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ScienceDirect

Procedia Manufacturing 8 (2017) 175 – 182

Procedia MANUFACTURING

14th Global Conference on Sustainable Manufacturing, GCSM 3-5 October 2016, Stellenbosch, South Africa

Requirements and tasks for active energy management systems in automotive industry

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Abstract

The "2020 climate and energy package" enacted by the EU aims to reduce emission of greenhouse gases, to increase the share of renewable energy and to improve overall energy efficiency. These goals are forwarded to the industry using regulations or funding opportunities. Taking a deeper look e.g. into automotive industry the companies reflect these goals to their plants across Europe. Energy efficiency is a plant-related KPI to gain customer satisfaction, enhance greener production and optimise internal costs. Current developments especially deal with base load reduction for production plants. In order to achieve this, all resources within the factory, interconnected by processes or by energy flows, have to be actively managed. This paper deals with the requirements on energy management systems stemming from the task to control production, infrastructure as well as technical building systems (TBS) simultaneously with focus on specifics of the automotive industry.

Peer-review under responsibility of the organizing committee of the 14th Global Conference on Sustainable Manufacturing

Keywords: energy management system; production planing and control; energy storage management; flexibility, automotive

1. Introduction

The improvement of energy efficiency is one of the core objectives of the European policy as well as the local governments and industry for many years. Tremendous efforts in the manufacturing industry have traditionally

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Peer-review under responsibility of the organizing committee of the 14th Global Conference on Sustainable Manufacturing
doi:10.1016/j.promfg.2017.02.022

focused on reducing the energy consumed by the different pieces of equipment or changing the processes [1]. In the light of the "2020 climate and energy package", this will not suffice much longer. Besides increased energy efficiency (by 20 %) its goals are to cut the greenhouse gas emissions by 20 % while raising the share of renewable energy used in the European Union to 20 %, prompting significant change in the structure and behaviour of the European energy systems [2].

Very high scale projects like WindNODE (outcome of the founding programme "Schaufenster intelligente Energie – Digitale Agenda für die Energiewende") and "Kopernikus-Projekte für die Energiewende" show, that German government perceives the relevance of this demand for change. Both named initiatives as well as others deal with the expanding integration of renewable energy sources. The latter require great efforts from the grid operators to economically provide the same quality of energy supply to their customers. However, the energy yield now depends significantly more on time of the day as well as regional aspects. This leads to transportation and storage necessities. With the decentralisation of energy production customers are becoming producers as well and new business models are expanding into the traditional energy market. In order to remain atop of other upcoming developments and to make use of such new business models, companies need to transform their traditional energy management to an active energy management. One of the biggest and generally most innovative industry sectors is the German automotive industry.

This paper discusses the specific energy efficiency goals for the automotive industry (section 2). Section 3 describes typical energy management systems (EMS) and processes and derives the status quo in the automotive industry. In section 4 a sketch for an active energy management system fit for the future is discussed. In particular, the basics of a software platform providing necessary transparency are presented. It shows how energy management systems may be able to deal with other pre-existing systems in the production environment (i.e. horizontal and vertical integration). Further discussion focusses on how the data integration should work and how the derived information can be used for planning and control tasks by active energy management systems using new production planning and control (PPC) strategies and energy storages. Section 5 describes the process of selecting and implementing an energy data system as a major part of any active energy management system, highlighting the boundaries and interfaces it needs to cooperate in full with the existing process and IT landscape.

2. Energy efficiency: Importance for the automotive sector

Energy efficiency is a key factor in the automotive industry. Production plants of Original Equipment Manufacturers (OEM) in this sector are in a global competition within their corporation. Headquarters expect top level quality, on time delivery and great flexibility at competitive costs from their production plants. Because energy consumption at average OEM car production plant is high - about one third of the annual capacity of a modern offshore wind park such as Baltic II (1.2 TWh p.a. [3]) - energy costs are high, too. Hence, energy efficiency became a relevant issue in the above-mentioned internal competition. Especially paint workshop and body shop are highly energy intensive areas of production. Furthermore energy awareness of customers is becoming a competitive factor for OEM on a global scale. This is reflected in the various environment programmes and efficiency brands OEMs have established, e.g. Think Blue. / Think Blue. Factory. (VW), ultra (Audi) or EfficientDynamics (BMW).

An effective tool corporations use to foster internal competitiveness is sets of indicators, which are used to compare car production plants with one another. These (1) group-determined plant indicators become increasingly important. Within this group, indicators such as energy consumption per vehicle produced, share of renewable energy as percentage of total consumption, share of energy consumption by compressed air systems and electricity generation from onsite facilities are measured. This type of indicators is used in decision-making regarding local as well as company-wide investments, allocation plans and assembly plans. Thus, they are a strategic controlling instrument for automotive manufacturers to estimate costs and revenues. Furthermore, these indicators are used to address energy consumption targets for production plants.

One trend in recent years is that OEM production plants create knowledge on energy efficiency by themselves before sharing it within the corporation. Achieving certifications, realising pilot projects, implementing ideas management or energy awareness programs for workers are corner stones to this. Yet, to actually manage energy efficiency (2) locally determined plant indicators are a necessity. They are used on the shop floor level and also pay heed to local particularities as well as legal requirements. These indicators include energy consumption per production line or per production cell amongst others. Through their application, they support the implementation of various energy efficiency measures, such as lights management shutdown management, peak shaving, etc. Plant