

Improving energy and carbon management in construction and civil engineering companies – Evaluating the impacts of the CO₂ Performance Ladder

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Abstract

Energy and carbon management programmes are being implemented to facilitate continuous energy efficiency and carbon performance improvement in various economic sectors. In the Netherlands, the CO₂ Performance Ladder has been introduced as a market-driven certification programme for energy and carbon management. Among the 500 participating companies, mainly from the construction and civil engineering sector, the CO₂ Performance Ladder is often considered as the major stimulant for energy efficiency improvement and CO₂ emission reduction. This research addressed the question: *'What is the impact of the CO₂ Performance Ladder on improving energy and carbon management and reducing CO₂ emissions in construction and civil engineering firms'*. The research was based on interviews, descriptive analysis of energy efficiency and CO₂ emission reduction measures and quantitative analysis of CO₂ emission reductions. The research results indicated that the CO₂ Performance Ladder has improved various energy management practices at administrative level, while internalization of energy management practices at lower levels in the organization has just gradually started. Companies have implemented a wide range of new energy efficiency and CO₂ emission reduction measures. However, most measures only affected the supporting business processes instead of companies' core processes. About 30% to 50% of these measures have been identified as additional. The CO₂ Performance Ladder has particularly stimulated green electricity purchasing and the adoption of various behavioural measures for energy efficiency and reducing CO₂ emission reductions. The annual CO₂ emission reduction rate due to energy-efficiency improvement and fuel switching amounted to 3.2%/yr (2010-2013). First estimates suggest that about 1.0%/yr - 1.6%/yr of these CO₂ emission reductions can be attributed to the CO₂ Performance Ladder. However these figures should be handled with caution because of various uncertainties. Overall, we conclude that, driven by the potential competitive advantage in contract awarding, the CO₂ Performance Ladder has been responsible for improving energy management and enhancing CO₂ emission reduction among construction and civil engineering firms, which most likely would not have been achieved otherwise.

Keywords: energy and carbon management, construction industry, programme evaluation, CO₂ Performance Ladder.

1 Introduction

In many countries energy and carbon management programmes have been implemented in various economic sectors to stimulate continuous energy efficiency improvement and CO₂ emission reduction (Reinaud et al., 2012; McKane et al., 2010). In the Netherlands, the CO₂ Performance Ladder (CO₂PL) has been introduced as a market-driven certification programme for energy and carbon management in the construction and civil engineering sector. The CO₂PL is often seen as a major stimulant for energy efficiency improvement and CO₂ emission reduction among firms in this sector, since they are generally not subject to other specific energy or climate policies and programmes.

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The aim of this research is to evaluate the impacts of the CO₂PL on improving energy and carbon management and CO₂ emission reduction in construction and civil engineering companies. This research thereby responds to the interest of various stakeholders to get better insight in the performance of the CO₂PL. This research contributes to scientific literature by further extending empirical insights into the impact of energy management programmes on improving energy management practices in non-industrial sectors, which is a topic that has not been widely studied before. For more details, see section 2.

This paper is organized as follows. Section 2 briefly reviews the literature on energy management systems. Section 3 shortly introduces the CO₂PL. Section 4 addresses the research methods and data collection. Section 5 presents the main research findings of our study. The results are discussed in section 6. In section 7 we will draw the conclusions.

2 Energy management systems

2.1 Energy management systems, standards, practices and programmes

It has been acknowledged that there is sufficient potential to increase energy efficiency and reduce CO₂ emissions to meet future energy and climate targets (UNEP 2011). However a wide range of barriers impede the tapping of this potential (see e.g. SPRU 2000; De Groot et al. 2001; Sorrel 2004; Palm and Thollander 2010; Fleiter et al. 2012). These barriers are often classified in economic (e.g. hidden costs, risks, split incentive), organizational (e.g. company culture) and behavioural barriers (e.g. bounded rationality, inertia). Energy management is frequently considered as a means to overcome many of these kinds of barriers (Ates and Durakbasa, 2012; Worrell, 2011; Backlund, 2012).

Unfortunately, a generally accepted definition of 'energy management' seems to be lacking (see e.g. Capehart et al. 1997; Carbon Trust 2010; VDI 2007; IEA/IIP 2012; DSA 2001). We will consider energy management as '*effectuating organizational, technical and behavioural actions in a structural and economically sound manner in order to minimize consumption of energy*' (Senternovem 2004). Since energy use is often the main cause of CO₂ emissions for many companies, energy management is also considered the principle element of carbon management (Carbon Trust 2010). Therefore, in the remainder of this paper no explicit distinction has been made between energy and carbon management.

Energy management needs to be an integral part of organisation's wider management processes to be fully effective (Carbon Trust 2010; Capehart et al. 1997). The integration of energy management in the organisation's overall management structure can be facilitated by using *Energy Management Systems* (Thollander and Ottoson 2010). Various comparable definitions of energy management systems exist in academic and practitioner literature (Reinaud et al. 2012; ISO 2011; Kahlenborn et al. 2012; DSA 2001). We define an energy management system as '*a set of interacting procedures, processes and practices ensuring the systematic planning, implementation, monitoring and reviewing of activities for the continuous improvement of corporate energy or carbon performance*'. The systematic approach in achieving continuous improvement is based on the Deming cycle or Plan-Do-Check-Act continual improvement framework (ISO 2011).

An *energy management standard* specifies the requirements of an energy management system. Several official energy management standards have been

developed over the past years by (inter)national standardization bodies (DSA 2001; NSAI 2005; ANSI 2005; CEN 2009). The internationally acknowledged ISO-50001 (ISO 2011) is probably the most well-known standard for energy management. Companies can seek certification of their energy management system through accredited agencies to ensure complete compliance with such energy management standards. Apart from the (inter)national standardization bodies other parties, in most cases governments, can formulate non-standardized specifications or guidelines for energy management systems (Reinaud et al. 2012). Kahlenborn et al. (2010) and McKane et al. (2010) provide overviews of various energy management standards, specifications or guidelines developed over the past years.

A wide range of *energy management practices* is highlighted in energy management standards, specifications or guidelines (see e.g. EPA 2014; ISO 2011; Carbon Trust 2011). In general the key practices include:

- Management involvement (making commitment to continuous improvement, providing organizational support and resources)
- Energy policy (setting targets, adopting procurement rules)
- Energy planning (drawing up action plans, assess opportunities)
- Implementation (taking measures, monitoring emissions, training of employees, communicating results)
- Checking (analysing and evaluating energy performance and progress)
- Reviewing (management review)

For a wide-spread adoption among target groups, energy management systems must be embedded in wider *energy management programmes* and be accompanied with other obligations, incentives or measures (Reinaud et al. 2012; Stenqvist and Nilsson 2012). Both governments, NGOs and industries are therefore developing various approaches to promote the uptake of energy management systems (Dahlgren 2014). These approaches may include for example mandatory energy management programmes, like in Japan (Kimura and Noda 2014), incentive based energy management programmes, like in Sweden (Stenqvist and Nilsson 2012) and market-driven certification programmes for energy management like in the United States (Scheihing et al. 2013).

2.2 Evaluating performance of energy management programmes

In contrast with the large amount of research on the relationship between environmental performance and environmental management systems, see e.g. Heras-Saizarbitoria and Boiral (2013) and Nawrocka and Parker (2009), the amount of empirical research evaluating the benefits, performance and impacts of introducing energy management programmes is less extensive (Bunse et al. 2011). Below we will briefly summarize the existing research.

The *motivations* for adopting energy management programmes have been researched by e.g. Okereke (2007), Kolk and Pinkse (2004). Companies mainly adopt these programmes to reduce costs and environmental emissions, prepare for or comply with governmental regulations, contribute to the design of climate policies and programmes, enhance corporate reputation, and increase eligibility for using financial incentives or other competitive advantages.

Various researchers studied the *barriers* (drivers) that inhibit (stimulate) the adoption of energy management systems. These include, in random order: the commitment of top management; appointed (ambitious) energy manager; employee

awareness, involvement and motivation; priority given to energy management and energy issues; financial resources and organizational support; incentives or support programmes; organizational culture of continuous improvement; and availability of information (based on Rudberg 2013; Heindrichs and Busch 2012; Reinaud et al. 2012; McKane et al. 2010; Rohdin and Thollander 2006; SPRU 2000; Blass et al. 2014; Rohdin et al. 2007; Brown and Key 2003).

Several studies examined the *adoption* of energy management practices by firms in particularly industrial sectors in the context of different energy management programmes. In general, energy management practices were not widely adopted, even not among energy-intensive firms. Though, several studies suggested that especially well-organized, large and energy-intensive firms were more successful, active and motivated in adopting energy management practices compared to other firms (Ates and Durakbasa 2012; Thollander and Ottoson 2010; Lee 2012; Backlund et al. 2012; Brunke et al. 2014; Harrington et al. 2014; Christoffersen et al. 2006; Martin et al. 2012).

Only a few studies touch upon the *impact* of introducing energy management programmes on adopting new energy and carbon management practices. These studies, mainly using qualitative approaches, confirmed the positive *impacts* of introducing various types of energy management programmes, on adopting new energy and carbon management practices (Kimura and Noda 2014; Backlund et al. 2012; Helby 2002; Stenqvist et al. 2011; Krarup and Ramesohl 2002). Other studies, using more quantitative approaches, did not provide consistent evidence about the (direct) relationship between implementing energy management (systems) and firms' carbon and financial performance (Böttcher and Müller 2014; Lee 2012; Martin et al. 2012). A few studies assessed quantitative impacts of introducing energy management programmes on energy conservation in industrial sectors (Rietbergen et al. 2002; Cahill and Gallachóir 2012; Stenqvist and Nilsson 2012).

Most of the studies cited above focussed on evaluating the outcomes, rather than impacts, of introducing energy management programmes on improving energy management practices. Moreover, most studies focussed on evaluating energy management systems, practices and programmes in primarily industrial sectors. As a result, up till now there is limited scientific insight into the impact of introducing energy management programmes on improving energy management practices in non-industrial sectors. In this research we will therefor study the impact of CO₂PL as an example of an energy management programme introduced in a non-industrial sector, i.e. the construction and civil engineering sector.

3 The CO₂ Performance Ladder

3.1 The CO₂ Performance Ladder and energy management

The CO₂PL is a market-driven certification programme for energy and carbon management that can be used as a tool to reward climate friendly behaviour when awarding contracts. It is based on the concept of Energy Maturity Models (Ngai et al. 2013; Antunes et al. 2014; Introna et al. 2014) and discriminates five 'certification levels'. These certification levels indicate the maturity of the company's energy and carbon management. Hereby, companies should focus on four key topics to improve its energy and carbon management. These key topics are (A) drawing up CO₂ emission inventories, (B) setting and achieving CO₂ emission reduction targets, (C) transparency and communication of the company's CO₂ footprint and energy policy and (D) participation in (supply chain) initiatives. Table 1 shows the general

requirements for each key topic that a company should meet for each maturity level. These general requirements are broken down into subrequirements that can be found in the CO₂PL handbook (SKAO, 2012). Table 1 also shows some important subrequirements. These subrequirements are strongly linked to existing international standards for reporting greenhouse gas emissions (ISO-14064-1) and energy management (ISO-50001). A gap analysis of the ISO-50001 and CO₂PL learns that most of the ISO-50001 requirements for energy management systems have been covered by requirements for key topics A and B of the CO₂PL at level 3, which includes management involvement, energy policy and planning, implementation, checking and reviewing. Some detailed subrequirements in ISO-50001 being part of the paragraphs on 'energy review', 'energy objectives, energy targets and energy management action plans' and 'monitoring, measurement and analysis' have not been explicitly covered in the CO₂PL. The requirements for internal auditing are more concise in the CO₂PL than in ISO-50001. The CO₂PL specifies requirements that go beyond the ISO-50001 standard, particularly in key topics C and D. See Primum 2014 for the full gap analysis.

Table 1: General requirements and some important - *subrequirements* of the CO₂PL.

Level	A: Insight	B: Reduction	C: Transparency	D: Participation
1	The company has partial insight into its energy consumption.	The company investigates opportunities for reducing energy consumption.	The company communicates its energy reduction policy on an ad hoc basis.	The company is aware of sector and/or supply chain initiatives.
2	The company has an insight into its energy consumption.	The company has an energy reduction target, described in qualitative terms.	The company communicates its energy policy internally (to a minimal degree) and possibly externally.	The company is a passive participant in initiatives aimed at reducing CO ₂ emissions in or outside the sector.
	- <i>The company has an up-to-date energy audit report.</i>	- <i>The reduction objective has been endorsed by higher-tier management.</i>	- <i>The company has an effective steering cycle with designating responsibilities.</i>	
3	The company has converted its energy consumption into CO ₂ emissions	The company has quantitative CO ₂ reduction objectives for its own organisation.	The company communicates about its carbon footprint and reduction objectives both internally and externally.	The company is an active participant in initiatives aimed at reducing CO ₂ emissions in or outside the sector.
	- <i>The company has a detailed and up-to-date emissions inventory for the actual scope 1 & 2 emissions in accordance with ISO 14064-1.</i> - <i>The emissions inventory is verified by a certifying organization to at least a limited degree of certainty.</i>	- <i>The company has drawn up an energy management programme (in accordance with EN50001 or equivalent), which has been endorsed by higher-tier management, communicated internally and externally, and implemented within the company.</i>	- <i>The company has a documented internal and external communication plan with designated tasks, responsibilities and methods of communication</i>	
4	The company reports its carbon footprint in accordance with ISO-14064-1 for Scope 1, 2 & 3.	The company has quantitative CO ₂ reduction objectives for Scope 1, 2 & 3 CO ₂ emissions.	The company maintains dialogue with government bodies and NGOs about its CO ₂ reduction objectives and strategy.	The company initiates development projects that facilitate reductions in CO ₂ emissions in the sector.
5	The company requires that its A-suppliers have a Scope 1 & 2 emissions calculation in accordance with ISO-14064-1.	The company reports on a structural and quantitative basis the results of the CO ₂ reduction objectives for Scope 1, 2 & 3.	The company is publicly committed to a government or NGO CO ₂ emission reduction programme.	The company takes an active part in setting up a sector-wide CO ₂ emission reduction programme in collaboration with the government or an NGO.
		- <i>The company succeeds in meeting its reduction objectives</i>		

Source: SKAO (2014)

The company decides about the aspired certification level (1-5). It prepares a self-assessment report to ensure that the company's energy and CO₂ management complies with the CO₂PL requirements. A portfolio of several audit documents, such

as policy documents, technical reports, annual reports, communication procedures, is prepared for an external audit. A third party organization conducts an independent certification audit to verify whether the subrequirements for all key topics, linked to the aspired certification level and the preceding levels, are met. The company is awarded a 'CO₂PL certificate' indicating the achieved level. Companies qualify for a competitive advantage in the awarding of procurement contracts, depending on the achieved certification level. For more information about the certification process, the use of the CO₂PL in public procurement procedures and the competitive advantage in awarding contracts, the reader is referred to SKAO (2014).

3.2 Literature review on the CO₂PL

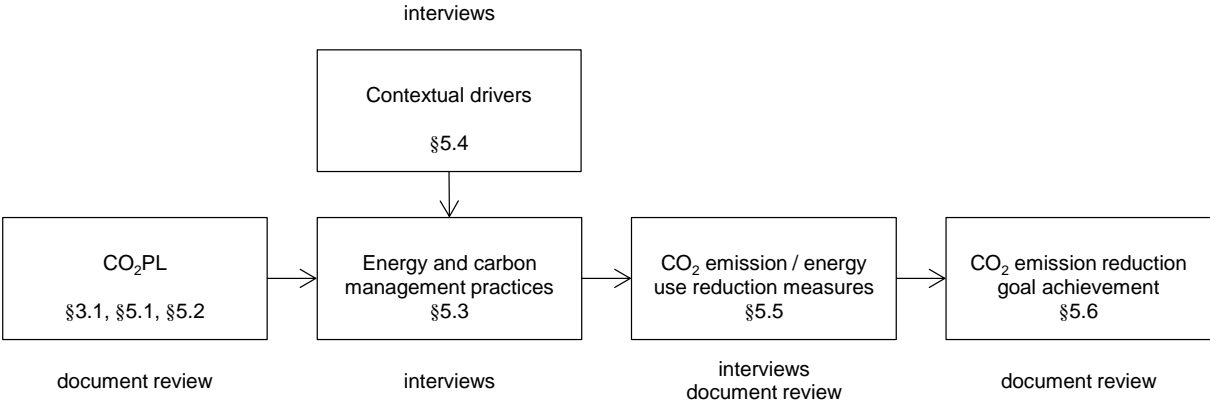
The number of peer reviewed academic papers on the CO₂PL is still limited. Dorée et al. (2011) analysed the critical success factors of the scheme, being the certification combined with incentive mechanisms, the institutional embedding and the attention given to the support structure. Rietbergen and Blok (2013) claimed that CO₂ emissions of participating companies could potentially be reduced by 0.8-1.5%/yr in absolute terms, which would be sufficient to keep up the pace with the annual reduction rate necessary to remain below the 2020 Dutch emission ceiling for sectors not participating in the European Union emission trading scheme (EU-ETS). Rietbergen et al. (2014) concluded that the target-setting process in the CO₂PL did not necessarily lead to the establishment of the most ambitious goals for CO₂ emission reduction. These aforementioned papers did not address the impact of the CO₂PL on improving energy management. A range of other non-peer reviewed papers, theses and reports on different aspects of the CO₂PL has been published (Addo-Nkansah et al. 2012; Boersen 2012; Oost 2012; Oudejans 2012; Wilbrink 2012; Primum 2012). The latter two references are the most relevant for this research. Wilbrink (2012) studied the impacts of the CO₂PL on business operation, CO₂ emission reductions and the costs of the scheme in the very early stage of the CO₂PL. Primum (2012) primarily evaluated how well the CO₂PL was implemented by certified companies.

4 Research questions, methods and data collection

4.1 Research questions, topics and methods

The main research question addressed in this study is *'What is the impact of the CO₂ Performance Ladder on improving energy and carbon management and CO₂ emission reduction in construction and civil engineering firms'*. A mixed methods approach, combining both qualitative and quantitative data collection techniques and analysis procedures (Saunders et al. 2009) was used to investigate the impact of the CO₂PL on improving energy and carbon management in the involved companies. The research has been broken down into five topics, see Figure 1.

Figure 1: Research framework and data collection.



- First, we investigated the main characteristics of the CO₂PL, the participants’ opinion about the CO₂PL and the main reasons for participating in the scheme.
- Second, we investigated whether the CO₂PL has had significant effects on adopting new energy and carbon management practices in certified firms. Personal interviews with corporate representatives responsible for coordinating the implementation of the CO₂PL, were conducted to identify the impact of the CO₂PL on improving corporate energy management practices, see annex A for the questionnaire. The main interview topics included are the organizational changes, the monitoring and analysis of energy use and CO₂ emission reduction, the functioning of the Plan-Do-Check-Act Cycle, the management involvement, target setting for CO₂ emission reduction and employee involvement. A fully comparable control group was not available since all major companies in the construction and civil engineering sector already participated in the CO₂PL. However, a few smaller non-certified companies in the same sector was used as a small control group.
- Third, we studied whether additional energy conservation and CO₂ emission reduction measures have been taken by certified firms, due to the CO₂PL. The various measures were taken from companies’ energy management plans and websites. The impact of the CO₂PL on taking these measures is rated by the interviewees conform the method by Rietbergen et al. (2002).
- Fourth, we investigated the achieved CO₂ emission reductions due to energy efficiency improvements and fuel switching (thus excluding reductions from changes in production output), the additional impacts of the scheme on CO₂ emission reduction and the goal achievement of CO₂ reduction targets. The necessary data were taken from corporate energy management plans, annual company CO₂PL progress reports and databases with company information on turnover.
- Fifth, as the CO₂PL was probably not the only driver for changing energy management practices, the influence of other contextual drivers, such as corporate strategies, other governmental policies and market-based standards was also discussed during the interviews.

Table 2: Profiles of (interviewed) companies

Company name	n ¹	CO ₂ PL Level	certified since (Q/yr)	NACE ²	CO ₂ emission reduction target				CO ₂ emissions			Other policies, standards and certifications		
					type	start-end	target (%/yr)	achieved (%/yr)	2013 (tons)	reduction (%/yr)	period	ISO14001	CSRPL	LTA3
1 ARCADIS	2	5	1/2010	71	CO ₂ /FTE	2008-2015	-1.2%	-3.3%	6686	-5.0%	2008-2013	yes	no	no
2 Baas	1	3	4/2010	42, 43	CO ₂ /FTE	2009-2015	-2.7%	-4.3%	3930	-9.6%	2009-2013	no	no	no
3 Ballast Nedam	1	5	4/2009	41, 42	CO ₂ /M€	2008-2020	-2.9%	-3.8%	50000	-8.9%	2008-2013	yes	no	yes
4 BAM Civiel	2	5	4/2010	41, 42	CO ₂ /M€	2009-2015	-2.7%	#N/A	5523	-11.0%	2009-2013	yes	no	no
5 BAM Infratechniek	1	5	2/2010	41-43, 71	CO ₂ /M€	2009-2015	-2.7%	#N/A	15670		2009-2010	yes	no	no
6 BAM Rail	2	5	2/2010	42	CO ₂	2009-2012	-5.3%	-8.8%	6272	-8.9%	2009-2013	yes	no	no
7 Beelen Recycling	2	5	1/2012	38, 43	CO ₂ /M€	2010-2013	-2.7%	1.7%	14814	18.9%	2010-2013	yes	yes	no
8 Besix	2	5	4/2010	41, 42	CO ₂ /M€	2009-2015	-1.7%	-5.4%	5729	-3.1%	2009-2013	yes	no	no
9 Boskalis	2	5	2/2011	42	CO ₂ /M€	2009-2020	-0.5%	-13.3%	61710	-17.8%	2009-2013	yes	no	no
10 Den Ouden Groep	1	3	3/2011	38, 42, 43	CO ₂ /M€	2010-2014	-2.1%	1.1%	6914	-3.7%	2010-2013	yes	no	no
11 Gebroeders van 't Hek	1	3	1/2011	42	CO ₂	2010-	-2.0%	-2.6%	6606	1.3%	2009-2013	no	no	no
12 GMB	1	5	1/2011	41, 42, 43	CO ₂ /M€	2009-2015	-4.1%	-7.6%	14490	1.3%	2009-2013	yes	no	no
13 GP Groot Infra	1	4	3/2011	38, 42	CO ₂ /FTE	2011-2020	-2.0%	2.8%	14800	8.4%	2011-2013	yes	no	no
14 Heijmans	1	5	4/2010	41, 42, 43	CO ₂ /M€	2012-2016	-1.5%	-0.2%	45234	-6.3%	2009-2013	yes	no	yes
15 Imtech	1	5	1/2010	42, 43	CO ₂	2008-2013	-2.1%	-3.0%	8549	-1.8%	2008-2013	yes	no	no
16 Mourik	2	5	1/2011	41-43	CO ₂ /M€	2009-2020	-2.0%	-4.8%	11230	-2.6%	2009-2013	yes	yes	no
17 Ooms Civiel	1	5	1/2011	41-43	CO ₂ /M€	2009-2014	-2.1%	0.5%	11080	-4.0%	2009-2013	yes	no	yes
18 Ordina	2	3	3/2011	62	CO ₂ /FTE	2010-2020	-2.2%	0.2%	15281	-3.0%	2010-2013	yes	no	yes
19 Strukton Groep	1	5	4/2009	41-43, 71	CO ₂ /M€	2009-2020	-1.5%	-3.8%	36708	-6.2%	2008-2013	yes	no	yes
20 Strukton Rail	1	5	4/2009	42	CO ₂ /M€	2008-2020	-1.3%	-3.1%	15902	-0.3%	2008-2013	yes	no	no
21 TKF	1	3	2/2011	27, 35	CO ₂ /M€	2009-2015	-4.7%	-4.3%	9761	-2.1%	2009-2013	yes	no	no
22 Van Gelder Groep	1	5	3/2011	42, 43, 71	CO ₂ /FTE	2010-2015	-1.7%	-11.4%	8100	-5.3%	2010-2013	yes	no	yes
23 VHB	1	5	4/2010	41, 42	CO ₂	2009-2015	-1.0%	2.3%	4466	1.0%	2009-2013	yes	no	no
24 Van Wijnen	2	5	1/2011	41	CO ₂	2009-2015	-2.1%	-4.2%	8196	-3.4%	2009-2013	yes	no	no
25 Wolter en Dros	1	4	1/2010	43	CO ₂ /M€	2011-2013	-0.1%	-3.8%	5273	-8.5%	2008-2013	yes	no	no
26 A. Hakpark	-	3	3/2011	41, 42	CO ₂	2011-2012	-2.0%	12.0%	24798	2.7%	2010-2013			
27 A. Jansen	-	3	3/2011	43	CO ₂	2010-2014	-0.5%	-9.4%	11617	-11.8%	2010-2013			
28 J.P. van Eesteren	-	4	4/2010	41	CO ₂ /M€	2012-2015	-7.2%	2.8%	2357	-32.0%	2011-2013			
29 Geluk	-	3	1/2012	42	CO ₂ eff.	2009-2015	-10.0%	#N/A	5697	-1.1%	2009-2013			
30 ABB Benelux	-	3	2/2011	71, 33	CO ₂ /FTE	2009-2019	-2.5%	-16.6%	5706	-19.8%	2009-2013			
31 Baggerbedrijf de Boer	-	3	1/2012	42	CO ₂	2010-2015	-0.9%	2.2%	27737	1.4%	2010-2013			
32 BAM Wegen	-	5	4/2009	41-43	CO ₂	2011-2015	-0.5%	-0.1%	47293	-3.4%	2008-2013			
33 Capgemini	-	4	1/2011	66	CO ₂	2011-2016	-6.9%	-5.5%	33636	-9.0%	2009-2013			
34 Croon Elektrotechniek	-	4	2/2010	27	CO ₂ /hour	2011-2015	-2.9%	-0.2%	8476	3.5%	2008-2013			
35 Dura Vermeer	-	5	4/2009	41-43	CO ₂ /FTE	2010-2014	-1.3%	-4.7%	29281	-7.0%	2009-2013			
36 Fri-Jado	-	4	3/2010	28	CO ₂ /FTE	2009-2012	-9.1%	-9.2%	3684	-9.3%	2009-2013			
37 Gebr. Van der Lee	-	3	3/2011	42, 43	CO ₂ /M€	2010-2013	-1.0%	#N/A	23705	-0.4%	2010-2013			

Table continued

Company name	n ¹	CO ₂ PL Level	certified since (Q/yr)	NACE ²	CO ₂ emission reduction target				CO ₂ emissions			Other policies, standards and certifications		
					type	start-end	target (%/yr)	achieved (%/yr)	2013 reduction (tons)	reduction (%/yr)	period	ISO14001	CSRPL	LTA3
38 De Vries & Van De Wiel	-	4	2/2010	43	CO ₂	2011-2020	-1.0%	-5.5%	12259	-3.5%	2010-2013			
39 Grontmij Nederland	-	5	2/2011	74	CO ₂ /FTE	2009-2015	-4.8%	-1.2%	7526	-9.3%	2009-2013			
40 Hollandia	-	5	3/2011	25	CO ₂ /hour	2013-2020	-3.1%	#N/A	6542	-7.8%	2010-2013			
41 Antea	-	5	4/2010	71	CO ₂ /FTE	2009-2015	-4.7%	-6.7%	4222	-10.1%	2009-2013			
42 Joulz	-	5	4/2011	35	CO ₂ /FTE	2007-2020	-2.2%	-9.4%	11953	2.1%	2010-2013			
43 KWS Infrabouw	-	5	2/2010	42	CO ₂ eff.	multiple	0.0%	#N/A	92357	0.0%	2009-2013			
44 Martens en Van Oord	-	3	4/2010	42, 43	CO ₂ /BAU	2009-2020	-1.0%	-0.9%	19778	4.0%	2009-2013			
45 ProRail	-	4	1/2010	49, 71	CO ₂	2010-2020	-13.5%	-34.3%	18500	-37.4%	2008-2013			
46 Rexel Nederland	-	3	2/2011	46	CO ₂ /FTE	2010-2015	-8.8%	-17.0%	2516	-22.2%	2010-2013			
47 RoyalhaskoningDHV	-	5	1/2010	71	CO ₂ /FTE	2012-2017	-4.4%	-8.3%	12071	-17.8%	2012-2013			
48 Shanks	-	3	1/2012	37, 38	CO ₂ /M€	2010-2020	-1.0%	-3.5%	391686	-2.0%	2010-2013			
49 Theo Pouw	-	3	1/2012	38	#N/A	#N/A	#N/A	#N/A	62260	5.3%	2010-2013			
50 van den Herik Sliedrecht	-	4	4/2011	41-43	CO ₂ /M€	2010-2013	-1.7%	-12.6%	6225	0.0%	2009-2013			
51 Van Gansewinkel Groep	-	3	3/2010	38	CO ₂ eff.	2010-2014	0.0%	#N/A	112410	4.8%	2010-2013			
52 Van Oord Nederland	-	5	4/2010	41-43	CO ₂ eff.	2010-2015	-1.0%	-4.8%	42119	-44.4%	2009-2013			
53 Vialis	-	4	4/2010	71	CO ₂	2009-2013	-6.3%	-10.3%	3683	-12.6%	2009-2013			
54 Victor Buyck	-	4	3/2011	25	CO ₂ /hour	2009-2014	-2.1%	-10.8%	4961	-7.1%	2009-2013			
55 Visser & Smit Hanab	-	3	3/2011	42-43	CO ₂ /M€	2013-2016	-1.7%	#N/A	21024	-5.4%	2010-2013			
56 Volker Rail Nederland	-	5	4/2009	25, 42, 71	CO ₂ eff.	2009-2015	-2.7%	#N/A	10642	-0.4%	2008-2013			
57 VWBVGO	-	4	2/2012	41	CO ₂ /M€	2011-2014	-1.7%	-2.9%	22147	-9.1%	2010-2013			
									1483805	-7.4%	2010-2013			
58 De Nijs	1	not certified		41	no				1268			yes	no	yes
59 De Vries & Verburg	1	not certified		41	no				1000			yes	no	yes
60 Giesbers bouw	1	not certified		41	CO ₂ /M€	2011-2017	-4.7%		731			yes	no	no
61 Hurks	1	not certified		41	no				no			yes	no	no
62 Nijhuis	1	not certified		41	no							no	no	yes
63 Plegt Vos Infra	1	not certified		41, 42	CO ₂ /FTE	2009-2020	-3.0%					yes	no	no
64 Ten Brinke	1	not certified		41	no				no			no	no	no

¹ Number of interviewees.

² NACE codes: 25 = Manufacture of structural metal products, 27 = manufacture of electrical equipment, 33 = repair and installation of machinery and equipment, 35 = electricity, gas, steam and air conditioning supply, 38 = waste collection, treatment and disposal activities; materials recovery, 41 = construction of buildings, 42 = civil engineering, 43 = specialized construction activities, 46 = wholesale trade, except of motor vehicles and motorcycles, 49 = land transport and transport via pipelines, 62 = computer programming, consultancy and related activities, 66 = activities auxiliary to financial services and insurance activities, 71 = architectural and engineering activities; technical testing and analysis (EC, 2008).

³ CO₂ = volume target for CO₂ emission reduction, CO₂/FTE = CO₂ emission reduction target measured against Full Time Equivalents, man hours or productive hours, CO₂/M€ = CO₂ emission reduction targets measured against turnover or production value. multiple rel. = multiple relative targets, CO₂ eff. = other CO₂ efficiency targets

⁴ CO₂ footprint 2010.

⁵ Rolling base year.

This research specifically focusses on the impact of the CO₂PL on improving internal energy and carbon management practices and CO₂ emission reductions. The impact of the CO₂PL on managing supply chain CO₂ emissions is not a focal point of our research.

4.2 Research population

The target population to which we want to generalize the research findings was limited to firms that met the following conditions. Companies must have obtained a CO₂PL certificate at least before the second quarter of 2012, because companies must have had sufficient time to implement the CO₂PL as an energy or carbon management system. Furthermore, only companies with a CO₂ footprint larger than 5 ktons of CO₂ emissions in scope 1 and 2 were included, since these companies were roughly responsible for about 80% of the total emissions covered by the CO₂PL scheme (Rietbergen and Blok 2013). Finally, companies must still be an active participant in the CO₂PL. The target population consisted of 57 firms, out of more than 500 certified companies (date: February 2014), covering about 1.48 Mtons of aggregated CO₂ emissions in 2013. Table 2 shows the company profiles of the research population. Most companies had construction and civil engineering as their main activity. All companies were classified as large companies since they generally exceed the criteria for small and medium-sized enterprises according to CEC (2003)¹.

4.3 Interview sample

Thirty-three companies, which were randomly selected from the target population, were contacted to participate in the research. Finally, a sample of twenty-five firms was selected (companies 1-25 in Table 2); six firms were rejected because a new CO₂PL coordinator was recently appointed; and two firms were not willing to participate. The interviewees held varying positions such as Sustainability, Health, Environment and Quality (SHEQ) manager, sustainability officer, environmental coordinator, director, energy consultant etc. In total twenty-seven interviews with thirty-four representatives of twenty-five certified companies were conducted in the period from March 2014 until July 2014. In December 2014, seven additional interviews were conducted with non-certified companies (companies 58-64 in Table 2). These latter companies were shortlisted on the Cobouw 50, a list with the 50 largest companies in the construction and civil and engineering sector in the Netherlands (Cobouw 2013).

4.4 Interview procedure and data analysis

The semi-structured interviews were mostly conducted by alternating couples of interviewers. The interviews, that typically took 100 to 120 minutes, were tape recorded, fully transcribed and sent back to the interviewees for review and approval. The interview guide, that contained open-end questions and short questionnaires with closed questions, was based on a literature review of the CO₂PL, energy and environmental management systems (see sections 2 and 3). The transcripts were coded, cross checked and categorized for further textual analysis by using QSR NVIVO 10 software package (QSR 2012). In section 5, the similarity in the responses was reported as follows: 0-25% agreement was categorized as 'low' or a

¹ The number of large construction companies in the Netherlands, each employing more than 100 people, was 320 in the year 2014 (CBS 2014).

'few', 25-50% was categorized as 'several', 50%-75% was categorized as 'considerable', 'substantial', 'the majority', and 75%-100% was categorized as 'high' or 'most'. Some quotes of interviewees were translated from Dutch to English and cited in the research findings. The capital letters in curly brackets refer to certified companies, but cannot be directly linked to the companies in Table 2 to maintain participant anonymity.

5 Research findings

This section presents the following topics: the general opinion about the CO₂PL (5.1), the motivations to adopt the CO₂PL (5.2), the impacts on improving energy management practices (5.3), the contextual drivers for energy and carbon management (5.4), the implemented measures for energy efficiency and CO₂ emission reduction (5.5) and the quantitative impacts of the scheme on CO₂ emission reduction (5.6).

5.1 General opinion about the CO₂ Performance Ladder

Participating firms generally had a positive attitude towards the concept of energy and carbon management introduced by the CO₂PL: *'I think it is a good instrument to create awareness about your emissions and especially the continuous improvement and reducing your emissions.'* {D}, *'Before, we did not have any kind energy management system, so this is a giant step forward.'* {P}, *'Energy was considered as a necessary evil. You need energy to do construction work. We did not think about energy efficiency in our work, and that has certainly changed due the introduction of energy and carbon management.'* {I}. Though, there was a wide range of critical remarks among almost all firms that could not easily be ignored. Companies were critical about the application of the CO₂PL in procurement procedures, such as: *'There is limited capacity to distinguish yourself in contract procurement because all the competitors are at the same level.'* {J}, *'It has become a commercial rat race.'* {E}, *'It is just a checkbox that must be ticked in contract awarding procedures.'* {S}; about the format of the scheme, such as: *'There is limited continuity in the scheme's requirements.'* {D}, *'The requirements are multi-interpretable.'* {D}, *'SKAO created their own standards instead of building close upon existing ISO standards.'* {T}, and other issues such as: *'It is so simple to obtain a level 5 certificate ... you don't have to put effort in it.'* {B}, *'It's just paper work.'* {S}, *'It's more a checklist rather than a management system.'* {Q}, *'The scheme narrows the focus to CO₂ while other CSR topics are also important.'* {E}.

5.2 Motivation for adopting the CO₂ Performance Ladder

Almost all companies primarily adopted the CO₂PL because of the (expected) competitive advantage in contract awarding. The CO₂PL can give companies competitive benefits, either as a pre-qualification criterion (preceding the tendering) or as a contract award criterion. Relevant quotes of interviewees include: *'We have adopted the CO₂PL because you cannot bid on ProRail works without a CO₂PL certificate and you will lose a lot of revenue.'* {D}, *'You'll have to take part in the CO₂PL for a 10% competitive advantage, since margins are very low. We should be glad if we can get 2-3% margin.'* {E}, *'The reason to adopt the CO₂PL is purely commercial. You cannot afford to miss 5 or 10% compared to your competitors.'* {J}. Secondary reasons for adopting the CO₂PL were improving public image, seeking confirmation of previous efforts on energy efficiency improvement or CO₂ emission reduction, broadening of existing CSR policies and strategies, reducing CO₂

emissions, cost reduction, complying with requirements of the holding company, clients or customers. Several firms (not included in our sample) did not continue their certification (see www.skao.nl) after the expiring date since the CO₂PL did not give them additional competitive benefits compared to other existing CSR policies and certifications². Among the companies not holding a CO₂PL certificate, the lack of competitive benefits, the narrow focus of the scheme and the lack of priority for CO₂ emission reduction were the main reasons for not participating in the scheme up till now. However, three of these non-certified firms claimed that a CO₂PL certificate could be obtained easily since they fulfil the (most important) CO₂PL requirements.

5.3 The impact on improving energy management practices

We asked interviewees to rate on a 0 – 3 point scale the state of various energy management practices at present and 1-2 years prior to the introduction of the CO₂PL. Interviewees could choose whether these energy management practices were fully implemented, implemented on an average level, partly implemented or non-existent in the daily business operation. No specific indicators were given to distinguish between the various levels. See appendix for the questionnaire.

Figure 2: Participant group self-reported comparison of energy management practices, before and after the implementation of the CO₂PL (n = 25).

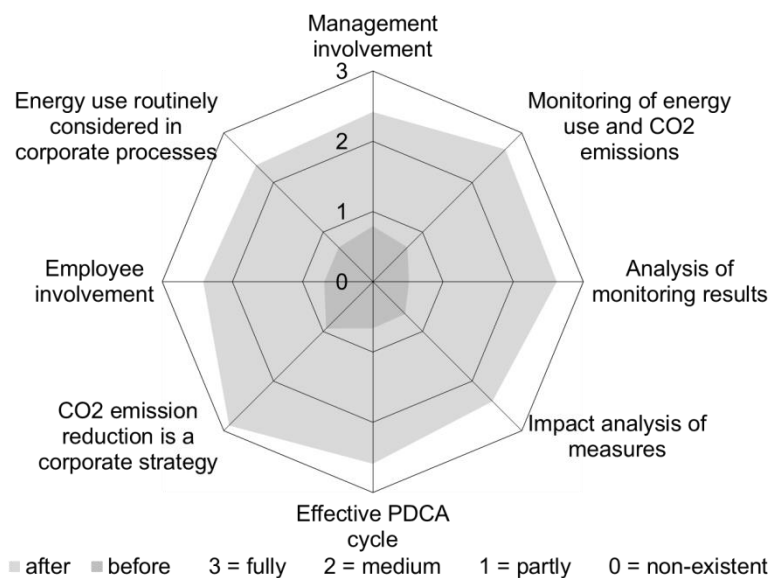


Figure 2 reveals that on average almost none of the energy management practices were even partly implemented in the daily business operation prior to the introduction of the CO₂PL. Since the introduction of the CO₂PL all these energy management practices have improved significantly. In the following paragraphs the results presented in Figure 2 are discussed in more detail by linking them to the responses on the open-end interview questions.

5.3.1 Management involvement

A positive shift in the boards of directors' attitude towards energy management was observed among almost all companies since the introduction of the CO₂PL. Prior to the introduction of the CO₂PL the majority of the boards of directors were not actively involved in energy and CO₂ management, did not explicitly hold responsibilities for energy and CO₂ management and did not show any leadership on this topic. Since

² Based on a telephone survey among these companies.

the introduction of the CO₂PL, the boards of directors have, in general, become much more responsible, concerned and involved in their companies' energy and CO₂ management. For example, interviewees stated that *'CO₂ and energy management have become a recurring topic on management meetings.'* {L}, *'CO₂ has even become part of the remuneration package.'* {P}, and *'The board of directors decides upon CO₂ emission reduction measures, even before we propose them.'* {G}. Not surprisingly, this attitude shift was mainly driven by the commercial benefits of holding a CO₂PL certificate, the multiple benefits of CO₂ emission reduction and sustainable business strategies, the obligations of the CO₂PL scheme and in some cases the intrinsic motivation of individual board members. The interviews also revealed more critical quotes that highlighted the boards of directors' very pragmatic attitude towards the CO₂PL like *'The CO₂PL is not a matter of choice, but a need.'* {B}, *'The only thing the board of directors wants from us is that we reduce energy, implement nice projects and keep the CO₂PL certificate on the wall.'* {X}, *'There are also managers that say: 'please deliver me this certificate once a year, and I don't want to see your face for another year.'* {J}. Despite these critical remarks about the management involvement, the majority of the interviewees said that there was sufficient management support to implement the basic elements of the CO₂PL properly. Among non-certified companies, management is more dedicated towards implementing a broader CSR strategy in their corporate business rather than CO₂ emission reduction strategy.

5.3.2 Organizational changes

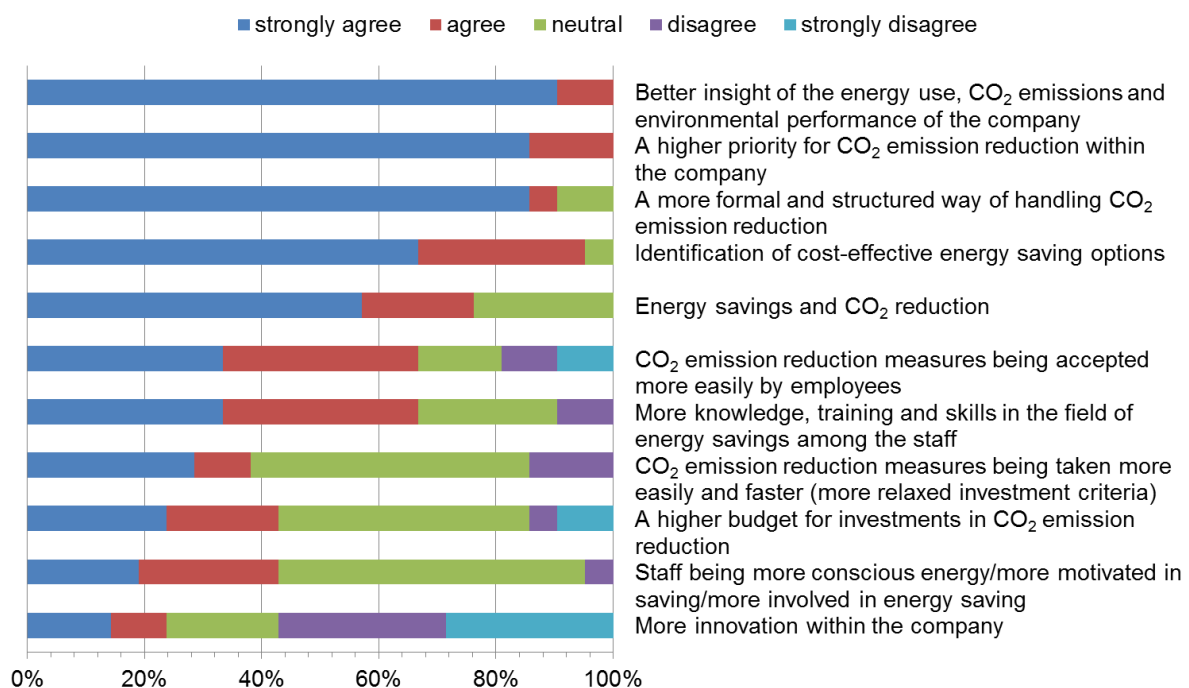
Prior to the introduction of the CO₂PL, people from various departments, such as the purchasing manager, administrators/accountants, building and facility managers and equipment support managers, already held responsibilities for the companies' energy management. Energy management was however often not a coordinated effort yet in the majority of the companies. In most companies a small CO₂PL project team was formed to initiate the (further) development of the company's energy and carbon management, to implement the CO₂PL in the organization and to obtain the CO₂PL certification. After having implemented the CO₂PL, one specific staff member became responsible for coordinating the continuous improvement of the energy and CO₂ management, being the linking pin between the management, the rest of the company and a CO₂PL team. The size of the CO₂PL team (2-6 persons) and its character (multidisciplinary group on CO₂PL, part of CSR group, duo of management - CO₂PL coordinator), the frequency of the meetings (4-20 times per year), the amount of extra appointed staff for the CO₂PL (extra staff or tasks assigned to existing staff), the responsible departments (e.g., SHEQ, CSR), and type of management (project management, vs line management) differed widely among the certified firms. However, the majority of the interviewees agreed that there was sufficient organizational support for implementing the CO₂PL.

5.3.3 Monitoring and analysing energy use and CO₂ emissions

The practice of monitoring energy use and CO₂ emissions, the analysis of energy use and CO₂ emissions and the impact analysis of measures has changed substantially since the implementation of the CO₂PL. In most of the companies information about energy consumption was already available prior to the introduction of the CO₂PL, mainly through energy bill payments. However, real 'insight' in the energy flows and CO₂ footprint was lacking. Almost all companies agreed that, due to the CO₂PL, better insight was gained in the CO₂ emissions and energy use, e.g.

by (sub)metering of energy use, gathering more (detailed) data, frequently drawing up monitoring reports, and internal discussions about energy use and CO₂ emissions (see Figure 3). Relevant quotes include for example: *‘The CO₂PL provided us with insight in our energy use and CO₂ emissions. Prior, we did not know whether we emitted 100 kg of CO₂ or 1 million tons of CO₂.’* {W}, *‘Prior to the CO₂PL, half of CO₂ footprint was based on guesswork, simply because we did not have the data.’* {G}, *‘It turned out that we have been paying the energy bills of office space that did not belong to us anymore. There was simply no one who was checking these kinds of things.’* {I}. Apart from the CO₂PL, company reorganisations, strengthened internal cooperation and centralized procurement of energy also considerably enhanced the insight in the companies’ energy use and CO₂ emissions. Almost all companies introduced certain performance metrics to further analyse these energy use and CO₂ emission data on company level (see also paragraph 5.3.5). The level of detail of the more in-depth analysis of energy efficiency and CO₂ emission performance varied widely among the certified firms (e.g. at the level of buildings, projects, machinery, individual cars). Companies stressed the difficulty of developing meaningful performance metrics, e.g. due to the project based type of work, varying types of construction and civil engineering activities, and the wide use of subcontractors. Although companies claimed to have enhanced their insight in the impact of CO₂ emission reduction measures, this is limited to easily measurable CO₂ emission reductions of purchasing green electricity and driving more efficient lease cars. The majority of the non-certified companies also started to make CO₂ footprints on an annual basis since around 2012, however with varying consistency, accuracy and completeness. Further analysis of these data seemed to be limited among the non-certified companies.

Figure 3: Responses to the question “The CO₂PL contributed to ...”



5.3.4 Plan-Do-Check-Act (PDCA) cycle

Certified companies generally agreed that the CO₂PL facilitated the introduction of a PDCA cycle for energy management in their business operation, resulting in a more formal, structured and planned approach for energy savings and CO₂ emission reduction (see Figure 3). Prior to the introduction of the CO₂PL, a PDCA cycle for energy and CO₂ management was almost non-existent in many companies, except for the very energy-intensive, large or ISO-14001 certified firms. Even, these firms that already implemented some kind of PDCA cycle for energy management prior to the CO₂PL, agreed that CO₂PL improved their steering cycle, e.g. by more specific attention to CO₂, more regular audits and communication requirements. Non-certified companies just recently integrated energy efficiency and CO₂ emission reduction as one of the topics in PDCA cycles for ISO-14001 or CSR Performance Ladder³, if available.

Quotes from certified companies that support the importance of developing a PDCA cycle for energy and CO₂ management include: *'In the beginning, many measures were introduced, but there was no steering cycle, nobody was responsible, and therefore many measures failed.'* {H}, *'The PDCA steering cycle works ... you will have to face the facts regularly, it should not be something that you do only once, otherwise the continuous improvement cycle does not work properly.'* {K}, *'Iterating the PDCA cycle, making it a recurring topic on the agenda and then it will be properly embedded in the business operation. In some cases this means that the paperwork shows that nothing has been done for a long time, which is important signal for the companies' management.'* {S}. Thus, at least at administrative level the CO₂PL has ensured that CO₂ is more routinely considered in the corporate processes. Key elements in the PDCA cycle, like the annual external audits, the internal audits and bi-annual reporting requirements and management reviews were generally considered as useful triggers for putting regular attention to the companies' energy and CO₂ management. Despite these positive impacts, several signals showed that the PDCA cycle did not always work properly. Several companies said that the lack of 'acting' impeded the continuous improvement cycle: *'The steering cycle exits: Plan, Do, Check and then ... Act, but there steering cycle is failing due to the limited priority given to energy and CO₂ emission reduction within the company.'* {U}, *'The problem is that after three quarters of the steering cycle you sometimes fail to 'Act', to give the finishing touch, to evaluate and to decide whether energy saving or CO₂ emission measures will become a standard part of the business operation.'* {F}, *'We plan, we implement and we check more and more, but acting ... that is something that can certainly be improved. That does not only relate to energy/CO₂, but also to quality and safety.'* {M}. The lack of financial resources / cost-effective CO₂ emission reduction opportunities was also considered as a barrier for the continuous improvement of energy management among a few firms: *'We are losing interest in the CO₂PL since the low-hanging fruits have been picked.'* {S}, *'The PDCA cycle is still in place; however it is being cut off somewhere, since there are no financial resources to invest.'* {T}, *'The continuous improvement cycle for energy management has been effective in the past years, but there are certain limits to the continuous improvement since the general measures for CO₂ emission reduction have been implemented.'* {C}.

³ The CSR Performance Ladder is a management system for corporate social responsibility (FSR 2014). Companies that have adopted the CSR Performance Ladder may also competitive benefits in contract awarding procedures.

5.3.5 Setting CO₂ emission reduction targets

Since the introduction of the CO₂PL CO₂ emission reduction has become a corporate strategy for all firms, amongst others due to explicit requirement of setting companywide CO₂ emission reduction targets. Prior to the introduction of the CO₂PL, almost none of the certified companies established such targets, except the few energy-intensive companies in our research (see also section 5.3.4). Among non-certified companies, the number of firms that have established CO₂ emission reduction target was still low. The CO₂PL allows that companies can set different type of CO₂ emission reduction targets. The main target types were volume targets for CO₂ emission reduction, targets for CO₂ emission reduction measured against FTE, and targets for CO₂ emission reduction measured against turnover or production value. Table 2 provides an overview of the target types and levels for each company. For further insights in the process of setting CO₂ emission reduction targets, see an earlier study by Rietbergen et al. (2014).

5.3.6 Employee involvement, awareness and training

Several certified companies think that stigmas about energy use in the construction and civil engineering sector, like *'The more fuel you burn, the harder you work.'* {H}, *'We have all been raised by the idea that the chimney must exhaust smoke to earn money.'* {M}, *'On a construction site a generator must run 24/7. That is sustainable, otherwise you are going bankrupt.'* {J}, are gradually being tackled, also due to the CO₂PL. These companies agreed that the CO₂PL helped creating awareness among the employees about energy use and CO₂ emissions, started motivating people to contribute to energy conservation and CO₂ emission reduction and involved them in energy and carbon management (see Figure 3): *'Creating awareness by the CO₂PL is very important ... that is what makes people change their behaviour.'* {A}, *'You need to report your footprint, draw up plans, implement measures and review ... thus automatically people will become more aware than in the past.'* {R}, *'Employees are talking about it, conscious decisions are being made, it is being taken into consideration.'* {T}, *'You feel that CO₂ is becoming an issue also among project leaders, just like the topic of safety performance introduced 10 years ago.'* {M}. Companies are also modestly positive about increased training opportunities, knowledge and skills about energy and CO₂ among employees, such as eco-driving instruction, toolbox meetings (short talks delivered at the workplace) about energy use, and training for the efficient use of machinery (see Figure 3). Though, the majority of the companies agreed that adoption of energy management practices, that go beyond management and staff level, are difficult, slow, and not effective yet. The main reason is that energy conservation and CO₂ emission reduction still do not have very high priority yet among construction companies. *'For the guys that are paving the roads with asphalt during the night, safety is their main concern and not CO₂ emission reduction. For sure that they use strong construction site illumination.'* {J}. Energy conservation and CO₂ emission reduction is in most cases still considered as a by-product of measures that reduce costs, save time or increase safety performance: *'For example, employees propose a different construction method that saves time ... so you need less energy for your construction site hut ... in that order.'* {F}, *'We will certainly reprimand someone if a generator is running without any purpose, since it only costs money.'* {Y}, *'The e-driver training programme is first of all a measure to reduce costs and improve safety performance ... and as a result it also reduces CO₂ emission.'* {U}. Other barriers for implementing energy conservation and CO₂ emission reduction measures in projects were

experienced discomfort of energy saving measures: 'We have installed start-stop switches in our mobile equipment. That's smart until winter times, when the engine cools down rapidly and the guy cut through the wires of the start-stop system.' {S}; inertia: 'People are aware of the impact of their driving style on emissions. Changing driving style is something that we are working on, but that is not something you change today or tomorrow.' {W}; and lack of communication: 'Most employees at the buildings sites do not have an e-mail address, so it is very difficult to reach them.' {A}. Thus, CO₂PL has not ensured yet that CO₂ is routinely considered in the corporate processes at lower levels in the organization. Therefore, companies have introduced strategies, such as constantly repeating the CO₂ message, implementing measures one by one instead of all measures at once, trying to eliminate the human factor, and more frequent checks, to overcome these aforementioned barriers.

5.4 Contextual drivers for energy and carbon management

In the previous section we have seen that various new energy and carbon management practices have been adopted since the introduction of the CO₂PL. The question is however whether the adoption of these energy and carbon management practices can be fully attributed to the CO₂PL or whether other contextual drivers, such as corporate strategies for cost reduction and sustainability, governmental policies, and market-based standards/certifications have been dominant as well.

Cost reduction and sustainability were generally considered as most important drivers for implementing energy conservation measures. Cost efficiency has already been a priority issue in energy-intensive firms such as dredging companies, where energy cost comprise more than 50% of the contract price. In other construction firms, where the share of energy costs in total contract prices of construction projects is generally in the range of a few percent, cost reduction has become very important in the past 5 years, due to the economic decline, the small margins and fierce competition. The societal trend towards developing sustainable business operations and CSR was also mentioned as an important trigger for companies for intensified energy and carbon management.

All companies were subject to the Dutch *Environmental Management Act* (VROM 1993). Though, none of the companies ranked the environmental management act among the important drivers for energy efficiency and CO₂ emission reduction in their daily business operations. A few certified companies participated in the third generation of *Long-term agreements on energy efficiency*, LTA3 (RVO 2014), mainly by having shares in asphalt plants⁴. Due to its specific focus on energy efficiency improvement of asphalt plants, the LTA3 did not strongly influence the internal energy management of these construction and civil engineering companies.

Almost none of the certified firms had implemented the *ISO-50001 standard* for energy management (ISO 2011). In contrast, almost all companies adopted the *ISO-14001 standard* for environmental management (ISO 2004) in various parts of their companies. The majority of these companies received their ISO-14001 certificate shortly before or after the CO₂PL was adopted by the company. The CO₂PL was generally considered as a more important driver for energy conservation than the ISO-14001 standard: 'The CO₂PL is just the specification of the 'CO₂ paragraph' in

⁴ Since 2013, asphalt industries have been regulated under the EU-ETS. As a result the asphalt industries switched from the LTA3 to the LEE covenant (Long-term agreement on energy efficiency for EU-ETS companies).

the ISO-14001. {G}, *'The CO₂PL has a much more compelling effect on the energy management (than ISO-14001) ... there is no room anymore for a noncommittal approach.'* {O}, *'In the CO₂PL there is commercial pressure to maintain energy management at a high level.'* {J}. The few very large companies that obtained the ISO-14001 certificate already several years prior to the start of the CO₂PL scheme, acknowledged the ISO-14001 standard as an important starting point for environmental management and the CO₂PL as a fruitful follow-up for energy and carbon management. Among the non-certified companies ISO-14001 was more frequently considered as the cornerstone of CO₂ management. The *CSR Performance Ladder* also seemed to be a driving force for energy and CO₂ management among non-certified companies. Among certified companies, the *CSR Performance Ladder* has not been widely adopted. Several certified companies, often belonging to larger multinationals, participated in the *Carbon Disclosure Project* (CDP 2013). Although considered as important at high strategic corporate level by several firms, the CDP did not seem to have practical implications on internal energy and carbon management in the Netherlands. *BREEAM certifications* of projects were not relevant for most of the certified companies. Non-certified companies were dealing more frequently with BREEAM, but there was generally a stronger focus on the energy-efficiency of the object to be built rather than the construction process itself.

5.5 Implemented measures for energy efficiency and CO₂ emission reduction

According to the rules of the CO₂PL, companies can reduce their CO₂ emissions by implementing energy efficiency measures, through technological innovation or by changing the type of energy sources. It is not allowed to reduce CO₂ emissions through carbon offsetting. Table 3 shows the categorized measures for energy efficiency improvement and CO₂ emission reduction that were implemented by certified firms. The total number of measures taken by the 25 firms was around 400. Most measures can be categorized as 'green mobility', including measures such as capping CO₂ emissions of lease cars, requiring maximum allowable fuel economy labels of lease cars, eco-driving instructions and training, checking tire pressure and the use of electric cars. Nearly all firms also started purchasing green instead of grey electricity to reduce their CO₂ emissions on projects or in office buildings. The category 'machinery' includes measures such as the more efficient use of machinery, buying more efficient machinery, and energy metering of machinery. Companies producing (raw) materials such as asphalt or concrete implemented various measures to reduce energy use in their production facilities. Energy efficiency measures in office buildings were also often taken, such as energy efficient lighting, insulation, and energy efficient equipment for heating and cooling. Several companies installed renewable energy equipment, like solar panels on the rooftops of their office buildings. Finally, there is a wide range of measures classified under the category 'other', including for example behavioural measures on production sites, energy efficient office equipment/green IT, more efficient project management, alternative workplace strategies, reducing paper use etc. Companies ranked the CO₂ capping of cars / fuel efficient cars, general energy saving measures in office buildings and green electricity among the measures that contributed the most to CO₂ emission reduction. These types of measures often do not require any behavioural change, can be implemented without a lot of effort and only affect supporting business processes.

Table 3. CO₂ emission reduction measures adopted by certified firms

Measure category - Subcategory	Measures implemented			Extent to which the CO ₂ PL stimulated the adoption	
	#	% of total	by % of the firms (n = 25)	% (n = 353)	
Green mobility	147	37	100	53	
- CO ₂ capping, fuel efficient cars	21	6	84	51	
- Eco-driving	24	6	76	70	
Green electricity	24	6	92	74	
Machinery	41	10	80	59	
- Efficient use of machinery	23	6	60	65	
Production of materials	17	4	36	35	
Building	67	17	100	38	
- General energy saving measures	45	11	100	65	
Renewables	9	2	36	42	
Other	88	22	100	37	
Total	393	100		50	

We asked interviewees to rate the extent to which the CO₂PL has stimulated the adoption of each CO₂ emission reduction measure (cf. Rietbergen et al. 2002). A rating scale with the following verbal qualifiers (and numerical percentage) was used: none (0%), to a small extent (25%), to a reasonable extent (50%), to a large extent (75%) or to a full extent (100%). The percentages assigned to the verbal qualifiers were used to calculate the aggregated impact. On average, the CO₂PL has stimulated the adoption of CO₂ emission reduction measures to a reasonable extent (50%), see . We also asked companies to judge whether the measures would also have been taken in the hypothetical absence of the CO₂PL. Companies stated that 30% of the measures would not have been taken without the CO₂PL.

The adoption of energy efficiency measures was primarily accelerated because of the enhanced insight in cost-effective energy conservation options and not because of more relaxed investment criteria for energy efficiency, increased technological innovation or increased investment budgets (see Figure 3). Although the CO₂PL requires companies to set targets for renewable energy, purchasing of green electricity was particularly stimulated by the CO₂PL because it can quickly reduce CO₂ emissions at reasonable costs without compromising any working procedures. Various behavioural measures in the category 'green mobility' (such as eco-driving programmes), 'machinery' and 'other' have also been stimulated by the CO₂PL to a reasonable or large extent. The high impact of the CO₂PL on these types of measures was confirmed by the significantly higher share of certified firms that switched to green electricity and introduced eco-driving campaigns compared to non-certified firms. The impact of the CO₂PL on introducing more fuel efficient cars might be overrated since all non-certified firms also introduced more fuel efficient cars in the past years. Moreover, it is very likely that favourable national fiscal policies for greening Dutch car fleet played a decisive role.

5.6 CO₂ emissions reductions, additionality and goal achievement

Fifty-four companies published data to construct aggregated CO₂ emission trends in the period 2010-2013. CO₂ emissions of these companies decreased by 7.4%/yr⁵ in that period of which 85% related to direct scope 1 CO₂ emissions and the remaining part to indirect scope 2 CO₂ emissions.

⁵ The CO₂ emissions have not been corrected for weather conditions, since only a minor share of the CO₂ emissions relate to the energy use for heating office buildings.

The CO₂ emission reductions originating from energy efficiency improvement and fuel switching were separated from the CO₂ emission reductions due to changes in the production output by comparing the frozen efficiency CO₂ emissions with the actual emissions. The frozen efficiency CO₂ emissions are the estimated CO₂ emissions if no energy efficiency or fuel switching would have occurred (Phylipsen et al. 1998). The frozen efficiency CO₂ emissions in year j were calculated as follows:

Equation 1: Frozen efficiency CO₂ emissions

$$\text{Frozen efficiency CO}_2 \text{ emissions}_j = \sum_{i=1}^{50} \text{CO}_2 \text{ intensity}_{i,2010} * \text{deflated turnover}_{i,j}$$

Where,

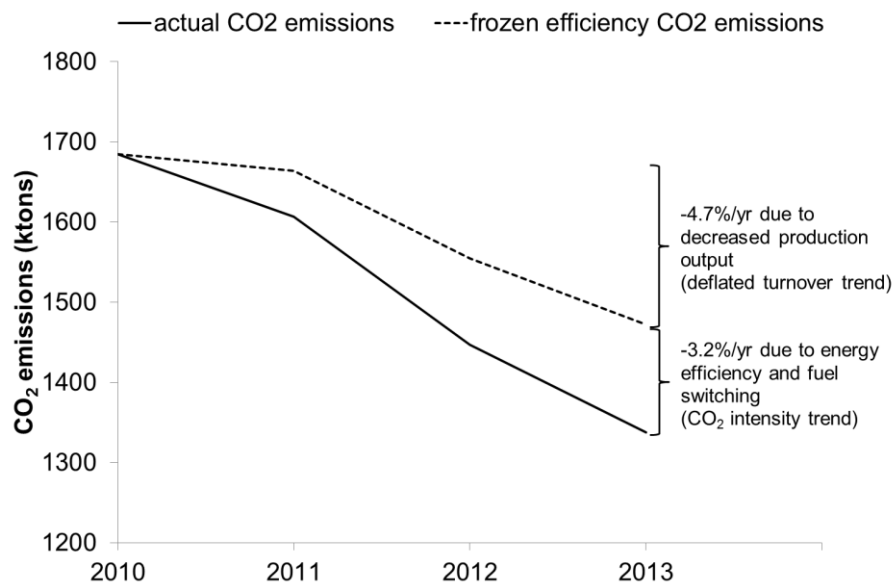
CO₂ intensity_{i,2010} = CO₂ emissions per € deflated turnover of firm i in 2010

deflated turnover_{i,j} = deflated turnover of firm i in year j

The deflated turnover was used as a proxy for the firm's production output, due to the lack of physical measures of output which are a preferred indicator to measure production output (CIEEDAC 2015).

Figure 4 shows the frozen efficiency CO₂ emissions and the actual CO₂ emissions of 50 companies in the period 2010-2013. The total CO₂ emissions of these 50 companies decreased by 7.9%/yr. The annual CO₂ emission reduction rate due to energy-efficiency improvement and fuel switching (reflected by the CO₂ intensity trend) amounted to 3.2%/yr. The remaining 4.7%/yr was attributed to a drop in the production output (reflected by deflated turnover trends).

Figure 4: Actual and frozen efficiency CO₂ emissions in the period 2010-2013 (n = 50).



Using values for the rated additionality of 30-50% as found in the previous section, implies that 1.0% – 1.6% of the annual CO₂ emission reductions can roughly be attributed to the CO₂PL. This corresponds to 97 – 167 ktons of cumulative avoided CO₂ emissions in the period 2010-2013 extrapolated for the entire target group of 57 companies.

Forty-six companies published data to evaluate goal achievement of the CO₂ emission reduction targets, see Table 2. 67% of these companies complied with the annual reduction rate required to reach the agreed target level. Firms at certification level 5 firms must succeed in meeting their targets in contrast with firms at lower certification levels. The percentage of firms that is on track did however not significantly differ by certification.

6 Discussion

6.1 Interpretation and comparison of the research results

In the case of the CO₂PL, the potential competitive advantage in procurement contracts was the primary driving force for companies to improve their energy and carbon management practices. This strongly confirmed conclusions by e.g. Dorée et al. (2011), Krarup and Rahmesohl (2002) and Reinaud et al. (2012) that energy management systems must be embedded in a broader energy management programme and be accompanied with other obligations, incentives or measures to be effective. This strong incentive of the competitive advantage may however also be a potential threat for the successful continuation of CO₂PL as a tool for improving energy and carbon management if the scheme will not be adopted more widely among commissioning parties. Another threat for improving energy management via the CO₂PL in the long-term is the limited ability to really distinguish between leaders and laggards in terms of energy management, since most large companies hold a level 5 certificate.

Our study confirmed the earlier conclusion by Wilbrink (2012) that the CO₂PL was considered as a real asset for improving energy management among the majority of the certified companies. More specifically, our study revealed that the CO₂PL stimulated management involvement, increased priority for energy issues, improved PDCA cycles, improved insight in CO₂ emissions, performance and reduction options, and increased employee awareness, thereby tackling a wide range of potential barriers inhibiting the effective implementation of energy management as suggested by e.g. Rohdin and Thollander 2006; Blass et al. 2014; McKane et al. 2010. These results confirmed the positive impacts of introducing energy management programmes on improving energy management practices found in other studies (Stenqvist et al. 2011, Helby 2002; Backlund et al. 2012; Kimura and Noda 2014). Our study also confirmed conclusions from Krarup and Rahmesohl (2002) and Backlund et al. (2012) that energy management programmes tend to have little impact on investment criteria and the planning of energy efficiency measures.

Despite the various new energy management practices introduced in the certified firms, the impact of the CO₂PL as an energy management system could also be criticized. First, the implemented energy management practices were rather administrative in nature. Second, in relation to the previous point, adoption of energy management practices beyond staff level, at lower levels in the organization, was still in its early stage. Third, interviews with several companies suggested that the impact of the CO₂PL has already reached its limits, like: PDCA cycles starting to fail, lack of quick win opportunities, cynical views on certifiable management schemes, pragmatic attitudes of top management, and narrow focus on just CO₂ emission reduction. Fourth, several interviewees argued that the CO₂PL was often just used as an administrative checklist rather than a real management system, especially with regards to requirements in key topics C and D. The above mentioned criticism is in

line with Kimura and Noda (2014) claiming that energy management systems were not always effective in inducing tangible energy conservation measures. Based on these above mentioned observations, it is however too early to conclude that the CO₂PL also tends to lead to a ceremonial behaviour rather than genuine improvements of energy management as was suggested by Boiral (2007) in the case of ISO-14001, especially because improving energy management is considered a long-term effort.

Our study suggested that impacts of the CO₂PL on improving energy management practices were more substantial in less energy-intensive (75%) than more energy-intensive (25%) firms, confirming findings by Kimura and Noda (2014). However, we also found evidence that, although larger and more energy-intensive firms already introduced some energy management practices before the introduction of the CO₂PL, the CO₂PL contributed to further improvement of energy management practices in these companies. These latter findings seemed to contrast Wilbrink's study on the CO₂PL claiming that the CO₂PL did not have a substantial impact on improving energy management among specifically larger companies. The contradicting findings might be explained by the time lag between our study and Wilbrink's study and the strong emphasize of the CO₂PL on continuous improvement of energy management.

We found that 30% of the energy efficiency and CO₂ emission reduction measures would not have been taken without the CO₂PL and that the CO₂PL stimulated the adoption of these measures to a reasonable extent (50%). A rated additionality of 30%-50% is in line with results from several other studies that roughly attributed 40%-60% of the energy savings or CO₂ emission reductions to adopting energy or greenhouse gas management programmes (Ericsson 2006; Cahill & Gallachóir 2012; Stenqvist & Nilsson 2012; Ecorys 2013; Wilbrink 2012).

In our study we found clear signs that the CO₂PL was the major contributor to improving energy management practices. In contrast, Helby (2002) could not clearly separate the effects of introducing an energy management programme from the effects of ISO 14001, because both were strongly interwoven. The slightly more modest impacts of the CO₂PL on energy management in the few firms that obtained a ISO-14001 certificate several years before the introduction of the CO₂PL confirmed earlier observations by McKane et al. (2012) that ISO-14001 played a catalytic role in drawing up energy policies, setting targets and assigning responsibilities, while at the implementation level (performance measurement, energy audits, management reviews) the role of ISO-14001 was weaker. Also based on the findings in non-certified firms, we therefore expect that in the absence of the CO₂PL energy management practices also would have been improved, since other incentives such as ISO-14001 would have filled the gap of the CO₂PL. However, we expect that energy and carbon management would not have been improved as advanced, fast and dedicated as it has been in the case of the CO₂PL due the strong incentive of green procurement, the specific focus of the CO₂PL on energy and carbon management and third-party certification.

The average annual CO₂ emission reduction rate (7.4%/yr) among 53 companies in the target population in the period 2010-2013 was way beyond the projected CO₂ emission reductions (0.8-1.5%/yr) if companies would comply with their CO₂ emission reduction targets (Rietbergen and Blok 2013). The difference was attributed to favourable long-term economic forecast used in Rietbergen and Blok (2013) compared to the actual economic downturn in the past years.

A first estimate of the additionality of the CO₂PL shows that CO₂ emission reductions have been enhanced by 1.0%/yr - 1.6%/yr in the period 2010-2013. A comparison of the CO₂ intensity trend among the investigated firms (-3.2%/yr) with generally accepted values for autonomous energy efficiency improvement of 0.5-1%/yr (EEW 2013), also suggests a net positive impact of the CO₂PL and other contextual drivers on CO₂ emission reduction. Based on the findings in section 5.4, it is expected that the impact of other contextual drivers is rather limited and most impacts can be attributed to the CO₂PL. However, firm conclusions on the quantitative impacts of the CO₂PL cannot be drawn yet due to several uncertainties like the lack of sector specific baselines, the lack of a control group, unknown intra-sectoral structural changes and the debatable use of turnover as a proxy for firms' production output (CIEEDAC 2015). Despite these uncertainties, it is still very likely that the CO₂PL has enhanced CO₂ emission reductions among the involved firms, because of the magnitude of the annual CO₂ intensity reduction rate, the adoption of additional energy conservation measures and the improved energy management practices.

In the longer term it remains to be seen if the achieved CO₂ emission reduction rates due to energy efficiency improvement and fuel switching can be maintained. Up till now most energy conservation and CO₂ emission reduction measures did not require large investments, whereas future CO₂ emission reductions will likely be more expensive.

6.2 Validity and reliability of the research

The quality of the research approach can be judged by testing the reliability, external and internal validity, and construct validity (Golafshani 2013). *Reliability* refers to the consistency of the obtained results. We are aware that moderator, respondent and question bias may play an important role in the reliability of the qualitative research (Nawrocka and Parker 2009). However, we limited the threats of these biases by interview testing, using a standardized interview, carrying out interviews in alternating couples of interviewers, by promising full anonymity to the respondents, by posing both open and closed questions on similar topics during the interview, and by cross checking the coding of the transcripts. The reliability of the quantitative research, mainly depended on the random errors in the self-reported CO₂ performance data. Since random errors are cancelled out when calculating aggregated values, the uncertainties in the calculated CO₂ emission (intensity) trends are expected to be very limited. Conclusions about goal achievement were also considered very reliable, because especially CO₂ performance data in the base year must be updated annually in the case of changes in the organizational boundary.

External validity refers to the generalizability of the research results. The qualitative research results can at least be generalized to our target population, since our interview sample was randomly chosen, the rate of participation was high (93%) and the sample covered 44% of the target population. It is expected that the main research results can also be generalized to other certified medium-sized enterprises, with sufficient organizational capacity in the construction and civil engineering sector.

Internal validity refers to the confidence of the causal conclusions of the research. In this study a non-experimental self-report research design was chosen as the main approach to compare the impact of the CO₂PL on improving energy and carbon management. The results of the 'before – after' comparison should be

handled carefully as 'changes' and not directly as 'impacts' of the CO₂PL. However, the majority of the firms attributed the improved energy management practices strongly to the CO₂PL instead of other contextual drivers. Quasi experimental research designs are generally a stronger approach for counterfactual analysis. However, such research designs need a fully comparable control group with non-participants, which was not available. Nevertheless, the internal validity of the results was further strengthened by using a group of companies involved in the construction of residential and non-residential buildings as a comparison.

Construct validity refers to identifying correct operational measures for the concepts being studied. The inadequate operationalization, as a major threat to construct validity, was expected to be limited in the open-end questions during the interviews; most of the definitions, understandings and concepts related to energy management were based on the CO₂PL handbook of which all interviewees were familiar with. The energy management practices in the questionnaire with closed question like in Figure 2 could have been operationalized more specifically, e.g. by using methods suggested by EPA (2014). Summarizing several constructs in closed questions did not allow for a proper measurement of the maturity of specific management practices. Nevertheless, these closed questions provided insight in the changes in general energy management practices since the implementation of the CO₂PL that confirmed the responses obtained from the open-end questions.

6.3 Programme recommendations

This study illustrated that the CO₂PL has been an important asset for improving energy and carbon management and CO₂ emission reduction. However we have the following recommendations for the scheme owner to maintain the CO₂PL as an effective tool for energy and carbon management in the longer term. First, the CO₂PL should more strongly emphasize the continuous improvement as prescribed by PDCA cycles. Second, annual compliance assessments should shift more towards stimulating genuine energy management practices in core processes and projects rather than checking administrative procedures. The alternative could be that the CO₂PL steers stronger on achieving energy efficiency improvement or CO₂ emission reduction targets. Third, we recommend to critically evaluating the use of the CO₂PL in procurement procedures to stimulate CO₂ emission reduction on project level more effectively, e.g. by introducing benchmark values for energy use or CO₂ emissions per unit of activity or product.

6.4 Recommendations for further research

First of all, we suggest carrying out a longitudinal study evaluating the impacts of the CO₂PL on improving energy management in the longer term, while changing energy management practices is often considered as a long-term process. Second, we recommend to evaluate to what extent energy management practices also have been internalized in different layers of the organization, e.g. by in-depth company case studies. Third, we recommend studying the impact of the CO₂PL on managing supply chain CO₂ emissions. In this study we only considered the impacts of CO₂PL on improving internal energy management, while the potential for CO₂ emission reduction in the supply chain is probably much larger. Finally, we also recommend to further investigate the net quantitative impacts of the CO₂PL on CO₂ emission reduction, e.g. by constructing sector specific baselines, analysing intra-sectoral structural changes and measuring physical production output.

7 Conclusion

The CO₂ Performance Ladder (CO₂PL) is a market-driven certification programme for energy and carbon management that primarily attracts construction and civil engineering firms. In this study we addressed the question: *'What is the impact of the CO₂ Performance Ladder on improving energy and carbon management and CO₂ emission reduction in construction and civil engineering firms'*. The main conclusions emerging from this study are the following.

First, the CO₂PL has been responsible for improving various energy management practices in certified firms. Although these improvements were still rather administrative in nature, the internalization of energy management practices beyond staff level has gradually started. Second, companies have implemented a wide range of new energy efficiency and CO₂ emission reduction measures. However most measures only affected the supporting business processes instead of companies' core processes. About 30% to 50% of these measures have been identified as additional. The CO₂PL has particularly stimulated green electricity purchasing and the adoption of various behavioural measures for energy efficiency and reducing CO₂ emission reductions. Third, the annual CO₂ emission reduction rate due to energy-efficiency improvement and fuel switching amounted to 3.2%/yr (2010-2013). First estimates suggest that about 1.0%/yr - 1.6%/yr of these CO₂ emission reductions can be attributed to the CO₂ Performance Ladder. However these figures should be used with caution because of various uncertainties, like unknown intra-sectoral structural changes, the lack of a comparable control group and the debatable use of turnover as a proxy for firms' production output. Nevertheless, it is still very likely that the CO₂PL has enhanced CO₂ emission reductions beyond business-as-usual.

Overall, we conclude that, driven by the potential competitive advantage of the CO₂PL in contract awarding, the CO₂PL has been responsible for a strong shift towards more mature energy management and enhancing CO₂ emission reduction among construction and civil engineering firms that most likely would not have been achieved by other contextual drivers solely. However, maintaining the CO₂PL as an effective tool for energy and carbon management and CO₂ emission reduction requires more focus on genuine energy management practices, stronger PDCA cycles, and more effective procurement procedures.

Acknowledgements

We are very grateful to all the interviewees for their participation in this study. The authors also thank P. Elshof, L. Minekus, S. Scheffer and C. Luuring for their assistance in the data collection. We thank Arjan van Rheede and the anonymous reviewers for their helpful comments.

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Appendix

Questionnaire

1. General questions

- Company name
- Interviewee
- Date
- Interviewers
- CO₂PL level
- What is your position within the company and your affiliation with the CO₂PL?
- What were the most important reasons for the company to obtain a CO₂PL certificate?
- How important is the CO₂PL for the company to win bids?
- What is your general opinion about the CO₂PL as a tool for improving energy management?

2. Contextual drivers

- Does the company hold an ISO14001 certificate, CSR Performance Ladder certificate, or any other type of certified environmental management system? If so, since when? Which management system has the most important impact on energy management?
- What are the most important triggers for energy efficiency improvement and CO₂ emission reduction in your company? Please prioritize, explain and differentiate between: general corporate strategies (e.g. cost reduction, sustainability), governmental policies (e.g. Long-term agreements, environmental permits, EU-ETS), other certifications (e.g. CO₂PL, CSR Performance Ladder, ISO14001, BREEAM).

3. Impact of the CO₂PL

- In what way has energy management changed since the introduction of the CO₂PL?
- To what extent has the CO₂PL been truly embedded in the company and adopted by the employees?
- Please indicate on a 4 point scale to what extent the following energy management practices were already implemented in the business operation prior to the introduction of the CO₂PL. 1 = non-existent, 2 = partly implemented, 3 = average, 4 = fully implemented, 0 = I don't know. Please clarify your answer.
 - The company's management shows visible leadership with respect to energy management (e.g. actively involved, board member has specific responsibilities for energy management)
 - Energy conservation and CO₂ emission reduction is an objective of the company and is part of the company's strategy
 - Energy and CO₂ emission are being monitored in such a way that they can be managed.
 - Energy and CO₂ emissions are being analysed, e.g. by relating the figures to turnover/FTE/km/production, corrected if necessary, and broken down in significant emission streams)
 - Employees are involved in energy conservation issues and stimulated to do so.
 - The impact of energy conservation and CO₂ emission reduction measures are being monitored in such a way these measures can be evaluated.
 - An effective PDCA cycle is in place for the continuous improvement of energy management (setting targets, energy planning, implementation, review).
 - Energy conservation and CO₂ emission reduction are routinely considered in the business operation (e.g. in procurement procedures, as part of management reports, operational planning and execution).
- Please indicate on a 4 point scale to what extent the energy management practices mentioned above have been implemented in the business operation since the introduction of the CO₂PL. 1 = non-existent, 2 = partly implemented, 3 = average, 4 = fully implemented, 0 = I don't know.

4. Energy saving and CO₂ emission reduction measures

- The following list of energy saving and CO₂ emission reduction measures has been compiled retrieved from progress reports and companies' websites. Please indicate for each measures when the measure was implemented.

- Please rate the extent to which the CO₂PL has stimulated the adoption of each CO₂ emission reduction measure. Choose between: none (0%), to a small extent (25%), to a reasonable extent (50%), to a large extent (75%) or to a full extent (100%).
- Please judge whether the measure would have been taken anyway, also without the CO₂PL.
- Which measures have contributed the most to CO₂ emission reduction?

5. CO₂ footprint, targets, activity indicators

- What is the annual company's CO₂ footprint in the 2009, 2010, 2011, 2012, 2013. Please differentiate between scope 1 and scope 2 emissions?
- What is the annual company's turnover in 2009, 2010, 2011, 2012, 2013?
- What is the company's CO₂ emission reduction target?
- Since when does the company establish CO₂ emission reduction targets?

6. Organisation

- To what extent is top management committed to energy and carbon management? Please explain.
- How has the organization of energy management changed since the introduction of the CO₂PL? Did the company already have an appointed energy manager or coordinator prior to the CO₂PL? Is the CO₂PL a team effort or solely a task of the coordinator?
- Are there certain barriers for the effective implementation of the CO₂PL in your company?
- Do you annually perform internal audits? What do they deliver?

7. Potential benefits of the CO₂PL

- Please indicate to what extent you agree with the following statements (choose between: strongly agree, agree, neutral, disagree, strongly disagree). The CO₂PL contributed to:
 - More innovation within the company.
 - Staff being more conscious energy/more motivated in saving/more involved in energy saving.
 - A higher budget for investments in CO₂ emission reduction.
 - CO₂ emission reduction measures being taken more easily and faster.
 - CO₂ emission reduction measures being accepted more easily by employees.
 - More knowledge, training and skills in the field of energy savings among the staff.
 - Energy savings and CO₂ reduction.
 - Identification of cost-effective energy saving options.
 - A higher priority for CO₂ emission reduction within the company.
 - A more formal and structured way of handling CO₂ emission reduction.
 - Better insight of the energy use, CO₂ emissions and environmental performance of the company.
- Please elaborate on the above mentioned statements.