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Efficiency Benchmarking in Agricultural Engineering – Challenges by the European Ecodesign Directive

Energy efficiency has effects on the availability of resources and on climate change. The EU intends to enhance the energy efficiency of products by the Ecodesign Directive. A preparating study sees a need for action concerning agricultural engineering products, as they offer a high energy saving potential. This need is not yet scheduled in order to account for special challenges of the industry. The industries of agricultural and construction engineering are discussing a voluntary commitment in contrast to the product centred approach of the Ecodesign Directive. The approach to improve the efficiency of agricultural and construction engineering should be holistic and is yet to be developed.

Keywords
Efficiency, ecodesign directive, mobile machines

Abstract
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According to the basic economic principle, the benefit from available resources must be maximised (maximisation principle) or a defined benefit must be achieved with the least possible resources (minimisation principle). "Efficiency" measures the relation of benefit and resource input, while "effectivity" disregards the costs of a benefit. Considerable factors can be energy, money, time or environmental effects. Particularly energy efficiency is growing more important, as this value reflects the shortage of resources as well as negative environmental effects.

Motivation for energy efficiency

The global and regional shortage of conventional and alternative energy sources is a driver for energy efficiency. Maximising the benefit from a resource grows more important with the resource's decreasing availability or increasing costs. At the same time, the greenhouse gas emissions connected to energy use have negative effects on climate change and are to be reduced or avoided. The development or use of energy-efficient products can be motivated by:

- Manufacturers of more efficient products gain a competitive edge over competitors or the own predecessor product – the efficiency degree serves as the user's basis of comparison and as selling point.
- Low utilisation costs as a fundamental economic factor – the user can gain more benefit from the same input or gain his intended benefit from less input, so that the additional effort of efficiency improvement pays off.

If resources are not seen as scarce in terms of time or place, as the example of the resource "climate" shows, then maximising efficiency is often subordinated to other concerns. The negative environmental effects of a technology are not necessarily assigned to its costs. This may be a result of the chosen scope of observation of the technology's cost-benefit calculation. The operator of a traffic system, for example, may not include the caused environmental damages in the system's costs because they appear with a delay of time or place.

In summary, there are different reasons to maximise efficiency, but due to diverse perceptions and mechanisms products or their utilisation are not necessarily efficient.

Political and legal starting point and developments

Because of the border crossing effects, climate and resource protection belong to the main activities of the European Union (EU). The EU sees the improvement of energy efficiency as a substantial contribution to the achievement of greenhouse gas emission targets [1], in order to counteract shortage of resources and climate change.

With the Action Plan for Energy Efficiency the European Commission aims to reduce the annual consumption of primary energy by 20 % until 2020 [2]. One measure of the Action Plan is of great importance for the efficiency benchmarking of agricultural products: the Ecodesign Directive 2009/125/EC.

The EU first issued the Ecodesign Directive in 2005, intending to increase the energy efficiency and level of environ-

mental protection of specific products [3]. The amendment in 2009 extended the Directive's scope from energy-using products to products having "an impact on energy consumption during use" [1] . These products are specified as energy-related products (ERP). German legislation implemented the Directive by issuing the energy-related products act (Energieverbrauchsrelevante-Produkte-Gesetz, EVPG) [4].

According to the Directive, energy-related products available on the European market must meet special requirements of ecodesign. Ecodesign as per Directive means the integration of environmental aspects already during product design, in order to improve a product's environmental performance throughout its whole life cycle. So the influence of the Ecodesign Directive exceeds the product's utilisation phase [1]. But the utilisation phase is the determining phase for many products, as here lays the main potential for energetic efficiency improvement.

The Directive itself does not define concrete product requirements. Only the implementing measures – adopted through a three-year Working Plan – set the specific minimum ecological requirements for product groups and lots. The Working Plan 2009–2011 established measures for some products, as refrigerators and TVs, but several product groups were not yet considered.

A preparating study on behalf of the EU was completed in December 2011, suggesting more product groups for the next Working Plan 2012–2014. The study provides a ranking of product groups serving as priority list for the new working plan [5].

Agricultural engineering in the spotlight of the Ecodesign Directive

The current Working Plan does not include the products of the agricultural industry, but they are considered in the preparating study for the next Working Plan. Agricultural product groups are, amongst others, represented by mobile agricultural machinery and stationary agricultural equipment [6]

Agricultural tractors form a group of mobile agricultural machines with a special status, as the study classifies them as means of transport for persons or goods and therefore excludes them from the scope of the Ecodesign Directive. According to the Directive, only the attached equipment belongs to the energy-related products whose efficiency needs to be improved. The tractor serves as energy supply for the attachments' working process and their mobility. According to the study, the energy use of the tractor anyway has to be included in the equipment's energy assessment. The efficiency of the tractor itself is not matter of the Directive [6].

The authors of the preparating study rank 36 product groups and recommend the first 20 for the next Working Plan. In terms of energy saving potential, the two named agricultural product groups rank 16th and 18th. However, the groups were not recommended for the Working Plan 2012-2014, as not only the energy saving potential defines the placing in the ranking. As the study includes other aspects of environmental policy, the two agricultural groups eventually ranked 27th and 28th. The low ranks are mainly explained

- by the product groups being very heterogeneous,
- by the Ecodesign Directive overlapping with the Directives on emissions from non-road mobile machinery (NRMM)
- and by a prospective sectoral approach [6].

The agricultural groups are in the spotlight of the Ecodesign Directive because of their energy saving potential. But the authors of the study account for the special challenges of the agricultural industry and therefore advise against including agricultural product groups in the next Working Plan.

Challenges of efficiency benchmarking in agricultural engineering

By the ranking of the mobile and stationary agricultural machinery the authors account for the main opinions of the stakeholders. These were gathered for the preparating study and can be reviewed in its feedback log. As stationary and mobile construction machinery are faced with similar challenges, many positions are voiced mutually by the European association representing the agricultural machinery industry (CEMA) and the European Construction Equipment Industry (CECE). In the total ranking the product groups of construction machinery are therefore rated similarly to the agricultural groups [7].

The two organisations' main criticism on the Directive's approach for mobile and stationary agricultural machinery is [8]:

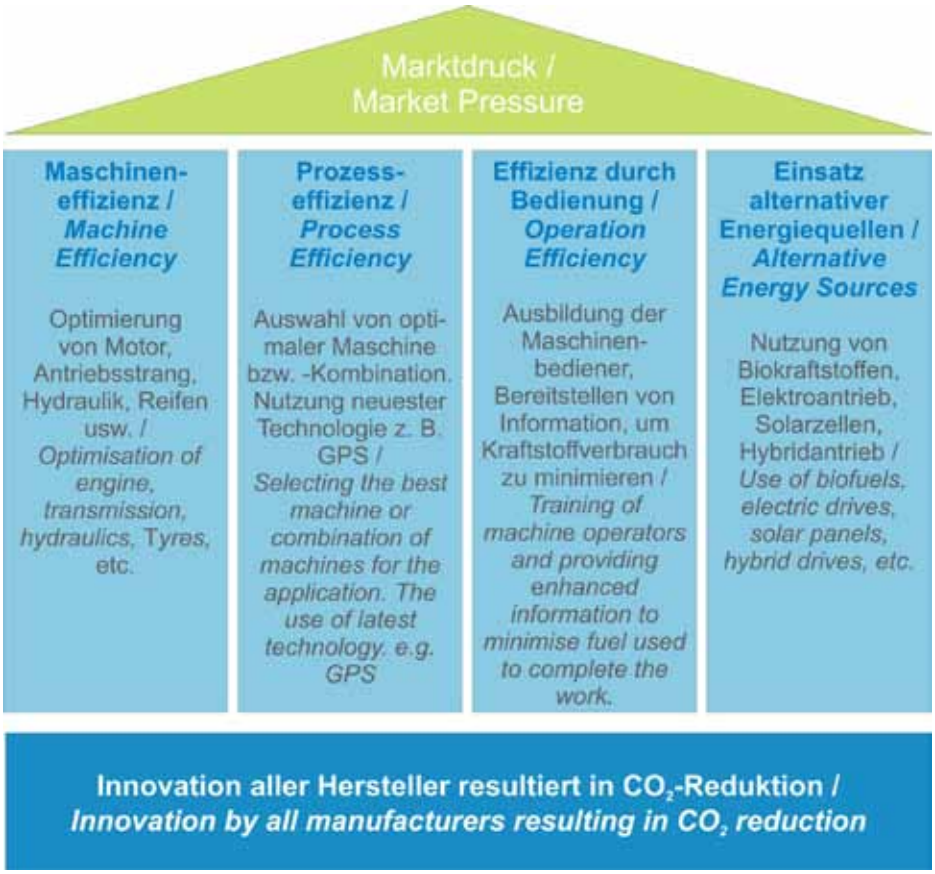
- A high energy saving potential and hence the high ranking is only scored by the wide classification of the heterogeneous product groups. If the products were grouped more narrowly by their intended purpose – domestic appliances are split in refrigerators, water heaters etc. – then only small groups would remain, each with a low energy saving potential.
- The product groups' energy saving potential derives from a questionable data base and calculation method.
- The Ecodesign Directive's scope overlaps with the Directives on emissions from non-road mobile machinery – resulting in goal conflicts.
- The Directive's product based approach results in less energy saving than a possible holistic approach.

A sectoral approach for agricultural and construction machinery is in discussion between the industrial organisations and the European Commission. This holistic and voluntary commitment should be preferred to the single product-orientated actions of the Directive.

The stakeholders consider the Directive's product-orientated approach not purposeful and rather prefer a voluntary commitment with the European Commission in order to improve efficiency on a holistic level.

For this the CEMA and the CECE formulate a common position with their preferred strategy to improve the efficiency of agricultural and construction machinery. The two organisations suggest a holistic approach standing on four market driven pillars (**Figure 1**):

Fig. 1



The four pillars of the holistic approach to improve efficiency according to [9]

- machine efficiency
- process efficiency
- operation efficiency
- alternative energy sources

This approach extends the scope and the measure of improving efficiency within the machine is complemented by ideal machine utilisation, operator-related factors and exchange of conventional by alternative energy sources.

Conclusions

A product- or machine-oriented approach to improve efficiency cannot take account of the complex connections in which agricultural and construction machines operate. Developing cycles to measure mobile machines' efficiency is very complex, due to changing environmental conditions, variable characteristics of the processed material, individual operator influences and links with other machines. The number of different cycles required in order to represent each single machine in every possible operating condition would be too great to be handled by manufacturers or users.

The preparating study for the Working Plan 2012-2014 of the Ecodesign Directive shows, that the EU sees potential for efficiency improvement in agricultural engineering, but at the same time recognises the special needs of this industry. In the field of agricultural and construction machinery the product-based approach of the Directive is challenging and possibly not purposeful. Therefore the approach of a voluntary and holistic commitment – arranged between the European Commission and the industries of agricultural and construction machinery – is promising.

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