were also insufficient to meet the MJA3 commitment, as they aimed to achieve 1.19% efficiency improvements compared to the 8% required by the MJA3 (Maastricht University 2009). In line with the lack of power of support services as identified in the previous section, the main reason for automation and technological measures appeared to be the attempt by Facility Services to reduce disturbance to users, to minimize the level of complaints. At the same time, a Facility
Services project manager also admitted that the scope for purely technological measures is limited:

‘I am also aware that for instance the movement detectors are not the solution. There will always be one malfunctioning or that needs to be configured differently that switches off the light in the wrong moment or something. It’s similar to when you get 10 dogs at home to guard the house. One is always barking’ (Project manager FD 1 2013, pers. comm. 10 June).

In addition, technologies need to pass the threshold of being a ‘proven technology’ to be applied within faculties. The underlying assumption seems to be that ‘unproven technologies’ would cause disruptions to the primary process which would subsequently lead to complaints by staff members and students. For instance, more energy efficient hand dryers that dry hands with cool air had to be uninstalled in some toilets, because staff complained about their noise (GO project coordinator operations 4 2013, pers. comm. 06 May). These complaints could also be related to a lack of communication to users about the benefits of the hand dryers, which may lead them to accept the discomfort caused by the noise. Nonetheless, the focus on technological fixes that are largely invisible and apply ‘proven’ technologies reduced the choice of options.

ICT, research and behaviour change were not part of the official energy efficiency strategy (Maastricht University 2009). Nonetheless, attempts were made to improve energy efficiency in these areas: One faculty IT department implemented a crude version of PC Power Management, first introduced in the late 1990s. ICTS also implemented server virtualization, albeit out of a different motivation than energy savings (Project manager ICTS 2013, pers. comm. 3 July). The environmental advisor mentioned moreover that he continuously tried to address energy efficiency in laboratories, with little success. No measures had been taken with regards to behaviour, despite the fact that awareness around the importance of behaviour change existed (Environmental advisor 2013, pers. comm. 10 June). One reason that was mentioned for this was that Facility Services does not have any employees who know about behaviour change issues (GO project coordinator operations 4 2013, pers. comm. 06 May). As a result, the potential for energy efficiency improvements of ICT, research laboratories and behaviour remained largely unexploited (see Figure 10).
In line with the previous findings that ICT, research equipment and behaviour were not on the agenda of the university’s energy efficiency strategy, it is hardly surprising that the understanding about the energy efficiency potential and savings options was the largest with regards to buildings (see Figure 11). The main sources of knowledge are business cases done by Facility Services, consultancy reports, visits to energy fairs and biannual meetings with energy coordinators of other Dutch universities (Energy coordinator 2013, pers. comm. 10 June). With regards to user behaviour only one study was conducted by three researchers investigating the energy-related behaviours and attitudes of over 200 university employees (Lo, Peters & Kok 2010). No projects followed from this study and it was the only research done by academics about energy issues at the university. No investigation into the energy savings potential of ICT or research equipment had taken place. A major barrier to improve energy efficiency of the ICT

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**Figure 11 – Data, knowledge and understanding with regards to the different energy efficiency determinants**
 infrastructure, research equipment and behaviour was thus the lack of knowledge about savings potentials and options.

In conclusion, the findings on the condition of the energy efficiency regime before the Green Office illustrate that the interaction between the five regime dimensions locked the university into a specific development pathway. The decision of the Executive Board to grant formal responsibility for energy efficiency to Facility Services freed all other stakeholders from any responsibility with regards to energy. However, as a result of its organizational role, Facility Services was unable to make radical steps, as it lacked the legitimacy, confidence and power to involve more actors controlling energy determinants and to implement measures despite complaints from students and staff. This constrained the feasible options to advance energy efficiency to largely invisible fixes of buildings with ‘proven’ technologies that do not lead to any disruptions of the primary process.

Niche activities
Given that the landscape did not provide any external push for more ambitious energy efficiency efforts, it can be assumed that Maastricht University would have remained on this development pathway without any internal changes. This change came through a student initiative that successfully lobbied for the introduction of a student-driven and staff-supported sustainability office. Looking back at the three years of Green Office activities, this section illustrates to what extent the three energy efficiency projects on Green IT, energy efficient buildings and sustainability strategy managed to impact the five dimensions of the energy efficiency regime. The findings suggest that the impacts were the largest on the dimension of actors and networks, strategy and policy as well as data, knowledge and understanding. The Green Office had an impact on awareness and acceptance within the higher management, but not the wider university community, and the least impact was on infrastructure, technology and behaviour. The analysis also suggests that the Green Office was able to have this impact, because it supplemented staff-driven energy efficiency projects through a student-driven approach.
The Green IT project series had the largest impact on *infrastructure, technology and behaviour*, compared to the other two project series (see Figure 13). The Green Office did not implement any behaviour change projects or projects in relation to research equipment, mainly due to lacking expertise (GO project coordinator operations 4 2013, pers. comm. 6 May). Due to technical problems and user complaints, the implementation of LED lighting and movement detectors failed, meaning that only the recommendation to close the building was implemented (Green Office 2012a & 2013). The implementation of PC Power Management was stopped in one faculty and college, and is currently being piloted in one sustainability research department on 24 staff PCs (GO project coordinator operations 2 2013, pers. comm. 23 May). The student research projects and sustainability strategy project series did not have any immediate impact on *infrastructure, technology and behaviour* (GO project coordinator operations 4 2013, pers.
Compared to the other four dimensions of the energy efficiency regime, the Green Office projects had the lowest impact on *infrastructure, technology and behaviour*.

In the case of the UCM Business Case and PC Power Management, the Green Office and collaborating departments underestimated difficulties that would emerge in the implementation. The wrong equipment was purchased in the implementation of the UCM Business Case that led to complaints by users who were also not informed about the implementation of the project. In an evaluation, participating stakeholders identified the missing collaboration between Facility Services and the Green Office in designing and implementing the case as a major reason for failure (Green Office 2013). Then, in the case of PC Power Management, the two major problems are that the work of employees is not saved when their computers go into stand-by and that staff cannot access their remote desktop when the computer is switched off (Project manager ICTS 2013, pers. comm. 3 July). Interviewees involved in the project framed these problems differently, either seeing them as a technological problem, a lack of acceptance among users to change their behaviour and/or insufficient communication. A similar factor for the UCM Business Case and the implementation of PC Power Management seems to be the missing attention that has been paid to the potential effects of the technology on user behaviour, visual comfort, feeling of trust and security.
Contrary to *infrastructure, technology and behaviour*, the Green Office had a major impact on *actors and networks*. The Green Office was added as a new actor that strengthened, weakened or added new relationships. Figure 14 illustrates how the Green Office was added as a new actor to the network and emerged as the central hub for all stakeholders involved in energy efficiency issues. As one Green Office operations project managers explained, the establishment of the Green Office enabled students to drive energy efficiency projects for the first time and thus to enter a network that has previously been dominated by university staff. One Green Office student employee now joins the energy group of Facility Services, student employees and volunteers developed the business cases and strategies, and students participated through six research projects. In addition, the Green Office also used the research capacity of the curriculum through student research projects on energy efficiency for the first time. The addition of students as active
change agents to the energy efficiency network was thus one of the largest impacts on this dimension.

The interviews suggest that the three-project series had further impacts, by strengthening, building and harming relationships between the Green Office and individuals in higher management and service units. With regards to strengthening relationships, the two Facility Services project managers emphasized that the Green Office managed to ‘strengthen the contact between Facility Services and ICTS on energy issues’. The projects also established new relationships with actors who had previously not been dominantly involved in energy efficiency projects or strategies – such as a sustainability group or deans. Nonetheless, the interviews also revealed that the Green Office had not established any relationships with researchers or research engineers (Research equipment engineer 2013, pers. comm. 3 July). The findings also suggest that project failure has the potential to harm relationships. For instance, the implementation of PC Power Management has the potential to threaten trusting relationships, between IT users on the one side, and faculty IT departments and ICTS on the other side (Faculty IT manager 2013, pers. comm. 4 July). The Green Office strengthened relationships when projects were successful and potentially harmed relationships when projects failed.

Compared to the other project series that established contacts mainly to individuals, the sustainability strategy projects show increasing participation of the wider university community in the drafting of energy-related strategies. For the Climate Action Report, the Sustainability Policy 2012-2014 and subsequent Sustainability Progress Reports, the energy group was the main stakeholder that provided data and ideas on energy issues (GO operations coordinator 4, pers. comm. 6 May). The Sustainability Vision 2030 marks the first project in which a larger number of students and staff were involved. Around 200 students and staff members submitted their ideas online, with many ideas about energy (GO student coordinator 3 2013, pers. comm. 26 June). Also the Sustainability Roadmap shows the highest level of involvement. Around 89 people - 42 students, 42 staff members and 5 members from external organizations - commented on objectives of the roadmap, including energy as the major operational issue. (GO student coordinator 2 2013, pers. comm. 21 June and 2 July). This increasing involvement of stakeholders occurred as the Green Office team realized that the stakeholder involvement can improve acceptance and thus implementation of sustainability policies (GO student coordinator 3 2013, pers. comm. 26 June).
Awareness and acceptance

The Green Office had a limited impact on this dimension, as the awareness and acceptance of energy efficiency among higher university management, ICTS and FD were increased, whereas the larger university community remained largely unaffected (see Figure 15). Several interviews suggest that the Green Office had the largest impact on awareness and acceptance among ICTS, directors, deans, certain students and project managers (e.g. (Supervisory Board member 1 2013, pers. comm. 3 July)). This awareness was created through the meetings that students conducted as part of the research projects, the UCM Business Case, the Green IT business cases or the sustainability strategies, as students started asking questions about energy efficiency and presented cost-benefit analysis of savings potentials (GO operations coordinator 4, pers. comm. 6 May). As a result, the operations manager of ICTS mentioned that ‘only since the Green Office is Green IT really an agenda point, as people were busy with other things beforehand’. The interviews illustrate that this awareness is a basic necessary condition to create acceptance.
among stakeholders for the additional energy and money that needs to be invested and potential discomfort that needs to be experienced to implement energy efficiency measures.

Nonetheless, the interviews suggest that the project series had a limited impact on the wider university community (Supervisory Board member 1 2013, pers. comm. 3 July). One reason for the limited reach was that the Green Office did not launch any awareness campaigns around energy efficiency itself or communicate around its energy efficiency projects. On the contrary, the Green Office worked together with a group of dedicated stakeholders to convince them through business cases and demonstration projects. For instance, one Green Office operations coordinator explains that not all research results have been shared with university stakeholders working on energy efficiency in buildings.

In addition, as one former student coordinator explains, the sustainability strategy projects exhibited little active communication to the wider university community, apart from the Sustainability Roadmap which is planned to be broadly communicated in September 2013 (GO student coordinator 2 2013, pers. comm. 21 June). The largest impact on user awareness could potentially be achieved in the implementation of these projects. However, as the two responsible Green Office operations coordinators explained, in the case of the UCM Business Case, the Green Office and Facility Services failed to use this opportunity (GO operations coordinator 4, pers. comm. 6 May). In the case of PC Power Management, the Green Office currently learns about how to create this awareness. This failure to communicate project results to the wider university community was a missed opportunity to increase the wider awareness around energy efficiency.

As a positive change to the organizational culture, the Green Office empowered the support services, by adding student voice to the lobby process. The energy coordinator mentioned that the participation of students now ‘provides a stronger support network to demand improvements, as the higher management tends to listen more to them than to us’ (Energy coordinator 2013, pers. comm. 10 June). For instance, by taking ownership of the UCM Business Case, the Green Office convinced Facility Services to pilot an innovative technology in a faculty, thus counterbalancing the risk aversion of Facility Services (GO operations coordinator 4, pers. comm. 6 May). However, the failure of the UCM Business Case also had a detrimental effect on the energy efficiency regime. The interviews revealed that the project failure strengthened the
risk aversion among Facility Service staff to implement innovative technologies in faculty buildings in the future, as this would only lead to complaints by users.

**Strategy and policy**

The Green IT and sustainability strategy project series both had an impact on the *strategy and policy* dimension, whereas the energy efficient buildings project series had no impact. With regards to *strategy and policy*, the Green Office had the largest impact on Green IT policies (see Figure 16). With the decision to implement PC Power Management, the first official policy measure was taken to improve energy efficiency of the IT infrastructure. The savings potential of PC Power Management was included in the Energy Efficiency Plan 2013-2016, as the first energy efficiency measure on IT (Maastricht University 2013). The Green Office convinced ICTS to integrate Green IT – understood mainly with regards to the energy efficiency of the ICT infrastructure – into its management and strategic plan (Manager operations ICTS 2013, pers.
comm. 4 July). Server virtualization and Green IT have also been included in the Sustainability Policy 2012-2014 (Maastricht University 2012a). Through these formal policies on energy efficiency, ICTS emerges as a third actor – after Facility Services and the Green Office – who actively improves energy efficiency.

The sustainability policy project series had a verifiable and immediate impact on strategy and policy, with increasing ambitions over time. In the first policy document that the Green Office drafted, the Sustainability Policy 2012-14, the only explicit objective with regards to energy is to maintain the commitments of the MJA3 (Maastricht University 2012a). Then, in the Sustainability Vision 2030, Maastricht University for the first time expresses the ambitious goal to achieve ‘zero net energy consumption’ (Maastricht University 2012b). Energy efficiency is thus part of a more comprehensive policy framework that also focuses on energy generation. The Roadmap mentions the aspiration to going beyond the MJA3 target with regards to energy efficiency and to decouple the energy consumption from the organization’s growth (GO student coordinator 2 2013, pers. comm. 21 June). An analysis of these strategic documents illustrates how the ambitions with regards to energy efficiency become more daring and are supplemented by steps to promote renewable energies.

However, the extent to which these policies will make a difference to the energy efficiency of Maastricht University still needs to be determined. One supervisory board member mentioned that one critical aspect in the development of these policies is the trade-off between ambitious demands towards improving energy efficiency and balancing these demands with what is acceptable and possible given current constraints (Supervisory board member 3 2013, pers. comm. 8 July). Another challenge was the alignment of ambitions with regards to the energy efficiency, with the other strategic plans of the university. As one Green Office operations coordinator mentioned, the sustainability and energy policies should not remain 'add-ons', but become fully integrated with the university’s long-term strategic objectives (GO operations coordinator 4, pers. comm. 6 May).
Data, knowledge and understanding

The findings suggest that the three project series improved the understanding of the savings potential of buildings and ICT, but not of research equipment or user behaviour (see Figure 17). In relation to the Green IT project series, the interviews with ICTS staff and Green Office employees suggested that it had the greatest impact on data, knowledge and understanding, compared to the other two project series. Not only the Green Office, but also ICTS learned from the business cases and the PC Power Management measure is currently being implemented. The Green Office and ICTS thus managed to generate knowledge on the major technological options to improve energy efficiency of the ICT infrastructure (Manager operations ICTS 2013, pers. comm. 4 July).

The energy efficient project series increased the understanding of the Green Office with regards to energy efficiency in buildings, but had a small impact on the understanding of other actors. The UCM Business Case provides the first analysis of the savings potential of LED
lighting and closing of a building on Saturdays. However, the business case, as well as the student research projects, were written in English and perceived as too long by Facility Service staff. This limited the learning potential for university employees (GO operations coordinator 4, pers. comm. 6 May; Environmental advisor 2013, pers. comm. 10 June).

With regards to the sustainability project series, the Sustainability Policy, Vision and Roadmap projects provide frameworks for action, whereas the Sustainability Progress Reports guarantee the annual monitoring of progress on these goals. The gradual increase of the comprehensiveness of sustainability strategy documents with regards to energy efficiency shows the improved understanding of the Green Office surrounding this issue (GO student coordinator 4 2013, pers. comm. 6 May). The Green Office achieved these learning affects, by reviewing sustainability visions and roadmaps from other universities and industries and conducting an extensive stakeholder feedback process (GO student coordinator 1 2013, pers. comm. 24 May). Hence the sustainability strategy project series makes an important contribution to understanding energy efficiency as part of a larger energy transition and sustainability framework and by mobilizing knowledge from external sources.
CHAPTER III

Discussion
Having presented the findings on the characteristics of the landscape, energy efficiency regime of Maastricht University and how the Green Office project series affected this regime, the third chapter answers the two research questions in relation to learning: (1) What lessons can be drawn from this case study to support theory development in relation to the Multi-Level Perspective? (2) How can the impact of the Green Office on energy efficiency be improved? The answers to these questions provide significant academic and practical insights.

Findings
The research process showed that precisely identifying landscape trends is difficult, given the definition of landscape as long-term trends that are beyond the influence of regime actors. This fact has also been recognized in other research, which perceived the landscape as ‘containing too many incomparable and unlike components’ (Grinn 2010: 133). To decrease the number of factors that could be included in the landscape as part of this research, its scope has been limited to enabling or constraining trends within the Netherlands that affect universities. Also the sample of interviewees was too small to make any reliable conclusions about energy trends in the Netherlands. For future research, more experts on energy efficiency should be interviewed and landscape trends should be further differentiated, for instance according to their temporal length or geographic spread. Nonetheless, the findings were still valuable, because they emphasized that no external trend currently exists that could push Maastricht University to take more ambitious steps on energy efficiency, so that any stimulus for change would need to come from within.

With regards to the regime, all different characteristics of the energy efficiency regime were collected, which were then grouped into five dimensions: The dimension of infrastructure, technology and behaviour was divided into four direct determinants of energy usage, namely buildings, ICT, research equipment and user behaviour. These four determinants found in the infrastructure, technology and behaviour dimension were used to set boundaries on what findings to include in the other dimensions: for instance, in the actors and networks dimension only stakeholders that control decisions on maintenance, investment and usage of these determinants were included. I am aware that using the main characteristics of the infrastructure, technology and behaviour dimension to describe the four dimensions introduced a certain
hierarchy. In other words, one could also argue that *infrastructure, technology and behaviour* represented the dependent variable that was to be influenced by the other four independent variables. However, this research never assumed that a linear causality existed between the variables, it much rather expected circular causality. The clustering was applied to set boundaries regarding factors to include/exclude in the descriptions of the dimensions of the energy regime, to avoid a data overload.

A major conclusion with regards to the state of the energy regime of Maastricht University before the Green Office was a lock-in which prevented any radical steps forward. A small group of university employees from Facility Services were officially involved in energy management. They focused on building maintenance and optimization with ‘proven’ technologies that did not cause any disruptions to students and staff. A lack of awareness and acceptance for energy efficiency measures penetrated different levels of the organization. The lack of organizational power to push for changes constrained the scope of action for Facility Services. The MJA3 presented the main commitment of the university to energy efficiency, which however was perceived as an add-on, voluntary commitment that was not integrated into a larger, binding policy framework. Finally, an understanding about the savings potential for ICT, research equipment and behaviour were missing. All these factors linked into each other which allowed for incremental improvements in building optimization, but prevented ambitious changes.

Figure 17 illustrates how the three Green Office project series affected all dimensions of the energy regime of Maastricht University. The Green IT project series was the most successful of the three project series. IT is an important determinant of energy usage and the Green Office managed to develop business cases together with ICTS that outline the reduction potential of measures. PC Power Management is now in the implementation phase. The energy efficient buildings project series was the least successful, as the student research projects did not have a tangible impact on projects and policies and since the UCM Business Case failed. These projects with no tangible impact on the regime are illustrated by the arrows bouncing back from the regime in Figure 17. The sustainability strategy series had the largest impact on the strategy and policy, actors and networks and awareness and acceptance dimensions, because it included projects that enabled widespread participation from the university community. Despite the fact that the impact of the project series could have been improved, especially with regards to
infrastructure, technology and behaviour, these findings suggest that the Green Office provided the internal push to break through the lock-in of the energy efficiency regime on some dimensions.

Figure 17 - Impact Green Office on UM energy regime

Necessary conditions that transition scholars identified as important to scale niches were also found to be useful to explain the success and failure of Green Office projects. The building of a network of powerful actors who share expectations about the importance of energy efficiency and trust the Green Office was one first necessary condition that was fulfilled (Schot & Geels 2008; Leenders 2009; Grinn 2010; Raven et al. 2011; Smith & Raven 2012). As the findings illustrate, the Green Office emerged as the hub of this network that provides an entry point for the student community to run energy efficiency projects in collaboration with relevant actors. In particular, the Green IT and sustainability strategy project series managed to build this network and involve relevant actors in the project design. One reason for the failure of the UCM Business Case was exactly this missing link to Facility Services in the design and implementation of the project. Users represent one actor group that were overlooked in the Green IT projects and the UCM Business Case, which later posed challenges during the implementation. Until now, the
Green Office also did not manage to actively engage researchers and academics. The development and mobilization of this network is a key variable in explaining success and failure of the project series.

Learning is a second necessary condition that was recognized in the literature and that applies to the Green Office (Bos & Grin 2008; Schot & Geels 2008). The student research projects had only a limited impact, as the results were not always shared with external actors, or the reports were perceived as too long to be read. On the contrary, the close collaboration between the Green Office and ICTS in the development of the Green IT projects led to learning about Green IT among the ICTS staff members involved so that ICTS subsequently adopted the Green IT discourse in its management and strategic plan. Even the failure of the UCM Business Case might have positive benefits, due to the learning it triggered, as demonstrated by the evaluation that the Green Office conducted (Green Office 2013). In this sense, Geels and Schot (2010) write that also ‘failed projects can contribute to the success of the overall sequence’ (p. 86). However, the Green Office still needs to find ways to better reflect on the lessons learned and also share those across student generations.

Thirdly, the Green Office engaged in structural changes to alter the regime itself and make its own activities conform to the current demands of the regime (Markard, Raven & Truffer 2012). The Green IT and UCM Business Case respected demands by the regime in that they spent public money only if returns on investment could be guaranteed, as they represented through cost-benefit analyses. In addition to the project level, the Green Office co-designed sustainability policies that provide a framework for the energy transition of Maastricht University to structurally change the regime itself. In the power struggles that emerged from these activities, the support from higher management for projects was crucial. For instance, the Green IT projects had support from the head of ICTS and the university’s vice president, whereas the UCM Business Case lacked sponsorship from a higher management level within Facility Services, which could be another reason to explain its failure (Jorgenson 2012; Raven 2012). Support through powerful alliances was thus an important strategy that the Green Office used to push for structural changes.

In addition to these necessary conditions on the scaling of niche activities, several findings of this research supplement findings discussed in the literature review with regards to energy efficiency at universities. In line with previous studies’ findings that energy efficiency is
oftentimes embedded either in climate change mitigation, environmental management or sustainability discourses, the results suggest that the Green Office integrated energy efficiency into a sustainability management framework (e.g. Rauch & Newman 2009; Mitchell 2011; Bero et al. 2011). The activities of the Green Office further illustrate the existence of an ‘energy efficiency paradox’ at Maastricht University, with substantial energy savings potentials that have not been examined or acted upon prior to the establishment of the Green Office (DECC 2012). Furthermore, several barriers to energy efficiency that were identified in the literature have also been found in this study, such as a lack of incentive structures, data quality, power relationships or risk perceptions (e.g. Levy & Dilwali 2000; Sorrell et al. 2000; Dahle & Neumayer 2001; Pearce & Miller 2006). These findings suggest that the situation with regards to energy efficiency at Maastricht University might be comparable to other universities.

Then, this study contributes additional findings to the literature, with regards to the barriers for energy efficiency and the role of students. The results suggest that a lack of power and legitimacy lead to risk aversion, carefulness and a lack of confidence in Facility Services and other support units. This organisational culture prevents the actors who are officially responsible for energy efficiency to push for changes that might interfere with educational or research activities. However, by emerging as allies of Facility Services and ICTS, the students in the Green Office empowered these actors and helped them to increase the priority of energy in university governance. The benefits of closely engaging students in energy efficiency measures seem to be that they can use their student voice to lobby for changes, gain easier access to certain stakeholders, can generate additional knowledge through student-research projects, increase the workforce working on energy efficiency issues and increase awareness within the student community and higher management. In this way, engaging students provided additional benefits to address the barriers that support staff faces in advocating for energy efficiency projects alone.

Nonetheless, the experience of the Green Office underlines that necessary conditions need to be fulfilled to reap these benefits of student engagement. By definition, students are still learning and lack experience and knowledge. This is why, the student projects should be conducted in close collaboration with Facility Services or other departments to provide regular feedback on the work of students to guarantee that the projects can be implemented. A potential risk of this close collaboration is that the risk aversion of support services might affect the students, so that they themselves adopt the attitudes and norms of Facility Service employees,
rather than convincing them to be more radical. At the same time, students require a support structure and mandate to become active. The Green Office provides those through student salaries, office space, a supervisory board, working budget for projects and official university mandate. Next, student projects should be complementary to existing efforts, to avoid replicating what other actors could do better and address weak points in the energy efficiency regime. For instance, the UCM Business Case was not additional, as Facility Services could have implemented it. However, all projects under the sustainability strategy project series were additional as no actor possessed the time, workforce and legitimacy to conduct these projects. These necessary conditions need to be addressed to effectively engage students.

**Theory development**

![Figure 18 - Linking of Green Office activities into a sequence of steps](image)

This study aims to contribute to the larger body of literature on energy transitions by reflecting on one of the critical issues in transition studies that has been under-researched, namely the linking of niche activities into sequences to influence the regime (Schot & Geels 2008; Markard, Raven & Truffer 2012). Based on the lessons learned from this research, Figure 18 was developed to illustrate a model of change that can be used to describe an idealized image of the
activities of the Green Office. For the sake of simplicity, the model only describes change processes within the university and excludes the influence of outside actors or the landscape.

In the first step, the Green Office team chooses the determinant of energy consumption that it wants to influence, such as issues around building construction, ICT, research equipment and behaviour. This choice should be based on an analysis of which action would bring the largest returns with the least effort. This would mean that potentially a pre-study has to be launched to obtain data on all energy usage determinants. Another option would be to select the path of least resistance, by looking for collaborators within university departments who are interested in running an energy efficiency project. The Green Office makes an informed choice about what determinant to address, as a result of this first step.

In the second step, the Green Office reaches out to actors that control decisions on usage and maintenance of, and investment in this determinant. The aim of this collaboration is to launch a joint investigation to improve understanding surrounding energy efficiency potentials and options. It is important that a variety of actors is involved, including higher management, collaborating departments and users. As the results indicate, even in technological projects the behaviours and attitudes of users that need to be changed as part of the technical fix should be analysed to avoid negative surprises in the implementation phase. The output of these first two steps is either a business plan for a specific project or a policy proposal to influence energy strategy at the university. As an important step to increase the wider awareness and acceptance for energy efficiency measures, the output of the second step should be communicated, especially to stakeholders that might be affected by the changes.

The third step describes the complex relationship between structural changes and tangible projects. In the instance that the Green Office develops an energy strategy or policy proposal, the third step illustrates the adoption of this proposal by the university and its integration into the strategic planning of the institution. In the instance that a business case for a tangible project was developed, the third phase describes its implementation. The interaction between the different dimensions in the implementation phase is complex: the projects gain legitimacy, relevance and a framework for action through the energy strategies. Vice versa, the policies gain legitimacy and relevance only because they are acted upon through tangible projects. Both the projects and strategies can positively influence awareness, acceptance and organizational culture, as a good communication strategy should advance user awareness and acceptance.
The fourth and fifth steps close the cycle. The fourth step illustrates the final impact of the projects through measurable changes on infrastructure, technology and behaviour. The model illustrates why any changes on infrastructure, technology and behaviour take time, as the previous steps need to be successfully accomplished first. The fifth step displays the effects of the projects on the other variables. Project failure or success provides important lessons learned that enhance data, knowledge and understanding, as well as strengthen or weaken the network. The communication of project success is important to illustrate the benefits of energy efficiency measures to further increase user awareness and acceptance. The regime slowly changes in cases where the Green Office manages to successfully fulfil these steps multiple times and with regards to all energy usage determinants.

The research furthermore illustrates that this process can only be launched through an agent that takes the initiative to instigate the process. Agency can be described in the words of Giddens (1984) as the ‘ability to take action and make a difference over a course of events’ (p. 14). In this understanding, agency is closely linked to the power that an actor has within the regime, to convince or force other actors to do something that they might not have done otherwise (Dahl 1957; Smith, Stirling & Berkhout 2005). Agency has been a critical issue in transition studies, as the conceptualization of niches has oftentimes focused explicitly on technologies, norms or rules that are being scaled up, protected or empowered, rather than the agents that drive the process (Schot & Geels 2010). This study addressed this issue through the definition of the Green Office itself – rather than only its projects - as an organizational niche. This organizational niche includes the student employees, volunteers and staff members that were running the projects series, i.e. the niche activities. In this sense, the Green Office as an agent of change includes actors that form a network, the resources that are at their disposal, and activities that emerge out of the combination of these factors.

The unique characteristic of the Green Office is that students, rather than full-time staff members, take leadership roles in running the office and its activities. In a university with a low power culture that values the input of students, students can become important agents of change (Buss et al. 2013). As an organizational niche, the Green Office provides the mandate, resources, institutional access and support for students to become active on energy efficiency and sustainability issues. Other options to involve students would be through volunteering, (un)paid internship positions or positions in committees. However, these options are limiting as they do
not provide the same scope of agency to students, as a Green Office does. On the other hand, a potential downside of the Green Office concept is the need to recruit students who can use the space provided to them to take active leadership on projects. Hence, the Green Office can be defined as an organizational niche that empowers students to become agents of change on energy efficiency and sustainability issues at a university.

**Recommendations**
Based on the empirical analysis and best practice mentioned in the literature review, several recommendations are put forward for the Green Office, to drive changes into each of the five dimensions of the energy efficiency regime:

*Infrastructure, technology and behaviour*
Whereas the energy savings potential of the ICT infrastructure has been well examined, the energy savings potential in buildings, research equipment and behaviour has not been appraised. The first recommendation would be to examine the exact contributions of each energy usage determinant to the overall energy consumption of the university, as well as its reduction potential. Then make a list of what measures could be applied to realize this reduction potential, identify areas with a high reduction potential and measures that are relatively easy to implement. Measures with a high impact-effort ratio should be addressed first to generate successes (Supervisory board member 3 2013, pers. comm. 8 July).

*Actors and networks*
The Green Office should clarify its role within the network, to avoid duplication of work that other departments could do better. For instance, technical interventions – such as the UCM Business Case - could be developed by Facility Services. On the contrary, Facility Services does not engage in awareness raising, behaviour change programmes, communication or policy decisions around energy efficiency. The division of labour between Facility Services and the Green Office could be transformed, meaning that the Green Office would design communication campaigns around energy efficiency projects that Facility Services would like to implement in buildings, to increase the awareness and acceptance of users.

In designing projects, the Green Office should further guarantee that high level sponsorship for projects exists, as in the case of the Green IT project series with the support of the university’s vice president. At the same time, the Green Office should consult users in the
design of the projects, by gathering knowledge of their behaviours and attitudes that might need to be changed. Then, close collaboration with project managers from support services or research departments is crucial. This collaboration requires that staff members integrate joint projects with the Green Office in their annual planning so that they have the time and resources to commit to them, in addition to their regular work.

**Awareness and acceptance**

Until today, levels of awareness and acceptance for energy efficiency projects among student and staff communities are not well understood. As a first step, it would therefore be helpful to conduct student or staff research projects to obtain a better understanding about the relevance that students and staff attach to energy efficiency and other sustainability issues at the university. The Green Office should investigate options for how to increase awareness around energy consumption, through reporting of the consumption to faculties, energy consumption displays in buildings, etc. This type of user feedback has proven successful in increasing awareness in other organizations (Alonso *et al.* 2011). Then, as Figure 18 illustrates, the Green Office should improve the quantity and quality of communications during and after projects, especially targeting stakeholders that might be affected by changes. Influencing awareness and acceptance in every project phase is important to gain legitimacy for projects that might disrupt the primary process.

**Strategy and policy**

Since the development of the Sustainability Vision 2030 and Roadmap, Maastricht University possesses a comprehensive framework to address its energy transition, focusing on renewable energy generation alongside energy efficiency. In future policy projects the Green Office should focus on changing the internal rent system to alter incentive structures, and to develop a revolving loan fund to reinvest the university’s savings in energy efficiency measures (Sorrell *et al.* 2000). A revolving loan fund would also help minimize rebound effects which are a downside of energy efficiency projects and are not currently addressed within the policy framework of Maastricht University (Greening, Green & Difiglio 2000; Herring & Sorrell 2009).

Once these systems have been put in place, the Green Office could conduct specific projects with faculties to increase their ability to individually improve their energy efficiency
(Carranza et al. 2013). Those projects could focus on making behaviour change programmes or other tools available that can be rolled out on a faculty level. The Green Office should also consider mobilizing the lobby power of students more often. This could be organized, for instance by running signature campaigns to gain support for strategic measures or projects. Such a campaign could also help to raise awareness, while at the same time providing more legitimacy for Green Office activities.

Data, knowledge and understanding
Data, knowledge and understanding are essential in designing effective projects and policies. The question is thus how to generate this knowledge in a cost-efficient and fast way. Engaging students and researchers in applied research to answer questions about the sustainability transition of Maastricht University would be the application of a best practice to generate new knowledge by using the university’s research capacities (University of British Columbia 2013). Furthermore, engaging researchers would be important to gain expert knowledge on specific issues. For instance, the Green Office could write a grant application in partnership with a behavioural psychology department to develop a community-based marketing campaign to address energy-related behaviours of students and staff.

The dissemination of the research findings and knowledge needs to be planned well, which increases the requirements for coordination. Student-research projects should answer questions that are relevant for change project and be finished in time for the knowledge to be usable. Ways need to be found to communicate the content of long research reports to project managers who are unused to reading long academic articles or do not have the time to do so. Sharing this knowledge is critical to the generation of widespread organizational learning on energy efficiency issues at the university.

Limitations
This study faces four main limitations. First, the relative importance of landscape trends, regime characteristics and impact of niche activities could not be established, due to the complexity of these factors and the lack of quantitative data about certain characteristics of the regime before the establishment of the Green Office. This made it for instance difficult to appraise the level of awareness for energy efficiency among different university actors. The second shortcoming is that the characteristics of the energy efficiency regime before the Green Office were based on
interviews and document analysis in 2013, which compromised the accuracy of the regime description for 2010. These two shortcomings should be addressed in future research on student-driven Green Offices, by conducting a baseline analysis of the energy regime through qualitative and quantitative method in the founding year of the Green Office.

The third shortcoming relates to the choice of transition studies and the Multi-Level Perspective as methodological framework. Transition processes occur on a long-term timescale of 30-40 years; however, this study focuses on a three-year period only. Accordingly, an important question that cannot be answered here is to what extent the Green Office has brought Maastricht University is on a lasting transition pathway. It might be that the Green Office brought about small changes before the regime then stabilizes in a new lock-in. In addition and as noted before, the amorphous nature of the Multi-Level Perspective makes it difficult to operationalize the three levels and apply them in an organizational context (Shove & Walker 2007).

The fourth limitation relates to potential biases of the interviewees and myself (Donaldson & Grant-Vallone 2002). An obvious bias among Green Office employees and their supporters would be a tendency to inflate the impact of the Green Office. I tried to address those potential biases by asking critical questions and also interviewing stakeholders who had a sceptical stance towards the project series. My involvements with the Green Office and my ambitions to bring the concept to other universities make it apparent that I would have a strong motive to inflate the success of the Green Office. Nonetheless, my ambition to obtain a better understanding of the Green Office concept and how it could be improved is my primary aim as well as my personal motivation behind this research. And this improvement can only be achieved through critical analysis, which is why that I continuously highlighted limitations of the Green Office and areas of improvement.

**Conclusion**

With regards to the major landscape trends, four enabling and seven constraining trends were identified. The overall picture suggests that the constraining trends outweigh the enabling trends so that the landscape mainly holds back ambitious steps to improve energy efficiency at Dutch universities. However, this finding should be taken with caution, as the findings are based on a relatively small sample from only one university as well as two external experts. Furthermore,
the concept of landscape should be further defined more clearly in future research, in order to develop specific questionnaires and interview guides that could then be distributed to a wider sample. This would make it possible to gain insights into energy efficiency trends affecting Dutch universities. More generally, the findings on the landscape gained in this study are valuable, as they suggest that not enough external pressure existed on Maastricht University to radically improve energy efficiency, so that all stimuli for change would need to come from within the institution.

The findings on state of the energy efficiency regime before the Green Office suggest that its five dimensions were stabilized in a lock-in so that allowed only incremental, technology-driven improvements of buildings took place. Disregarding behaviour change, ICT and research equipment and focusing on measures that would bring partial disturbances to the primary process effectively constrained the scope of ambitions. The situation emerged from the formal assignment of Facility Services to guarantee the university’s commitment to the MJA3. Facility Services faced a relative lack of control, influence and legitimacy to involve actors controlling ICT and research equipment or to launch behaviour change programmes. As a result, no data or knowledge was available on the savings potential of these measures. Moreover, no actors from ICT services, research departments or higher management were involved in the energy group. The MJA3 was also not integrated into any strategic university planning documents, but rather managed as a voluntary add-on. Despite the fact that it was not possible to obtain quantifiable data, interviews also suggest that awareness and acceptance of energy efficiency measures were relatively low within the university community. The lack of direct incentives and the invisibility of consumption were two factors accounting for this observation. Given the lack of external pressures and the relative stability of the regime, no significant steps to improve energy efficiency could have been expected.

The three Green Office project series influenced all dimensions of the energy regime to different degrees. The Green Office had a small impact on infrastructure, buildings and behaviour, as one Green IT project is currently in the implementation phase and a LED lighting project failed. At this point, no behaviour change or research equipment projects have been implemented. The Green Office was added as another actor to the existing network, in which it emerged as a network hub with connections to relevant actors – apart from research equipment services - that for the first time allowed students to participate in the university’s energy
reduction efforts. The findings suggest that the Green Office increased the awareness and acceptance for changes among higher management and project managers involved in joint projects, but did not have an impact on the larger university community. The Green Office influenced strategy and policy, as the energy efficiency goals were integrated into a larger framework of sustainability goals that include the promotion of renewable energies. The student research projects - though not widely communicated -, the business cases and sustainability strategies provide improved data, knowledge and understanding of the energy efficiency potential for the university and options to reap this potential.

The academic contribution of this essay is additional findings on energy efficiency at universities, the development of a model of change, and its practical contribution is made through recommendations for the Green Office. The findings make a valuable contribution to the literature, as the relative powerlessness of support services within an organizational culture that values education and research was identified as another barrier to energy efficiency. The role of student-driven change projects were appraised as a relatively costs-efficient and successful way of empowering support services to advocate for more radical changes. The model of change provides an idealized representation to describe how the Green Office should link its activities to influence different dimensions of the energy efficiency regime step-by-step. Based on the findings and the theoretical deliberations, eleven recommendations were developed to improve the impact of the Green Office. Among others, the Green Office should further mobilize student and staff-research projects, focus on changes in the internal rent system and advocate the establishment of a revolving loan fund. These recommendations should help the Green Office and future Green Offices to reflect on their role within the energy transition of the university and how to leverage resources despite the constraints that Green Offices faces.

The study aims to have short- and long-term impacts. The research has generated novel findings about the Green Office concept that I will share with the current Green Office team and other people working on sustainability in higher education. The research has also improved my understanding of student-driven Green Offices, which I will use in the design of future Green Offices and coaching of Green Office teams. Potentially, this study provides the basis for a methodology to evaluate the impact of student-driven Green Offices in general. The Multi-Level Perspective could be used to analyse the impact of other projects, for instance on community engagement, sustainability education and research. This methodology should include clear
quantitative and qualitative indictors with regards to the landscape, regime and niche. In the long term, this growing body of knowledge could help to better understand and manage student-driven Green Offices specifically, as well as the energy and sustainability transitions of universities in general.
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## Appendix

### 1. Green IT timeline

<table>
<thead>
<tr>
<th>Phase</th>
<th>Steps</th>
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| **Ideation** (3 months: Nov 2010 – Jan 2011) | - Internal kick-off meeting within Green Office (GO) team and potential volunteers  
- Establishing contacts to ICTS and student group from the University of Amsterdam that implemented a similar project  
(Sources: Green IT meeting notes 2010, pers. comm. 30 November; GO project coordinator operations 1 2013, pers. comm. 15 March; GO project coordinator operations 3 2013, pers. comm. 19 June) |
| **Control-Alt-Delete Emissions (CADE) Business Case** (6 months: Jan – June 2011) | - ICTS & GO decide to pursue business case in January 2011  
- Green Office writes business case, with the input of 6 ICTS and Facility Services (FD) employees  
- In June 2011, the finalized business case focuses on 8 measures: PCs & workstations (PC Power management (PCPM) & hardware changes), Servers (virtualization, server temperature, new server room), Network devices, Cisco Energy Wise, and VoIP Phones  
(Sources: Green IT meeting notes 2010, pers. comm. 30 March; Green Office 2011b; GO project coordinator operations 1 2013, pers. comm. 15 March; GO project coordinator operations 3 2013, pers. comm. 19 June) |
| **Decision** (Sept 2011) | - High level meeting: Green Office, UM vice-president, director ICTS and UM Chief Information Officer in September 2011  
- Decision to further investigate implementation of PCPM across UM. Next steps include the writing of a detailed proposal for a central PCPM policy for UM. ICTS takes lead and GO assists and monitors the process.  
- Decision to further investigate speed up server virtualization of ICTS servers. ICTS should draft project proposal  
- Decision to further investigate on how to reduce energy consumption of data centers. ICTS and GO should develop a more detailed proposal  
- Measures of the initial business case that were not followed through:  
  - **VoIP Phones** as ICTS exchanged the phones to more energy efficient ones anyway  
  - **Hardware** changes of PCs and workstations could not be changed directly as it is too expensive to exchange the whole hardware as once and also because agreements within current tenders could not be changed ad hoc. Energy efficiency standards would need to be integrated in new tenders for hardware, to gradually replace the existing hardware infrastructure  
  - **Network devices** not followed through as judged too expensive and savings potential as too low;  
  - **Cisco Energy Wise** not introduced as it among others would require a complete revision of the network infrastructure, which was seen as overambitious given existing workloads and too expensive, given unclear savings potentials  
(Sources: Green IT meeting notes 2011, pers. comm. 15 September; GO project coordinator operations 1 2013, pers. comm. 15 March; GO project coordinator operations 3 2013, pers. comm. 19 June) |
| **Policy proposal PCPM** (9 months: Oct 2011 – June 2012) | - Goals: Investigate options (PowerMan or Windows 7), determine savings potential and cost-benefit analysis  
- October 2011 until January 2012 Green Office and ICTS measure the power consumption of computers at three locations.  
- Throughout the process, the GO involved in the measurements and their analysis, as well as in establishing contact to faculty deans, student parties and faculty ICT departments to gain approval for the roll-out of PCPM.  
- First draft of proposal for UM wide introduction of PCPM in January 2012. The proposal is finalized at the end of May 2012.  
- Between March and May, Green Office prepares a communication plan to assist the roll-out of
Beginning of June 2012, ICTS and the Green Office submit a joint policy proposal to the CBB to invest 25 000 Euro in licenses for the PowerMan software to roll-out PCPM on 5000 student and staff desktops at UM. Presentation to the CBB in June 2012. The CBB gives a positive decision on this business case on June 25th 2012, due to its savings potential of 64 000 Euro per year on IT related energy costs.

**Policy proposal server virtualization (Oct ’11 – May ‘12)**

- **Goals:** Investigate hardware options, savings potential and investment costs of speeding up server virtualization
- ICTS takes the lead on this project, starting in October 2011. At the beginning, overview of hardware options and inventory of current servers. In February still challenges to obtain data on energy consumption of servers and how much speeding up server virtualization would save.
- In April, ICTS decides not to continue investigating server virtualization speed up as energy consumption measurement is too difficult to measure the power consumption of individual servers and since new servers are virtualized anyway. This already generates positive results as the numbers of servers is increasing, whereas the power consumption of the computer floor is decreasing.
- Until summer 2012, the importance of server virtualization to improve energy efficiency remains on the agenda of ICTS, as part of the SURF IT scan (see below section on ‘policy proposal data centre’).
- In May, the Green Office also does not further pursue the writing of a server virtualization policy – which would also include the servers hosted by the faculties-, due to workforce constraints and the scheduled introduction of PCPM. Server virtualization at ICTS continues to be done, due to reasons other than energy savings, but is not speeded up or enshrined in policy.

**Policy proposal data centre (Oct 2011 – ongoing)**

- **Goals:** Investigate options for outsourcing, increase of temperature in the server room and building of a new server room
- ICTS decides to postpone work on proposal until beginning of 2012, due to high workload at ICTS. GO takes the lead on preliminary explorative research to investigate options for outsourcing.
- GO contacts companies and other Dutch universities to investigate sourcing options and their feasibility for UM
- ICTS’s attitude towards the project shifts in December 2011/January 2012, due to concerns about the security of data after outsourcing. GO still pursues investigations into outsourcing which are however dropped at the beginning of 2012.
- GO and ICTS participate in a symposium of the SURF foundation on Green IT in January 2012 and learn about a pilot project to investigate energy efficiency of servers and data centers on 14 indicators. GO convinces ICTS to participate in the pilot and ICTS decides about its participation in January 2012. Results of the scan are available in May 2012. Shortly afterwards, the SURF foundation stops the project as it turned out too difficult to compare energy efficiency of the different data centres of Dutch universities.
- In July 2013, energy efficiency of the data centre is on the agenda of ICTS, as discussions with Facility Services take place about the building of a new data centre. The exact role of the Green Office in this project still needs to be determined.
**Implementation PCPM**
(10 months: September 2012 – June 2013 & ongoing)

- In November 2012, the implementation of PowerMan – for collecting data on user activity - is planned on staff computers in one faculty and college. The Green Office announces the introduction on its website.
- In November and December, the introduction is postponed due to discussions about the appropriate hosting option for PowerMan. The Green Office investigates the issue further and the appropriate 500 first licenses for PowerMan are purchased. PCPM is installed to gather data on user activity. The active part of the software – that switches of the devices after inactivity – has not been launched.
- In January 2013, the Green Office and ICTS also give a presentation on PCPM at another SURF Symposium.
- In February 2013, the Green Office communicates a list of FAQs about PowerMan, as part of the prepared activation of the software. Miscommunication and technical problems of PowerMan – data is lost if the computer shuts down and employees forgot to save their documents beforehand –, leads users to opt out and the faculty IT department decides to postpone the activation of the software.
- In March, crisis talks take place between the central and faculty IT departments and the Green Office to resolve the issue. The agreement is that a pilot of the software should be launched and evaluated in a sustainability research department – with only 24 staff computers. Communication and transparency between ICTS, faculty IT department, the Green Office, managing director of the department and the computer users is increased.
- In April and May, the pilot starts slowly, until 20 out of 24 PCs run PowerMan. The introduction is communicated to users and first lessons shared with other IT departments. Two main technical issues need to be resolved: Challenge with saving data on some computers and inability to log into the computer – as it is shut down – through a remote desktop.
- In June, interviews are conducted with 10 of the employees that use PCPM in the sustainability research department. One faculty also decides to install PowerMAN together with the migration to AthenaDesktop.
- In September, the GO and ICTS aim to evaluate the pilot, in terms of user satisfaction, savings generated and technical feasibility. The results should be used to convince the other faculties to introduce PCPM.
- The IT department of the business faculty decides to implement PowerMan on all staff computers in its faculty.

(Sources: GO project coordinator operations 2 2013, pers. comm. 23 May; Project manager ICTS 2013, pers. comm. 3 July; Manager operations ICTS 2013, pers. comm. 4 July; Faculty IT manager 2013, pers. comm. 4 July)

### 2. Energy efficient buildings timeline

<table>
<thead>
<tr>
<th>Student research</th>
<th>Description</th>
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<tr>
<td><strong>UCM Think Tank</strong></td>
<td>A group of 11 students develops recommendations for UM on how to achieve its ambition to increase energy efficiency by 2% per year from 2005 until 2020. The research was conducted as part of an undergraduate Think Tank project. (Sources: Alonso et al. 2011)</td>
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<tr>
<td><strong>PREMIUM Behaviour change</strong></td>
<td>A group of 5 Masters students that participated in the PREMIUM programme, investigated student behaviours that affect energy usage, waste and recycling at UCM and developed recommendations on how to make student behavior more environmentally friendly. Data was gathered through a questionnaire, 13 interviews with students and observations. (Sources: Averkova et al. 2012)</td>
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<tr>
<td><strong>Sustainability Master Research Project</strong></td>
<td>5 students from a Sustainability Masters programme developed four scenarios on how to strategically improve energy efficiency in UM buildings. As part of this research they interviewed 5 stakeholders involved in energy management at the university. (Sources: Kurth et al. 2012)</td>
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A student intern compiled and analyzed data and information with regards to UM’s energy consumption and the potential for renewable energy production. Energy efficiency is also addressed within the report. (Sources: Spira 2012)

A group of 5 Master’s students developed a report that outlined potential measures that could be taken to improve energy efficiency in a monumental faculty building. Also one student from the Hogeschool Zuyd was involved in the project, as well as two researchers. The research was part of the larger project of the Hogeschool Zuyd ‘Handboek duurzaam monumenten’ to write a handbook to investigate the potential for energy efficiency in monumental buildings in the region. Certain aspects with regards to legal and process issues are going to be included in the handbook. (Sources: Monumental building researcher 2013, pers. comm., 4 July; Brumioul et al. 2013)

As part of an undergraduate course on integrated assessment, a group of four students – including two Green Office student employees – conducted an integrated assessment analysis about energy efficiency at UM. The study involved interviews with 7 UM stakeholders, including managing directors, two deans, two student representatives, the head of the finance department and the environmental advisor. (Sources: Carranza et al. 2013)

Goal: The UCM Business case was the first major project of the Green Office to propose measures to improve the energy efficiency of a monumental university building.

Between October ‘11 and June ‘12, a team of Green Office student employees and volunteers collected and analyzed data on the building’s energy consumption, as well as potential measures that could be taken. Initially, the list covered a comprehensive list of measures. Ideas that were raised during the process to install hand dryers to reduce paper consumption, behavior change measures, window insulation and attempts to reduce the consumption of paper cups have been dropped, due to a lack of time or feasibility.

The final business case proposed four measures, namely the installation of LED lights, presence and daylight detectors, PC Power Management and close the building on Saturdays. The final business case was presented to the energy group of FD in September 2012, which approved the implementation of LED lights.

The recommendation to close the UCM building was implemented in autumn 2013. The implementation of the first measures was conducted during the winter break 2012/13. LED tube retrofits were installed in two luminaires in a common area, presence detectors/movement sensors were installed in two rooms and daylight detectors were installed in a corridor. After complaints from students and staff about light quality and problems with the sensors, the FD project manager de-installed the measures. The energy group and the Green Office then terminated the project in May 2013.

In May and June 2013, the Green Office project coordinator evaluated the project, interviewing 9 stakeholders that have been involved. (Sources: GO project coordinator operations 4 2013, pers. comm., June and July; Carranza et al. 2013)

3. Sustainability strategy timeline

Following the establishment of the Green Office, the team spend the first months getting an overview about the stakeholders at UM and compiled a list of project ideas.

The decision to write a sustainability baseline analysis was made by the team after the idea had been mentioned by several stakeholders and also reoccurred in general practices of other
universities.
- The Green Office announced in its first Annual Plan 2011 that it would write a sustainable development report and action plan in 2011.
(Source: MUGO Annual Plan 2011)

| Climate Action Report | Goal: Establish a baseline report on the state of sustainable development in education, research, community and operations at Maastricht University. | Between February and May, the student employees and volunteers defined the scope of the document and gathered relevant data and information, by involving around 30 stakeholders. | The first draft was written June, discussed in the GO Supervisory Board and then finalized by the Green Office team until September. With regards to energy, the report provides an overview of data, energy consumption trends, and the energy efficiency commitment of the university. | The report was published in November. The results were presented on a sustainability conference organized by the GO and a sustainability research centre at UM, a student sustainability conference, discussed in an article in the university newspaper and a final version of the report was send as a Christmas present to around 40 key stakeholders.
(Source: Climate Action Report meeting notes 2011, pers. comm. 10 February until 6 October; Climate Action Report 2011) |
| Sustainability Policy 2012-2014 | Goal: Following the first Sustainability Policy 2008-2010, draft a new policy in consultation with major stakeholders at the university. | In summer ’11, the Green Office requests and gets the task from the Executive Board to write the policy. | Between August 2011 and March 2012, the Green Office meets several stakeholders to obtain their input in and feedback on the policy, which sets goals for the areas of organization, operations, education, research and community. | In March 2012, the policy is submitted to the Executive Board for decision, which subsequently approves it.
(Source: GO student coordinator 3 2013, pers. comm. 26 June) |
| Sustainability Progress Report 2011 | Goal: Following the Climate Action Report, use a similar framework to continue to report on the progress of Maastricht University on sustainability issues. | The Green Office starts collecting and analysing similar data on the sustainability performance of Maastricht University as has been published in the CAR, just with regards to 2011. | The Sustainability Progress Report (SPR) is published in November 2012. | (Source: Green Office 2012b) |
| Sustainability Progress Report 2012 | Goal: Following the SPR 2011, use a similar framework to continue to report on the progress of Maastricht University on sustainability issues. | The Green Office starts collecting and analysing similar data on the sustainability performance of Maastricht University as has been published in the SPR 2011, just with regards to 2012. | (Source: GO project coordinator operations 4 2013, pers. comm. 6 May) |
| Sustainability Vision 2030 | Goal: In line with an objective from the Sustainability Policy 2012-2014 develop a vision about where Maastricht University should develop in terms of sustainability until 2030. | 200 students and staff members submitted their ideas for the sustainability vision online as part of a competition and 21 students and 10 staff members read drafts of the roadmap and provided feedback. | In February 2012, the Green Office gathers a team of student employees and volunteers to analyze in detail sustainability vision documents of five universities from the USA and Canada and design the process of how the vision should be developed. | In May, the Green Office organizes an event attended by 40 students and staff officially opening the participatory process that will lead to the Sustainability Vision 2030. The President of Maastricht University delivers a short speech to open the event. Input into the vision was also gathered through a small workshop with five students during a festival. Around 200 students and employees submitted their ideas for the vision during a competition. At the end of May, the project... |
team analyses the input from the workshop and competition to draft the first version of the vision.
- The draft is also discussed by a steering group of student and staff representatives from the university council – chaired by the UM vice-president - during two meetings in June and August 2012.
- On a working day in June, the Green Office wrote the final version of the vision and it was submitted September 24th to the Executive Board which approved the vision beginning of October. The vision was communicated to the university community via the Green Office website, newsletters and emails to other university departments.
(Source: GO student coordinator 1 2013, pers. comm. 24 May)

### Roadmap
(Sept 2012 – ongoing)

- Initially, the drafting process for the roadmap was planned from September until December 2012, but lasted until June as the stakeholder consultation took more time than expected.
- 89 people read drafts of the roadmap and provided feedback, including 42 students, 42 staff members and 5 members from outside organizations
- Between October and December 2012, 15 volunteer were recruited and divided into three portfolios - Operations, community & culture, education & research. During weekly meetings, they reviewed roadmaps of other Dutch industry organizations.
- The preliminary research findings from the teams were compiled in a first draft in January 2013.
- In January and February, this first draft was discussed in a student focus group – with open invitation to all students - of 17 students active in the field of sustainability, including representatives of student parties and study associations, with members of the Green Office Supervisory Board, the Director of Facility Services and the UM Management Team.
- Based on this feedback the second draft was produced in March 2013. The main revisions were of the Education & Research section. In April and May, this draft was then also discussed in a focus group including 15 members of Facility Services.
- Between May and June, several meetings took place with deans, as well as educational and research directors to get feedback on the Education & Research aspects of the Roadmap.
- In June 2013, the final version of the roadmap is finalized and submitted to the Executive Board of UM for decision. The communication of the roadmap is planned to take place between September and December 2013 in collaboration with the UM communications department.
(Source: GO student coordinator 2 2013, pers. comm. 21 June and 2 July)

### 4. Generic interview guide

I would like to thank you for participating in this interview. Your participation in my thesis is of great value to understand the impact of the Green Office on issues of energy efficiency, management and renewable energies at Maastricht University. The results will be written up in a final research report that I am very happy to share with you.

Before starting with the interview, I would like to inform you on the official formalities. Your participation in the interview is voluntary, I am going to record this interview, yet et al. data will be treated anonymously and you are free to withdraw your participation in the study at any point in time. I still maintain the right as a researcher to use quotes from the material to include them in the final dissertation report.

#### Landscape
- What do you think are currently the important trends in the Netherlands that support improvements in energy efficiency at Maastricht University?
- What do you think are developments that worsen this situation?

#### Regime
- With regards to these aspects, what do you think were important factors that enabled or constrained energy efficiency at UM in 2010?
  - Infrastructure, technology & equipment
Niche

- In which Green Office projects have you been involved?
- How would you evaluate the impact of these projects on energy efficiency at Maastricht University with regards to:
  - Infrastructure, technology & equipment
  - Behaviour, awareness & culture
  - Actors, networks & strategic games
  - Strategy, policy & management
  - Data, knowledge & understanding
- What do you think should be the role of the Green Office to help improve energy efficiency at UM?

Do you have anything else to mention that you think is important for my research, before we finish the interview? Thank you very much for your help!

### 5. Interview schedule

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<th>Times interviewed</th>
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