# GLOBAL CHALLENGES FOR PRODUCTION AND DISTRIBUTION FACILITIES

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**Abstract:** The global challenge of where to locate production and distribution facilities for logistics goods is discussed fiercely on a corporate and political level. However, the fact that ecological and economic expenditure need to be reduced by the appropriate choice of location is undisputable. Yet there is a lack of comprehensive and transferable models for the location decision according to different types of distribution and production facilities.
In order to clarify the described problem and to prove the models the processes of the consolidation of biomass should be taken into account as an exemplary model for energy production.
Furthermore, in the paper is given a forecast of probably topics of common research activities on the field of resource efficiency and sustainability. This should open a scientific discussion process between the members of the CECOL.

**Keywords:** energy effiency, ressource management, logistics, biomass logistics

## 1. TRM Aspects

In the view of the integrated implementation for solving the resource problems the total resource management is based on the concept of “total quality management” (TQM). This strategy is characterized by that the attribute „total “does not scope only the quality areas, but also all partners along all value added processes of the manufacturing enterprise and all aspects to improve the situation. The term “management” means that performance must be planned and controlled in order to optimize the entire value added process of companies. Accordingly the term „total resource management“ (TRM) is formed, which extends to all resources, to all partners and to all design aspects of value added chains in manufacturing companies and must be accomplished according to sustainable management tasks and optimization of energy consumption along the whole process in the supply chain of companies.
According to TRM, by which a resource-optimized value has to be established and some selection and valuation criteria has to be introduced, which refer to the consumption of resources. In this place the cumulated energy expense (CEE)[3.] is presented, which indicates the cumulated energy consumption for all materials. In order to receive an overview of the concrete energy consumption of a certain supply chain, an energy consumption growth curve is introduced to determine energy consumption along the supply chain networks. This curve diagram reflects the cumulated energy consumption along the value added process in the supply chain from the production of raw materials up to transport of finished goods into the warehouse. On this basis it is possible to analyze,

how the energy increases along the value added chain, which portion of energy consumption growths in relation to the product in each individual value added phases and which improvement potentials exist in the supply chain.

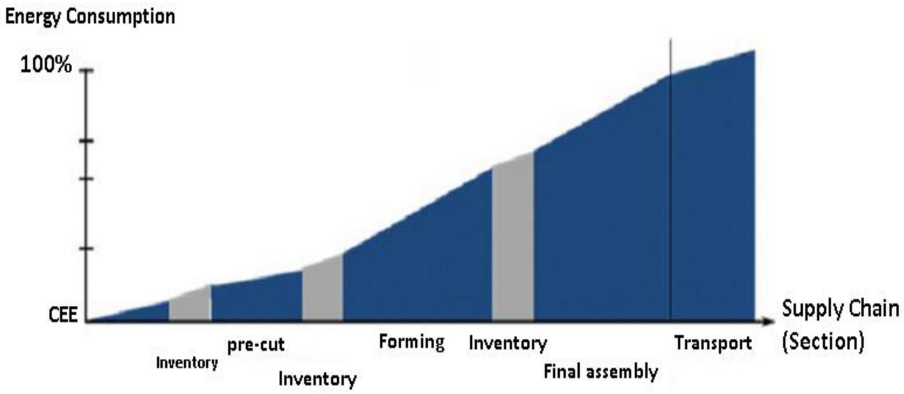


Figure 1. Energy consumption growth curve

An exemplary energy consumption growth curve is presented in figure 1. Parallel to this energy consumption analysis it can be determined, which emissions occur along the entire supply chain. Furthermore a $CO_2$-growth curve could be used in order to analyse the cumulated $CO_2$ discharge along the whole supply chain. After the analysis with the help of an energy consumption and emission growth curve, the concrete implementation and measures regarding an energy-optimized improvement of the supply chain can be derived [comp. 4. and 5.]. An optimization of the energy consumption and the emissions can be achieved on the one hand by a structural change of the supply chain, on the other hand by a change of strategies and the applied technologies.

## 2. Energy potential radar

Furthermore, a tool named energy potential radar (EPR) with quantitative impressions is developed in order to indicate, in which way energy-efficient thinking and processes in the manufacturing enterprise are already implemented. An evaluation of an EPR analysis is represented in figure 2.

The result from the analysis with EPR is the estimate of the positioning of the enterprise according to the fulfilment of significant conditions and criteria of energy awareness. Thereby crucial deficits and their causes regarding to energy aspects have to be explored, which give the starting points to an increase of the energy efficiency. Contents of EPR are the collection and evaluation of 20 fundamental facts and characteristics in the enterprise about energy efficiency.

With the help of an innovative neuronal Fuzzy-Logic approach an appropriate model was developed in order to evaluate and summarize the degree of performance of 5 different criteria namely responsibility, value, scope, information and activity.

- Value: Is the energy efficiency one of the main topics in the corporate mission statement?
- Activity: How is the success of energy efficiency related measures determined?
- Responsibility: Who is dealing in the corporation with the topic energy efficiency and what is the level of authority?

- Scope: What are the major fields of action for energy efficiency related measures?
- Information: Do partners of the corporation get integrated according to matters of energy efficiency?

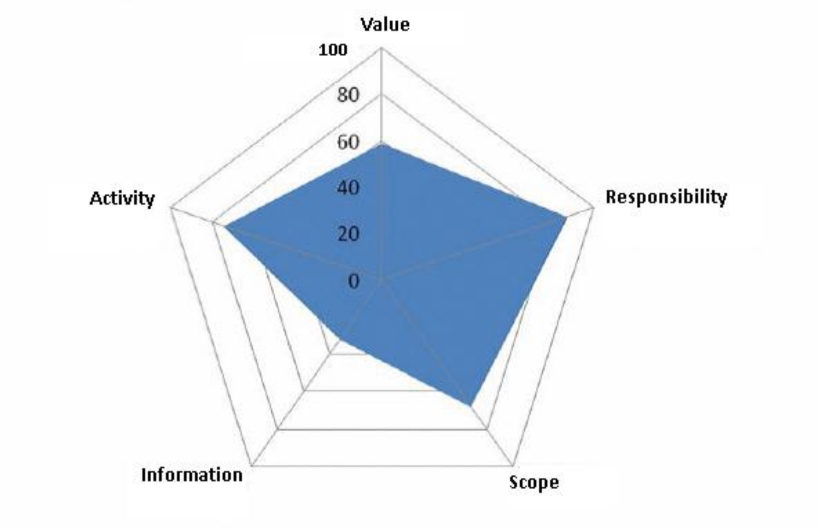


Figure 2. Evaluation with EPR Analysis

In order to develop and operate effective TRM, it is also important to define on the one hand an appropriate responsibility for employees and on the other hand employees with a significant competence profile are also necessary. These competence profiles cover i.e. professional, methodical, design as well as social competencies. In the future in order to sustain the resource management two production factors namely information and knowledge must be integrated into TRM. With the integration of these two mentioned production factors the enterprises can achieve their production goals with optimized energy consumption along the entire value added process and with sustainable energy management.

## 2.1 Energy efficient model for the positioning of facilities

The development of costs for human resources, diverse level of quality as well as increasing logistics costs contribute to a rethinking process of global procurement strategies. Besides rising logistics costs, thoughts on sustainability (also as a marking instrument) and a faster reactivity argue for global procurement strategies as well. Indisputable is the fact that ecological and economic effort hast to be reduced by the choice of appropriate locations. Nevertheless, there is a lack of comprehensive and transferable models for location selection for distribution and production facilities of different kind. Exemplary the processes of consolidation of biomass for energy production shall be used to illustrate the described problem task and to present an appropriate model to increase energy efficiency.

## 2.2 Ecological optimization of the positioning of biomass facilities

It is obvious that an ecological and economic use of biomass in Germany could not be handled from one single biomass facility [6.]. The choice of biomass facilities locations demands models, which determine possible sites under the restriction of prices, seasonality, energy density of the biomass goods and the driveways to collect the biomass and consolidate it. These models have to compare different sites to choose the best ecological and economic one. On one hand, it could be economic to transport biomass over long distances because of preferable prices but on the other hand, the transport could exhaust more energy than what can be produced from the transported goods. In this paper the energy efficiency for transportation of the biomass should be improved. Therefore the following model was created, which is an imitation of an alignment problem [7.] to decrease the waste between different facilities. The same problem occurs at the fabrication of shafts out of cuboids. The waste between the shafts should be minimized. The collection from biomass around the facility itself must be taken within a circle (it is the shortest way around a facility). The circles must be so large that the demand of every facility is guaranteed. For up to 20 circles the location and the radius is mathematical evidenced. Figure 3 shows the location of the circles.

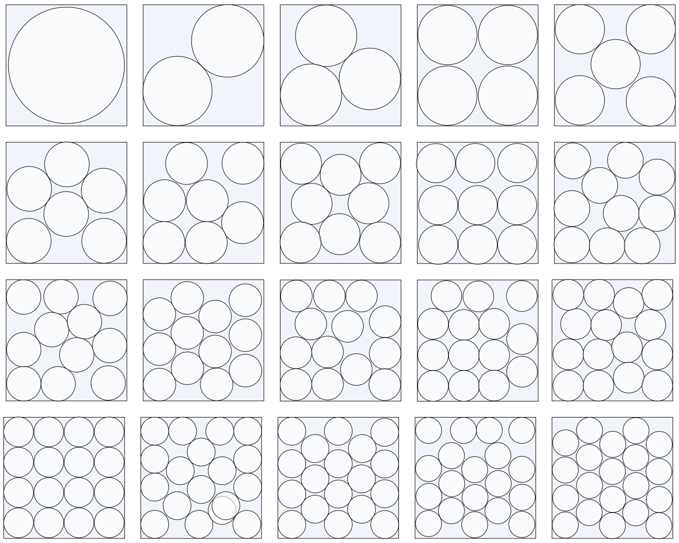

Fig. 3. Location of circles in trivial square [7.]

First calculations show that around 13 facilities could be raised in Saarland (area of 50 x 50 km). The calculation is based on the assumption that 25% of the biomass available in 2007 in Saarland is accessible for this non-food use in gasification facilities. Every facility has a feeder radius of around 6.7km and these thirteen 1MW arrangements could deliver the electricity for 26,000 households.

### 2.3 Conclusion for rising biomass facilities

The energetic usage of biomass is in an early stage of development in Europe. Therefore, appropriate strategies should be chosen from the beginning to push the progress and development intelligently [comp. 8]. Here the number and distribution of biomass recovery facilities is important. The facilities shall be located in a way that there is a maximum of area coverage without having regional ecological competition. In addition, the occurrence of mono cultures around these facilities resulting from regional biomass planting should be avoided. With the help of the developed modells politics are able to identify corresponding tentendcies and accordingly to act against that or support it. Due to biomass appearing mostly in rural regions, the energetic usage of biomass can contribute to increase employment in economically underdeveloped regions. Further, the energetic usage of biomass can balance the fluctuations of demand and supply of energy provided by wind and solar energy by connecting and disconnecting certain biomass facilities accordingly.

## 3. Aspects of realization and outlook

For the aimed effect of comprehensive resource management the definition of a clear responsibility and the embedding in the organizational structure of an enterprise as well as the tie of the topic in a supply chain are substantial. A reorientation of the value system in the enterprise on basis of a broad consciousness creation regarding to the meaning of the deployment and handling of resources is naturally a condition as a factor of middle and long-term competitiveness.

Not only for the mentioned reasons, but also considering a long-term profitability and competitiveness the comprehensive resource management has to be in a specific way a „top-priority case“ and be thus a task of the top management. This means concretely that the responsibility for the reliable supply and the efficient utilization of resources in the enterprise has to be clearly defined and be tied in top level management. For the meaning of the resource problem it is not acceptable to just nominate a single „resource representative”, which has often only an alibi function and mostly works as a moderator.

As main barriers today's enterprise structures, in which there is no explicit resource responsibility, a lacking resource awareness of personnel and managers as well as are short term profit orientation are generally regarded. Consequently the topic resources with all its strategic and operational indexes should be integrated into the entreprise controlling. The condition for a broad benchmarking should also be created by a standardisation of goals and indicators. Here an interface related to regulative general conditions could be created, for example limit values, criteria for tax privileges or promotional programs. It is obvious that logistics can act as a regulation framework on the resource management because in this way logistics objectives can be linked with resource objective targets and furthermore new design and decision criteria can be developed from it. These relate for instance resource consumption in each section of a total supply chain and the efficiency of the resource utilization. From the resource-related criteria the essential economic criteria can be derived. All this can only take place under the following conditions:

Problem solutions have to result from an interdisciplinary view. Only an interdisciplinary scientific procedure with a „collaboration“ of technology (production engineering, transportation, inventory, handling and packaging technology, waste disposal technology), business administration, economics and information technology can lead to feasible and promising solutions.

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