

## Last but not Least: Quality and Safety First

Remanufacturers are responsible for the safety and reliability of their products – just as manufacturers are.

This is why quality control and quality assurance measures throughout the entire remanufacturing process with all its five steps is such an important issue. Remanufacturers take quality serious. Most of them therefore apply the same standards of quality and business management systems which are required and applied by original car manufacturers.

Many remanufacturers have achieved or are working toward the ISO 9000 Quality Standard and QS 9000 certification, which is an even higher standard of quality.

However, remanufacturing is still different from manufacturing. This is why remanufacturers have also worked out additional guidelines and self commitments, such as the Recommended Trade Practices of the European automotive parts remanufacturers. By undertaking such efforts and applying quality management systems and standards, remanufacturers are in the position to guarantee a thoroughly monitored and quality assured process and product.

This is the reason why remanufactured products come with the same or even with a better warranty than new.

Why are remanufactured products this reliable? What's the reason behind some remanufacturers even granting life time warranties on their products? It's not just because they have quality procedures during the process. There are also explanations from product maintenance and reliability forecasting sciences and literature:

**Product  
Responsibility**

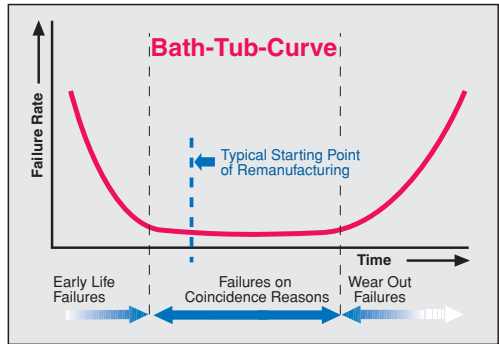
**ISO Standard QS  
9000 Certification**

**Self  
Commitments**

**Warranty**

Figure 95:  
“Bath-Tub-Curve“

Discussing only the scientifically proven and most important fact, one has to look at the failure rates and product life time.



### Three Failure Rate Phases

There are three phases of failure rates during a technical product’s life:

#### Early Life Failures

First there are the early life failures – often at a surprisingly high rate in the beginning.

Everybody is familiar with the fact, that even a brand new car might not start already on its second morning. Due to material defects or a manufacturing error, an electrical contact in the starter has failed. The starter has to be turned in for remanufacturing.

#### Lowest Failure Rates

Then there is a second phase – a very long phase of lowest failure rates. The product or part is working for the duration it has carefully been designed for. Failures only occur on coincidence reasons, by accidents, extraordinary stress etc.

#### Wear-Out Failures

In the end, failure rates go up again – due to wear and fatigue of parts and materials. Due to its appearance, the graphic showing the whole three phase connection is called “bath tub curve“ even in science.

The pleasing fact is, that old units arriving for remanufacturing still have their parts at the very beginning of the long and stable second phase of low failure and high reliability expectations. If their defective parts e.g. early failed electrical parts or worn out minor parts like carbon brushes or bearings are replaced, their main mechanical parts will easily withstand the stresses of the next use.

This is the main reason why remanufactured products are so reliable. Of course, one has to know a specific part's position in the failure rate and life time connection to forecast its reliability for the next use period. Remanufacturers are aware of the theoretical knowhow and they have gathered practical experiences as well.

Whenever they are not sure or consider the wear-out failure rate is close to happening, they will not reuse that part or remanufacture that unit.

This especially applies to units and products relevant for a car's safety for example, such as rack and pinion steerings, brakes etc.

Here the same principles have to be followed like with aircraft overhauling, which is a process carried out by any airline or aircraft mechanic and which is nothing else than remanufacturing regarding the most comprehensive so-called "D-checks" which include every step from disassembly to reassembly.

Aside from theory, from the field of remanufactured products, there is also good news. They work to their customer's satisfaction.

**Knowing One's Position**

**If in Doubt: No**

**Aircraft Standards**

**Higher Rates**

# Remanufacturing's Success Factors: An Aid to Decision Making

## Impressing Volumes

At present remanufacturing – the ultimate form of recycling – already exists in impressive volumes both in automotive and non automotive industries and markets. A further growth in numbers and applications can be expected and should be encouraged. Where are the prerequisites, the success factors and the limits? Are there further remanufacturing business opportunities neglected so far?

As every product will retire at a time, the necessity of recycling is showing up in all industries, and a decision making is required. The first question arising is entitled

- Recycling by Remanufacturing (“Upcycling“)?

or just

- Recycling by Reprocessing (“Downcycling“)?

## Conserving Values

Remanufacturing is the preferable process as it conserves the added value which has been put into the product by design and manufacturing. Reprocessing destroys all this value by shredding and smelting it down and just recovering some natural resources.

## Product Assessment

To assess a product's suitability for remanufacturing, all factors of technical, economical and ecological nature will influence the decision and have to be taken into consideration.

The suitability of products for remanufacturing can be examined by evaluating a range of eight different criteria:

- Technical Criteria ( kind or variety of materials and parts, suitability for disassembly, cleaning, testing, reconditioning)
- Quantitative Criteria ( amount of returning products, timely and regional availability...)
- Value Criteria ( value added from material/ production / assembly)
- Time Criteria ( maximum product life time, single-use cycle time...)
- Innovation Criteria ( technical progress regarding new products vs. remanufactured products...)
- Disposal Criteria ( efforts and cost of alternative processes to recycle the products and possible hazardous components...)
- Criteria Regarding Interference with New Manufacturing (competition or cooperation with OEM's ...)
- Other Criteria ( market behavior, liabilities, patents, intellectual property rights...)

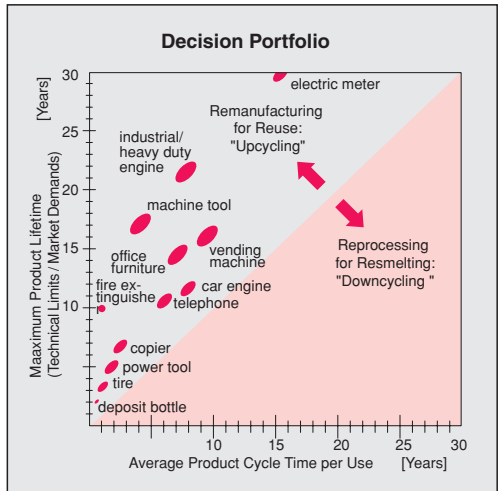
In each field, an evaluation of the parameters in brackets has to be calculated for decision making between remanufacturing or reprocessing.

Known from marketing strategy tasks and other fields, portfolio methods can be of some help and have been developed by the author in order to prepare decisions by developing scales for the evaluation and comparison of different criteria or of questions within certain criteria. As one example of such a portfolio, the evaluation of the time criteria mentioned above and the findings of suitable products, which in fact are

### **Portfolio Methods**

already being remanufactured in practice, is carried out in a connection between maximum product life time and average product cycle time per

Figure 96:  
Portfolio Evaluating  
Time Criteria for the  
Decision between  
Remanufacturing and  
Reprocessing



**New  
Marketing  
Strategies**

use.

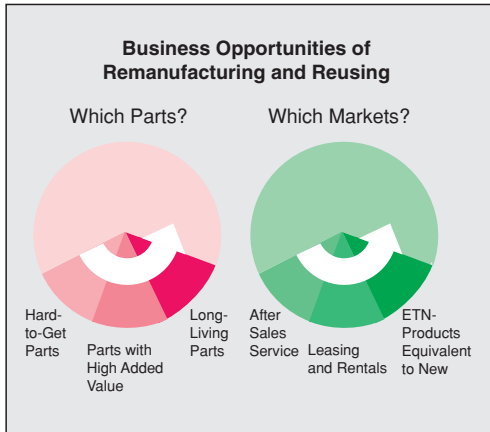
There are clear indications, that the range of products or parts, as well as the possible markets, are still only at the beginning of the game called remanufacturing. This includes new marketing strategies such as leasing. Such an approach "Sell the performance, not the Product" is successful today in the field of copying machines.

An example, where this approach named "sell the performance, not the product" is successful already today, can be shown in the field of copying machines. The customers' needs can be defined as "to make 10.000 copies per month" (not "to own a copying machine"). Accordingly he does not buy the equipment, but has a leasing contract with the supplier, who guarantees that an up-to-date copying machine with the required

performance is always available in the customer's office. From time to time this copying machine is exchanged for a "new" model – the latter having been remanufactured and upcycled in the OEM's premises or by an independent subcontractor to him. In this field therefore new business opportunities arise also for small and medium sized regional enterprises.

While after sales service, leasing and rentals are known market fields for remanufactured products, the "ETN-Product" approach is still an exception. ETN means "Equivalent To New" and says that a product sold as a new product contains also remanufactured parts. This is a new business opportunity for small and medium sized

**Equivalent to New**



*Figure 97: Parts and Markets for Remanufacturing*

enterprises as well as for OEMs. This is desirable and it will become common one day without making a great fuss about it. In the future, new products will contain remanufactured parts as they contain reprocessed material from the steel industry today.

## **Energy and Material Savings by Remanufacturing: A Star is Born**

### **No Recycling of Energy**

Energy cannot be recycled. It is being spent for whatever process is carried out to create a product. Then it is lost, or, to be honest, it is embodied in the product.

### **Much Energy for Material Recycling**

As there are also materials embodied in a product, traditional recycling processes aim at conserving a majority of these materials by shredding the product, separating its main different materials, smelting them down to recycled materials and producing new parts from them. These recycling processes, besides giving up the energy that has been embodied in the first product, need a lot of additional energy to arrive at the next product.

### **More Energy for Manufacturing**

At least however, their energy requirements are in most cases still somewhere below those of manufacturing new parts and products from all new material. Some material recycling processes nevertheless need even more energy to close the loop than processes which start from ore. There are also some emissions that accompany many material recycling processes.

### **Much less Energy for Remanufacturing**

Remanufacturing conserves the energy embodied in a product and, compared to all the above, nearly needs no additional energy. In fact, if one undertakes the effort of a careful and thorough comparison of energy requirements of remanufactured or manufactured products, this leads to remarkable results:

In a case study carried out by the author's research group, the most frequently remanufactured automotive units

- **starters** (5 types, heavy duty and passenger car)
- **alternators** (3 different types )

have been evaluated regarding the energy consumption of

- **manufacturing** or
- **remanufacturing.**

The same kind and type of unit was considered. In order to achieve fully realistic results, the comparison was based on the assumption, that both the parts for the newly manufactured unit as well as the amount of new spare parts running into the remanufactured unit are produced using materials with today's shares of recycled steel, aluminium, copper etc.

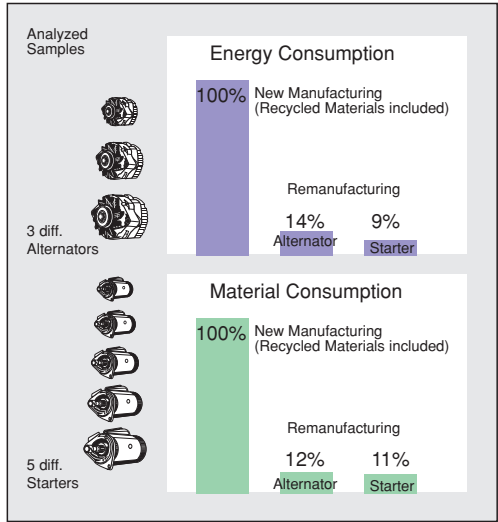
The results were amazing: to manufacture one new starter on average requires more than eleven times the amount of energy of a remanufactured one. A similar situation can be found with alternators. Here a new one requires close to seven times of the energy to make than a remanufactured one. In other words these products can be realized with an effort of only 9% ( for starters ) or 14% ( for alternators) of energy if remanufactured and not manufactured new.

### **Realistic Assumptions and Results**

### **Multiple Savings**

## 100 Energy and Material Savings

Figure 98:  
Regarding Energy and  
Material  
Consumption,  
Remanufacturing is  
Far Ahead of  
Manufacturing



The results about material conservation by remanufacturing were impressive as well: One new starter on average requires more than nine times the amount of new material needed than a remanufactured one. Or, new alternators require more than eight times the amount of raw material than is needed for remanufacturing the same units from old ones.

So, with the same amount of energy or material given, one could make from 7 to 11 units more by remanufacturing them than by manufacturing.

### An Extrapolation to World Scale

Figure 99 (right page):  
Energy Savings by  
Remanufacturing  
Worldwide

All over the automotive industry and all across many other industries, many more units and products are being remanufactured. Using statistical data and calculating the scientific data about materials and energy intensity of processes used for manufacturing or remanufacturing all those products and units, one can extrapolate the overall energy savings by remanufacturing.

350 Tankers  
of Crude Oil

Worldwide Energy Savings  
by Remanufacturing



Electricity from  
8 Nuclear Power Plants

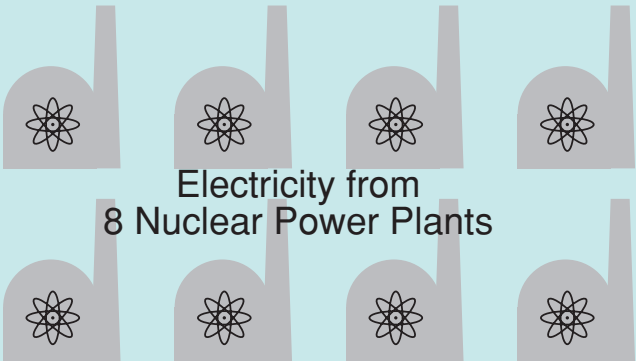
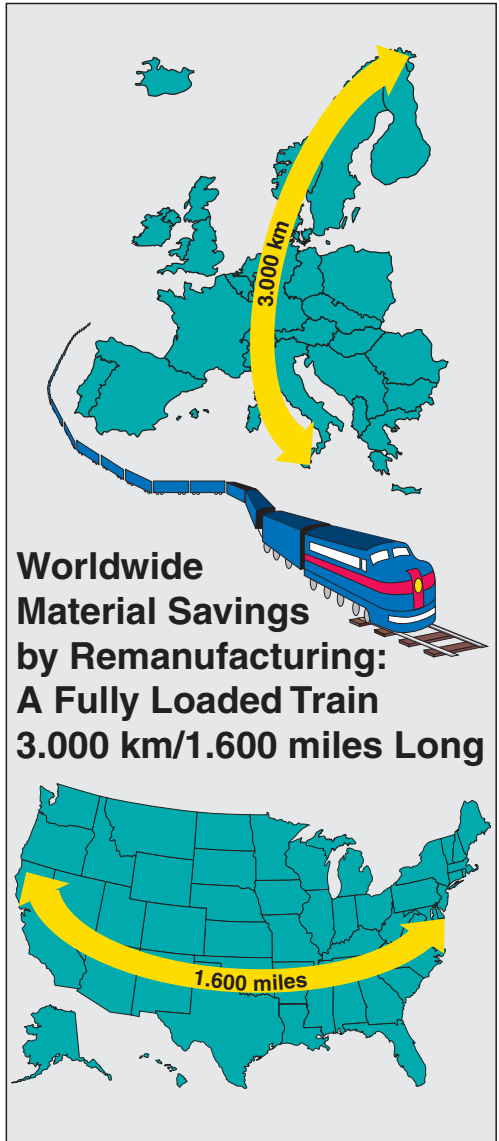


Figure 100:  
Material Savings by  
Remanufacturing  
Worldwide



As a result of such an extrapolation it can be stated:

**Worldwide  
Energy and  
Material Savings  
by  
Remanufacturing**

- **Energy:** The savings of energy by remanufacturing amounts worldwide to 120.000.000.000.000 BTU's ( British Thermal Units ) a year. This is an amount of energy equal to:
  - 16.000.000 barrels of crude oil, which equals a fleet of 350 tankers – or
  - the lifetime fuel consumption of 75.000 car owners – or:
  - the electricity generated by eight average size nuclear power plants – or:
  - the energy needed for industrial and commercial activities of 1,8 millions employees in total.
  
- **Material:** The savings of materials by remanufacturing amounts worldwide to 14.000.000 tons a year. This quantity of raw materials is equal to
  - a railway train with 230.000 full cars, occupying a track of 1650 miles in length.

Regarding energy savings achieved by remanufacturing already at today's product ranges and volumes one can really state "A Star is Born". Imagine the energy savings that would be possible if remanufacturing activities are encouraged and continue their spread and growth in many more applications. This bright star might well be raised to a brilliant little galaxy giving light and life to nature and the environment on our planet and become just as indispensable as the sun shining every day.

**Giving Light and  
Life to the  
Environment**

# Remanufacturing's New Horizons: An Outlook to the Future



The approach of the magic year 2000 triggered new considerations about inspiring the proliferation of save-the-planet movements and focusing our minds towards a sustainable future in the new millennium.

The term “sustainable development“ is understood as the principle that current economic progress should not endanger the prospect of future generations. Questions risen are world population growth, nutrition, employment and education, natural resource depletion, energy consumption, green house gas emissions, climate change and global warming.

## **Think Global - Act Local**

The questions are of global scale. Answers however have to be found on local levels – in our existing industries and everyday lives.

Remanufacturing in its existing application and scale has presented itself as a proven solution generating multiple lives for our products; saving energy, natural resources, landfill requirement and reducing air / water pollution.

## **New Businesses and Jobs**

Remanufacturing is creating new businesses and jobs at the same time – it has the potential to compensate or even turn around the losses of jobs in manufacturing employment.

Thus, in the scientific community, remanufacturing has already become recognized as a win-win situation for everyone, harmonizing economy and ecology. Remanufacturing represents an already existing solution, not just a scientific approach to the “Factor 4” (double comfort / half resource depletion) discussion. The more, the better: Regarding product output / energy input, remanufacturing already matches manufacturing by “Factor 10”.

**From  
“Factor 4”  
to  
“Factor 10”**

This good news will spread. University teachers as well as government officials have started to further promote the unique idea of remanufacturing. Lecturers are bringing remanufacturing into a discipline in engineering schools where they will also teach product design for recycling and remanufacturing.

**Universities  
and  
Governments**

Remanufacturing is appearing on the political agenda because it creates jobs and protects the environment.

Public administrations’ and private companies’ purchasing policies will prefer remanufacturable or remanufactured products when they buy office furniture, computer systems or components for their vehicle fleets.

Already today world class companies don’t just buy remanufactured products – they also discover remanufacturing to boost their own productivity and competitiveness. Remanufacturing is also a business for the small, family-owned, local companies, which are the backbone of every national economy. These may tie the most intelligent knots in the global players’ networks by remanufacturing.

**World Class  
Companies**

### **Eco- Innovation**

Remanufacturing is an eco-innovation driver, with potentials on the economic and the ecologic sides as well. It will conquer new disciplines, new product areas and new markets – if public recognition also follows.

### **Bridging Technology and Society**

We must not forget that the strongest driving force in our market place is always the consumer – technological “push“ needs market “pull“. Remanufacturing technology matters, but not as much as the people who will drive it and ultimately benefit. Fortunately, customer research indicates a rising awareness which is more than just lip service towards protecting the planet; particularly if consumers can have some fun and save money at the same time. Remanufacturing offers this magic twin opportunity.

There is a strong potential for growth – the kind of healthy, balanced growth we need.

### **Take Action**

Remanufacturers are in business at the right time in the history of this world to provide answers to many of our economic, environmental and employment challenges. Grasp the opportunity and take action.

## **Acknowledgements**

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The 100 figures span two decades of remanufacturing and activities from three continents.

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## Further Information about Remanufacturing

For further information about remanufacturing, the organisations and institutions who have supported this book can be contacted as follows.

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