



REMANUFACTURING IN DENMARK (2015)

INCENTIVE

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Remanufacturing

The concept of the circular economy is gaining ground in the political debate, and more and more companies recognize and are keeping it in mind when they formulate their business plans. This report focuses on one element of the circular economy: remanufacturing.

We use the Remanufacturing Industries Council's definition of "remanufacturing":

Remanufacturing is a comprehensive and rigorous industrial process by which a previously sold, worn, or non-functional product or component is returned to a "like-new" or "better-than-new" condition and warranted in performance level and quality.

This report is an supplement to the work on a Factbook carried out in the CE100 partnership (Ellen MacArthur Foundation, 2014 - *CE100 Charter: Vision for Reman*). When we use the term "Factbook" we refer to this work.

This report is also serves as extended summary of a Danish report mapping remanufacturing in Denmark (Incentive, 2015 - *Genfremstilling i Danmark* [Remanufacturing in Denmark]). For additional background information we refer to this report.

Incentive has created this report on behalf of the Danish Business Authority.

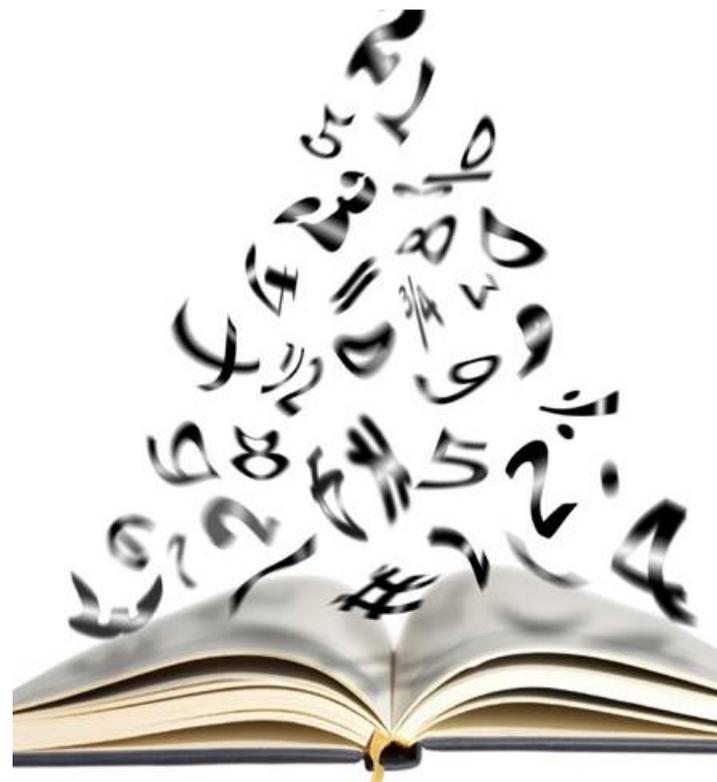


Summary

In the following report we present these seven topics:

1. The method used to assess the potential for remanufacturing in Denmark
2. The economic assessment of the potential for remanufacturing in Denmark
3. The environmental assessment of the scope of remanufacturing in Denmark
4. The companies doing remanufacturing in Denmark
5. The motives for the companies doing remanufacturing
6. The barriers companies face when engaging in remanufacturing
7. The future perspectives for remanufacturing in Denmark

An extended summary



The method

We carried out the assessment of remanufacturing in Denmark in four steps:

1. We identified industries in Denmark where remanufacturing is feasible.
2. We used interviews with Danish companies doing remanufacturing to investigate the scope of remanufacturing in Denmark. We found a very limited scope of remanufacturing.
3. We estimated the potential for remanufacturing in Denmark based on the assumption that Danish industries potentially can accomplish the same degree of remanufacturing as similar American industries all ready have accomplished.
4. We used the intensities for remanufacturing estimated in the Factbook for the US to assess the potential of remanufacturing in the relevant Danish industries. For example, we have applied 1% remanufacturing intensity from the American machinery industry to estimate the scope of remanufacturing in the Danish machinery industry.

These four steps are further detailed Incentive, 2015 - *Genfremstilling i Danmark*.

Danish industries

The seven sectors below qualify for remanufacturing in Denmark. We have used industry code from Statistics Denmark:

- + Metals
- + Electronics
- + Electrical equipment
- + Machinery
- + Transport vehicles industry
- + Furniture and other manufacturing

The production in the industries amounts to around 8% of the total production in Denmark. In 2011 there were approximately 7,200 active companies in the industries employing 119,000 full-time employees, with a turnaround of USD 45 billion.

2. POTENTIAL (DANISH INDUSTRIES)

The value of products potentially remanufactured in Denmark is around DKK 2.3 billion annually.

Potential for remanufacturing in Denmark by Danish industry, 2014

Industry	Intensity (%) (remanufacturing /production)	Production (million DKK)	Investment (million DKK)	Employment (full-time workers)	Exports (million DKK)	Imports (million DKK)
Metals	0,9	439	18	318	104	184
Electronics	0,4	126	18	65	26	126
Electrical equipment	0,9	163	10	83	46	130
Machinery	0,9	1.280	63	544	317	833
Transport vehicle industry	1,0	147	7	80	38	300
Furniture and other manufacturing	0,9	136	12	86	38	138
Total	0,9	2.289	127	1.177	569	1.712

Sources: Own calculations based on data from Statistics Denmark and from the Ellen MacArthur Foundation: *CE100 Charter: Policy Vision for Reman*. DRAFT REMAN FACTBOOK.

Notes: The intensity shows the share of the total production being remanufactured.
The industries take offset in the sector code DB07 grp36 from Statistics Denmark. Only sectors that do remanufacturing are shown.
The levels of investment, exports and imports are calculated based on standard production in the industries and are not based specifically on remanufacturing.
The assessment is subject to uncertainty but gives an indication of the scope.

2. POTENTIAL (FACTBOOK INDUSTRIES)

The value of products potentially remanufactured in Denmark is around US \$384 million annually.

Potential for remanufacturing in Denmark by Factbook industry, 2014

Industry	Intensity (%)	Production	Investment	Employment	Exports	Imports
	(reman/newman)	(thousand \$)	(thousand \$)	(full-time workers)	(thousand \$)	(thousand \$)
Aerospace	n/a	0	0	0	0	0
HDOR equipment	n/a	0	0	0	0	0
Motor vehicle parts	1.10	26,254	1,237	87	6,839	55,160
Machinery	1.00	326,954	16,188	991	81,251	200,960
IT products	0.40	22,485	3,230	71	4,672	23,237
Medical devices	0.50	5,730	498	19	1,972	4,987
Retreaded tires	n/a	0	0	0	0	0
Consumer products	0.10	2,286	177	9	601	2,507
All other	n/a	0	0	0	0	0
Wholesalers	n/a	0	0	0	0	0
Total	0.96	383,711	21,329	1,177	95,335	286,850

Sources: Framework from the Ellen MacArthur Foundation: *CE100 Charter: Policy Vision for Reman*. DRAFT REMAN FACTBOOK.

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Environmental benefits

Remanufacturing in Denmark today shows not only limited environmental detriment but also indications of environmental benefits:

CO₂ savings: A study estimates that remanufacturing reduces CO₂ emissions by 7 million tons every year in the EU, and it has a potential to reduce emissions by 800 million tons in 2050 (Capital requirements regulation, 2010).

Less drain of natural resources: When products are remanufactured, it is not necessary to add the same amount of new resources as it is to manufacture new products. This reduces the need for new resources.

Resource optimization: Processing and producing remanufactured products use up to 85% less energy than does manufacturing products from raw and reused materials (Steinhilper, 1998).

Water savings: Remanufacturing can reduce water consumption by up to 65% compared to the manufacturing of new products (WRAP, *Remanufacturing Office Furniture*, 2014).

Reducing waste: Remanufacturing reduces the amount of scrap products that are recycled, incinerated or sent to a landfill.

Environmental costs

Remanufacturing carries the following environmental costs:

Logistics: The processes of collecting products, transporting them to the production facilities and bringing them back to market are resource intensive.

Detailed separation: The remanufacturing process, where components are removed and the products are prepared, can be resource intensive.

The overall picture

For the environmental benefits to exceed the costs, manufacturing must be implemented on a large scale. This is certainly the case for large companies.

For companies that only recently began remanufacturing, the scope is so limited that we estimate the environmental benefits to be virtually nonexistent.

Over the longer term, companies can realize substantial environmental benefits from remanufacturing. When the extent of remanufacturing increases and companies begin to achieve economies of scale, the benefits will be substantial.

4. COMPANIES DOING REMANUFACTURING IN DENMARK

9 companies in Denmark doing remanufacturing

We conducted 64 preliminary interviews with Danish companies and subsequently 25 exhaustive phone interviews with the most active companies. We subsequently identified the 9 companies listed in the table below doing remanufacturing in Denmark in 2014.

We use the information from the preliminary and the exhaustive interviews to outline the motives for companies to engage in remanufacturing and the barriers preventing them from doing so.

In Denmark remanufacturing is feasible in certain industries:

- + In machinery, remanufacturing can be an option, but high-value products are required.
- + In electronics, multifunction office machines, printers and scanners are remanufactured. Furthermore, remanufacturing of printer cartridges has been done for years.
- + In the furniture industry, remanufacturing is in the start-up phase. The companies work determinedly on implementing remanufacturing in their production and have high expectations for the future. In pharmaceuticals, which is a subsector to the sector furniture and other manufacturing, three major companies are doing large-scale remanufacturing with great success. The products being remanufactured include CT and MRI scanners.
- + In the electrical equipment industry, remanufacturing is beginning to gain a footing.

Companies doing remanufacturing in Denmark in 2014

Machinery	Electronics	Furniture and other manufacturing	Electrical equipment	Metals	Transport vehicles industry
Bila	Brother Canon	Desso IKEA Philips Medical Radiometer Siemens Medical	Philips Lighting		

5. MOTIVES FOR DOING REMANUFACTURING

Strategic economic decision

The majority of companies state that the decision to implement the circular economy is rooted in a strong economic consideration. Put simply, the companies can reduce production costs.

In addition, the companies see the circular economy as part of a long-term strategy. Embracing the circular economy is part of preparing for the future market conditions - regarding both demand and the increasing prices on raw materials. Some of the companies also mention possible future regulatory requirements as a motivator.

The companies' motivation is often more than just a desire to reduce costs. Remanufacturing provides an opportunity for companies to distinguish themselves from competitors and to capture new markets.

Corporate social responsibility (CSR) is also an obvious motivation for the companies to engage in the circular economy.

The attention given to the circular economy by the media today facilitates an opportunity for the companies to position themselves as innovative and socially responsible.

Long-term strategy

To many companies the circular economy enables a whole new way of structuring their work. They need to complete tasks they have never done before. This can lead to start-up problems, but it means an increased awareness of the companies' own products.

When the companies begin to get their old products back, they gain insights into how their products are being used and where errors occur. They can use this knowledge to improve and optimize their products. Most companies do not consider this benefit when they first decide to do remanufacturing.

For the companies, a good business case is a prerequisite for their adoption of circular economy. Several companies say they are willing to make risky investments in circular production, but the risk implies they move slowly and with caution.. The companies see it as an investment in the future, motivated by both production and CSR considerations.

Barriers for remanufacturing

Through 64 initial interviews and 25 subsequent in-depth interviews we identified a number of barriers for the use of remanufacturing in production in Denmark. The barriers are categorized below.

The companies

- + **The logistics chain:** Costly and complicated collection of cores.
- + **Compliance with quality requirements:** Costly to ensure the quality of remanufactured products.
- + **Long-term investment:** Remanufacturing requires cost-intensive R&D with a long payback period that can be too risky for some companies.
- + **Too much transparency:** Remanufacturing requires cooperation between suppliers and customers, as well as an open value chain. It can give competitors an advantage and increase espionage.
- + **Sales vs. leasing:** To counter customers' scepticism of remanufactured products, some companies lease their products to the customers. The inability to lease some product types may be a barrier.

Authorities and legislation

- + **Annual budget vs. operating budget:** Offerings are based on annual budgets and do not embrace the potential savings related to remanufactured products.
- + **International trade:** International laws may restrict or prevent the transport of remanufactured products into or out of the country.

Demand side

- + **Limitations in tenders:** Several companies emphasize that the Danish authorities do not demand remanufactured products in public procurement.
- + **Perception of quality:** The companies fear that customers will perceive remanufactured products as being of lower quality than new products.

Structure

- + **Rapid technological development:** Some products change so fast that new products are significantly different from old products, thereby making it difficult or impossible to remanufacture old products.
- + **Wages:** High wages make remanufacturing very expensive in Denmark.

Structural differences in remanufacturing

The most dominant industries for remanufacturing in Denmark are considerably different from those in the US.

Aerospace and HDOR are the largest industries for remanufacturing in the US, with potentials of 2.5% and 3.8% (Ellen MacArthur, 2014). Both of these industries are almost nonexistent in Denmark. In Denmark metals and machinery are the two largest markets for remanufacturing.

The remanufacturing potential in the metals and machinery industries is around 1% of the total production.

We find a potential for remanufacturing of 0.15% of GDP. The scope of remanufacturing in the US in 2014 were 0.28% of GDP.

This is due to structural differences between the US and Denmark. The Industries in which remanufacturing is feasible constitute a smaller share of GDP in Denmark than in the US.

Future for remanufacturing in Denmark

For a country the size of Denmark remanufacturing is an international strategy not a national:

- + The salaries in Eastern Europe are around one sixth of the Danish and the manual process of remanufacturing is therefore unlikely to take place in Denmark.
- + In addition, for remanufacturing to be a good business strategy for the companies, scale is needed, and Denmark is too small.

It is difficult to make an accurate forecast about the future scope of remanufacturing, because there are many different factors that can affect the development of remanufacturing in Denmark.

For the companies, the rising prices of raw materials point to increased use remanufacturing, because the manufacturing of new products will be relatively more expensive. Conversely, increasing wages and transport costs will make it more likely that the companies will consider doing the remanufacturing abroad, where the costs are lower.

The decomposition of existing barriers for remanufacturing may also be a decisive factor for the companies' motivation to increase remanufacturing in their business models. An active effort to improve consumer perception of remanufactured products and an increased focus on remanufacturing in public procurement and legislation are potential ways to address barriers.