Evaluating industrial energy management systems – considerations for an evaluation plan

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Introduction

Purpose:

To explore and identify aspects of Energy Management System (EnMS) evaluation to be addressed by evaluators to assess impact and outcome of industrial EnMS practices.

Explorative research questions:

•Why and under what circumstances should industrial EnMS be evaluated?
•Which are the objectives for EnMS implementation from a public versus a private perspective?
•Which indicators could be considered for monitoring and rating success of an industrial EnMS?
•Which are the essential EnMS practices?

Methodology:

•Empirical base:
- the Swedish PFE, a comprehensive EnMS program for energy-intensive industries.

•Stakeholder consultation:
- Swedish Energy Agency: interviews with staff responsible for operation & evaluation of PFE.
- EnMS standard certification companies: survey and interviews with external auditors.
- Industrial energy end-users: site visits and interviews with EnMS coordinators at eight pulp and/or paper mills.

•Data assessment to examine potential indicators of improved energy performance.

Why and under what circumstances should industrial EnMS be evaluated?

Industrial EnMS needs to be evaluated because…

•Whenever public funds are involved for EnMS stimulation there is a justified demand for knowledge on results and effectiveness.

•As one of 25 Energy Efficiency Policy Recommendations the IEA advise governments to require energy-intensive industries and stimulate other industries to implement EnMS which conform to ISO 50001 or equivalent.

•EnMS programs (EnMP) may complement or even replace alternative policy instruments like taxation, pricing of emissions, energy efficiency regulations (e.g. Denmark and Sweden).

•Evaluation is required to improve policy programs like EnMPs (Reinaud et al. 2012).

•Also when freestanding industrial EnMS implementation and certification is promoted without the comprehensive EnMP approach, evaluation efforts may be constructive (GeorgiaTech 2011).

•For the broad category of less energy-intensive SMEs there is limited knowledge on practical implementations of EnMS.

Input from the Swedish Energy Agency (SEA)

Evaluation activities:

•The overall PFE program impact (i.e. the energy efficiency improvement) is assessed through a bottom-up approach, and concludes:

- gross annual electricity savings from required actions and procedures.
- value of investments and straight payback periods.
- gross annual energy savings and other energy benefits from voluntary reports of other non-required actions.

•But, gross-to-net conversion factors (e.g. free-riders, spill-over, double counting etc.) have not been estimated by the SEA.

•A number of surveys and interviews with different stakeholders to gather knowledge about EnMS implementation and program compliance.

•But, the isolated impact from individual program components, like the EnMS, has not been estimated.

Source: Moberg 2012

Input from certification bodies

Some essential energy management practices…

•Energy audit and analysis:
-Large & profitable energy saving potentials strengthened the business case for energy efficiency.

-The EnMS framework has generated thorough technical-economic analysis of actions, identification of significant energy aspects.

-However, there could be stronger focus on energy efficiency improvement from O&M measures.

•Roles and responsibilities:
-EnMS coordinators, appointed by top management, are responsible for compliance with PFE and standard requirements.

-EnMS coordinators feel they have clear mandate from management to perform their tasks.

-At larger industrial plants the chief EnMS coordinator has access to division level EnMS coordinators (i.e. process engineers) and together with other staff (e.g. technical experts from maintenance department) they form cross-functional EnMS teams.

•Dissemination in the organization:
-Awareness of EnMS practices has spread across organizations and involved new categories of staff.

-EnMS teams hold regular meetings to prepare the division level implementation of actions.

•Life cycle cost (LCC) procedures for energy efficient procurement and project planning:
-PFE requires companies to develop and apply LCC procedures. New, challenging but rewarding.

Source: Franck & Nyström 2008; Modig, 2012

Input from industrial energy end-users: 8 pulp and/or paper mills

Objectives, targets and monitoring exist on different levels…

•**Group-wide:**
- 6/8 of mills declare targets (quantified and time-framed) to reduce total specific energy use.
- Targets to reduce specific CO2 emissions are likewise common.

•**Site-level:**
-7/8 of mills declared targets to reduce specific energy use (for all or for certain enery carriers).
-5/8 of mills declared objectives to increase internal electricity production.
-2/8 of mills declared objectives to increase use of biomass fuels
-2/8 of mills declared objectives to increased energy delivery to adjacent society

•**Division or process-level:**
-5/8 of mills track specific energy use for significant energy aspects (e.g. process equipment) to maintain acceptable performance levels.

•At 1/8 of mills the respondent demonstrated low awareness about energy performance targets

Improved energy performance

3.12 - Energy performance
measurable results related to **energy efficiency** (3.8), **energy use** (3.18) and **energy consumption** (3.7)

NOTE 1 In the context of energy management systems, results can be measured against the organization's energy policy, objectives, targets and other energy performance requirements.
NOTE 2 Energy performance is one component of the performance of the energy management system.

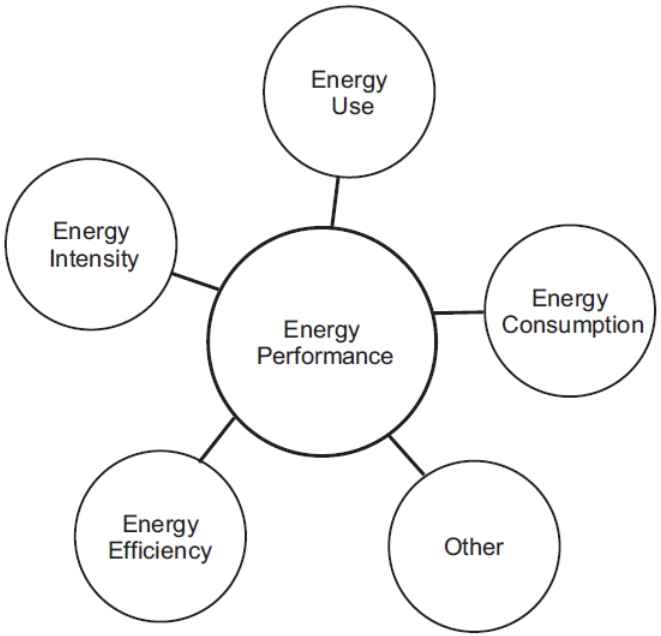


Figure A.1 — Conceptual representation of energy performance

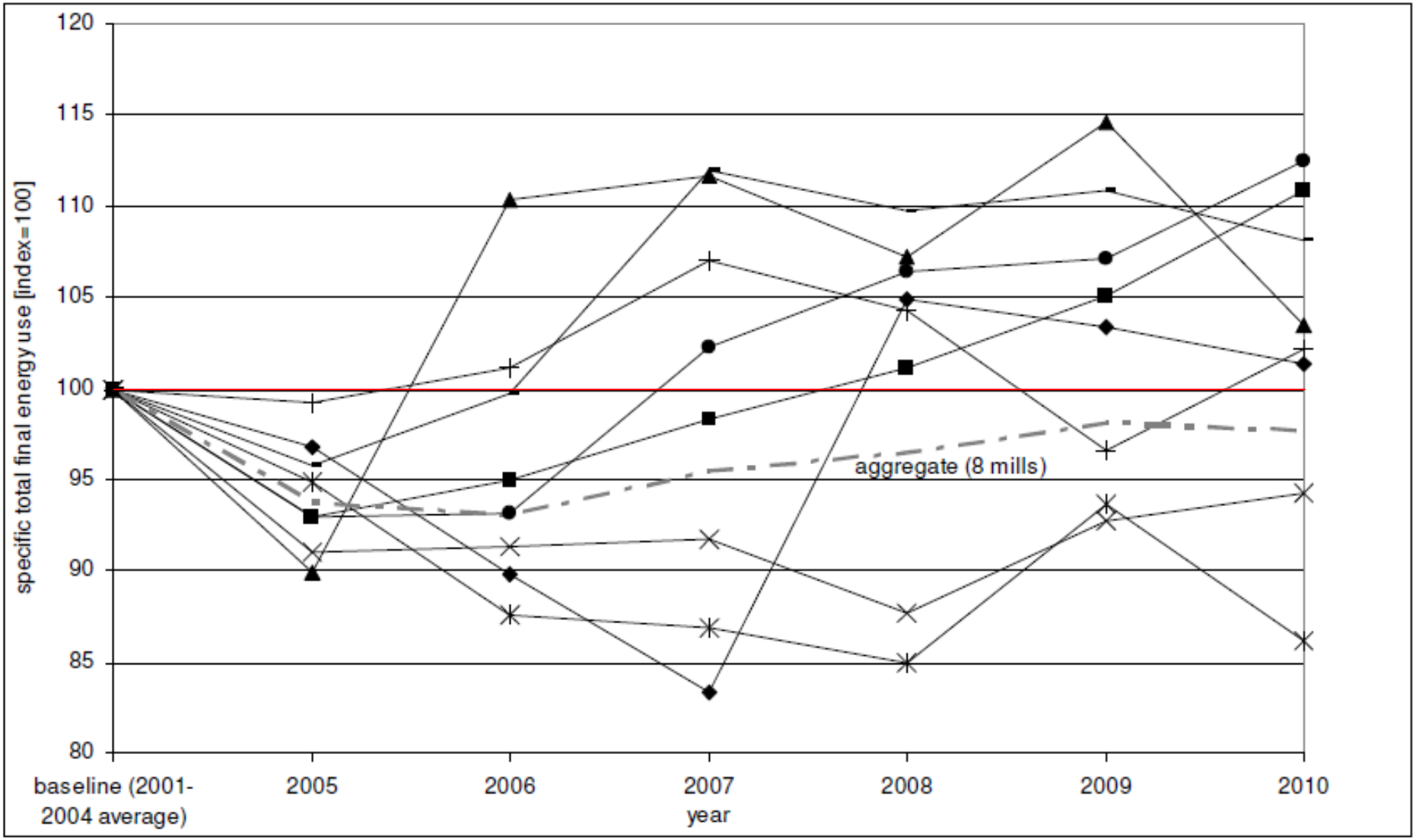
Source; ISO 50001

Three energy performance indicators were selected…

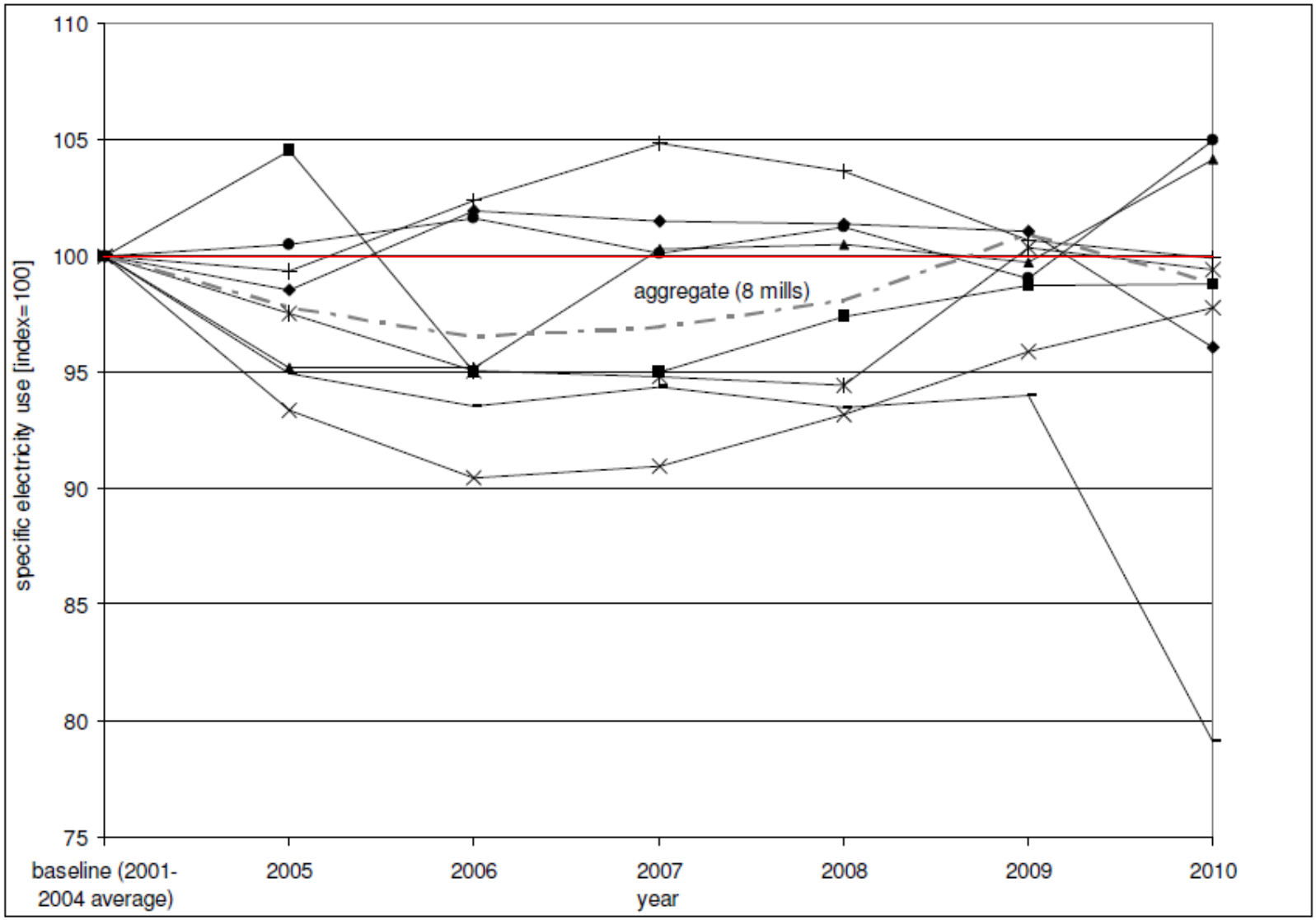
1. Specific total energy use [GJ per tonne physical production]
2. Specific electricity use [kWh per tonne physical production]
3. Specific CO_2 emissions [kg CO_2 per tonne physical production]

The performance with EnMS in place (2005–2010)
versus
The performance before the EnMS implementation (2001–2004 annual average)

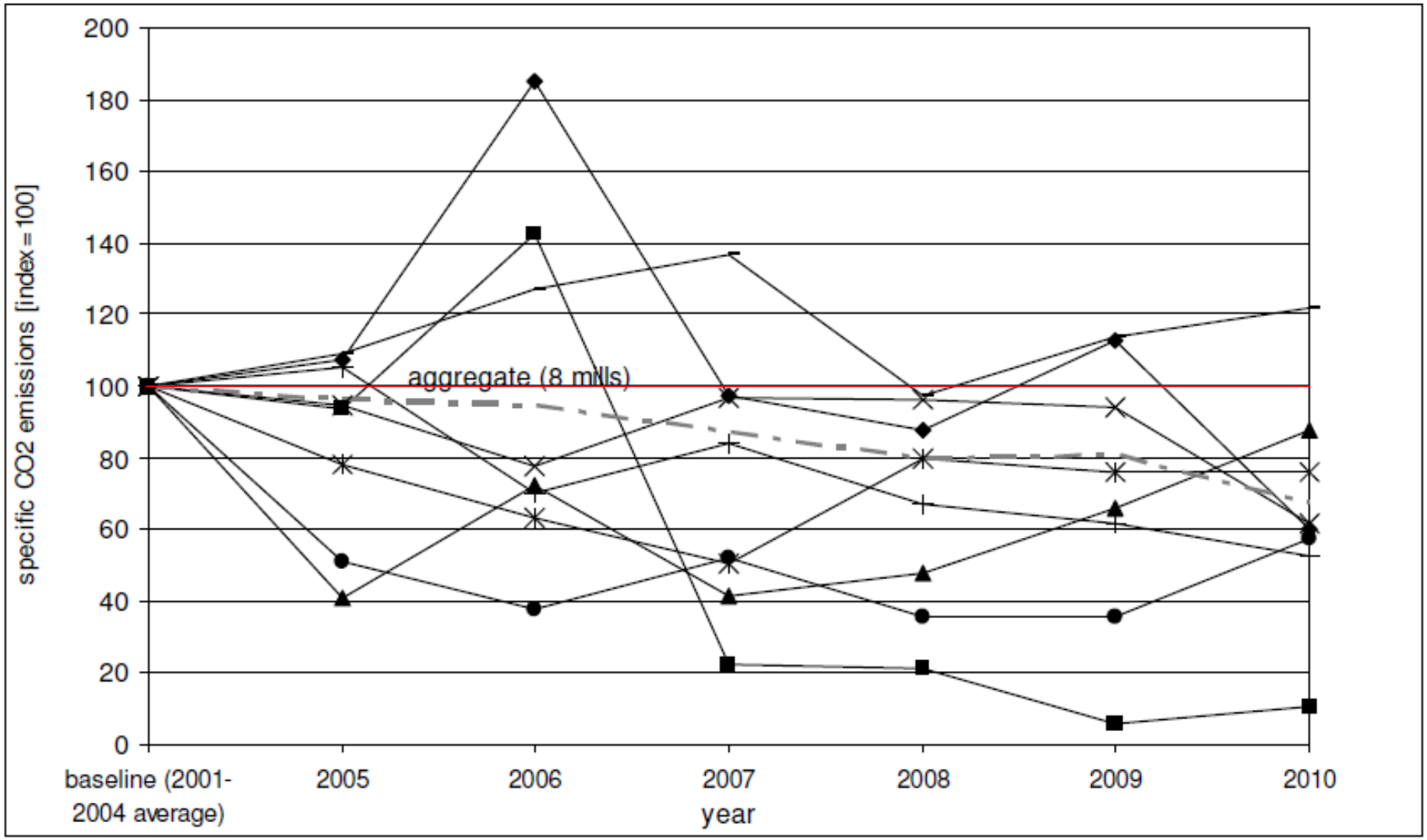
1. Specific total energy use [GJ per tonne physical production]



2. Specific electricity use [kWh per tonne physical production]



3. Specific CO_2 emissions [kg CO_2 per tonne physical production]

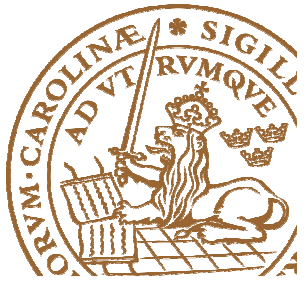


Conclusions (1)

- With ISO 50001 and high level policy recommendations that requires or stimulate industrial EnMS, evaluation has really come to fore.
- Non-quantified objectives like energy efficiency or improved energy performance appear as diffuse and are rather means to achieve other societal goals.
- The societal goals behind EnMS stimulation have to be defined in the policy planning phase and take count of the national context and political priorities.
- Ideally the societal objectives (formulated by policy makers) are consistent with the firm internal objectives of improved energy performance.
- Clear target formulations from the start enables cost effective monitoring and evaluation based on relevant performance indicators, tracked through companies' reporting over the program period.
- Requirements on certification can be motivated for several reasons; especially when companies are offered economic incentives to join an EnMP and introduce EnMS.
- The external auditor can share the responsibility and ease the burden of the administrating agency to verify program compliance.

Conclusions (2)

- Essential among EnMS practice is the activity of the cross-functional and multi-person EnMS team.
- The organization and activity of the EnMS team could be an indicator of the progress and the existence of real ambitions for energy efficiency improvement and other low-carbon solutions.
- From a company perspective the critical test performed by a skilled external auditor is often appreciated.
- In the case of SMEs, for which there are concerns about the cost for certification, potential benefits need to be examined as well. The external review is adapted to the type of company.
- The EnMS certification cannot guarantee improved energy performance in all regards.
- Certified mills, despite EnMS targets to reduce specific energy use, increased energy intensity. In some cases this was due to increased use of biofuels and internal electricity generation, which were other (conflicting) site-level EnMS targets.
- In the Swedish PFE, BU evaluations conclude large and cost effective electricity savings. However, the data analysis demonstrates that specific electricity use has increased for individual mills. To cross check companies' program compliance an evaluation plan could combine bottom-up methods with the use of top-down indicators.
- Specific fossil CO2 emissions have decreased significantly for all but one mill. Though managed under the EnMS framework the decarbonisation cannot be attributed solely EnMS and PFE.



Thanks for your kind attention!

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