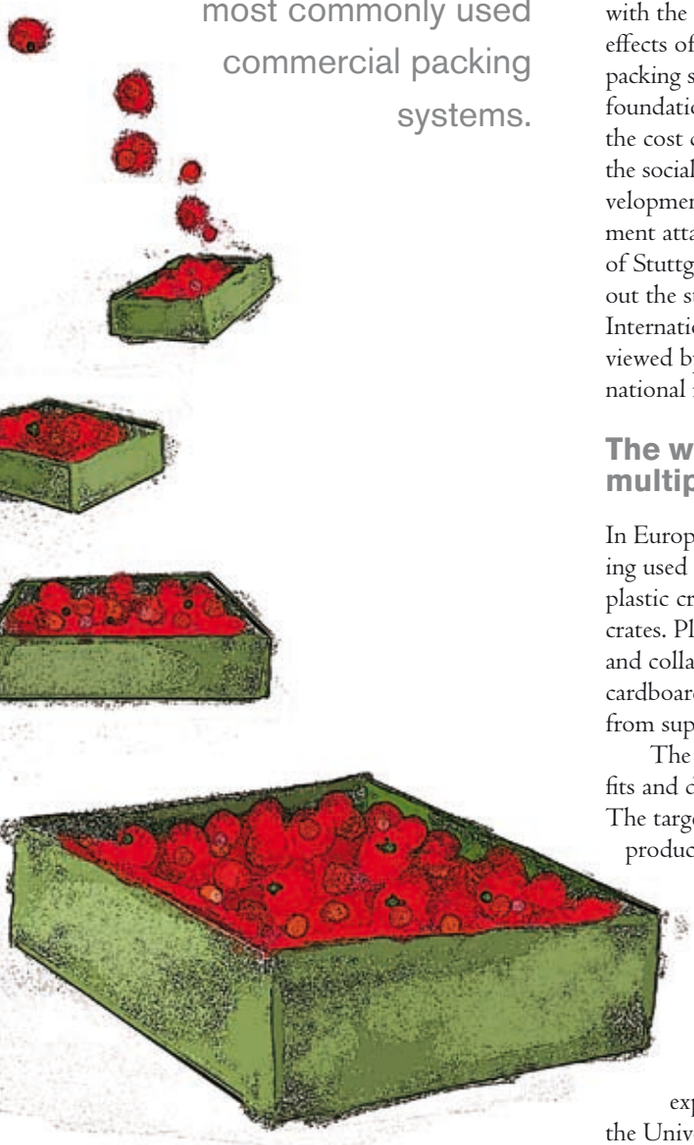
The multipurpose plastic crate is the environmental winner

for the distribution of fruit and vegetables

The distribution system for fruit and vegetables is very extensive, complex and above all a continuous logistical process, with a significant impact on the environment and even societal relationships. In Germany they have studied the ecological and social effects of the most commonly used commercial packing systems.



In April 2005, the German environmental foundation, Stiftung Initiative Mehrweg (SIM), began a life cycle assessment project, with the aim of analyzing and comparing the effects of Europe's top three transportation packing systems on the environment. The foundation also collected information on the cost differences between the systems and the social impact with regard to sustainable development. The life cycle engineering department attached to the building physics faculty of Stuttgart University was chosen to carry out the study in close collaboration with PE International. The study was checked and reviewed by the independent Five Winds International research institute.

The winner was the multipurpose plastic crate

In Europe there are three main types of packing used for transporting fruit and vegetables: plastic crates, cardboard boxes and wooden crates. Plastic crates are returnable, reusable and collapsible solutions. Wooden crates and cardboard boxes only go in one direction, from supplier to customer.

The study compared the ecological benefits and drawbacks of these packing systems. The targets of the study were the five major producers of fruit and vegetables (namely the Netherlands, Spain, Italy, France and Germany) and the four biggest markets (the Netherlands, the UK, France and Germany).

"In this way we can model the market as realistically as possible," explains **Leif-Patrik Barthel**, MSc., of the University of Stuttgart. "In fact our research is more comprehensive than a typical life cycle assessment. It deals with the issue according to the principles of sustainable development. In addition to technical and financial audits, the social aspect was taken into account."

Returnable plastic crates achieved the highest score in the comparison test. Disposable wooden crates came a close second. With its low market share (8-10%), the second place does not result in any concrete benefit to the environment. Cardboard boxes finished far behind on points.

According to this research, the environmental benefits of plastic crates compared with one-way systems grow when their service life and the amount of recycled material used in their manufacture is increased. The returnable system was also much more cost-efficient than the one-way system.

Losers also benefit

The reliable assessment of the environmental, economic and social potential of the packing options required that the features of each system were taken into account throughout the entire life cycle. The study also placed particular emphasis on the fact that it was possible to model the whole European transport system for fruit and vegetables.

"The results of the study can be utilized by the logistics, production and packing industries," says **Dr Sabine Deimling** of PE International. "Whatever the outcome of the research, all the parties stand to benefit. Even the suppliers and users of the solutions that fared badly can make their product or system more environment-friendly. Our task is to develop realistic scenarios, to offer companies ecological, economic and social criteria on the basis of which they can make better decisions in the future. For instance, the paper industry has shown particular interest

in our work and why cardboard packages fared so much worse than the other alternatives."

Databases aid further development

The assignment was to transport 1 000 tons of fruit and vegetables using each of the three systems. The starting point was that the transport packages had to be the same size (600 x 400 x 240 mm) and that each one could hold 15 kilos of fruit or vegetables. Transportation of one thousand tons required a total of 66 667 crates.

Owing to the recyclability of plastic crates, the researchers had to determine their average service life and the number of times they had been filled during their lifetime. Therefore both conservative and technical scenarios were arrived at. The basis used in the conservative alternative was a service life of 10 years and 50 times filled, and in the technical one 20 years and 100 times filled. The conservative alternative included a substantial calculated safety margin, while the technical scenario represented a typical transportation system when the study was being undertaken. Additionally, the conservative scenario included an estimate that 13 333 plastic crates would have to be replaced because of damage during those ten years.

The findings were astounding. To transport the same amount of products as the return system based on plastic crates throughout their entire service life (66 667 crates), in the one-way system a staggering 3 333 350 crates would be needed (conservative option). In the technical option, double the amount of crates would be needed.

"The technical audit of a product life cycle takes into account all the stages in the service life from raw material through component manufacture, assembly, use and recycling or final disposal. We need a lot of information in order to model the entire life cycle. That is why we have at our disposal a comprehensive database, which covers all the major materials, additional materials and process data," says Leif-Erik Barthel.

"The database and software we use for international life cycle assessments enable us to utilize and complete existing information. If necessary, we analyze new information on the performance of a process and add it to our database. In the case of this particular study, in practice this entailed that we at the university and our partners at PE International gathered the missing data as carefully as possible. Our regional partners in Spain, Italy and France also assisted us in this project."

Research in line with sustainable development

The systems were studied and compared according to the principles of sustainable development, taking note of their environmental impact as well as economic and social indicators.

When determining the environmental impact, basic energy requirements, global warming potential (the greenhouse effect), depletion potential of the ozone layer (impact on the ozone layer), the acidification potential (proportion of acid rain), eutrophication potential (proportion of overfertilizing) and the photochemical ozone-forming potential (proportion of summer smog) were taken into account.

Economic indicators were compiled from life cycle costs. Social indicators were formulated from total working hours, women's total working hours, division of labor according to level of education as well as fatalities and the number of other accidents.

The final outcome is that the most economical alternative is the plastic crate system, the use of which during its life cycle also leads to the least number of deaths. The environmental impact of both plastic crates and wooden crates are in the same league. Some of the biggest environmental impacts are caused by the one-way cardboard box transportation system.

The study represents scientific advances in life cycle assessment. It will give the packing industry, logistics service providers and also the producers of fruit and vegetables a solid base for selecting the most environment friendly and sustainable packing and transportation systems. In addition, consumers can find out the extent of the effect of the transportation solution for fruit and vegetables, by measuring the economic and environmental impacts. The foundation hopes that this data will also affect consumer behavior.

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The study was carried out by:

- ***The Foundation for Reusable Systems (Stiftung Initiative Mehrweg, or SIM)*** *SIM is a German foundation for scientific research, which provides financial support for scientific and research concepts aimed at creating environmentally optimized logistical systems with focus on the re-use and alternative use of packaging.*
- ***Life Cycle Engineering Department of the Chair for Building Physics at the University of Stuttgart*** *provides independent ecological, economic and technical research to support life cycle planning of products, processes, and services and related decision-making. Together with PE International, the department is the world's largest center of excellence in the field of Life Cycle Assessment and Life Cycle Engineering.*
- ***PE International*** *is the international market leader in strategic consultancy, software development and extensive services in the field of sustainability. The global operation provides companies with methods, in-depth knowledge and a spectrum of experience to make both corporate operations and products more sustainable.*

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