

# Managing energy efficiency in the process industry with performance measurement and rewarding - Case Borealis Polymers Oy

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MANAGING ENERGY EFFICIENCY IN THE PROCESS INDUSTRY WITH  
PERFORMANCE MEASUREMENT AND REWARDING – CASE BOREALIS POLYMERS  
OY

Research objectives

The objective of this study was to examine the impact of measuring and rewarding energy efficiency on work motivation. The goal was to find out, whether measuring and rewarding energy efficiency are experienced as motivating in the case company and how these elements should be further developed so that work motivation could be expected to improve.

Sources

The theoretical part of the study was compiled out of a wide range of research articles, reports and academic textbooks concerning performance measurement, work motivation, rewarding and measuring energy efficiency. The data used in the empiric part consisted of theme interviews with the case company representatives and written material from the company.

Research method

The study was conducted by using theme interviews and informal discussions with the case company representatives. The interviewees consisted of directors, technical professionals and floor level employees i.e. operators. Altogether twenty one people were interviewed. Additionally, the company's written material, such as scorecards, was used as a study material.

Results

The study showed that influencing measuring and rewarding energy efficiency is experienced difficult especially in the floor level of the company. For this reason, the effects of measuring and rewarding energy efficiency on work motivation were experienced as limited. During the interviews, five themes on how to enhance energy efficiency in the case company emerged: shared ownership, employee involvement, concrete training, illustrative measuring and real-time information. As a conclusion of this study, Map to motivation -framework was constructed.

Keywords

Energy efficiency, performance measurement, rewarding, work motivation

## ENERGIATEHOKKUUDEN JOHTAMINEN SUORITUKSEN MITTAUKSEN JA PALKITSEMISEN AVULLA PROSESSITEOLLISUUDESSA – CASE BOREALIS POLYMERS OY

### Tutkimuksen tavoitteet

Tutkimuksen tavoitteena oli tarkastella energiatehokkuuteen liittyvän mittaamisen ja palkitsemisen vaikutusta työmotivaatioon. Tarkoituksena oli selvittää koetaanko energiatehokkuuden mittaaminen ja palkitseminen motivoivana case-yrityksessä, ja kuinka näitä elementtejä tulisi kehittää motivaation lisäämiseksi.

### Lähteet

Tutkimuksen teoriaosan lähdemateriaali koostui laajasta joukosta kirjallisuutta, tieteellisiä artikkeleita ja tutkimusraportteja koskien suorituksen mittausta, motivaatiota, palkitsemista sekä energiatehokkuuden mittaamista. Empiriaosassa lähteinä käytettiin case -yrityksen edustajien joukossa tehtyjä teemahaastatteluita sekä yrityksestä saatua kirjallista lähdemateriaalia.

### Tutkimusmenetelmä

Tutkimus toteutettiin case-yrityksessä teemahaastatteluin ja epävirallisin keskusteluin. Haastateltujen joukko koostui yrityksen johtajista, teknisistä asiantuntijoista sekä ohjaamotyöntekijöistä eli operaattoreista. Tutkimuksessa haastateltiin yhteensä kahtakymmentäyhtä henkilöä. Lisäksi yrityksen sisäistä kirjallista materiaalia, mm. tuloskortteja, käytettiin tutkimuksen lähdemateriaalina.

### Tutkimustulokset

Tutkimus osoitti, että energiatehokkuuden mittaamiseen ja palkitsemiseen vaikuttaminen koetaan hankalana erityisesti yrityksen työntekijätasolla. Tästä syystä energiatehokkuuden mittaamisen ja palkitsemisen motivoivan vaikutuksen koettiin olevan rajallinen. Haastattelut työntekijöiden kanssa toivat esille viisi teemaa, kuinka edistää energiatehokkuutta case-yrityksessä: jaettu omistajuus, työntekijöiden osallistaminen, konkreettinen koulutus, havainnollistava mittaaminen ja reaaliaikainen informaatio. Tutkimuksen lopputuloksena syntyi Map to motivation -viitekehys.

### Avainsanat

Energiatehokkuus, suorituksen mittaaminen, palkitseminen, motivaatio

## **FOREWORD**

This thesis has been written as a part of a more extensive research project - *Energy efficiency from a business management perspective* funded by the Finnish Agency for Technology and Innovation (Tekes). The project was carried out in collaboration between the department of Accounting and Finance of Helsinki School of Economics and the Laboratory of Energy Economics and Power Plant Engineering of Helsinki University of Technology. I started working in the project in September 2008, and after taking three months off and spending the time in Paris as an exchange student, I finished my thesis in September 2009.

The study was conducted in cooperation with Borealis Polymers Oy and I want to express my thanks to all the company's representatives interviewed for the fluent cooperation. I want to thank especially Matti Marttila and Mikko Laine from Borealis for their deep interest towards this study. Another big thank you goes to my supervisor Professor Teemu Malmi and instructors Tuija Virtanen, D. Sc. (Econ.) and Mari Tuomaala, D. Sc. (Tech.) for their assistance and valuable viewpoints throughout the research process. I also want to thank all my co-workers at the laboratory and my friends and family for their interest and support. Finally, I want to thank my co-worker Leena Sivill, Lic. Sc. (Tech.) for her valuable comments during this research.

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# 1 INTRODUCTION

*Tell me and I'll forget, show me and I may remember, involve me and I'll understand*

- Chinese proverb

## 1.1 Background and motivation

In modern-day organizations the key role of performance measurement is to communicate the culture, the strategic will and the result orientation of a company with multidimensional and forward-looking measurement (Järvenpää 1998). Multidimensional measurement stands for measuring different fields of business or activities in an organization, whereas, striving to generate forward-looking measures and measurement data can help to make improvements in an organization and to gain competitive advantage.

One new field of measurement, that has raised a lot of interest in process industry, has been the measuring of energy efficiency performance. The main reasons for the increased interest towards measuring energy efficiency have been the growing energy expenses and the concerns about global warming. Improving energy efficiency is closely connected to reducing CO<sub>2</sub> emissions and preventing climate change. The European Union has set an objective to achieve 20 % energy savings by 2020. (EC 2005) In the industrial sector, most of the energy is consumed by energy-intensive process industry. In Finland, industry consumes over 50 % of all the energy used and 80 % of this energy is used in the process industry. (EK 2009)

Energy efficiency is generally defined as a ratio between useful output of a process and energy input into a process (Patterson 1996). According to Tanaka (2008), measuring energy efficiency in the industry is still in many ways in its infancy. It seems that a lot of development and research work is still needed before energy efficiency measures of industry can be considered

reliable. Because of the number and the complexity of industrial processes and product end-uses, it is difficult to design consistent and comparable energy efficiency indicators.

An important perspective for enhancing energy efficiency is the motivation of employees and personnel of a company. It should be considered, whether energy efficiency measurement can contribute to work motivation. In literature, especially the meaning of intrinsic motivation is often emphasized (see e.g. Deci and Ryan 1985). Intrinsic motivation stems from work itself and is a prerequisite for creativity or innovation.

Rewarding is often closely connected with performance measurement and one of the goals of rewarding is to increase work motivation. Thus in this thesis the connections between measuring and rewarding energy efficiency and work motivation are studied. The research theme supports present-day organizations' ambitions to improve operations continuously. Work motivation can be considered as one of the important factors behind continuous improvement in organization.

At the moment, energy efficiency in industry is most often measured with a lagging indicator called *specific energy consumption* (SEC). It describes the energy used per the useful output produced (for example MWh/t). This measure can be included in the scorecards of employees in energy intensive plants. Rewarding can thus be tied with the measure. Even so, the possibilities for employees to influence the measure may not be at a realistic level. Employees' may feel that they have no control over the energy efficiency measure. This can be considered demotivating. In this study the aim is to examine the role of energy efficiency measurement and rewarding in motivating employees to enhance energy efficiency.

## **1.2 Research objectives**

In this thesis measuring energy efficiency is studied from the perspective of work motivation. Also, rewarding linked with measuring energy efficiency and its motivational effects are studied. The research was conducted in one case company from the field of the process industry. The case company operates in chemical industry providing plastics solutions based on polyethylene

(PE) and polypropylene (PP). The interviews were conducted at the management level and at the Hydrocarbon operations of the company.

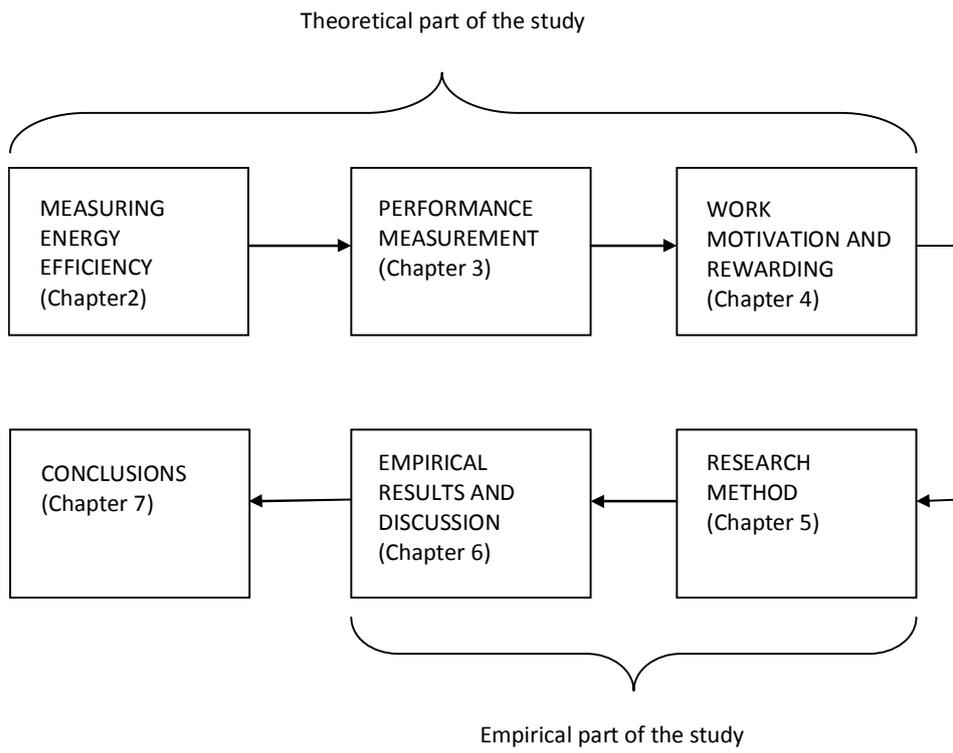
The research questions for this study are:

- 1) *How is energy efficiency measured and managed in the case company?*
- 2) *How is measuring and rewarding of energy efficiency recognized as motivating?*
- 3) *How could energy efficiency management be enhanced?*

The study was conducted by using theme interviews. Altogether 21 people from different levels of the company were interviewed. The aim was to gather different outlooks on the current state of measuring and rewarding energy efficiency in the case company. Also, new ideas on how to advance measuring and rewarding energy efficiency were expected to be found. The research was focused to study the local performance measurement i.e. local scorecards in the case company. The case company also has group-level performance measurement. However, the local performance measurement has a more visible role in the company. Also, the rewarding of the case company is in great extent linked with the local scorecards. Thus, the local scorecards and the role of energy efficiency in these scorecards were chosen as the main interest of this thesis.

### **1.3 Structure of the thesis**

The thesis is structured as follows: At first, the academic discussion behind measuring energy efficiency in the process industry, performance measurement in general and rewarding and work motivation is presented in chapters 2, 3 and 4. The fifth chapter describes the methodology used, realization of the study and the case company. In chapter six, the results of the study are presented, summarized and discussed. Last, chapter seven will conclude by presenting the main conclusions of the study, acknowledging the possible limitations of the study and making suggestions for further research.



*Figure 1. Structure of the study*

## **2 MEASURING ENERGY EFFICIENCY**

This chapter establishes a basis for this study by introducing the concept of energy efficiency and typical measures of energy efficiency. Furthermore, the challenges related to measuring energy efficiency are discussed to highlight the current issues in managing energy efficiency with performance measurement.

### **2.1 What is energy efficiency?**

Energy-using products Directive 2006/32/EC (Article 3b) defines energy efficiency as “a ratio between an output of performance, service, goods or energy, and an input of energy”. In general, energy efficiency refers to using less energy to produce the same amount of services or useful output (Patterson 1996). Consequences of increased efficiency are diverse and can be different for an economist, an engineer, or an environmentalist. The objective can vary from enhancement of the security of energy supplies or reduction of costs to reduction of carbon emissions (EC 2008a).

### **2.2 Measures of energy efficiency**

In order to evaluate energy efficiency in process industry, special tools are needed. Patterson (1996) suggests that energy efficiency indicators are categorized in four groups: thermodynamic, physical-thermodynamic, economic-thermodynamic and economic. According to Patterson (1996, 377) the different indicators can be used together to quantify changes in energy efficiency more comprehensively. Kilponen (2003) has proposed a fifth category, environment. First, thermodynamic indicators measure both energy input and useful energy output in thermodynamic units (joule, watt). Physical-thermodynamic indicators are hybrid indicators, where the energy input is measured in thermodynamic units but the output is measured in physical units. In economic-thermodynamic indicators the output of the process is measured in terms of market prices and the energy input is measured in thermodynamic units. With economic indicators, the changes in energy efficiency simply in terms of market value.

Finally, environmental indicators measure the ratio between emissions produced related to energy consumed or the production.

Energy efficiency in industry is most often measured using an indicator called *the specific energy consumption* (SEC). This is a physical-thermodynamic indicator and it describes the ratio between energy used and the useful output produced measured in physical units, most commonly tonnes of product (for example GJ/t) (EC 2008b):

$$SEC = \frac{\text{Energy used}}{\text{Products produced}} \quad (1)$$

In industrial processes, the total energy used is typically a sum of fuel, electricity and steam. An attempt should be made to convert all energy into primary energy in order to make them commensurate. The SEC is commonly used to monitor the use of energy in a process over time. The SEC can also be further processed into a dimensionless energy efficiency index (EC 2008b):

$$EEI = \frac{SEC_{ref}}{SEC} \quad (2)$$

The energy efficiency index (EEI) makes a comparison among the actual specific energy consumption and reference consumption. The reference is typically obtained from the plant's historical data. It can also be some other benchmark, such as BAT (best available technique) value. (Tuomaala et al. 2009, 2)

When measuring energy efficiency in monetary terms, some alternative measures can be found. For instance, energy costs (€) can be traced on a monthly basis. On the other hand, energy costs can be proportioned with turnover (%). Furthermore, energy costs can also be proportioned with manufacturing costs (%).

The advantage with physically based indicators compared to economic indicators is that they are not affected by price fluctuations, but can be directly related to individual processes and analysis of improvement potentials (IEA 2008). Still, a problem with the physically based indicators is their comparability. For example, reliable comparisons over time or between installations using indicators, like SEC, are possible only if operating conditions are identical. In case of complicated processes, this means that for example feedstock and product mix is similar. (Auvinen 2008, 69) On the other hand, the economic indicators of energy can increase the cost control in an organization. Although, a tight energy cost control can help to reduce waste and maintain the established level of energy efficiency, it doesn't provide information, whether energy is used efficiently or what could be done to enhance energy efficiency (Caffall 1995). It can be suggested that new leading indicators, which can be expected to later contribute also in economic measures, are needed in measuring energy efficiency.

### **2.3 Challenges in measuring energy efficiency**

Measuring energy efficiency in industry has been studied fairly little. Majority of the research has concentrated on macro level (e.g. Ang 2006), instead of studying energy efficiency measures on corporate level. Especially problems are caused by the inadequate knowledge of all the contributing factors behind energy efficiency (e.g. Auvinen 2008, 9). Thus, it seems that many challenges in measuring energy efficiency are still hindering the management of energy efficiency with performance measurement in organizations.

Patterson (1996) has discussed some of the methodological problems and issues encountered, when attempting to operationalize energy efficiency indicators. Most of the problems are common to the full range of the energy efficiency indicators, and some of them are simply characteristic for particular energy efficiency indicators. According to Patterson (1996), methodological problems occur especially, when indicators are summed up and the traceability of particulars becomes weaker. Another problem he mentions is how the energy consumption is allocated to different products in a case of multiple products. Tanaka (2008) describes challenges in measuring energy efficiency in far integrated production facilities. In this kind of setting, the material and energy streams are interlinked and there are such interactions, which make the

cause and effect -relationships difficult or even impossible to interpret. Furthermore, external matters, such as production shutdown or the temperature of surroundings, have a contribution for energy efficiency indicators. (Tanaka 2008)

The previous challenges describe the early stage in the development of reliable and exploitable measures in managing energy efficiency in the industry. At the moment, the technological aspects may have had the emphasized role, when developing new energy-related measures. On the side, the people management aspects should be recognized, when coming up with new measures. Work motivation is an important goal of a performance measure. In general, performance measurement has been under a lot research during the last few decades (e.g. Kaplan & Norton 1992, Kaplan & Norton 1996a, Toivanen 2001). In the next chapter, the performance measurement related studies are discussed to find principles applicable also in measuring and managing energy efficiency in companies.

### **3 PERFORMANCE MEASUREMENT**

In this chapter, the performance measurement is discussed more generally to provide grounds for understanding the possibilities and challenges in managing with performance measurement in organizations. First, the different roles that performance measurement can represent in an organization are presented. Thereafter, the most well-known performance measurement system, the Balanced Scorecard (BSC) is introduced. The BSC describes the change, also ideological, from financial to multidimensional measurement in management accounting during the past few decades. Measuring energy efficiency is often non-financial, and therefore, the special features of non-financial measurement are also introduced in this chapter. Last, the challenges of performance measurement are discussed and will act as an introduction to the wide range of issues noteworthy, also when managing energy efficiency with performance measurement.

#### **3.1 The roles of performance measurement**

Lönnqvist (2002, 35) has reviewed different studies of the roles of performance measurement in organizations. He has found that there are various uses for performance measurement. (Lönnqvist 2002, 36) Epstein (2008, 126) has suggested that performance measurement systems can be exploited to link corporate objectives with results. Lately, Epstein has concentrated on the measuring of corporate sustainability and has listed three main roles for performance measurement systems, when it comes to enhancing sustainability in a company: Performance measurement systems can be used to capture the logic behind strategy. They can be used as a monitoring system. Finally, performance measurement systems can be used to facilitate discussion about important factors in the company to further improve performance. (Epstein 2008, 128-129)

First role that Epstein mentioned, capturing logic behind strategy, facilitates an understanding of what is important in an organization. In other words, how daily activities add value, and how each employee contributes to the mission. In turn, monitoring is essential for keeping track of the progress. Also, external stakeholders can be interested in keeping track of the progress of the

measures. The third role, facilitating discussion, is needed to lead the company for better performance. This discussion can focus organizational efforts on performance areas that create long-term improvements and value for stakeholders. (Epstein 2008, 128-129)

In comparison, Lönnqvist (2002, 87) found ten most important roles for performance measurement systems, when he performed studies among corporate managers:

1. Diversion of the activities of the employees
2. Communication of the important goals
3. Evaluation of the current situation
4. Concretizing the strategy of the company as for feasible goals
5. Perception of problems
- 6. Motivating employees**
7. Monitoring of the implementation of the strategy
8. Production of information as a support for decision-making
9. Forecasting future events
10. Enabling of reward system

The sixth role, presented by Lönnqvist is highlighted, since one of the goals of this study is to find out what is the role of measuring energy efficiency in creating work motivation. When managing energy efficiency, all the different roles Lönnqvist has presented can be considered important. Other important roles for performance measurement besides the ones presented above can surely be found. Still, the three roles mentioned by Epstein (2008) and the ten roles found by Lönnqvist (2002, 87) are a good starting point for considering the different possibilities in managing with performance measurement.

The next part introduces the best-known performance measurement system, the Balanced Scorecard, and the principles behind it.

## **3.2 The Balanced Scorecard**

### **3.2.1 Background and structure**

When the Balanced Scorecard was introduced in 1992 by Kaplan and Norton, it complemented financial measures, which report the results of actions already taken, with three sets of operational measures. The additional measures were about customer satisfaction, internal processes and about the company's ability to learn and develop. These three activities were seen to drive future financial performance. (Kaplan & Norton 1992, 71) Since then, the Balanced Scorecard has been the most widely used performance measurement system. Other theoretical models for performance measurement have based on almost equal principles (Toivanen 2001, 66).

Kaplan and Norton (1992, 71) defined Balanced Scorecard as a group of measures, that provides a quick and an extensive view of the situation for the top management. As already suggested, the basic model by Kaplan and Norton includes four perspectives: financial, customer, internal and learning and growth. These four perspectives offer corporate executives an opportunity to measure, how their business units create value for current as well as the future customers (Kaplan & Norton 1996a, 8). Behind all the four perspectives is the vision and strategy of the company. For each perspective should be defined strategic goals, measures, concrete goals and action plans. (Toivanen 2001, 52)

According to Kaplan and Norton (1996a, 19), BSC is more than a measurement system. The real power of Balanced Scorecard is realized, when it is translated from a measurement system as a management system. The main emphasis of Kaplan and Norton's Balanced Scorecard is to put corporate strategy, not control at the centre of attention (Kaplan & Norton 1992, 139). The logic proceeds by integrating financial and non-financial operational measures in cause-and-effect relationship which assumes the following: measures of organizational learning and growth → measures of internal business processes → measures of customer perspective → financial measures. (Nørreklit 2003, 591) Hence, if the company can improve the performance of the learning and growth measures, eventually the results will show in the internal business process

measures, and furthermore in the customer satisfaction measures. In accordance with the cause-and-effect relationship, also the financial measures will be improved.

The following figure (Figure 2) illustrates the cause-and-effect relationships and time-related effects of the original Balanced Scorecard:

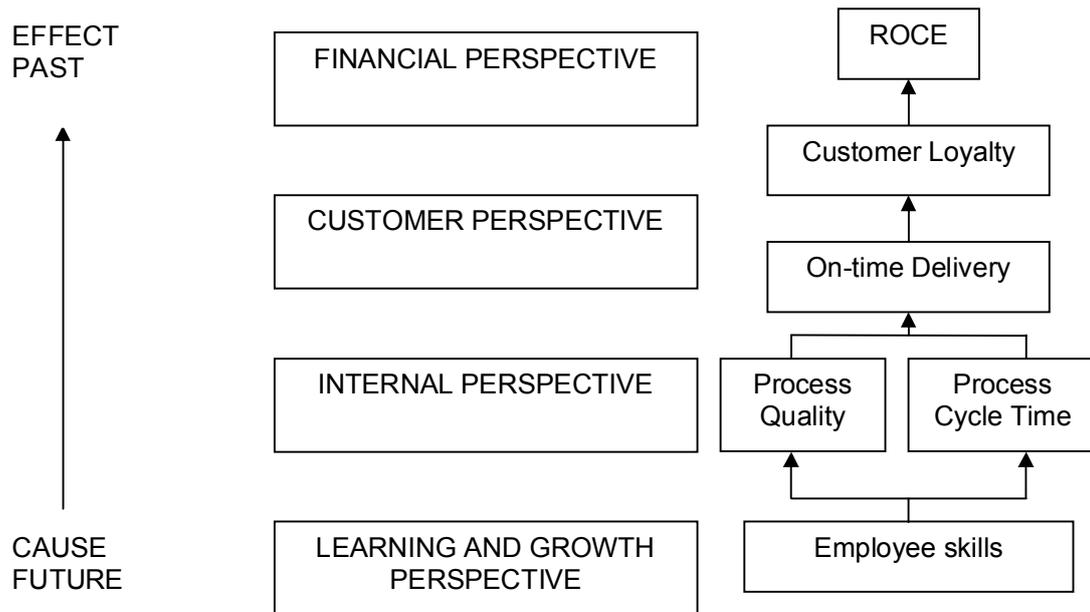


Figure 2. The cause-and-effect relations in the Balanced Scorecard (Rahkonen 2005, 11; adapted from Kaplan & Norton 1996a, 31 and Olve et al.1998, 26)

In order to say, the Balanced Scorecard is really balanced several conditions must be fulfilled. First, the scorecard should be in balance with financial and non-financial measures. The management should not only rely on financial measures. Second, the so-called lagging indicators and leading indicators should be in balance. According to Malmi et al. (2002, 31) this is the key matter to be considered when it comes to building practical appliances of BSC. Third, the scorecard should include both long- and short term measures. Fourth, both external (financial and customer) and internal (internal processes and learning and growth) measures should be balanced. Fifth, a balanced scorecard should include both easily measured matters and more difficultly measured matters. (Malmi 2002, 31-32)

Malmi (2001, 211) has stated that scorecards are, basically, used in two different ways in companies. The first way that scorecards are used approaches management by objectives (MBO). Targets or objectives are set for BSC measures and managers are held accountable for these targets. On the other hand, some companies seem to have no targets for their measures. These companies are using BSC as an information system, instead as a steering device. In organizations, where BSC is used as a means to implement strategy not only as an information system, BSC provides a tool for upper and lower levels of management to agree on targets. Malmi interviewed representatives from 17 companies. The research results showed that more than half of the interviewed companies stated that BSC was serving both purposes. About one third of the companies saw BSC as a tool to implement strategy. And about one in ten of the companies thought the BSC was pure information system. When said to use BSC to implement strategy, it comes close to the presentation by Kaplan and Norton (1996b), i.e. BSC is used as a strategic management system. (Malmi 2001, 211)

### **3.2.2 Current state and critic**

Since Balanced Scorecard was introduced, many companies have chosen to balance their objectives and have measured both operational and financial targets. According to a *Performance on Management* –journal, in United States and in Great Britain 40 percent of large companies were using the Balanced Scorecard in year 2001, when at the same time situation was fairly different e.g. in France and Portugal, where only 3 percent of companies used Balanced Scorecard (Lönqvist 2002, 21). Toivanen (2001, 97) has studied the state of Balanced Scorecard in Finland. He found that 23 percent of Finnish companies were using BSC. Also 15 percent were mobilizing it. This research also showed that BSC was more popular in large companies than in small ones.

The appliance of BSC in Finland has also been studied by Malmi (2001). In his research, one of the focus areas was the existence of cause-and-effect reasoning. This means, whether the measures used are derived from the corporate strategy. Most of the interviewees from 17 companies stated that they have derived their measures, according to the cause-and-effect reasoning, from the strategy. Still, when asked to give examples of such cause-and-effect chains,

the claimed link between strategy and measures appeared weak in most companies. Accordingly, the cause-and-effect relationship of BSC, i.e. one of the key ideas of Kaplan and Norton (1996a), has caused some confusion in discussion. (Malmi 2001, 210)

Nørreklit (2003, 591-592) has questioned the existence of cause-and-effect relationship in the Balanced Scorecard. He has concluded that the text of Balanced Scorecard is not as convincing as it is persuasive - a feature characteristic of the management guru texts. For instance, it is not universally applicable that increased customer loyalty is the cause of long-term financial performance. It can be claimed that customers who are not loyal are expensive, but it does not follow that loyal customers are inexpensive. Nørreklit (2000) also questions the Balanced Scorecard's ability to work as a strategic management tool. It is not easy task to implement BSC into a dynamic environment. In that case the difference between existent and designed strategy should be acknowledged.

Atkinson (1997, 26), on the other hand, has criticized the Balanced Scorecard for concentrating on the "top-down" approach and measuring performance as a one-way process. In this approach, Atkinson says, management fails to assess the stakeholders' contribution to the goals of the company or neither are the stakeholders able to assess the performance of the company. Also Mintzberg has criticized the Balanced Scorecard for creation of too management-concentrated strategies. He states that the role of management is overemphasized in Kaplan and Norton's way of thinking. For this reason, the Balanced Scorecard is based mainly on the ideas and knowledge of the management and the strategic learning is restricted to the learning of the management. (Toivanen 2001, 60)

### **3.3 Non-financial measurement**

The operational measures introduced in the previous chapter can also be called as non-financial measures. Non-financial measures are expected to measure operational processes and to provide up-to-date information. Hence, non-financial measures can include production process measures, such as cycle time and defect rates; customer service measures, such as on-time delivery statistics or qualitative measures, like measures of customer satisfaction, employee morale and

product innovation (Otley 1999, 368) Non-financial measures have an emphasized role in many new accounting innovations. For example, in Kaplan and Norton's Balanced Scorecard, typically, 80 percent of all the measures are non-financial. As such, the Scorecard is said to be in balance in regards to financial meters. (Malmi et al. 2002, 32)

There are several reasons, why non-financial measures have been experienced important. First, one of the biggest weaknesses of financial measures is that they don't activate enough on operational level (Fisher 1992, 33). Non-financial measures, on the other hand, can reveal operational, functional and technical insights (Vaivio 1999, 2004), which can lead to organizational learning (Pohjanpalo 2005, 15).

Second, when several factors influence the financial measures, the cause-and-effect –relation may not be seen. For instance, when the operations managers have felt they can't influence meters, it has caused frustration and indifference. (Fisher 1992, 33) Financial measures are often summarized aggregates. Therefore, both financial and non-financial measures must be part of the information system at all levels of the company. Thus, employees can understand the drivers behind long-term financial success. (Kaplan & Norton 1996a, 8)

Third, the problem of maximizing only financial measures can lead to the weakening of the whole result of the company. As Ittner et al. (2003, 725) have described it, concentrating only on financial measures can encourage managers to sacrifice long-term performance, while maximizing short-term financial results and thereby maximizing their bonuses.

However, also non-financial measurement can sustain dysfunctional behavior in the company and there can be problems with non-financial measures. According to Fisher many non-financial systems are still in their infancy. For this reason, an understanding of the strengths, weaknesses, and tradeoffs with non-financial measures requires development of an overall framework that explains these interrelationships. (Fisher 1992, 38) A weakness for non-financial measures is their poor comparability. The measures and their values are local. It can be hard or impossible to summarize these values to have a total value. (Toivanen 2001, 127)

### 3.4 Challenges in performance measurement

In literature, several challenges with performance measurement can be found. According to Partanen (2007), well-functioning and correctly built indicators may be used defectively and deficient indicators with insight. Spitzer (2007, 21) can be quoted, when it comes to the potentials of performance measurement: “Everything that is powerful for good, if misused, can be powerful for bad”. The following challenges represent possible practical problems or challenges encountered when used performance measurement as a management tool in a company.

#### Characteristics of good performance measures

The significance and effects of a performance measurement system will depend on the measures selected, and how they are used. Choosing performance measures is one of the critical steps in building a scorecard. The measures chosen should guide the actions to the wanted direction. The measures also tell what the management recognizes as important, and what is not measured, will be seen as less important. “What you measure is what you get” is an old adage. (Partanen 2007, 278) Hannula (1999, 79) has divided the criteria for good performance measures into validity, reliability, relevance and practicality:

- The **validity** of a measure describes its ability to measure the critical success factor it is supposed to measure. (Lönnqvist 2002, 58)
- The **reliability** describes the trustworthiness of a measure. The measurement is not useful if the results are random, biased and logically suspicious. (Partanen 2007, 279) If the reliability of a measure is weak, then the validity of measure won’t realize either. (Lönnqvist 2002, 59)
- The **relevance** of a measure depicts if the measure is relevant for the user and for the needs it is used (Hannula 1999, 78). For instance, it is not relevant to have a measure that measures a success factor that is insignificant when it comes to realizing the strategy (Lönnqvist 2002, 59).
- The **practicality** signifies the benefit-cost relationship of a measure. Thus, if the gathering of data and the calculation of a measure takes more effort, than what is the benefit of the measure and so produces relatively big costs, a measure is not practical.

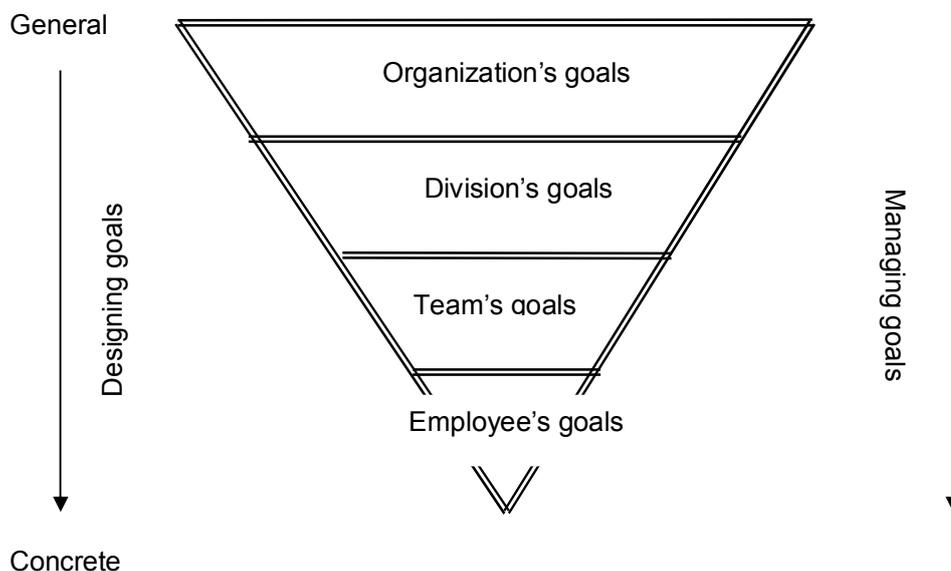
Also if a measure is difficult to use or the result is difficultly interpreted, the practicality of a measure can be questioned. (Lönqvist 2002, 60)

### Cascading corporate-level measures

Another challenge in performance measurement is how the corporate-level measurement system is cascaded down through the organization. Epstein (2008) has presented that the corporate-level measures should be used for brainstorming to find complementary sets of measures down through the hierarchy. Managers are responsible for the cascading of the measures. All business units, functional groups, facilities, teams and even individuals can, thus, obtain guidance from the measures, which are set at the upper level, and which are coherent with corporate strategy. A prime goal here is to create “performance logic” among all measures.

According to Epstein, from the bottom of organization up managers must ask how each variable measured contribute to a higher-level variable, and in turn, contribute to organizational results. The critical matter here is that all the measures at corporate, functional and team levels connect to each other in the measurement system. (Epstein 2008, 126) The measures used need to serve the people who actually execute strategy, no matter what level of the organization they work, not just the top management level. Thus, setting the corporate-level measures is just the starting point. Business unit managers should be challenged by top managers to create measures of their own aligned with top-level measures. These measures are then used to motivate employees to work according to the strategy developed for the whole company. Employee groups should customize their own measures. As a consequence the measures would “come from the global strategy and serve local needs”. (Epstein 2008, 127)

How corporate-level strategy and vision i.e. organizational goals are cascaded down through the organization, can be described with the following figure (Figure 3). The strategy and vision of a company can be abstract in a way that they don't open up for a regular employee. This makes it important to split up the objectives into concrete and simple goals. (Ukko et al. 2007, 24)



*Figure 3. Cascading organizational goals down through the organization (Ukko et al. 2007, 24: adapted Niermeyer & Seyffert 2004).*

#### Activating people through performance measurement

Catasús et al. (2007) have argued that the existence of performance measures alone won't guarantee that people will be activated. According to the researchers, the measures used in the organization most probably enhance the matters that are already important. They criticize the often used adage: "what gets measured gets managed". Also Emiliani (2000) has presented that there is a risk that "the measure gets managed effectively". This means that the number gets managed but not the underlying activity or situation.

In accordance, Partanen (2007, 252) has emphasized, that the performance measures chosen should motivate for action. He has stated that only the actions ultimately realize the significance of a measurement system. Nevertheless, when it comes to measuring and activating sustainability, Otley (2003, 319) has suggested the following: "What gets measured generally gets done. And what is not measured may suffer in comparison".

## 4 WORK MOTIVATION AND REWARDING

Work motivation was mentioned as one of the goals of performance measurement (Lönqvist 2002, 87). Likewise, it is often recognized as one of the biggest goals of rewarding. However, the debate of the impacts of rewarding on work motivation is plentiful and several motivational theories of rewarding exist. Based on the literature, it seems that it cannot be directly assumed performance related financial rewarding to increase motivation (e.g. Vartiainen 1998; 2002). This chapter introduces the concepts around work motivation and rewarding commonly used. Motivational theories of rewarding are also presented in this chapter. At the end of this chapter, the linkages between performance measurement, rewarding and work motivation are discussed to provide a framework for studying the motivational impacts of measuring and rewarding energy efficiency. When aiming to enhance energy efficiency with performance measurement and rewarding, the goal should be in motivating employees, if their contribution is desired.

### 4.1 Work motivation

Personnel is said to be the most important resource in many companies. For this reason the forces behind work motivation are worth studying. “Motivation is a central concept in working life, when tried to understand how people interpret their environment and how they get engaged to working and what steers their actions” (Vartiainen & Nurmela 2002, 188). Work motivation usually signifies what *energizes*, *directs* and *maintains* the work actions of an individual (Steers et al. 1996, 8).

At the moment, no one generally accepted motivation theory exists that would unambiguously explain the behaviour of a person. The behaviour of an individual is not only about motivation, but it is also about will and ability to use knowhow according to the strategy and vision of the organization. (Vartiainen & Nurmela, 2002, 190) Work motivation related issues have been studied for centuries. Porter and Miles (1974, 546-547) have divided important variables affecting work motivation in three groups: (1) *individual characteristics* i.e. interests, attitudes and needs, (2) *job characteristics* i.e. types of rewards, amount of feedback, degree of autonomy

and degree of variety in tasks, and (3) *work situation characteristics* i.e. work environment – particularly the attitudes of supervisors and peers – and the organizational climate and reward practices. Porter and Miles (1974, 546-547) did not intend to make these factor groups exhaustive, but to indicate some of the more important variables influencing work motivation.

In literature, motivation is generally divided into intrinsic and extrinsic motivation. (e.g. Sansone & Harackiewicz 2000) An employee is intrinsically motivated, if the content of work is experienced interesting and motivating. An extrinsic motivation steers the work, if it is done out of instrumental value of the work. Most of us are motivated out of both intrinsic and extrinsic reasons at the same time. (Vartiainen & Nurmela 2002, 190) Thus, intrinsic and extrinsic motivations can't be totally separated from each other, but both should be considered.

Shamir (1991, 408) has stated that intrinsic motivation definitions typically include one or two of the following assertions: 1) intrinsic motivation stems from the expected pleasure of the activity itself rather than from its results; 2) intrinsic motivation is based on self-administered rewards rather than on rewards distributed by an external agent. The more interesting the employee experiences the work, the higher is his or her intrinsic motivation to succeed in the work. (Vartiainen 1998, 19)

Intrinsic motivation can be influenced through different interaction structures. Especially, the feedback from different players, for example from management, colleagues and customers is an important factor creating intrinsic motivation. Intrinsic motivation is about excitement, energy and, in depth, interest. (Vartiainen & Nurmela 2002, 196-197) Later, in chapter 3.3, the theory of intrinsic motivation (Deci and Ryan 1985) is presented. This theory is one of the motivational theories of rewarding and it is presented together with the other motivational theories of rewarding.

What comes to extrinsic motivation, it is created through something extrinsic to the activity or something extrinsic to the person (Sansone & Harackiewicz 2000, 445). Expectation of external rewards is the basis for extrinsic motivation. External reward can be financial, such as money or other financial benefits, or non-financial, like prestige or safety. (Viitala 2005, 153) The external

motivation can be caused by a carrot or a stick – wish of receiving a bonus or fear of being fired (Amabile 1998, 79). Herzberg's (1966) classic motivation-hygiene model has suggested that financial rewards can only have a limited effect on motivation. Sufficient financial rewards can take away dissatisfaction and ensure action, but are inadequate to motivate for innovating, developing operations and ensuring satisfaction. Therefore, both intrinsic and extrinsic motivational factors are needed. (Vartiainen et al. 1998, 19)

The researches have shown that work motivation has influence on work intensity, stability and task control as well as on performance quality. A motivated employee tries more and concentrates better on work, which will make him or her succeed better at work. (Liukkonen et al. 2002, 6) When the pursuit is to enhance energy efficiency, it, it is thus worth studying the forces behind employees' motivation towards energy efficiency. Viitala (2005, 162) has listed following matters with vital influence on work motivation:

- clear, acknowledged goal, possible to achieve and measurable
- evaluation of goals based on accepted criteria, performed regularly
- open and candid feedback, concentrated on actions and results
- positive and guiding support based on trustful idea of human
- incentives based on actions and results
- independent, diverse and suitably demanding work
- appropriate amount of work in proportion to time and goals

From the listing of Viitala (2005, 162) has to be noted, that the first prerequisite for work motivation is a clear, acknowledged goal, that is possible to achieve and measurable. Thus, it can be concluded, that a sense of being able to influence is a first prerequisite for work motivation. If the employees don't feel being able to influence measuring and rewarding energy efficiency, it may be needless to expect them to feel motivated either. This will lead to losing the energy and creativity of motivated personnel. The listing by Viitala (2005, 162) provides a useful checklist, when considering the issues influencing work motivation.

## 4.2 Rewarding

Reward systems have traditionally been used to attract suitable employees, make them stay and motivate them to do their best at work (Hakonen et al. 2005, 19). Rewarding has focused on motivating and increasing the performance of individuals and groups. This has generally been done by creating congruence between the goals and activities of employees and the organization. (Bonner and Sprinkle 2002) Rewarding can be viewed from several different perspectives dependant on the focus of interest. Moisiso et al (2006) have mentioned as possible perspectives: individual, group, organization, labour market organizations or national economy. In this study, the individual, group and organization level issues are in the main focus. These levels include influencing on motivation and using rewarding as a management tool.

Recently, more and more have been discussed of strategic rewarding, which was already wrote in the 90s by Lawler (1990) and Gomez-Mejia & Balkin (1992) (Hakonen 2006, 9). Strategic rewarding aims to link reward programs to the business needs of the organization (Henry 2007) and to help the company to drive performance (Henry 2006). It is said to help the organization to differentiate from competitors and strengthen the focus on strategically important areas, such as customer, competence and quality expectations (Henry 2006). Strategic rewarding refers to developing actively the totality of rewarding and the functionality of the systems (Henry 2007).

Hakonen et al. (2005, 45) have proposed as the characteristics of strategic rewarding the following:

- Rewarding supports business strategy
- Rewarding is part of the management systems
- The organization has rewarding strategy or policy derived from business strategy
- The rewarding and rewarding processes are examined carefully and necessary roles responsibilities and tasks are assigned
- The management secures that rewarding is taken care of and there are needed resources and capabilities

- The functionality of the rewarding system is evaluated and improved. The functionality consists of the impacts of the system as well as of the experiences of managers and personnel about the system.

As a prerequisite for strategic rewarding is performance management. In order to reach personal and group-level goals, a measurement system that is based on business strategies and critical success factors is needed. The indicators used to measure financial as well as strategic business performance of company are key elements in the reward framework. (Henry 2007)

In practice, strategic rewarding is said to view rewarding as a totality. Total rewarding is believed to ensure optimal benefits from rewarding. (Henry 2007) The following figure presents the model of total rewarding (Figure 4). In total rewarding, different forms of rewards have different connections with work motivation of personnel. These connections should be acknowledged in order to have a well-designed totality. Total rewarding considers both tangible and intangible rewards. The model includes also rewards with different time dimension to support different goals. (Luoma et al. 2004, 37)

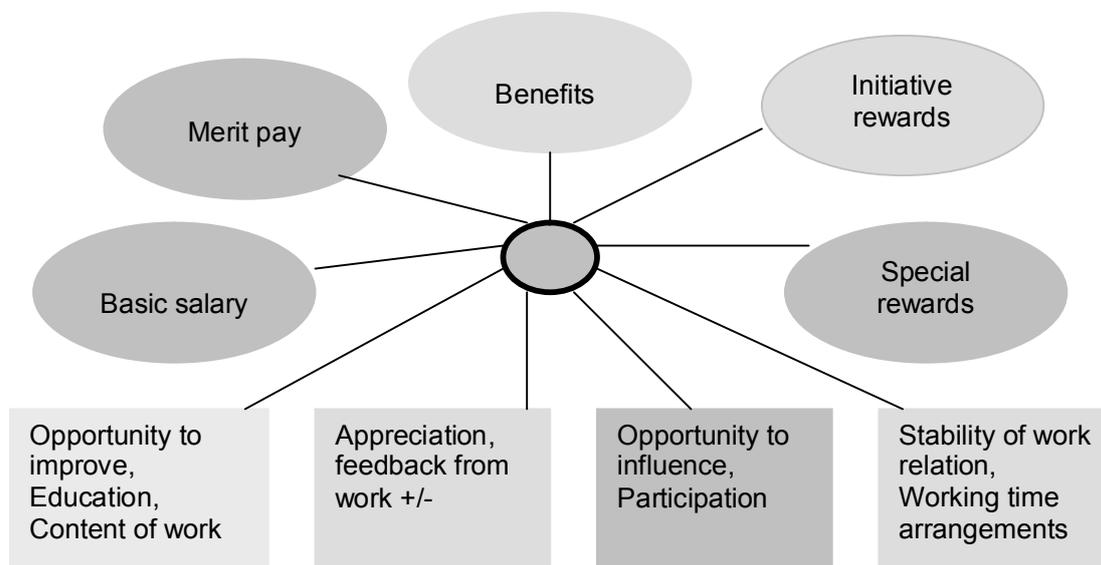
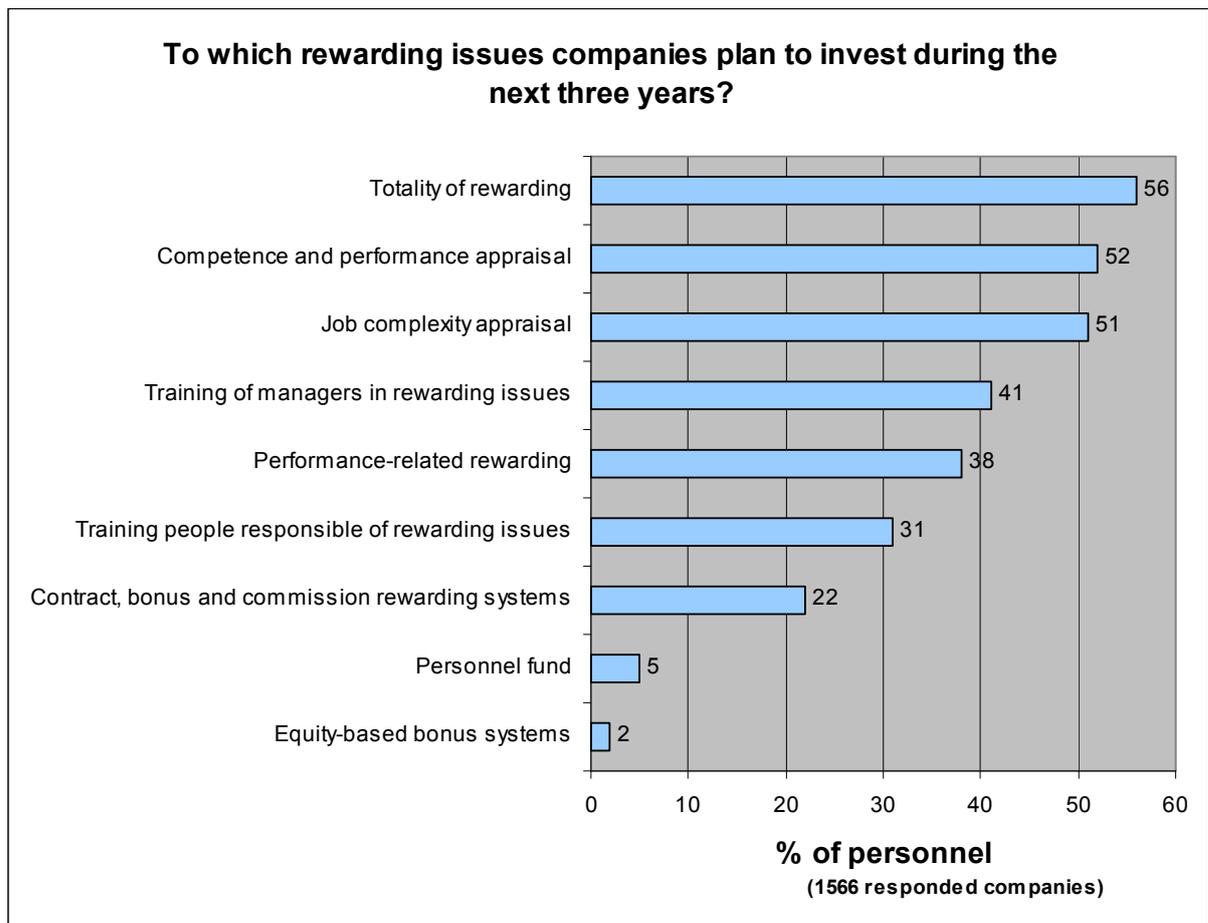


Figure 4. The model of total rewarding (Hakonen et al. 2005, 20)

As already suggested, rewarding systems can range from tangible to intangible. Tangible rewards are money or other rewards with monetary value. The conversation in the field of rewarding has traditionally concentrated on tangible rewards (Luoma 2004, 38-39). The tangible rewarding has been noted to have more effect on directing and maintaining work, than creating enthusiasm or in-depth interest. Intangible rewarding has been suggested as a respond for this shortage. Intangible rewards can be in forms of feedback, encouragement and compliments (Luoma 2004, 43). Vartiainen and Nurmela (2002, 197) have stated that they are something one can't see. They can be written in the manuals of the company or exist as a part of the organization culture (Vartiainen & Nurmela 2002, 197). Ukko et al. (2007, 44) have emphasized that both tangible and intangible rewards are in great deal about communication. In other words, rewarding sends a message telling what kind of performance is valued in the company. To conclude, it seems important to consider what message rewarding is sending, because in any case it will communicate about the values and goals of the company.

The Confederation of Finnish Industries, EK has conducted a large pay system inquiry in its member companies in 2008. The study was executed for the second time and it is the biggest research in the field in Finland. The survey was answered by 1738 companies, which employ altogether 523 000 people. The response rate was as high as 72 percent. As a part of the research, the development trends in rewarding in Finnish companies were studied. In this research, the totality of rewarding was recognized as one of the main development trends in rewarding during the next three years. The following figure (Figure 5) describes the research results for future trends in rewarding. Based on the figure, it can be concluded that the ideas of strategic rewarding are increasing their importance also in Finnish companies. The totality of rewarding is seen as a matter worth investing. Equally, the competence and performance appraisals, training managers in rewarding issues, job complexity appraisals and performance-related pay systems were emphasized as the right direction in the companies. These emphases fit also well to the principles of strategic rewarding.



*Figure 5. Rewarding issues planned to invest in Finnish companies (EK 2008)*

Strategic rewarding derived from the business strategy should thus also be used to support, if a strategic goal is increasing energy efficiency. The totality of rewarding can contribute the goal by providing different forms of rewarding with diverse time dimensions, which can have different connections with the work motivation of personnel.

#### **4.2.1 The effects of rewarding on work motivation**

Rewarding and its relation to work motivation have raised a lot of discussion. (e.g. Kohn 1993; Deci & Koestner 1999). A widely held hypothesis is that monetary incentives lead to greater effort than in their absence (Bonner and Sprinkle 2002, 305). Bonner and Sprinkle (2002) present

that the increased effort can have an effect on performance in three ways: *effort direction* i.e. the tasks individuals focus on; *effort duration* i.e. how long individuals devote themselves to the task and *effort intensity* i.e. the amount of attention individuals devote to the task (Malmi and Brown 2008, 293). However, some theories imply that monetary incentives can lead to decreased effort and performance (see e.g. Deci and Koestner 1999; Deci and Ryan 1985)

Deci & Koestner (1999) have stated, that attaching extrinsic compensation on work that withholds intrinsic motivation, can decrease intrinsic motivation. Their studies have shown that extrinsic compensation can have a negative effect on quality of work, innovation and creativity. This was explained with decreasing feeling of personal self-regulation or diminishing will to work.

Alfie Kohn (1993) has also criticized the strong belief that there is a positive connection between work motivation and incentives. He says that a growing number of evidence supports the opposite. The article by Kohn, published in *Harvard Business Review*, has been noted as provocative and highly controversial (Steers et al. 1996, 501). According to Kohn, most often the problem is not the incentive program, but the psychological assumptions behind it. His research implies that the rewards succeed at only one thing – securing temporary compliance. But if one would want to produce a lasting change in attitudes and behavior, then rewards, like punishment, are in great extend ineffective. According to Kohn, these extrinsic rewards do not alter the attitudes that underlie our behavior. Thus, they don't create a commitment to any action or value.

Kohn's ideas have received considerable response both from the world of academia and from the world of practice. The responses have raised following issues: 1) rewards can serve as form of recognition, not simply as financial incentives, 2) "effectively designed" incentive systems can work, if they are structured explicitly to encourage teamwork or to encourage creativity and innovation, 3) organizations cannot work solely on intrinsic rewards and 4) if all (extrinsic) reward systems are to be abandoned, what is the realistic alternative? (Steers et al. 1996, 501)

It seems that the debate on the effects of rewarding on work motivation, effort and performance will not end soon, but continues. The different perspectives can be used in companies to provoke

discussion on the effects of rewarding. The rewarding may send a message both explicitly and implicitly, what kind of behavior is wanted, required or expected in the company. To support the business strategy of the company, it is important to be aware of the message the rewarding is currently sending. Most often motivation is one of the goals of rewarding. Some famous theories on the effects of rewarding on motivation exist. These theories presented next are used later in the empirical part, when analyzing the motivational effects of measuring and rewarding energy efficiency.

### 4.3 Motivational theories of rewarding

The following theories help to understand how individuals behave as a consequence of rewarding and why they behave as they do. These theories help to explain why rewarding is important for some individuals and less important for others and how rewarding affects behaviour. (Hakonen 2006, 19)

#### *Expectancy theory*

Expectancy theory (Vroom 1964) is about individuals making choices between possible behaviours. The behaviour of an individual is affected by, how likely he or she regards the expected result. Another affecting matter is what the person expects will happen, if the goal is reached. In addition, the person takes into account how attractive the result is. (Hakonen 2006, 19-20) The concretisation according to theory is presented in the following figure (Figure 6):

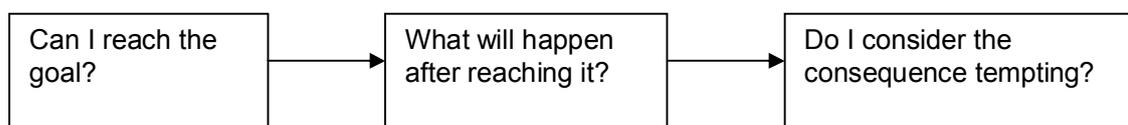


Figure 6. Choosing behaviour according to expectancy theory (Hakonen 2006, 20)

When linking expectancy theory with rewarding, an individual considers, whether the rewarding is in relation to the behaviour and to what extent the rewarding is a way to achieve desirable things (Hakonen 2006, 28).

### *Theory of intrinsic motivation*

Deci and Ryan (1985) have created the theory of intrinsic motivation to replace the idea that individuals are motivated along with external rewards. According to their theory, intrinsic motivation is based on the basic human needs of competence and autonomy. If something influences on these two factors, it will have also an influence on intrinsic motivation. If the matter increases competence or autonomy, it will increase also internal motivation and the other way round. If tasks are controlled by some external factor, they are experienced as being outside of one's own influence and the intrinsic motivation will decrease. (Vartiainen & Nurmela 2002, 196)

According to the theory by Deci & Ryan (1985), rewarding can be experienced as informal, controlling or amotivational. If rewarding informs to a person of his competence, rewarding is experienced motivating. On the other hand, if rewarding is experienced controlling of an outsider, intrinsic motivation will decrease. Furthermore, if the rewarding includes negative feedback, the feeling of competence decreases and so will intrinsic motivation. Especially performance-based monetary rewarding is expected to decrease intrinsic motivation and verbal rewarding increase it. (Hakonen 2006, 23)

### *Goal-setting theory*

In the goal setting theory (Locke & Latham 1990), the actions of individuals are directed by conscious goals and intentions. According to this theory, a person is motivated best, when the goals are specific, challenging and accepted by employees (Heneman & Werner 2005, 32). In addition, regular feedback should be received of work. (Hakonen 2006, 22) According to the theory, incentives can increase work motivation. When incentives increase work motivation, they can lead to setting more goals, setting more difficult goals and greater commitment to work (Heneman & Werner 2005, 33). Thus, performance related rewarding can encourage setting more demanding goals (Hakonen 2006, 22).

### *Equity theory*

This theory by Adams (1965) is one of the organizational equity theories. Individuals evaluate their input and output –equation in relation to a reference person or a group. (Hakonen 2006, 24)

This theory is in close connection with rewarding. It suggests that motivation doesn't only depend on the pay and performance -relationship that the employee experiences, but it also depends on the pay and performance -relationship that the other employees experience with whom the person compares him or herself. Thus, equity theory looks at the role that social comparison play in motivation. (Heneman & Werner 2005, 29) If an employee experiences that he or she is receiving less compensation than others, it will cause dissatisfaction. The equity is reached either working harder to earn a pay increase or reducing the inputs on work. (Heneman & Werner 2005, 30)

#### *Reinforcement theory*

According to the reinforcement theory, desired action in an organization should be reinforced with rewards. Also, it is likely that the frequency of a behavior will increase, when a valued reward is made contingent to the behavior. To strengthen the contingency between the behavior and reward, the following should be acknowledged: firstly, the desired behavior should be defined clearly, secondly, the reward should be close in time with the behavior and thirdly, the reward should be close in magnitude with the behavior. (Heneman & Werner 2005, 27)

However, the appliance of this model on work, where there are several possible ways to complete the task, is questionable. Usually, it is not known what kind of action will lead to the wanted result. For this reason, reinforcement of the desired action is not possible. Thus, reinforcement theory can be used to justify rewarding only, when the wanted course of action is known. These theories fit well with routine work, but badly for developing new procedures or new ways of work. (Vartiainen & Nurmela 2002, 191-192)

#### **4.4 Framework of work motivation, rewarding and performance measurement**

In this section, the possible linkages between work motivation, performance measurement and rewarding are presented and discussed. At first, the linkages between performance measurement and rewarding are discussed. Finally, all the three items are discussed together and presented in a framework before gradually moving on to the empirical part of this thesis.

### *Performance measurement and rewarding*

Kaplan and Norton (1996a, 217) point out that the question is not whether, but how reward system should be connected with performance measurement system. For example, it is widely acknowledged that the “real power” of the BSC concept can only be reached, if the BSC measures are linked to the reward system (Kaplan and Norton 1996a, 217; Otley 1999, 367).

A concern faced by all companies with reward systems is how to evaluate or appraise performance (Steers et al. 1996, 500). Generally, if rewards are expected to have a positive impact on an individual’s motivation to participate and perform, it is crucial how the quality and quantity of performance are evaluated. Similarly, if the evaluation systems are unreliable or lack validity, it is unlikely that the rewards based on the evaluation can have much effect on performance either. (Steers et al. 1996, 500)

Kaplan and Norton (1996b, 81) have urged to ask the following questions, when linking rewarding with BSC: Does the company have the right measures on the scorecard for which to base the rewarding? Does the company have reliable and valid data for the selected measures? Is it possible that unintended or unexpected consequences could arise from the way the targets for the measures are achieved?

Hence, the way in which the performance measurement is organized in a company, can be expected to have an influence on the success of the reward system. Both performance measurement and rewarding are most likely to fail, if they are in direct conflict with organizational goals. According to Spitzer (2007, 13), regardless of how important and powerful rewards are, they are no better than the measurement system they are based on.

### *Work motivation, rewarding and performance measurement*

Several researches state that one of the most important functions of performance measurement is to motivate employees (e.g. Lönnqvist 2002; Ukko et al. 2005). A research by Ukko et al. (2005, 74) remarked that performance measurement has a clear positive effect on work motivation. Behind motivation improvement was the possibility to affect one’s own goals, clarification of job

descriptions, better understanding of the corporate business entity in regards to one's own goals and the linkage between performance measurement and rewarding. (Ukko 2005, 74)

According to Lönnqvist (2003, 114-115) the motivational effects of performance measurement can be enhanced by linking rewarding to measures. He reminds that it may not be an easy task to do in practice: If the rewarding is determined only on the grounds of a few measures, there may appear partial optimization. In that case, it is possible that employees strive for success in these few measures with the cost of some other success factors. Also, Kohn (1993) has stated that an organization that implements a reward system based on narrow, specific and easy-to-measure performance measures will motivate action, which aims at excelling in those measures. He continues, that as a result, the performance metrics often motivate performance, which is incomplete or in conflict with the company strategy.

Thus, consideration must be used, when choosing the measures to be linked with rewarding. And it has been said for managers: "Be aware, you may just get what you reward" (Hakonen et al. 2005, 56). Thereby, the important goals not included in the measures of the rewarding system may stay unattained (Hakonen et al. 2005, 56)

Rewarding can have either a positive or a negative effect on work motivation (e.g. Sansone and Harakiewicz 2000). Despite the existent criticism towards reward systems, it should not lead to the total abandonment of rewarding. Instead, it should be further discussed and studied how performance measurement and rewarding could be organized not to influence negatively on work motivation, but to make the most of them.

The following figure (Figure 7) aims to describe the interdependencies between performance measurement, rewarding and work motivation. To begin with, rewarding should be linked with the most important performance measures. If these two elements are not connected, the direction of the company is not clear. With rewarding, the management can further emphasize the importance of chosen performance measures. But if the performance measures are badly chosen, rewarding has little chance in leading the company in right direction or motivating employees. The other two dimensions in the figure are the effects of rewarding and performance

measurement on work motivation. Most often employees are set accountable for different performance measures. But if they don't have any control over these measures, it will be experienced demotivating. In other words, employees should have realistic possibilities to affect performance measurement and also rewarding in order to feel motivated. The effects of rewarding on work motivation are not always easy to predict. It can have a positive, negative or neutral effect on motivation. When imposing rewarding, an effort should be made not to hinder employee's work motivation. For example, if an employee has performed extremely well, but is rewarded with a disproportionately small award, it is probable that it will decrease his intrinsic motivation in the future.

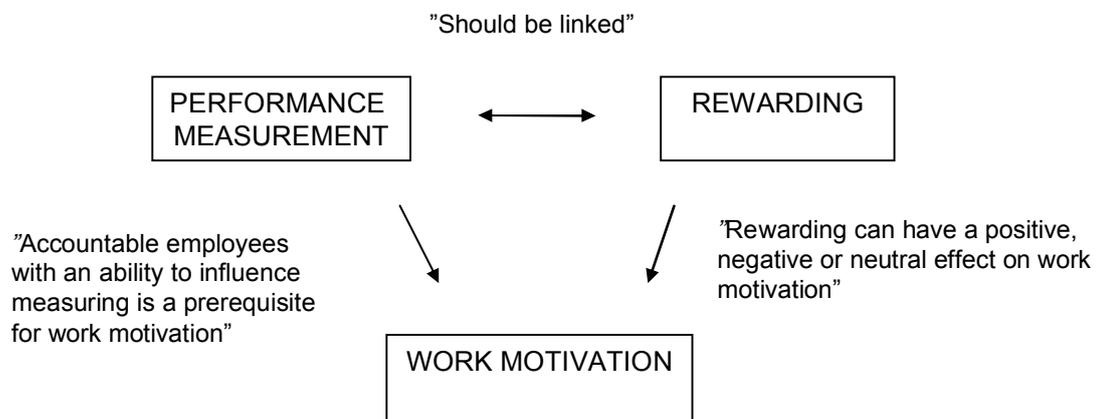


Figure 7. Interconnections between performance measurement, rewarding and work motivation

## **5 RESEARCH METHOD**

This chapter begins by explaining the choice of the research method. Then it moves on describing the realization of the empirical study and, last, the case company is introduced.

### **5.1 Choice of research method**

The research method chosen for the purpose of this study was case study method. More specifically, theme interviews i.e. semi-structured interviews were considered as the most suitable method for conducting the study. In this study, the main interest was in the views of the personnel on energy efficiency management related issues, which supported the choice of qualitative research and especially interviews. In the interviews, an interviewee is given an opportunity to express issues as freely as possible, which will enable an active and meanings creative role (Hirsjärvi & Hurme 2008). Theme interviews concentrate on certain topics, which are discussed. It is closer to unstructured than structured interview, since the questions and the form of the questions are not equal to all, although the themes are (Hirsjärvi & Hurme 2008). As the case study research does rely on rich empirical material (Vaivio 2008, 65), also written material and internal documents of the case company were utilized as a research data.

Many noted researchers have argued that progress in management accounting research is hindered because of the lack of understanding how management systems actually work (Keating 1995, 66). Case study developed in 1980s has been seen as an answer for this problem, because it offers a possibility to understand the nature of management accounting in practise (Scapens 1990, 264). Ghauri et al (2005, 114) have stated, case study being particularly useful, when concepts and variables are difficult to quantify, and when the phenomenon under study is hard to investigate outside its natural settings. When studying the motivational effects of energy efficiency management, the personal experiences of the personnel were valued highly. Also, as the related variables are difficult quantify, served case study best the purpose of this study. A more extensive survey would have allowed a quantitative analysis and generalizing of the results.

On the other hand, the personal experiences of the personnel, and related causes and effects might not have revealed as profoundly as they did in this research.

This study can also be methodologically described as normative by nature. The goal was to provide recommendations for the case company in order to improve its performance measurement and rewarding of energy efficiency. These recommendations would be given with the intention to enhance work motivation towards energy efficiency in the company. Malmi et al. (2005) have stressed the role of normative theories and constructive studies in developing management accounting research. They argue that the development and testing of normative theories is likely to produce research that has relevance also in practice.

Despite the many advantages, case study method has been criticized in the academic literature. Traditional criticism against case study research stems from a perceived lack of generalization (Scapens, 1990). Mainly, the scientific status of case studies has been regarded low, as it has been argued, that the findings apply only for the particular case and cannot be generalized to a larger population. (Lukka & Kasanen, 1995) Nevertheless, also the mainstream accounting researchers of today seem to accept case study method (Lukka & Kasanen, 1995). Many case researchers still emphasize that one should be careful with regards to the generalization of their results (Scapens 1990). The results of this study cannot be generalized to other companies, but the findings can be used as a support, when trying to understand the motivational effects of measuring and rewarding energy efficiency in other companies or when developing new measures of energy efficiency.

## **5.2 Execution of the study**

This study was started with a relatively large literature review on measuring energy efficiency, performance measurement, rewarding and motivation to understand the forces behind energy efficiency management. The case company, Borealis Polymers Oy was chosen for the purpose of this study, as it operates in energy-intensive process industry, which is considered to retain high potentials in energy efficiency. Preliminary discussion took place with the Energy Specialist and the Controller of the case company to understand what kind of topics might come up in the

interviews. Based on the literature review and the discussions, interview forms for the interviewees were composed. The interviews were conducted in two stages. First, members of top and middle management were interviewed in individual interviews. Then, samples of technical officials and operators at the Hydrocarbon operations were interviewed in group interviews. The aim was to have a comprehensive view from different levels of the company on current energy efficiency management related issues. The interviews were recorded in order to write down the material and analyze it thoroughly. This enabled also using direct citations from the interviewees, when presenting the results.

All the interviews were carried out during four months in the turn of the year 2008-2009. The exact dates of the interviews are included (Appendices 2 & 4). The first stage of the interviews included 8 interviews and several more informal discussions. In the interviews it was discussed about the role of energy efficiency as well as measuring and rewarding of energy efficiency in the company. Moreover, the motivational effects of measuring and rewarding energy efficiency were discussed. Later, the interviews were supplemented with several informal conversations with pivotal persons in the case company. In the first stage, the interviews differed slightly depending on the interviewee's task. The basic idea of the interview forms is seen in the attached sample form (Appendix 1). All the various interview forms are not attached. Also, an anonymous list of the participants in the first stage is attached (Appendix 2).

The second stage consisted of 4 group interviews, including altogether 14 persons. Their professions varied from operator to production manager at the Hydrocarbon operations. The exact questions and an anonymous list of the participants are attached (Appendices 3 & 4). In second stage of the interviews, the questions stressed more in what extent the employees can influence the consumption of energy or the results of the energy efficiency indicator. Also, the impact of measuring and rewarding energy efficiency on work motivation was discussed.

The interview material was transcribed and then read several times to uncover the voices of different interviewees. From the transcribed material, the essential parts were underlined and then listed into categories according to the research questions and different personnel groups. The aim was to go through carefully the material from different interviews to uncover the voices

of different employee groups towards energy efficiency management. Inside employee groups could also be found different voices, especially among managers. These similarities and differences in voices were considered as interesting research results.

When evaluating a research, the reliability, the validity and the possibility of the results are usually considered (Tuomi & Sarajärvi 2006). Reliability refers to the repeatability of the results and validity to the fact that in the research has been studied what has promised. In qualitative research, the aim is not in statistical generalization, but in describing some phenomenon or incident or to understand some action (Tuomi & Sarajärvi 2006). In this study, the aim was to protect the reliability and the rights of the interviewees. To increase the reliability, the interviews were recorded and direct citations were used. Also, the titles of the interviewees were replaced with code names to hide the identity of the interviewees.

### **5.3 Borealis Polymers Oy**

The production plants of Borealis Polymers Oy are located in Kilpilahti, Porvoo. It is the northernmost location of the Borealis group's production facilities. The plant in Kilpilahti was first opened already in 1971. The industry has been under several acquisitions since then. Borealis group was formed in 1994 by a merger between the petrochemical divisions of two Scandinavian oil companies, Neste Oy of Finland and Statoil of Norway (Merchant & Van der Stede 2007, 367).

Borealis Group is one of the biggest manufacturers of polyolefinplastics in Europe and among the ten biggest in the world. It provides plastic solutions for customers in infrastructure, automotive and advanced packaging markets. It is headquartered in Wien, Austria. Besides Finland, Borealis has got big production plants in Europe and the Middle-East. All in all, the company functions in three continents and employs 5500 people. (Borealis, 2009b) The Borealis Group is owned by IPIC (the International Petroleum Investment Company) with a share of 64 percents. The rest of the company is owned by OMV, which is a leading oil and gas company of Central Europe. (Borealis 2008)

In Kilpilahti the two main products are polyethylene (PE) and polypropylene (PP), which are together called as polyolefins. These products are produced, through olefin units, out of basic feedstocks from the oil and gas industries. Polyethylene and polypropylene plastics are used by customers to produce pipes, pipes, extrusion coating for steel pipes and packaging, as well as wire and cable sheathings. About 70 % of the production in Finland is exported. In addition to serving the Nordic countries, Borealis Polymers Oy serves the Russian and Eastern European industrial markets. Positioned strongly in Europe, the company aims to grow in Middle East and Asia (Borealis 2007). Borealis Polymers Oy employs approximately 900 people. About one fifth of them are working in research and development. (Borealis, 2009a). Year 2007 the net sales of Borealis Polymers Oy was approximately 1,1 billion euros. (Borealis 2007)

## **6 EMPIRICAL RESULTS AND DISCUSSION**

### **6.1 Measuring and managing energy efficiency in the case company**

#### **6.1.1 Importance of energy efficiency**

Borealis Polymers Oy operates in the highly energy-intensive process industry, where energy costs comprise a substantial amount of total production costs. Typically feedstock and energy costs are 70-80 % from the total production costs of petrochemicals industry. That is also the case at Borealis. The Manager B describes the importance of energy efficiency as follows:

*“Energy has nowadays a very visible role in the company. We have actively been taking part in the energy programs by Finnish government since 2003.”  
(Manager B, Hydrocarbon/12.11.2008)*

The Manager A identifies the growing energy prices as a reason why energy related issues have increased their importance. The effects can also be seen in the performance measurement of the company.

*“Because the meaning of it [energy] has increased financially, it has risen as a big topic in the agenda of management. This can be viewed also in that new measures are developed and more closely followed.”(Manager A, Polyolefins/10.11.2008)*

Borealis Polymers has signed the Energy Efficiency Agreement placed by the Ministry of Employment and the Economy of Finland for the term 2008-2016. This voluntary agreement obligates energy intensive companies to develop their energy efficiency with continuous improvement. (EK 2009) In the fall 2007, Borealis developed its own energy efficiency strategy to continuously reduce the environmental impacts of its operations. Following the new EE strategy, Borealis Polymers introduced an Energy Management System (EMS), which was

linked to the existing ISO 14001 Environmental System in March 2009. The EMS is expected to spread the energy efficiency –thinking to cover all the organisation levels.

At Borealis Polymers, it has been considered important to be involved in the current national energy efficient scheme. For instance, the company executed an extensive pinch-analysis at the Olefin unit to evaluate potential energy saving targets. The undertaking was financed by the government with a share of 40 percent. Also, many investments have been partly financed with the energy subsidy of the government. The possibility to have financial support has increased the motivation to advocate energy efficiency projects, besides that enhancing energy efficiency is considered as a strategic choice:

*“This [enhancing energy efficiency] is a strategic choice. It is part of our competitiveness” (Manager B, Hydrocarbon/12.11.2008)*

According to the interviews in the company, the importance of energy efficiency was not always as clear. When interviewed the management, various views of the state of energy efficiency in the company emerged. One repeated view was that the state of energy efficiency must be pretty good, since there is one person, the Energy Specialist, in the location working full-time with energy efficiency.

*“If there has been possibility to appoint one person for this, then it [the status of energy efficiency in the company] must be good. And of course, we have attained results, good results. Energy-supports for different projects. It has been this kind of pioneering work.” (Manager C/12.11.2008)*

A contradictory view among some managers was that energy efficiency doesn't have as important role in the company as it should have. According to the Manager F of Polyolefins, energy efficiency has not been highlighted as much as it could have been, although they have been able to improve their results slightly every year accordingly with the goals. He mainly concentrated on the state of energy efficiency in his plant of Polyolefins.

*“...It [the state of energy efficiency in the company] has now been bothering me somewhat, of course. It has not been raised as high on the wallpaper as it should have been raised.” (Manager F, Polyolefins/24.11.2008)*

According to the Manager F, the Energy Specialist works well towards the Group and applies well support. Challenges however exist in the visibility at the plant. More visible shop floor messaging of energy efficiency is needed. The Manager F added that the situation may be different at the Hydrocarbon operations. (Manager F, Polyolefins/24.11.2008) Those plants are the most energy-intensive plants in Porvoo and most of the energy efficiency work has been done there, like the pinch-analysis mentioned before. Still, parallel views were found also from the Hydrocarbon production.

*“If it [energy efficiency] is an important matter, it has not been able to introduce to the company. Or maybe it has but I have just missed it...”  
(Technical official A, Hydrocarbon/29.10.2008)*

The Manager C (12.11.2008) recognized that energy efficiency doesn't yet have a visible role in everyday work. He emphasized that it is still a challenge how energy efficiency is connected with the work of everyone in the company.

*“Yes, there are the energy efficiency measures, like megawatt-hour per tonne. But there is still a problem with the cause and effect -relationships: How I can contribute and how it is operationalized in the doings of everybody?”  
(Manager C/12.11.2008)*

When comparing the roles of different performance measures in the company, the Manager F concluded that the Energy KPI doesn't have the same role as some other measures in the organization.

*“It [energy efficiency] is important. Yes, it is...Let’s say it is an important matter. But it still hasn’t been as important measure for us as it could have been. Let’s say like the feasibility of the plant, quality or safety and other key indicators, like accidents, thus in that level it has not been.” (Manager F, Polyolefins/24.11.2008)*

The Manager F also added that improving energy efficiency is extremely relevant issue at the moment:

*“I believe it is a matter, where we haven’t been as good as we could have been. I mean in this kind of improving of energy efficiency. It is a fact that energy is becoming more and more expensive and it is stupid to waste it. And probably we have a lot to improve if we really make the effort in it.”*

But it was clear that some players were not convinced about the importance of energy efficiency in the company.

*“In my opinion, it has not been brought forward enough. That is my clear message.” (Technical official A, Hydrocarbon/29.10.2008)*

### **6.1.2 Performance measurement and rewarding**

The Borealis group has scorecards for almost every organization, division or production plant. The goals of the company are operationalized as scorecards and as key performance indicators (KPI). *“The organization is in great deal directed with scorecards.” (Manager A, Polyolefins/10.11.2008)*. Thus, performance measurement has a central role in the management processes of Borealis Polymers Oy.

A new organization model called EMO (European Manufacturing Organization) was implemented within Borealis Group in spring 2008. With the new organization model, the aim has been to standardize scorecards between different production localities in Europe. Besides the

official scorecards by EMO, the local scorecards at Porvoo have a big role in the company. The local scorecards were rooted in the organization, when the production plants were still part of Neste Chemicals' organization. In this study, the local scorecards are in the main interest, since they are discussed regularly in meetings and are also connected with the bonus system of employees and technical officials.

At Borealis Polymers, the system consists of two types of local scorecards: one *shared scorecard* and six *unit scorecards*. Firstly, the shared scorecard is shared for every operation at Porvoo. Secondly, every plant or unit has its own unit scorecard. The local scorecards involve employees and technical officials from operations. Thus, employees are involved with both shared and unit scorecards. Technical officials are involved only with the shared scorecard, and in addition, they have some personal goals agreed. The top management of the company is not involved with the local scorecards. Instead, the managerial level from middle management to top management have their own *business incentive plans* (BIP) provided by Borealis Group.

At Borealis Polymers Oy, the performance is said to be "*measured in the spirit of Balanced Scorecard*" (Manager B, Hydrocarbon/12.11.2008; Manager C/12.11.2008).

*"We have this Balanced Scorecard kind of approach. There are hard and soft measures [followed] together. And the measures are followed on weekly and monthly basis, all the time, in every management group's meeting or unit meeting."* (Manager B, Hydrocarbon/12.11.2008)

The scorecard approach at Borealis Polymers Oy was first introduced at the end of 90s. However, it seems that the performance measurement system utilized in the case company can't be typified as BSC, like Kaplan and Norton (1996a) have suggested it. There are some features characteristics for BSC, like different perspectives of measurement and lot of non-financial measurement, but what seems to be missing is the cause and effect -relationships between measures i.e. the interconnectedness between different perspectives. The measures are grouped in different perspectives and the financial measures are expected to improve after enhancing the

non-financial measures. Still, the linkages between measures don't seem clear, which makes the performance measurement system at Borealis Polymers differ from BSC.

As already mentioned, several non-financial measures are included in the company's scorecards. The scorecards include typically six to eight measures. For instance, non-financial measures in unit scorecard can be related to customer, health, safety and environment (HSE), reliability of the plant, innovativeness, personnel and economy. The shared scorecard also includes non-financial measures from the fields of health, safety and environment (HSE), innovativeness and personnel. The business incentive plans (BIP) for managers usually include extensive measures like profit or fixed costs of the company. In addition, they include measures that are more closely connected with the work of the manager or with the work of the group he or she is a member. The intention is to structure the BIPs to fit for the manager's job description.

Altogether, the local scorecards have been considered as a useful tool to direct the work of the personnel and the local scorecards clearly have a central role in the organization.

*"This is what we have found good and have kept it up over the years." (Manager A, Polyolefins/29.10.2008)*

### Rewarding

At Borealis Polymers Oy there are several variable parts of rewarding, besides the base pay. Rewarding is seen as a strategic tool.

*"Strategy-related matters are defined as performance goals, which are then measured. Rewarding is linked with these measures." (Manager G/26.2.2009)*

The most important variable rewarding for the employees is the yearly bonus paid according to the local scorecards. The bonus is a weighted score of the two local scorecards, shared scorecard and unit scorecards. At the moment, the unit scorecards are weighted with 65 percent and shared scorecard is weighted with 35 percent of the bonus. A fixed maximum worth is agreed yearly for

the scorecards. Thus, the bonus can't be, even at its best, more than about a one month's salary. Employees can have also other personal goals but they are not included in the scorecards or in the bonus system. What it comes to the incentives linked with the managers' business incentive plans (BIP), they are paid according to a percentage share of the annual pay. These percentages vary depending on the position of the manager.

All the local scorecards are revised once a year. Sometimes, the measures are changed, but most often only the goals of the measures are readjusted. At the same time, the rewards connected with the measures are agreed. A representative from all the employee groups takes part in the process where the measures and rewards linked with the measures are accepted. Also, technical officials and managers with personal goals can influence to some extent for their own goals. Taking part in the process is thought to be important for the commitment of the personnel.

According to the Manager A of Polyolefins, the local scorecards stand for 5-10 percent of employees' annual compensation and thus have a directional influence. It is clear, that the local scorecards have an important meaning for the employees as a part of their annual income. However, it can't be blindly trusted that the scorecards are really directing employees' work to the wanted direction. This aspect of the scorecards was therefore questioned in this study from the perspective of measuring energy efficiency.

There are also other forms of additional rewarding used at Borealis Polymers Oy. They are called as *the quick reward* and *the reward on initiative*. The quick reward is paid, if the employee exceeds the expectations for his or her work in some sense. It is suggested by the foreman and needs to be accepted by the superior of the unit. The reward on initiative is paid if the employee makes a good initiative that can be exploited by the company.

### 6.1.3 Measuring and rewarding energy efficiency

#### Measuring energy efficiency

Measuring energy efficiency at Borealis Polymers Oy is mainly non-financial measurement. The energy efficiency measure followed is a physical-thermodynamic measure. At Borealis the measure is called the Energy-KPI. This measure is more widely known as *the specific energy consumption* (SEC). It describes energy efficiency as the amount of energy consumed per unit of product (MWh/t) (Cefic 2005).

In addition, three other energy-related measures are followed in the company. These measures are CO<sub>2</sub> tons, Flaring tons and OAE (overall asset effectiveness). The CO<sub>2</sub> and Flaring are energy related environmental KPI's. The purpose of the OAE and Flaring is to measure the operational excellence and the reliability of the plant. The Manager A referred to the energy-related measures as follows:

*“With these measures we come to the question what is an energy measure and what is not.” (Manager A, Polyolefins/29.10.2008)*

In the following figure (Figure 8), the four measures considered as energy-related measures at Borealis and their linkages are presented. The SEC and the CO<sub>2</sub> are directly energy-related measures, whereas the OAE and the Flaring describe the quality (effectiveness) of the process. All measures are interlinked with each other: At first, the specific energy consumption (SEC) and the carbon emissions (CO<sub>2</sub>) correlate with each other. Then, the OAE as a measure of production efficiency has a strong influence on the SEC. This is because a well performing process features less malfunction and shutdowns, resulting into a better performance in respect of energy use. Flaring is also a measure of the process performance. The higher the flaring rate is, the more failures there are in the process. Since flaring means combustion, it has also affect on the SEC of the total site and on the CO<sub>2</sub>.

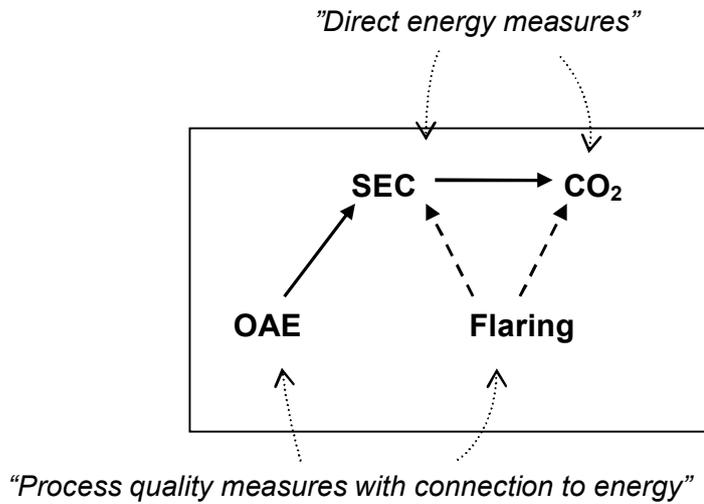
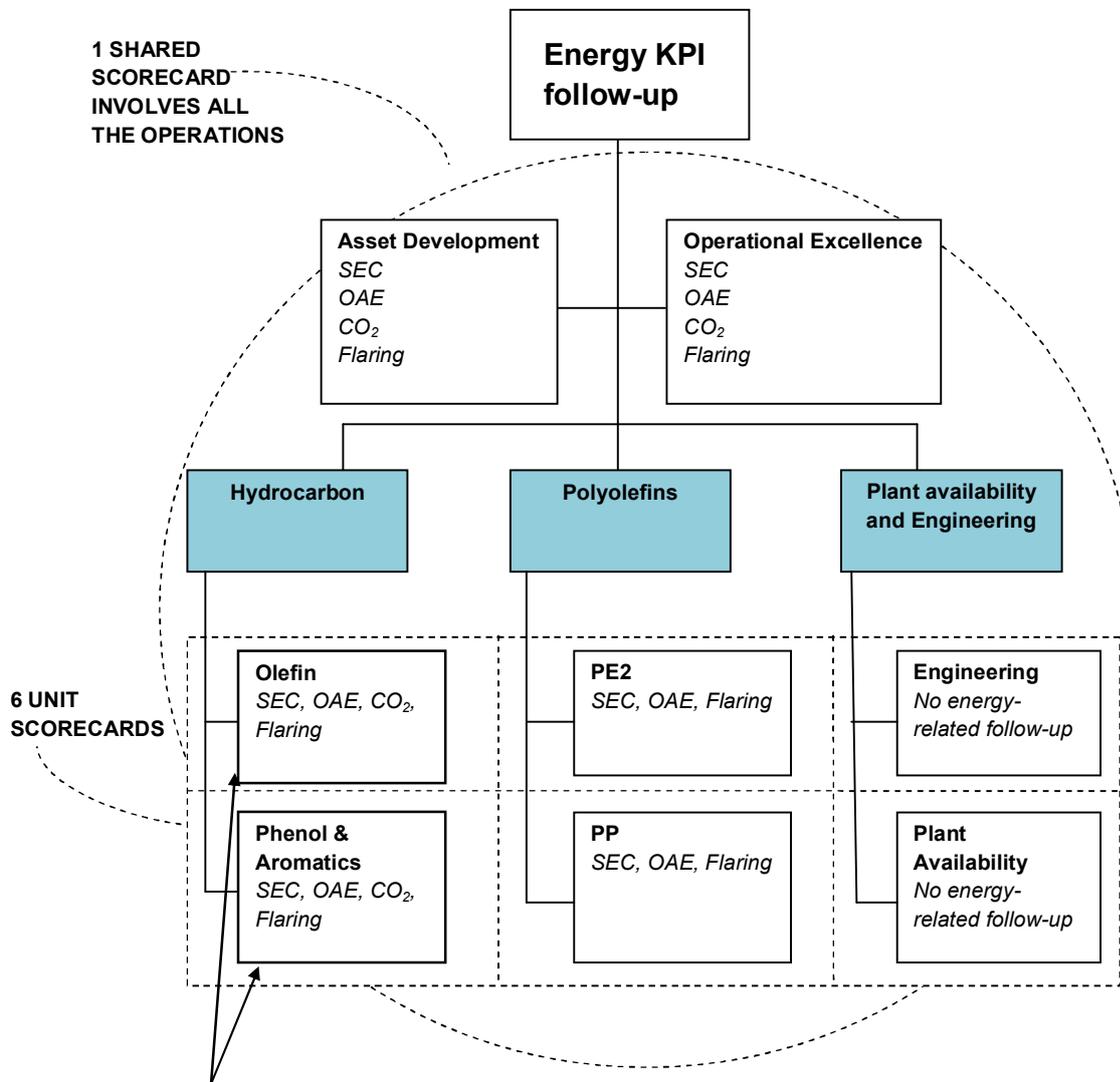


Figure 8. The linkages between different energy-related measures at Borealis Polymers Oy

Besides non-financial measurement, Borealis Polymers Oy has also had financial measurement of energy efficiency. At plant level, the costs of fuels, steam and electricity are followed on monthly basis proportioned with produced tonnes. However, what it comes to measuring energy efficiency financially, there is a problem with the changing market prices. Therefore, it is not apparent, if the operations have improved, or if the changing results are caused by the changes in the market prices.

At Borealis Polymers several measures are followed, but only limited share of them can be included in the scorecards and rewarding. This is also the case with energy-related measures. The following figure (Figure 9) describes the Energy-KPI follow-up at Borealis Polymers. The SEC and other energy-related measures are followed in the operations of Hydrocarbon as well as in the functions of Asset Development and Operational Excellence. The same measures are followed at Polyolefins, excluding the measure of CO<sub>2</sub>. From the figure 9 one can see, that energy-related measures are not yet followed at Plant Availability and Engineering of the organization.



The SEC is included only in the unit scorecards and rewarding of Olefin and P&A units

Figure 9. Energy-related measures followed at Borealis Polymers Oy

The figure 9 presents also the outreaches of the shared and unit scorecards. The shared scorecard involves all the operations as well as the functions of Asset Development and Operational Excellence. The unit scorecards are applied in the six units of Hydrocarbon, Polyolefins and Plant Availability and Engineering. What comes to the energy-related measures included in the scorecards, the SEC is being followed only in the unit scorecards of Olefin and Phenol &

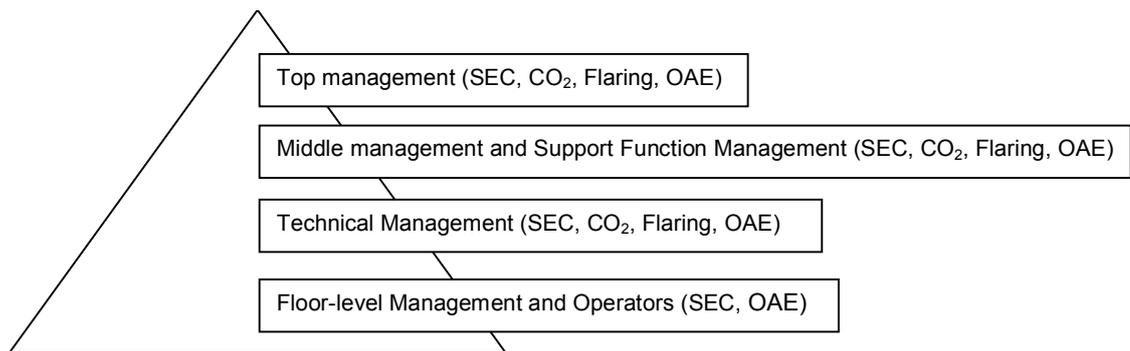
Aromatics. The OAE is included unit scorecards of Olefin, P&A, PE2 and PP units. On the other hand, the flaring is included in the shared scorecard. The CO<sub>2</sub> is not included in the scorecards.

The figure 9 shows, that following energy efficiency doesn't yet reach the whole personnel of Borealis Polymers. Especially, the Plant Availability and Engineering personnel have been little aside from the energy efficiency follow-up. This is despite the fact, that they are considered to have an important contribution to the energy efficiency, when taking care of the machines or suggesting improvements in the processes. If the machines are not maintained properly, the energy consumption can increase.

According to the Manager A of Polyolefins, it is an interesting but a difficult matter to decide in which scorecards to include energy related measures.

*“Is some measure so important that it should be included in both shared and unit scorecards? (Manager A/29.10.2008)”*

But double monitoring has been considered unfavourable management. (Manager A/29.10.2008). Next figure (Figure 10) describes the follow-up of the SEC and other energy-related measures in different organizational levels. As mentioned already, the scorecards and the rewarding include fewer measures that are otherwise followed. In past few years, the SEC has been largely included in the personal business incentive plans (BIP) of top management. Since the SEC is strongly affected by production volume, the measure was not included in the BIPs during downturn in 2009. Instead, the company has introduced a new volume corrected Energy KPI. This measure is not yet included in the scorecards or rewarding, but it is being tested to collect base line information during year 2009. The figure 10 shows that the SEC and other energy-related measures are followed fairly broadly in different levels of the company.



*Figure 10. Energy- KPIs followed in different organization levels.*

From the previous figure (Figure 10), it can be noted that the energy-related measures followed in the different levels of the organization are largely the same. This is the case even though; the information needed in the different levels must differ. At the floor level, fewer measures are followed, but the energy efficiency measure followed is the same. The rationality of using same measures in different levels of the organization was questioned in the interviews by few managers. As will be later presented in chapter 6.3.4 especially Manager A and F questioned the rationality of using the same energy efficiency measure in all levels. The Manager A of Polyolefins brought forward that the lagging measures, like SEC, should belong to the top level and the leading measures to the lower level. The Manager F of Polyolefins stated that the measuring and rewarding of energy efficiency should be connected with selected problem spots, instead of involving the floor level employees with the overall measure. The managers' ideas on this issue are presented more in depth in chapter 6.3.4, when the improvement proposals of the interviewees are introduced.

### Rewarding energy efficiency

Rewarding is connected with energy efficiency at Borealis Polymers in several ways: First, rewarding is connected with the SEC found in the unit scorecards of Olefin and Phenol and Aromatics. The SEC has a fairly big role in these two unit scorecards. For example, in the unit scorecard of Olefin plant SEC is weighted with 13 percents and in the unit scorecard of Phenol & Aromatics it is weighted with 10 percents. (Compensation and Benefits Manager/26.2.2009)

*“I think it shows a quite clear message that these [energy efficiency] issues are important. And people act according to what they see in these scorecards.” (Manager G/26.2.2009)*

Second, rewarding is connected with energy related measures OAE and flaring, which are also included in certain scorecards. Third, Borealis Polymers Oy pays rewards on useful initiatives and these initiatives can relate to energy efficiency. Fourth, energy expenses have a big role in the variable costs of the company and, thus, the energy efficiency improvements have effect on the profit of the company, which is taken into account in the business incentive plans of the management.

#### **6.1.4 Challenges in measuring energy efficiency**

At Borealis Polymers, several challenges in measuring energy efficiency have been recognized. First, according to the Manager A of Polyolefins, the measures of energy efficiency are still fairly new and lack of comparability. *“These measures are still searching for their form and they haven’t been operationalized everywhere in the company.” (Manager A, Polyolefin/10.11.2008)*

Another challenge mentioned by the Manager A of Polyolefins was the traceability of the measure. He recognized that the link between the SEC and the factors influencing the measure should be visible. Manager A emphasized that it is impossible for the employees to influence energy efficiency measuring, if they don’t know what issues are affecting the measure. (Manager A, Polyolefins/10.11.2008):

*“I see there is a challenge with traceability. It means that you can examine the separate plant level issues [behind the measure]. Otherwise, you cannot influence on it [the measure].” (Manager A/10.11.2008)*

*“If you have such measure as we have, Energy-KPI, which is kind of an index number or a ratio, it won’t help the operator greatly, if you say that it*

*[Energy-KPI] has risen from last month with 10 percent, unless he or she has an access to whether it has been steam or electricity and in which part of the plant.” (Manager A/10.11.2008)*

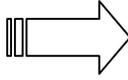
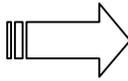
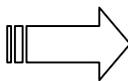
The Manager D recognized the sensitivity of the measure as a challenge. A technical energy efficiency measure, like SEC, can include a lot of information. Since several factors are influencing energy efficiency, it's not easy to come up with extremely simplified measure, which wouldn't shut out crucial information and offer biased information on energy efficiency. Instead, the measures are often consolidated. This leads to the measure not being sensitive to the changes in the operations. Together the challenges of traceability and sensitivity refer to the fact that the contributors to the measure, including their weighting, are not yet clear.

Last, a challenge with connecting the day-to-day working with the measure was recognized. According to the Manager C, the current measure, SEC, as such won't lead to the best result. He suggested that operators could be more involved in enhancing energy efficiency, for example, through different projects. They would be involved in thinking more complicated problems than just, how I operate and follow the rules correctly and make my best in that. Manager C's propositions are more profoundly discussed in chapter 6.3.2.

As a conclusion, a summary of the main challenges in measuring energy efficiency at Borealis Polymers and their consequences are presented in the following figure (Figure 11):

**Challenges in measuring energy efficiency:**

**Consequences:**

- |  |   |  |
|--|---|--|
| 1. Measure of energy efficiency is <u>new</u> and lack comparability   |  | Results cannot be compared between periods of time in all the cases                            |
| 2. Contributors to the measure, including their weighting are not clear ( <u>traceability</u> and <u>sensitivity</u> of the measure) |  | Employees don't know how to influence the measure and what factors affect the measure the most |
| 3. <u>Connection with day-to-day activities and energy efficiency measure</u>  |  | Energy efficiency measure doesn't channel employees' actions                                   |

*Figure 11. The main challenges in measuring energy efficiency at Borealis Polymers Oy*

The challenges mentioned can be expected to have an effect also on the motivation of personnel to improve energy efficiency. Next chapter deals with the motivational effects of measuring and rewarding energy efficiency.

## **6.2 Motivating with measuring and rewarding energy efficiency**

### **6.2.1 Personnel's possibilities to influence energy efficiency**

Motivating personnel to enhance energy efficiency is considered as a challenge in the company. At the moment, different personnel groups see their possibilities to influence energy efficiency in a different way. One should also distinguish the difference between being able to influence energy efficiency in general or being able to influence measuring and rewarding of energy efficiency. This is important when considering the motivational effects of measuring and rewarding energy efficiency. If personnel feel they cannot influence the measures as a basis of the rewarding, they may feel less motivated to influence energy efficiency in general.

Next, personnel's possibilities to influence energy efficiency as well as measuring and rewarding energy efficiency are discussed. First, management views on how personnel can influence energy

efficiency are introduced. Then, the point of views of the technical officials and operators are presented.

### Management

According to the Manager F of Polyolefins, the electricity consumption cannot be much affected by the operators. The machines use as much electricity as they do. But there are some other issues, where the operators can influence. For example, the consumption of steam and whether steam is being wasted. The Manager F also suggested that personnel can act by making initiatives which can be transferred into projects to improve energy efficiency:

*“...one way is probably to be aware of these issues, think them actively and do these initiatives and improvement suggestions. And that is something, I think, we haven't done enough.” (Manager F, Polyolefins/24.11.2008)*

The Manager F reminded that big changes are probably difficult to do without investments, because the plants have been designed to work with the existent equipments. According to him, the scarcity of investment funds is a fundamental problem in enhancing energy efficiency:

*“...big improvements cannot be done without investing on equipments. We cannot save 10 percent just like that only by running the machines...investment funds are anyway scarce. It is of course difficult to put all the money in there, because it is needed elsewhere too. It is a fundamental problem there.” (Manager F, Polyolefins/24.11.2008)*

Moreover, when the consumption of electricity and more complicated matters in operating are planned, specialists are needed:

*“...we need these designers and specialist to think, since it is not that simple. It is not like if you walk there and think how this plant could be cleaner, that is*

*something everything can figure out. But how this pump could be more energy efficient, then it is not that simple subject.” (Manager F, Polyolefins/24.11.2008)*

### Technical officials

All the eight officials interviewed considered their possibilities to influence energy efficiency fairly good, especially in the long run:

*“[We can influence] the use of energy, not with one act at this moment, but like in the long run. If you think like investments, and try to find the most energy-efficient ones.” (Technical official A, Hydrocarbon)*

*“I can influence [energy efficiency], when we choose or we do something in the plant, for the equipment-choice or other things...” (Technical official H, Phenol & Aromatics)*

Technical officials are involved with the shared scorecard. In addition, they have individual goals. The shared scorecard doesn't include the SEC but it includes energy related measure OAE and initiative measure. Most of the officials have the SEC in their individual goals. Thus, their performance is measured and rewarded based on the Energy KPI. Exceptions are the officials of Plant Availability and Engineering. The SEC is not included in their goals and hence neither is their rewarding directly connected with energy efficiency. This applies also to the mechanics of PA&E. This was considered as a limitation from the perspective that also these employees can have a significant influence on energy efficiency through their work taking care of the plant and suggesting improvements at the plant.

The officials interviewed were also asked how they see the operators' possibilities to influence energy efficiency measuring. First of all, most of them considered the local scorecards as a good management tool. The Technical official B (Olefin/3.2.2009) stated that the operators do react to the results in scorecards. The Technical official C recognized the SEC as fairly understandable for operators, but not necessarily all the items behind it:

*“It is understandable, but what are all the items that have an effect on it... What all measures, what consumptions - the list is quite a long. So it is not that unambiguous.” (Technical official C/3.2.2009)*

The main message of the Technical official C was that the SEC is not totally understandable for the operators at the moment. Therefore, they have made plans to develop the measure further in order to make it more concrete. The plan is to split the measure into smaller parts to improve the traceability of the measure. As a consequence, the measure would be more illustrative and understandable for the operators.

During the interviews, some of the officials could also change their opinion on measuring energy efficiency in the company. For example, the Technical official A of Hydrocarbon first stated that the SEC is concrete, very clear and understandable for everyone. He did recognize that the SEC is only directional, not at all accurate, but a first step to right direction. In the second interview, the Technical official A seemed to be more sceptical towards the SEC:

*“...probably in everyday work influencing [the SEC] is so difficult.” (Technical official A, Hydrocarbon/3.2.2009)*

*“It could just as well be pikojoule per ton, that’s how understandable the measure is.” (Technical official A, Hydrocarbon/3.2.2009)*

The Technical official A (Hydrocarbon/3.2.2009) continued by strongly questioning whether the measure has been internalized by the operators. Hereby, it can be concluded that the view of energy efficiency is still forming and several views and understandings of energy efficiency can be found inside the company.

## Operators

The operators participated in this study were from the most energy-intensive plant at Borealis Polymers Oy. The Hydrocarbon production is divided into two units, which are Olefin and Phenol & Aromatics. The SEC is included in the unit scorecards of both units. The measure is weighted with 10 percent in the Olefin's scorecard and with 13 percent in the Phenol & Aromatics' scorecard. As mentioned before, unit scorecards have a 65 percent weight in the annual bonus of operators.

The operators had different views about their possibilities to contribute to the energy consumption and energy efficiency related measures. Their views could also change during the interviews. Thus it can be assumed that this is not a simple question to be answered: whether or not one can influence energy consumption or related measures. Operators at the Phenol & Aromatics plant discussed about their abilities to influence energy efficiency as follows:

*“We operate here more according to the quality and there we don't necessarily care about energy efficiency.” (Shift Manager, Phenol & Aromatics/5.2.2009)*

*“And sometimes we have to drive uneconomically because of impurities [in the process] just to get the products in shape. So it is so...this is not the best possible plant, because we don't have margin [in the use of energy] in normal situation. Except now because we have small feeds [because of recession]. But what we have been driving here dozens of years, it has almost always been with full speed, so now it is a little bit of a problem there... (Operator1, Phenol & Aromatics/5.2.2009)*

Thus the discovery was that the priority number one is quality. Also, it is troublesome or even impossible for operators to lower the use of energy at least with full feeds. The operators saw their possibilities to influence energy efficiency fairly limited.

*“There is nothing to be done.” (Shift Manager, Phenol & Aromatics/5.2.2009)*

*“Well, in principal it is possible, if the controlling systems are developed, then we can get like percent or two [off] but it is this kind of fine tuning, and then we might lose it in some other part, when we have to operate uneconomically because of impurity.” (Operator1, Phenol & Aromatics/5.2.2009)*

The opinion among operators from the Phenol & Aromatics unit was that energy efficiency is not actually the core business of the operators. According to Operator 2, it is not their business to start playing solos and saving energy at the plant, instead it is someone else’s job to give instructions to the operators.

*“It is this kind of engineering science.” (Operator2, Phenol & Aromatics/5.2.2009)*

*“It is not our business” (Shift Manager, Phenol & Aromatics/5.2.2009)*

In this context, a significant shortage regarding the energy efficiency related training appeared. According to the employees interviewed from the Phenol & Aromatics unit, their training on energy efficiency related matters is scarce. At the moment, the prime training events are the K-days twice a year. These events are however like short briefings and fairly general by nature (Shift Manager, Phenol & Aromatics/5.2.2009). Thus it is impossible to learn more profoundly about energy efficiency related matters, that are more close to the own sphere of work. This means also that their knowledge on factors influencing the energy efficiency measure used in the company is inadequate at the moment. They commented their knowledge regarding the matters that are influencing energy efficiency measure as follows:

*“Actually, it is not totally clear...what issues are affecting on it... No one has come at least directly to explain those matters to us” (Shift Manager, Phenol & Aromatics/5.2.2009)*

*“And there is probably nothing, like some kind of program of those matters at all...like it would have gone through and made it clear. Everyone is just staring the one small thing they are operating and that’s it. And we don’t like know about the quantities or the prices [of the energy used] and such matters that influence...we don’t have this kind of information, clearly. (Operator2, Phenol & Aromatics/5.2.2009)*

According to the operators, one of the reasons, why they don’t have better knowledge on energy related matters, is that the number one criteria for the products has been quality. Also, because until now the plant has been operated with full feeds and there has not been lot of room for optimizing energy consumption. The prices for the products have been good enough and there has been no need to interfere on energy expenses. (Phenol & Aromatics/5.2.2009),

Nevertheless, the operators at the Olefin plant saw they can influence energy efficiency through adjusting the use of steam and temperatures in the process and by following the driving level of furnaces.

*“It is this kind of controlling and watching. We follow numbers and lines that they won’t escape too much. This is control cabin work.” (Operator1, Olefin/3.2.2009)*

What was alarming among operators was that there was no common knowledge among about the effects of their work on energy consumption or energy expenses of the company. When discussed about the possibilities to influence the energy expenses through energy efficiency at the Olefin unit, the answers were fairly optimistic. One operator summarized their biggest mission in influencing energy efficiency: *“we must keep the plant running”*. In general, the operators considered their influence quite big in the long run. Subordinate clause in this context included a message that the employees won’t get anything more even when able to influence energy efficiency.

*“The effect can be quite big in the long run. But we won’t get anything from this.” (Operator2, Olefin/3.2.2009)*

## 6.2.2 Motivation achieved by measuring and rewarding energy efficiency

### Management

All the managers agreed that measuring and rewarding energy efficiency is needed in communicating the importance of energy efficiency in the company. Energy efficiency was considered as a topic that is easy to justify to the personnel. The Manager F of Polyolefins emphasized that people do get motivated quite well of issues that are reasonable: “*and this is probably one of the most reasonable*”.

According to the Manager A of Polyolefins, problems arise, when the measures are developed further from the actual meter values. He added that it would be important for the operator-level workers to see the connections between their work and the indicator to be motivated. Likewise, if the measures are in euros, it is not necessarily any clearer for the operators, according to the Manager A:

*“If they [the indicators] are euros per tonnes, then the question is what I can do for this measure, as I don’t see euros here and the tonnes go as they go.”*  
(Manager A, Polyolefins/10.11.2008)

Another difficulty in motivating is setting the goal for the measure. According to the Manager A of Polyolefins, with some measures the goal that entitles for the bonus is reached already in the middle of the year. He raised the question how the measure should be build in order to maintain motivation throughout the year. He believed that money is a big motivator for most of the employees:

*“About 80 percent of employees are just doing their work, 20 percent of operators are initiative and intrinsically motivated about their work.”* (Manager A, Polyolefins/14.1.2009)

The Manager G also stated that the rewarding has its effects on the behaviour of employees:

*“I believe that any criterion in the scorecard with big enough weighting in rewarding is interesting from employees’ viewpoint. Of course, the closer it is with the work of the employees, the better.” (Manager G/26.2.2009)*

However, the Manager F of Polyolefins, emphasized more the intrinsic motivation of operators. According to him, motivation arises from the will to do a good job and to improve work performance and facilitate their work:

*“For example, initiatives rarely go through, if someone is developing them only to be rewarded.” (Manager B, Hydrocarbon/24.11.2008)*

#### Technical officials

All the technical officials claimed to feel motivated to improve energy efficiency. Behind their motivation were their educational background and a need to do a good job, they said. Rather than being motivated because of the measuring and rewarding of energy efficiency, officials were motivated out of pure interest towards their job:

*“Of course, I would say it is part of this work. You don’t have to think about it separately. It should be in the backbone of every engineer, at least, because of the financial matters, environmental matters and others that are emphasized these days.” (Technical official H, Phenol and Aromatics)*

*“So far that it is possible to influence, then of course. If you’re going to work here, you need to be a little bit motivated.” (Technical official E)*

The rewarding was thought to be more important for the operators:

*“It is probably so that in the operator-level the monetary rewarding is more influential. Probably, also there we can find those, for whom the content of work and the meaningfulness of work have a bigger effect.” (Technical official B, Olefin)*

Also, the meaning of immediate feedback for operators was emphasized. Verbal feedback was considered effective compared to the scorecard system and to the financial rewarding, since the scorecards are not updated so frequently. This means that, when the results of the scorecards come, they are already old:

*“Yes, the money motivates somewhat, when it is part of the merit pay. But for employees it must be even better, if they have feedback right away. Feedback, even if oral, if it comes straight away. It would be the best. Like, if it comes once a year, it is a bit late.” (Technical official G, Phenol & Aromatics)*

All in all, the scorecards were considered as a fairly good tool, since the operators do react to them. If the operators feel they have experienced injustice with the scorecards, they will react to that. (Technical official B, Olefin/3.2.2009) Still, it can be questioned, whether the reactions of the employees are an evidence of scorecards being a good way to motivate. It may be that the scorecards and rewarding are in part misdirecting employees' efforts. If they must use a lot of time and effort in defending their rights and in politicising, the struggle is not adding value to the company or enhancing energy efficiency.

### Operators

Influencing energy consumption and energy efficiency was important for the operators, at least for three reasons: to save money for the company, to pay attention to the environmental concerns and to receive the full bonus from the Energy KPI. During this study, the operators' motivation was suffering from the tight target of the SEC. In year 2008, the target was not reached and the

operators did not receive any bonus from this measure. The impossibility to reach the target became clear for them already in the middle of the year, which did not improve their motivation:

*“...we saw already in an early stage, that we have no chances to reach those targets. The target was way too tight, then it doesn't especially motivate.” (Operator2, Olefin/3.2.2009)*

They were disappointed, that the current economical situation was not taken into consideration in the Energy KPI target. As a consequence of the economic turmoil, the produced tons have reduced, but the energy consumption doesn't decrease in the same proportion. Thus, the Energy KPI has popped up. The operators stated that management should be flexible with the goals during times like these. According to the operators, the goals were not reached because of reasons that are irrespective of them. A voice of protest was audible in one operator's talk, when he stated their motivation being zero, if they are not rewarded (Operator1, Olefin/3.2.2009).

But the bonus certainly wasn't the only motivation for the operators to save energy, as mentioned already before. According to the Shift Manager from P&A, it is also a matter of job: *“you cannot do this anyway you like”*. Still, also the Shift Manager recognized that the bonus is a big motivation for many to influence energy efficiency.

*“...if you could influence, if you knew how to improve energy efficiency, then you would certainly do it. It is anyway almost 400 euros per year.” (Shift Master, P&A/5.2.2009)*

The bonus was considered as a part of their income formation. For example, the Operator2 from the Olefin unit was talking about *“the money we lost”*, when the Energy KPI target was not reached:

*“...we were left without 300 euros there.” (Operator2, Olefin/3.2.2009)*

All the operators agreed that they would need more job specific training on how to save energy. The Shift Manager from Olefin unit made a wish that they would be told, what they should do to reach the target:

*“...what we should do to get into those numbers, what they have there. When that sounds so utopistic...” (Shift Master, Olefin/3.2.2009)*

The operators at the Olefin plant said they would feel motivated to enhance energy efficiency, if they were given the chance. According to the Operator2 (Olefin/3.2.2009), this chance would mean that the measures can be affected and that they would receive real-time information on energy consumption:

*“...these measures would be the kind that we could have an effect on them, and that we would see right away in real-time, what is the situation. But if we don't know about these, then...” (Operator2, Olefin/3.2.2009)*

When discussed about the operators' possibility to have accurate information on energy efficiency, especially the punctuality of the scorecards did rise as a topic in both units. According to the operators, the scorecards are updated late especially in the beginning of a year. “It depends a bit who is working in there.” (Operator1, Olefin/3.2.2008) Also, usually during the last months of a year the numbers in the scorecards alter substantially. The reason for this was not clear for the operators. But as a result, everyone was mainly interested in the last scorecards:

*“In practice, during the last three months there [in the scorecard] you may have whatever numbers compared to the last [scorecard]. They do not tell the truth. It is not until the last one that will tell the truth.” (Shift Master, Phenol & Aromatics/5.2.2009)*

The bonuses were paid always in the turn of the year. The Operator2 (Phenol & Aromatics) acknowledged that their motivation was generally a bit low in the beginning of the year, since *“nothing is expected for some time”*.

### **6.3 Suggestions for improving energy efficiency**

In the interviews, several suggestions on how to improve energy efficiency at Borealis Polymers were discussed. Especially, five themes emerged during the study: *shared ownership, employee involvement, concrete training, illustrative measuring and real-time information*. Next, the five themes are described.

#### **6.3.1 Shared ownership**

The measuring and rewarding of energy efficiency doesn't yet include the whole personnel at Borealis Polymers. The Energy Management System (EMS), linked with the existing ISO 14001 Environmental System, is expected to spread the energy efficiency –thinking to cover all the parts of the organization. The Manager E described the expected development as follows:

*“...when the system starts to roll, then it should kind of force it, the measure, to all the units collectively and everyone would have to think from their own perspective what they can do for it.” (Manager E)*

Until now, the PA&E employees have felt being left aside from energy efficiency issues (PA&E Manager). Spreading the energy efficiency –thinking would include involving PA&E personnel with energy efficiency measuring and rewarding. This way they would be communicated that they can influence too:

*“We should be able [communicate] these people that you can also affect it...Thus, if we optimally maintain the equipments, then they will use less energy.” (Manager E)*

### 6.3.2 Employee involvement

In several interviews, the importance of employee involvement in energy efficiency improvements became apparent. Especially, the Manager C stressed the need for employee involvement. He stated, that *“the employees are the ones who know exactly what happens under the “iceberg”, in practise, how we work, what are our working habits and even values with something”*. According to Manager C, it is not enough that people know the energy consumption or energy efficiency of the month or the month before. Instead, they need to be involved and committed in thinking and improving energy efficiency, like in the sense of continuous improvement.

A way to do it could be the Borealis Way –program that already exists in the company. It is a continuous improvement cycle of five parts, do-analyse-solve-implement-review (DASIR). It has already been used in other projects and it has been acknowledged as a good way to involve people in making improvements. According to the Manager C, this approach would suite as well for energy-related projects. The employees would be involved in the projects to indentify and to create a shared view of a problem:

*“...like in this kind of systematic way, we use a lot of time to identify the problem and understand it. Because, very often it is so that we feel we have a touchingly shared view of the problem. But most likely, the view has not only shade differences but also understanding differences.” (Manager C, 24.11.2008)*

The Manager C added that when the problem has been clarified collectively, and the nature and the core of the problem have been found, then the solution can be found almost by itself. It could also be a more effective way to motivate than using financial rewarding:

*“If some problem is recognized, then employees and floor level management are involved to improve those matters. What could be a better price in the end, than to see the meaning through that?”*

### 6.3.3 Concrete training

All the operators wished to have more concrete training on how they can influence energy efficiency in their work. It seemed clear that the current k-days didn't fulfil this need. The Manager C suggested that the training should include reflecting best practices, writing them down and sharing them among employees:

*“If we have meaningful, simple and well understood instructions, whose making operators have participated, then it is already half sold for them.”*

The operators do have instructions on energy related matters, “*even few folders*”, as mentioned by one operator, but it seemed clear that the current instructions were not motivating them to enhance energy efficiency. The operators at Olefin unit wished to be reminded through training in which ways they can influence energy efficiency:

*“A reminder mainly would be good. A human mind is the kind that it gets used to (=rutinoituu) these things and then they are forgotten. That is just the way it goes.” (Operator1, Olefin/3.2.2009)*

At Phenol & Aromatics unit, the operators wished to have more practical and systematic training. The practicality of training was described as follows: “*For us it would be important that the training would concentrate exactly on what we do.*” (Operator1, P&A) With systematic training, the operators referred to following with samples the effects of energy reductions on product quality:

*“Then it should be so that it would be followed with samples. But when we take samples it costs. So we lack of this kind of systematic approach. It is a problem here.”*

#### 6.3.4 Illustrative measuring

One of the goals of this study was to find new illustrative measures for energy efficiency performance. The different employee groups were asked to give their suggestions. Their specific suggestions for new non-financial and financial measures are attached (Appendices 5 & 6). Most of the suggestions came from the managers and officials.

##### Non-financial measures

The main suggestions for new non-financial measuring concentrated on splitting of the current measure into smaller monitored parts and new follow-ups of steam and electricity consumption (see Appendix 5). The interviewees were also asked to think new and innovative ideas for measuring energy efficiency performance. In the field of security, the company uses measures such as accidents with truck and cleanliness and order. These measures have been considered very successful in directing employees' efforts, because they signal from many important issues: *"Cleanliness and order have many positive side-effects"* (Manager A, Polyolefins/14.1.2009). Moreover, these measures are evaluated subjectively and setting a motivating goal is not a similar problem as with the SEC. Coming up with new innovative measures during the short time of the interviews was not considered easy. Most of the ideas came from the officials of Olefin unit and are presented in appendix 5.

The initiatives were another topic, when considering new illustrative measures for energy efficiency performance. A remark made by the Manager D was that the initiatives related to energy efficiency could be separated from other initiatives to communicate the importance of these initiatives. Also, the Manager G supported the idea of highlighting the initiative system in the company:

*"Communication could be used more to highlight, for example, our initiative system. Nowadays, because the initiatives are wanted to keep confidential, they are not brought forth enough."* (Manager G/26.2.2009)

### Financial measures

Both the operators and the officials suggested that financial measures should be utilized more. According to the operators of Olefin unit, the financial measures would be easier to understand than non-financial energy related measures. The officials of Olefin unit made several suggestions on euro measures (see Appendix 6). It seems that financial measures could be exploited more especially in communicating the importance of energy efficiency in the company. Compared to thermodynamic measures, with financial measures the magnitude of energy costs could become more apparent. As the Manager A of Polyolefins stated: *“Financial measures are important in that sense that they concretize a matter and make them commensurate (=yhteismitallisiksi)”*.

### Measures in scorecards

The measures to include in the scorecards should be chosen carefully, since a scorecard can only have a limited amount of measures. Other “less” important measures can be followed on the side, but they would not be connected with the rewarding. The Manager A of Polyolefins highlighted the difference between leading and lagging measures. According to him, the lagging measures should belong to the top level and the leading measures to the lower level. The Manager F of Polyolefins emphasized applied the same thinking in measuring energy efficiency: at the employee level, the measuring and rewarding should be connected with selected problem spots instead of involving the operators with the overall measure.

*“We would pick from plants this kind of spots that can be affected with operating and we would measure then those. And the overall measure could be with us managers that understand all the other things that have influence.” (Manager F, Polyolefins/24.11.2008)*

What the Manager F meant was that several factors irrespective of the operators have an influence on the current overall Energy-KPI. For example, in a case of an economic turmoil, it is

difficult to motivate employees with a measure that is dominated by issue they can't control. Still, also the Manager F emphasized the importance of the operators to understand the wholeness of energy efficiency: *"It would be good for them to understand the wholeness better than now, because now it seems they don't understand it too well. And then from there, the chosen spots, that they can influence, would be measured. I would do it pretty much like that."* (Manager F, Polyolefins/24.11.2008)

### **6.3.5 Real-time information**

The operators wished to have more real-time information on energy efficiency. First of all, the punctuality of the scorecards was a problem, mentioned already in chapter 6.2.2. In addition, other shortages in the information access of the operators existed. According to the Operator1 of Phenol & Aromatics unit, the operators don't see the energy efficiency measure results in *"a concrete enough way"*. What he meant was that they can only see the results of the SEC in the long run, when the scorecards are updated. For example, the variations of the SEC during a month were not shown anywhere. He continued that the last month's figures are always past and gone life for the operators: *"For us everything should be concrete. Here and now. It would be the best."* The Shift Manager (Olefin/3.2.2009) wished to have the figures *"somewhere displayed"* and better at sight for the operators.

## **6.4 Summary and discussion of the results**

### Measuring and managing energy efficiency

One of the goals of performance measurement is to motivate employees (Lönnqvist 2002, 87; Ukko et al. 2005, 74), which was also the case at Borealis Polymers. Operating in highly energy-intensive process industry, the company follows a physical-thermodynamic measure called the SEC. At Borealis Polymers, measuring energy efficiency is mainly non-financial; in addition the energy costs are being followed in units. The SEC and other energy-related measures are followed widely in the organization, but the measures are only partly included in the unit

scorecards and connected with rewarding. For example, the SEC is only included in the unit scorecards of the most energy intensive units (Olefin and P&A). This was considered as a shortage in the interviews and more shared ownership of energy efficiency was suggested. In addition, it should be considered whether following the same energy efficiency measure in all the levels of the organizations is useful. Epstein (2008) has expressed that the corporate-level measures should be used for brainstorming to find complementary sets of measures down through the hierarchy. At Borealis, this would mean challenging business unit managers to create measures of their own aligned with top-level measures and furthermore the employee groups should customize their own measures. These measures would then serve the people, who actually execute strategy and motivate them to work according to the strategy, no matter what level in the organization they work. As a consequence, the measures would “come from the global strategy and serve local needs”. (Epstein 2008, 127) Until now, these principles have not been applied at Borealis Polymers, when following energy efficiency.

In literature, non-financial measurement is generally considered to have many benefits compared to financial measurement (e.g. Fischer 1992; Ittner et al. 2003). Non-financial measures are expected to measure operational processes and provide up-to-date information. One of the objects, when using non-financial measures is to activate on operational level. (Fischer 1992) It is stated, that non-financial and financial measures should be followed together in order to understand the drivers behind long-term financial success (Kaplan & Norton 1996a, 8). In this study, it became apparent that the SEC was not experienced as a non-financial measure that activates on operational level. Instead, the measure was suffering from very similar challenges as financial measures. Especially, the lack of cause and effect -relationship is usually considered as a typical problem of financial measures (Fisher 1992, 33), but it was a problem also with the SEC. Thus, it seemed that the SEC was not currently offering information on the drivers of energy efficiency that should be developed in order to see the effects also in the financial measures one day. Besides suffering from the lack of cause and effect -relationship, the sensitivity of the indicator was also a challenge. In other words, it was not clear, what are the weightings of all the different influencing factors on the measure. These two challenges plus the lack of connection with day-to-day activities were making the SEC lose its benefits compared to financial measures. From these challenges it also followed that it was not at all clear for the

operators, how they can influence the indicator with their daily work, or in what extent it is even possible.

Besides the previous challenges, the SEC was also suffering from challenges typical for non-financial measures. Fischer (1992, 38) has mentioned infancy and lack of comparability as such. With the SEC reliable comparisons over time or between installations would have demanded the operating conditions being identical, for example feedstock and product mix (Auvinen 2008). The lack of comparability was thus recognized as a challenge at Borealis Polymers, when measuring energy efficiency with the SEC. To conclude, it was clear that the SEC was still in its infancy and not easy to influence. The SEC was not having the many benefits usually typified for non-financial measures compared to financial measures. As the SEC was not describing the drivers behind energy efficiency, it can also be interpreted that the SEC was not either revealing operational, functional or technical insights (see Vaivio 1999, 2004), which could have lead to organizational learning (see Pohjanpalo 2005, 15).

The main interest in this study was in investigating the effects of measuring and rewarding energy efficiency on work motivation. Before concluding the interviews, the managers of the case company forecasted the previous challenges of the indicator to have negative influence on work motivation to improve energy efficiency; especially in the case of the operators.

#### Motivational effects of measuring and rewarding energy efficiency

When considering the work motivation to enhance energy efficiency, several influencing matters has to be acknowledged. At Borealis, the motivation to enhance energy efficiency varied among personnel groups. As causes for these variations could be recognized *individual characteristics* (Porter and Miles 1974) such as different educational backgrounds, and *job characteristics* (Porter and Miles 1974) such as the ability to influence energy efficiency or the measuring and rewarding of energy efficiency. The technical officials had a longer education and one of them described energy efficiency being “*in the backbone of every engineer*”. The technical officials stated that they can influence energy efficiency at least in the long run. What comes to the operators, it was not clear for them, how to improve the results of the Energy-KPI. For them, the

goal was impossible to achieve, when the current economic climate was having the most effect on the measure result. It seems that the ability to influence can be raised as one of the most important factors behind work motivation towards energy efficiency at Borealis Polymers. Viitala (2005, 162) has also mentioned a clear, measurable, and possible to achieve goal as one of the vital factors influencing motivation. Accordingly, it seemed that the technical officials were more intrinsically motivated to improve energy efficiency, when the operators were more concerned about the financial rewarding connected with the measure. It was clear that the operators' experience of inability to influence energy efficiency was lowering their motivation towards energy efficiency.

Consequently, it can be questioned, whether the operators at Borealis Polymers should feel motivated to enhance energy efficiency. In other words, in what extent their contribution can be considered relevant in enhancing energy efficiency. At the moment, no accurate research data on the saving potentials in the work of the operators exists in the company. Nevertheless, it was not questioned by the managers, officials or operators interviewed that the operators' contribution would not be important in enhancing energy efficiency. Thus, although there was no accurate data on the actual saving potentials, the operators' contribution to energy efficiency was welcomed in the company. One of the main conclusions of this study was that the operators' motivation towards energy efficiency was lower, because they felt they cannot influence energy efficiency. More research should be thus done to assure the operators the accurate information on the saving potentials in their work. The measuring and rewarding energy efficiency should then communicate on these potentials.

The rewarding at Borealis Polymers was versatile with several different elements (see chapter 6.1.2). In the interviews, the yearly bonus generated the most debate among interviewees. Some other forms of rewarding were also considered to have an effect on the motivation to enhance energy efficiency; especially initiative rewards and intangible rewarding, such as feedback and training. Despite of the wide debate it caused, the yearly bonus over Energy-KPI seemed to have a limited effect on the work motivation of the operators. Spitzer (2007, 13) has stated that rewards can't be any better than the measurement system they are based on. As the operators felt they can't influence the measuring of energy efficiency, they also felt they can neither influence

the rewarding of energy efficiency. The bonus over the SEC was still a matter of great interest for the operators. But their efforts were more concentrated on politicizing than enhancing energy efficiency. Basically, they were more interested in lowering the current goal than reaching it. This politicizing can be considered as an understandable consequence of a goal perceived unreachable. Therefore, it seems more urgent to concentrate on improving the measuring of energy efficiency, when as a result also the rewarding of energy efficiency can be expected to improve.

The effects of measuring and rewarding on motivation to enhance energy efficiency can also be analyzed through the motivational theories. The expectancy theory (Vroom 1964) supports the finding that rewarding energy efficiency is not considered motivating, if the goal is not considered likely to reach. This theory is about individuals making choices between possible behaviors. Choosing a behavior depends on how likely the expected result is regarded. (Hakonen 2006) At the moment, the goal of the SEC was considered impossible to reach. There were basically two reasons acknowledged, why the operators considered the goal impossible to reach. First, it was not clear for the operators what issues are affecting on the measure result and whether they can affect on them. Second, they considered the goal too tight in the current situation of the economic turmoil. Thus, although the consequence of reaching the goal i.e. rewarding was considered tempting and the employees were willing to make an effort to reach it, the current goal of the measure was not motivating them. It was not expected that they would reach the goal and be rewarded based on it, which made them choose their behavior accordingly, which was not to try to influence energy efficiency.

The theory of intrinsic motivation (Deci & Ryan 1985) emphasizes the needs of competence and autonomy as a basis for motivation. It seems that although financial rewarding cannot create intrinsic motivation, it could disrupt it. Rewarding perceived unreachable includes negative feedback and informs of the incompetence of the employees, which will lead to decreased intrinsic motivation. (see Hakonen 2006, 23) At Borealis Polymers, the yearly bonus was not considered to have a big impact on the motivation to enhance energy efficiency, but neither did the operators or officials considered it to have a negative impact on their work motivation. This view of the interviewees can however be questioned. At Borealis Polymers the case might have

been that the operators were losing their extrinsic and intrinsic motivation at the same time. Both performance measurement and rewarding were sending a message of the incompetence of the employees. At the moment, the measuring and rewarding of energy efficiency were communicating that energy efficiency improvements are out of the reach of the operators. This could lead to the limited effort among the operators. Therefore, it seems that one of the most important reasons to solve the challenges in measuring and rewarding energy efficiency is not to lose the intrinsic motivation of the employees.

According to the goal-setting theory (Locke & Latham 1990), a person is motivated best, when the goals are specific, challenging and accepted by the employees (Heneman & Werner 2005, 32). At Borealis the operators did take part in agreeing on the goals. However, their opinion was that they don't actually have much influence on the goals. The bonus system was an additional benefit offered by the employer, which could be taken away, if desired. Thus, the employees felt they should basically be grateful of what they are offered. What comes to energy efficiency, the goals were experienced at the moment too challenging and thus were not accepted, which again could lead to a decreased motivation and effort.

Equity theory (Adams 1965) refers to individuals evaluating their input and output –equation in relation to a reference person or a group (Hakonen 2006, 24). If an employee experiences that he or she is receiving less compensation than others, it will cause dissatisfaction. The equity is reached either working harder to earn a pay increase or reducing the inputs on work. Equity theory looks at the role that social comparison play in motivation. (Heneman & Werner 2005, 30) At the case company, the equity theory did not apply so much for the interrelationships of the employees, since they were rewarded equally based on the scorecards.

Reinforcement theory describes how desired actions should be reinforced with rewards. In order to succeed in reinforcing desired action, the desired behavior should be clearly defined, reward should be close in time and the reward should be in close magnitude with the effort. (Heneman & Werner 2005, 27) At the moment, the desired behavior consistent with improving energy efficiency was not clear for the operators. It was not all clear, how they can influence energy efficiency or in extent it is possible. However, they were rewarded based on energy efficiency

related measure. The reward also came once a year, which was clearly not in close enough relation with their efforts.

The motivational theories of rewarding can thus help to understand how individuals behave as a consequence of rewarding and why they behave as they do. Also, with these theories it is said to be possible to understand why rewarding is important for some individuals and less important for others and how rewarding affects behaviour. (Hakonen 2006, 19) At Borealis Polymers, the rewarding was considered to have a limited effect on work motivation. At the same time, the operators and technical officials believed it not to have any negative effect either, but this view was questioned in this study. When analysing the situation in the case company with the motivational theories, several causes for the low work motivation among operators could be recognized. Accordingly with the theories, work motivation was decreased because of the small probability of reaching the measure goal and rewarding, negative feedback on competence received from rewarding, unclear desired behaviour and too big distance between rewarding and the effort.

#### Enhancing energy efficiency management

Although the measuring and rewarding of energy efficiency were sometimes considered as a source of frustration, energy efficiency was not an indifferent matter for the operators; they saw energy efficiency as part of their work and also made suggestions on how to improve energy efficiency in the company. Several suggestions on how to enhance energy efficiency emerged during this study. A summary of the suggestions emerged are presented in Table 1. The suggestions related to the following five themes: shared ownership, employee involvement, concrete training, illustrative measuring and real-time information. These themes repeated in the responses of the interviewees and were raised here to describe the comprehensive proposals the interviewees had on improving energy efficiency management. Only few of the suggestions were related to rewarding. A reason for this - as already mentioned - might be that rewarding was expected to improve, if some of the challenges with measuring energy efficiency were able to be solved. One problematic issue related to rewarding that did come up in the interviews with the operators was the temporary influence of the bonus on motivation. The productivity bonus was

paid once a year, which was not enough to keep operators' interest in the results of the SEC the whole year. Besides organizing the financial rewarding differently, a solution for this problem could be also found from the field of intangible rewarding. With intangible rewarding, the company could concentrate on creating enthusiasm and in-depth interest (Luoma 2004, 43) towards energy efficiency. In the following table (Table 1), a summary of the key problems with energy efficiency at Borealis Polymers and improvement proposals for these problems that emerged in the interviews are presented.

Table 1. Summary of the key problems with energy efficiency at Borealis Polymers and the improvement proposals

PROBLEMS WITH ENERGY EFFICIENCY	IMPROVEMENT PROPOSALS
<p><b>Energy efficiency is not "owned" by the whole company</b> - Energy KPI (SEC) and rewarding related to the SEC involves a limited share of the personnel (e.g. the plant availability and engineering employees are not involved with measuring and following energy efficiency)</p>	<p><b>Shared ownership</b> - This would mean that all the different parts of the organization would think from their perspective, how they can enhance energy efficiency (This is expected to evolve since energy issues were intergrated with ISO 14001 in March 2009).</p>
<p><b>The role of energy efficiency in daily work is minor</b> -                      "It [the Energy-KPI] is understandable, but what are all the items that have an effect on it... What all measures, what consumptions, and the list is quite a long one. So it is not unambiguous." (Technical official C)                      "And is it internalized?" (Technical official A)</p>	<p><b>Employee involvement</b> - The employees should be involved in improving energy efficiency. They have a deep understanding e.g. of the working habits or values in the company. A way to do this could be the Borealis Way -program already existent in the company.</p>
<p><b>Employees' abilities to influence energy efficiency or the SEC are limited</b> - "There is nothing to be done." (Shift Manager, P&amp;A) The operators feel they can't really influence energy efficiency in their work. In an integrated process, the operators won't start playing solos and saving energy without clear instructions.</p>	<p><b>Concrete training</b> - All the operators wished to have more concrete training on how they can influence energy efficiency. The current k-days were insufficient for this. The training could include reflecting best practices, writing them down and sharing them among employees.</p>
<p><b>The current measuring of energy efficiency includes several challenges</b> - First, the measures are new and lack comparability. Second, the contributors to the measure and their weighting are not clear. Third, connecting day-to-day activities to the energy efficiency measure is a challenge.</p>	<p><b>Illustrative measuring</b> - Developing more illustrative financial and non-financial measures of energy efficiency was considered crucial in the interviews. For example, the "splitting" of the Energy KPI (SEC) was already planned at the Hydrocarbon unit. More suggestions of possible measures that emerged during the study are presented in chapter 6.3.4.</p>
<p><b>Employees' access to information contains shortages</b> - The scorecards are often updated late and they can contain errors, which is especially remarkable at the end of the year. The updates of the SEC, which are made once a month, are not frequent enough.</p>	<p><b>Real-time information</b> - Especially the operators wished to have more real-time information on energy efficiency. For them the last month's figures in the scorecards are already past and gone life.</p>

## 7 CONCLUSIONS

Energy issues have increased their importance as a consequence of diminishing energy resources and increasing energy costs. In the process industry, the energy expenses can represent a significant proportion of the total production costs. Hence, energy efficiency has become a matter of competitiveness for many companies. One of the important sources for energy efficiency improvements in industry are the investments on technology and production processes. Another less discussed but important opportunity is managing and motivating personnel to enhance energy efficiency. Performance measurement and rewarding have generally been used, among other things, to motivate employees. Measuring energy efficiency is still in its infancy and the effects of energy efficiency measures on employee motivation have not been studied widely.

This study focused on studying the measuring and rewarding energy efficiency in one case company from the field of the process industry. The measuring and rewarding energy efficiency were studied to find out the critical challenges in motivating employees and to come up with suggestions on how to enhance the energy efficiency management in the company. The suggestions for improvements that emerged during this study related comprehensively to the working methods and processes of the case company, not only on measuring and rewarding energy efficiency. In the theoretical part of this study, a literature review on measuring energy efficiency, performance measurement in general, work motivation and rewarding was conducted. Also, the connections between performance measurement, rewarding and work motivation were discussed. Conclusions made based on the literature review indicate, that rewarding should be linked with the most important performance measures. Otherwise, the direction of the company is not clear. On the other hand, if the measures are badly chosen, rewarding has little chance in leading the company in the right direction or motivating employees. Employees should feel able to influence on the measures they are made accountable of. Otherwise, the measures and rewarding are experienced demotivating. Furthermore, the effects of rewarding on motivation are not always easy to predict; they can be positive, negative or neutral. Thus, financial rewarding should not be automatically expected to improve motivation, even if it were connected with important performance measures.

In the empirical part, altogether 21 representatives of the case company were interviewed. The interviews were conducted in two stages; first, individual interviews among managers and second, group interviews with the operators and officials. Next, the conclusions of this study are presented accordingly with the three research questions of this study.

The first research question, *how is energy efficiency measured and managed in the case company*, provided an answer for the current state of energy efficiency in the case company. During the study it became clear that energy efficiency had an increasingly important position in the case company. The company followed performance with several energy-related measures, which were in part also linked with rewarding. The interpretations of the importance of energy efficiency did however differentiate inside the company and the views on energy efficiency were not shared. In the everyday work of the organization, the importance of energy efficiency was not yet as transparent as for example quality and security. One reason for this can be noted to be the fact that energy efficiency management did not yet include the whole organization. Thus the current management systems were not fully supporting the organization's strategic goal to enhance energy efficiency. Several plans had been made to change the state of affairs and to spread the energy efficiency –thinking to cover the whole organization. For example, the Energy Management System had recently been included in the ISO 14001 Environmental System. In addition, series of training sessions on energy efficiency had been planned.

Rewarding in the case company followed partly the principles of strategic rewarding. Energy efficiency had a strategically important position in the company and rewarding had been linked with energy efficiency to support the business strategy of the company. Borealis Polymers also utilized rewards with different time dimensions. A weakness in supporting the business strategy of the company was that the measuring and rewarding of energy efficiency did not yet include all the relevant parts of the organization. Although, energy-related measures were followed in several operations, all the relevant employees were not made accountable of the measures through rewarding. As Kaplan & Norton (1996a, 217) have stated, it should not be a matter of whether, but how rewarding is connected with strategically important performance measures. Accordingly with the framework on the interconnections between performance measurement,

rewarding and work motivation presented earlier in figure 7 (p.37), the goal of the company is not clear, if employees are not made accountable on strategically important measures. With rewarding, the management should further emphasize the importance of chosen performance measures. In this context, a problem faced by all companies with rewards systems, is how to evaluate or appraise performance. In other words, if rewards are expected to have a positive impact on an individual's motivation to participate and perform, it is crucial how the quality and quantity of performance are evaluated. (Steers et al. 1996, 500) To clarify the motivational effects of measuring and rewarding energy efficiency, it was considered important to study how reliable and valid the measuring of energy efficiency was experienced by the personnel of the case company. Since, if the evaluation systems are experienced unreliable or lack of validity, it is unlikely that the rewards based on the evaluation can have much effect on performance either. (Steers et al. 1996, 500) At the moment, it seemed that the energy efficiency measure (SEC) had more of a symbolic meaning in the scorecards than activating and motivating effect on the employees.

The second research question was hereby *how is measuring and rewarding of energy efficiency recognized as motivating*. As a part of this research question, the possibilities of different employee groups to influence energy efficiency were studied. A preliminary view made based on the theoretical review was that measuring and rewarding energy efficiency cannot be experienced motivating, if the employees feel they cannot influence the measures used. This seemed to apply at Borealis Polymers, when measuring energy efficiency. The officials felt they can influence energy efficiency and were also more motivated to improve it. On the other hand, the operators interviewed seemed less motivated to influence energy efficiency and the main reason for this was their feeling of inability to influence. The study showed that the Energy-KPI (SEC) followed at Borealis Polymers contained several limitations and shortages, which deteriorated its usefulness in leading and motivating employees. The operators felt the energy efficiency measure is influenced by many factors irrespective of them, which was considered demotivating. The feeling of not being able to influence was enforced with the challenging goal of the SEC, which was considered totally disproportionate by the operators.

As a consequence of not being able to influence the SEC, the operators also felt that they can't influence the rewarding of energy efficiency, either. In general, the challenges in measuring energy efficiency make it difficult to place a lot of weight on measure that is not yet sophisticated. Knowing the difficulties in developing a more reliable measure of energy efficiency (see chapter 2.3); it seems still early to combine rewarding with measuring energy efficiency. In fact, an interpretation was presented in this study, that the measuring and rewarding energy efficiency might be currently lowering operator's intrinsic motivation. Several causes for the operator's low motivation towards energy efficiency were found: First, the motivation was low because of the low probability of reaching the goal of the energy efficiency measure and being rewarded. Second, the measuring and rewarding forwarded negative feedback for the employees of their competence to reach the goal of the energy efficiency. This was analysed to actually reduce the intrinsic motivation of the operators to influence energy efficiency. Third, it was not clear for the operators what was the desired behaviour from them and what they could do to reach the goal of energy efficiency. Fourth, there was a too big distance between the rewarding and their effort, that it would have reinforced the efforts of the operators towards energy efficiency.

Still, taking into account the growing importance of energy efficiency for the competitiveness especially in the field of the process industry, the recommendations made based on this study do not suggest removing the energy efficiency measure from the scorecards or from the bonus system. Instead, the measuring and rewarding of energy efficiency should be developed further to support the work of the employees to enhance energy efficiency. The measuring and rewarding of energy efficiency should also be complemented with managing, training and information sharing, while the measures are being developed further to better describe the efforts of the accountable employees. Thus the preliminary view of not being able to motivate with a measure difficult or even impossible to influence was firmed.

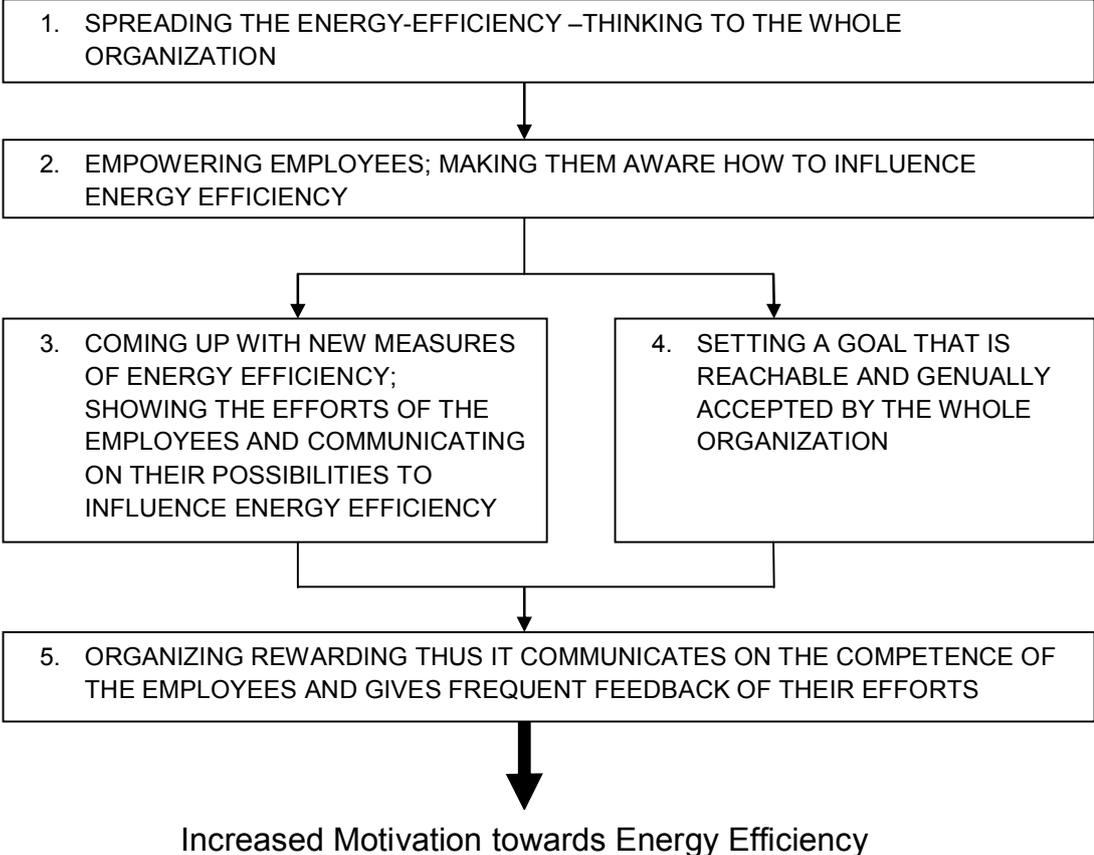
The third research question, *how could energy efficiency management be enhanced*, aimed to find new solutions in measuring, rewarding and managing energy efficiency in case company more constructively. The improvement suggestions that emerged in the interviewees during the study concentrated on shared ownership, employee involvement, concrete training, illustrative

measuring and real-time information. Shared ownership of energy efficiency equals to including the whole organization in finding new solutions to improve energy efficiency. Employee involvement was emphasized in the interviews as a way to produce improvements in energy efficiency, but also as a way to motivate and commit operators and other employees. In addition, the operators wished to have more concrete training on energy efficiency issues, when the current training was considered too superficial. Overall, an emphasis in the organization should be placed especially on coming up with new and innovative ways of measuring energy efficiency, when the challenges in rewarding energy efficiency were also closely related to the challenges in measuring energy efficiency. This could mean for example splitting the SEC into smaller followed parts, as already planned at Borealis Polymers, or separating the energy efficiency related initiatives from other initiatives to highlight them more. Finally, more real-time information on energy efficiency was requested by the operators to ensure them to have updated and concrete information on energy consumption and energy efficiency of the plants.

Besides the previous improvement proposals that emerged in the interviews, a map to motivation (Figure 12) was formed in this study by integrating the ideas from the theoretical framework and the empirical results of the study. The map includes crucial steps in developing energy efficiency management to improve the motivation towards energy efficiency in the case company. The map to motivation can overlap with the improvement proposals emerged in the interviews, but the aim of the map is to consider the improvements needed more broadly, based on both the theoretical frameworks and empirical results of this study. The steps in the map are not necessarily in chronological order, but should all be equally considered, when aiming to increase the motivation towards energy efficiency. First step emphasizes the importance of involving all employees in improving energy efficiency. This involvement should be enhanced by making all the relevant employees accountable of energy efficiency related measures and rewarding. In other words, this would enable using all the relevant human resources of the company to the work of improving energy efficiency. Second step is making the employees well aware how they can influence energy efficiency and thus empowering them to enhance energy efficiency. If the operators can influence energy efficiency in their work or if they already are, and it is considered important, it should be clearly brought to their attention too. At the moment, the operator's work was mostly directed by quality, production efficiency and security. Energy efficiency had a

smaller part in their work. The operators experienced their abilities to influence energy efficiency or measuring energy efficiency fairly limited and thus were not highly motivated to improve it. However, the production efficiency is known to be one of the main contributors to the energy efficiency, which means that operators were already doing important work towards energy efficiency. From the point of view of motivation, an experience of doing an important work that has a meaning is crucial, and the floor level employees were in a need of having a share of this. Thus empowering floor level employees; letting them know how they can influence or how they already are influencing is a one step, when aiming to increase motivation towards energy efficiency. Third, new measures of energy efficiency or modifications of the current measures, which show the efforts of the employees and communicate on their possibilities and competence to influence energy efficiency, should be developed. In developing new energy efficiency related measures, the people management aspects, especially the effects of the measures on work motivation should be recognized. When coming up with new measures, it should be noted that the measures provide employees the information that is namely relevant in their work, when enhancing energy efficiency. Fourth, the goal of the measure should be reachable and genuinely accepted by the whole organization not to lower the motivation and the employees' feeling of competence. Fifth, the rewarding should also be organized thus it would communicate on the competence of the employees and give frequent feedback of their efforts. At Borealis Polymers this could mean dividing the dimension of the bonus into six months, instead of the current twelve months. More frequent rewarding would remind more efficiently of the company's strategically important goal to enhance energy efficiency. Finally, as a consequence of the surely challenging steps, the work motivation in an organization could be expected to improve.

*Steps To Improve In Energy Efficiency Management*



*Figure 12. Map to motivation*

Some limitations have to be noted, when considering the results of this study. The first challenge during the study was to ensure, that the interviewer and the interviewees were always talking about the same issues. Sometimes the terms used are shared, but the interpretations are different. This possible limitation was under a special monitoring and an effort was made to use the language of a particular employee group. Another challenge was interviewing on topics such as measuring, rewarding and motivation, which could sometimes be strongly emotionally charged. Additionally some limitations have to be distinguished that rose from the research method. First, the results of the study cannot be generalized to a larger population. Still, the results provide a description and interpretations, how energy efficiency management functions in practise in the case company. The results can be used as a support, when studying other companies measuring

and rewarding energy efficiency and aiming to explain their impact on work motivation. Second, the researcher's own interpretations should be acknowledged, when considering the improvement proposals brought forward. Still, as an outsider of the company, the researcher can be seen to have fairly good possibilities to evaluate the results in a neutral manner. Also, as the sponsor of the study was mainly a public foundation, instead of the case company, the impartiality of the research was even greater.

Further research is needed in order to make the measures of energy efficiency more reliable. More knowledge is needed on the possibilities of the employees to influence the energy efficiency through operating or maintaining the plants. One important indication of a measure's quality is its impact on work motivation. When designing new measures, all the measure's target groups should be acknowledged. Different levels of organizations do not need the same information from the measure. Besides concentrating on the technical elements of the measure, an emphasis should be placed on what kind of information on energy efficiency is needed in different levels of an organization. Thus, further research is needed on how to better suit the measuring of energy efficiency for its different target groups. By designing better suited measuring of energy efficiency, the companies would not only be more able to motivate its employees, but also more competitive to survive with increasing energy costs.

Last, a quote from the Manager C of the case company to describe the significance of investing in measuring and managing energy efficiency to create motivation.

*“Isn't it so that people do get motivated, if you explain them what is the meaning of something. We are all looking for a meaning for our work. It will start from setting the measures properly, finding the right measures, which will serve the meaning of the company. We cannot fool people with other motivators to act as we want them to act. “*

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## APPENDICES

### Appendix 1: Example of the interview form (the first stage – managers)

Interviewee: \_\_\_\_\_

Interviewer: \_\_\_\_\_

Date: \_\_\_\_\_

*Measuring energy efficiency in process industry – How energy efficiency can be enhanced with performance measurement? How measuring energy efficiency contributes to employee motivation?*

#### 1. Profile (shortly)

- Responsibilities, tasks, reporting relations
- Work history

#### 2. Research topic

- Do you think the subject of the research is relevant?
- What kinds of results would you expect to be found?
- Can employees at plants enhance energy efficiency?
- What is the meaning of performance measurement in their work?

#### 2. Energy efficiency and performance measurement in general

- What is the status of energy efficiency in the company?
- How do you feel the measures activate people on average?
- What kind of advantages the company gets by measuring energy efficiency? What kinds of forums are used to discuss about energy-efficiency measures?

#### 4. Motivation

- How do you feel how measuring energy efficiency influences the motivation of employees?
- Should the motivation of the employees be paid more attention in the company?
- What kinds of effects a good work motivation could have on energy efficiency?

#### 5. Rewarding

- Does rewarding have positive or negative influences on employee motivation, or both? (short-term and long-term?)
- Rewarding and other management systems?
- Rewarding in enhancing energy efficiency?
- How rewarding could be developed further?
- Intangible rewarding and its meaning in enhancing energy efficiency?

## **Appendix 2: Interviewees in stage one (managers)**

### **Interviews:**

Technical official A, Hydrocarbon 29.10.2008

Manager A, Polyolefins 29.10.2008, 11.11.2008 (and several informal discussions)

Manager B, Hydrocarbon 12.11.2008

Manager C 12.11.2008

Manager D 10.10.2008 (and several informal discussions)

Manager E 24.11.2008

Manager F, Polyolefins 24.11.2008

Manager G 26.2.2008 (only through phone and e-mail)

**Appendix 3: Interview form (the second stage – plant managers, technical officials and operators)**

Interviewees: \_\_\_\_\_

Interviewer: \_\_\_\_\_

Date: \_\_\_\_\_

*Theme for the research: Energy efficiency related measuring and rewarding and their connection with work motivation - Case: Borealis Polymers Oy*

Questions:

1. How the use of energy is measured and how energy efficiency is followed at your plant?
2. What kinds of issues have an effect on the use of energy at your plant (or energy-efficiency measure)?
3. Can you influence the use of energy or the results of energy-efficiency measure with your own work?
4. Can you give examples where you have influenced energy efficiency in your work?
5. For what reasons would you like to influence energy efficiency?
6. Do you feel yourself motivated to enhance energy efficiency?
7. Can you name practical examples how the use of energy or energy efficiency could be measured in a new way?
8. How are you rewarded from energy efficiency?
9. How significant you experience this rewarding on your motivation to enhance energy efficiency?

#### **Appendix 4: Interviewees in stage two (plant managers, technical officials and operators)**

##### **Group 1:** Technical officials, Olefin (3.2.2009)

Technical official A (whole Hydrocarbon)

Technical official B

Technical official C

Technical official D

Technical official E

Technical official F

##### **Group 2:** Operators, Olefin (3.2.2009)

Shift Master

Operator1

Operator2

##### **Group 3:** Technical officials, Phenol & Aromatics (5.2.2009)

Technical official G

Technical official H

##### **Group 4:** Operators, Phenol & Aromatics (5.2.2009)

Shift Master

Operator1

Operator2

## **Appendix 5: Suggestions for non-financial energy efficiency measuring**

Technical official C, Olefin:

- Splitting energy consumption measure in smaller parts (+ euro spending visible) => measuring and following/trend DCS/computer system (visibility in the operators' control cabin)
- Regular reviews of energy consumption in shifts (every month)
- Steam leaks at the field, checking steam traps in observation tours
- Training. Using simulator in illustrating the consumption of energy

Technical official F, Olefin:

- The electricity and steam consumption & target level of biggest machines / in relation to load level
- Total electricity consumption
- Total steam consumption
- "Energy FA:K" – on?? – notification if not on
- Saving heat exchanger

Technical official D, Olefin:

- Energy consumption follow-up between responsibilities (for example, the cracker has been divided in five responsibilities and every shift has its own sphere of responsibilities).

Shift Master, Olefin

- Furnace specific measures (energy/ t)

## **Appendix 6: Suggestions for financial energy efficiency measuring**

Technical official A, Hydrocarbon: euro spending in trend screen

- The power consumption of biggest electric motors for trend eur/h
- The measurement of fuel gas eur/h
- Steam consumptions of different destinations eur/h
- The import of steam from power plant eur/h
- The cleanliness of heat exchangers (heat-transfer coefficient > eur/h)