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# Circulair gebruik van smeermiddelen".

23th of March 2021

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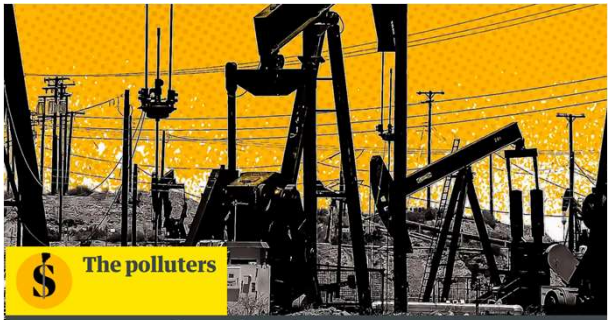
# Sustainability is (becoming) business critical

**BlackRock will immediately stop investing in companies that "present a high sustainability-related risk"**

*Laurence D. Fink, founder and CEO of BlackRock, world's largest asset manager*

*Source: The Economist*




*Source: The Guardian*

Media centre › Newsroom › All releases

**EUR 10 billion to support the Circular Economy in the EU**

DE EN ES FR IT PL

18 July 2019

©Mireia Gonzalez Torrijos/EIB

The EU's largest National Promotional Banks and Institutions and the European Investment Bank launch a EUR 10 billion initiative to accelerate the transition to a sustainable and circular economy

Five European national promotional banks & institutions and the European Investment Bank (EIB) launched today in

*Source: European Investment Bank*

ExxonMobil has been removed last month from Dow Jones Index...

Product stewardship for oil program

If you are licensed to manufacture excisable products and recycle oil or use in your business, you may be eligible for a benefit under the Product Stewa program (PSO).

*Source: Australian government*


*Source: Shell CEO*

**Poland Proposal Would Encourage Rerefining**

By Boris Kamchev - August 18, 2020

*Source: Lubes'n'Greases*

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# The industrial oil challenge

- 19 million tonnes of industrial lubrication oil is used every year – most of it is used only once
- Extracting the oil needed for industrial lubrication - and then disposing of it- comes at high environmental costs
- Industrial oil will stay in use for an unforeseeable future – the challenge is to use this asset in a sustainable way
- Current business model of lubricants: TAKE – MAKE – WASTE

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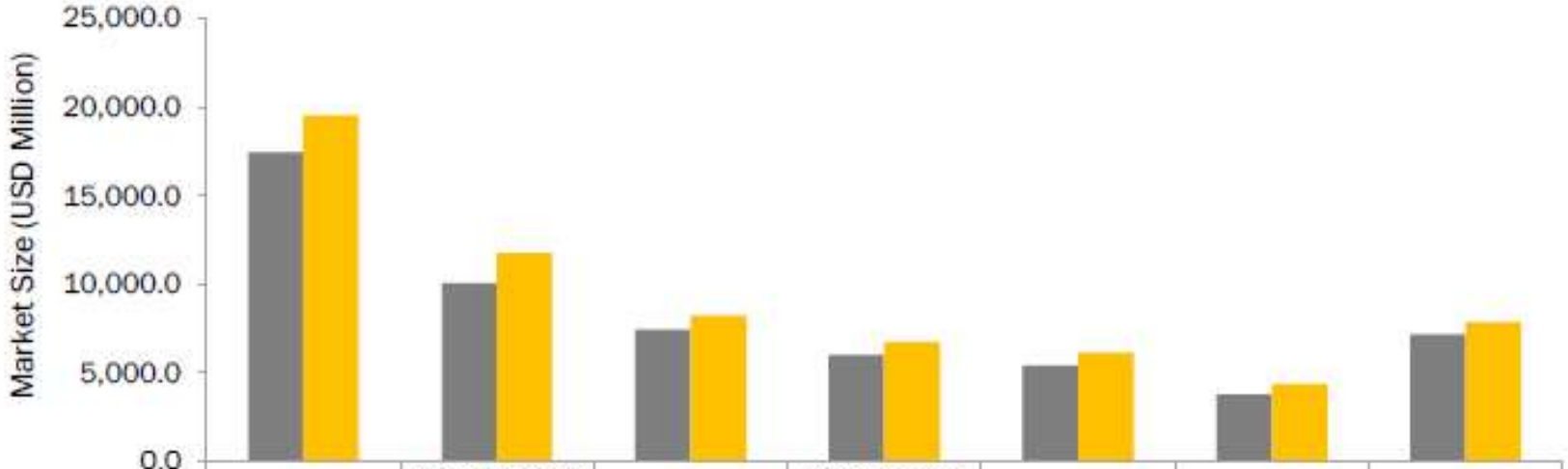
# Industrial lubricants - a huge market




| | Hydraulic Oil | Metalworking Fluid | Gear Oil | Compressor Oil | Grease | Turbine Oil | Others |
|---|---|---|---|---|---|---|---|
| 2016 | 17,432.9 | 10,028.9 | 7,395.9 | 5,959.7 | 5,375.7 | 3,761.5 | 7,144.1 |
| 2021 | 19,495.2 | 11,753.9 | 8,222.3 | 6,719.6 | 6,127.2 | 4,337.7 | 7,832.6 |
| CAGR | 2.3% | 3.2% | 2.1% | 2.4% | 2.7% | 2.9% | 1.9% |

*Source: Expert Interviews, Secondary Research, and MarketsandMarkets Analysis*

From TAKE – MAKE – WASTE

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A circular economy of oil

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It started with a customer…

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# Customer case: Eight years using the same oil, and counting…

Stainless-steel wire and strip manufacturer

- 12 weeks oil change cycle
- Tight requirements on product quality
- Highest product qualities only achievable with new oil

With integrated DST

- Eight years of using the same oil, and counting…
- 30 oil changes avoided – so far
- 25 % increase in productivity

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# HOW DOES IT WORK?

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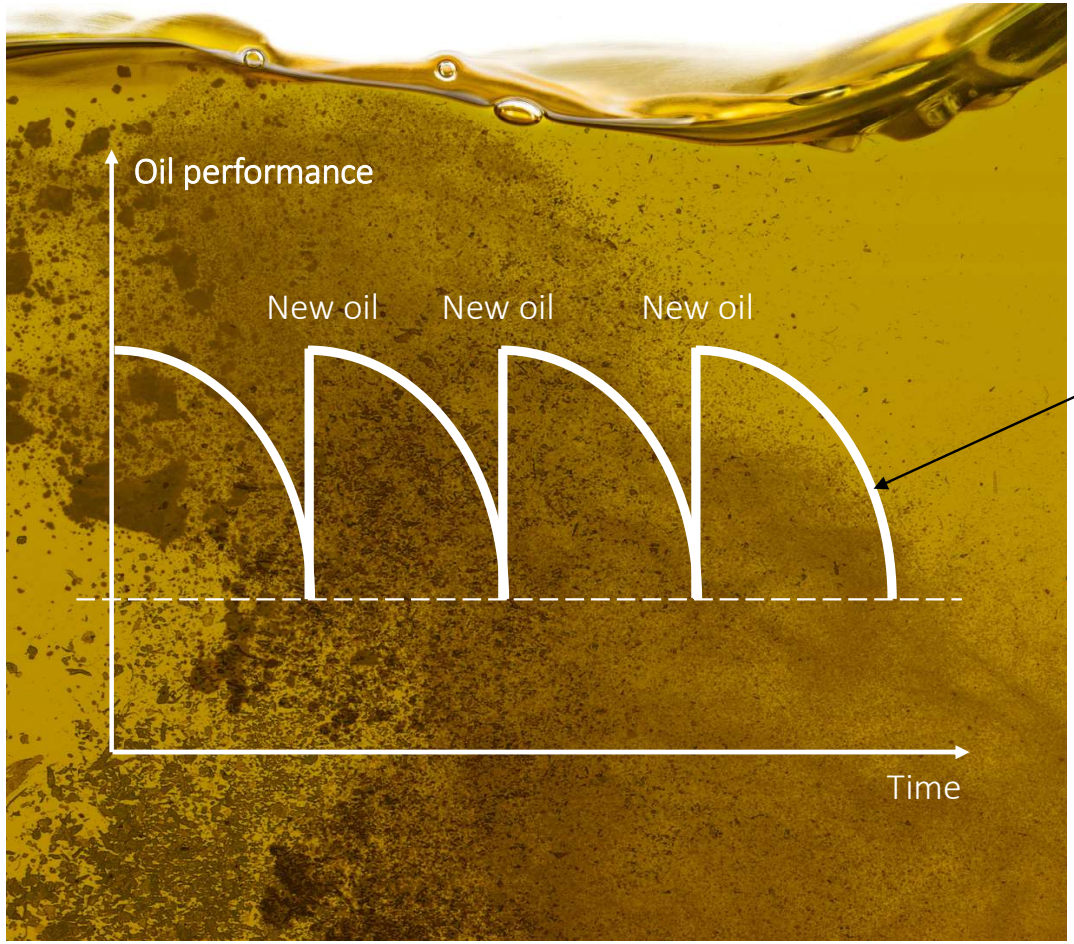
# Why we change oil




Oxidation

Contamination

Additive consumption

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# What we do

We combine **chemical** and **mechanical** separation and **Oil** into a unique patented process technology

DOUBLE SEPARATION

TECHNOLOGY BY SKF

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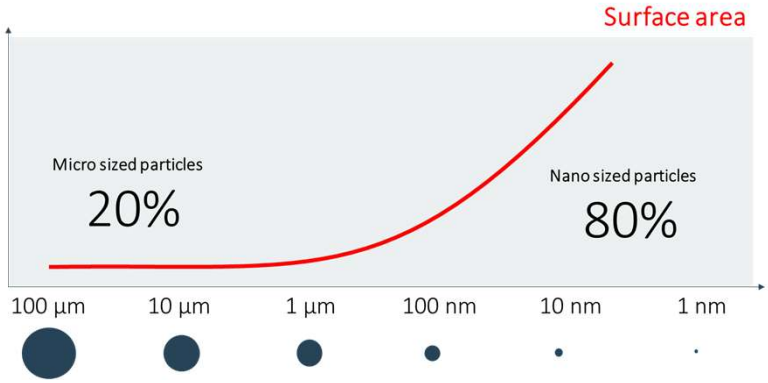
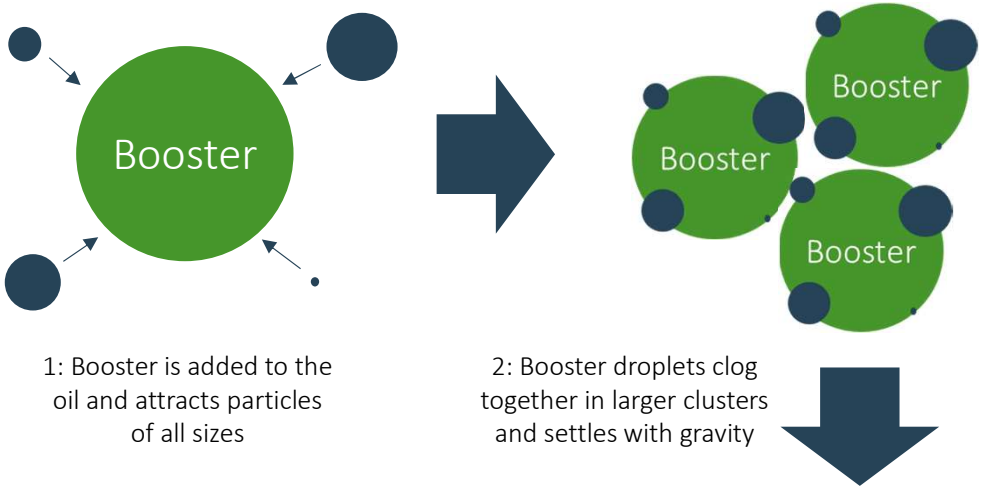
# Double Separation Technology

DST captures contamination particles and degradation products, varnish and pre-varnish down to **nano-size.**




*The nano-particles normally slip through conventional filters and constitute a huge surface in the oil acting as a* ***catalyst for oxidation***

## DST Principle:




1: Booster is added to the oil and attracts particles of all sizes

2: Booster droplets clog together in larger clusters and settles with gravity

→ DST enables a circular use of oil

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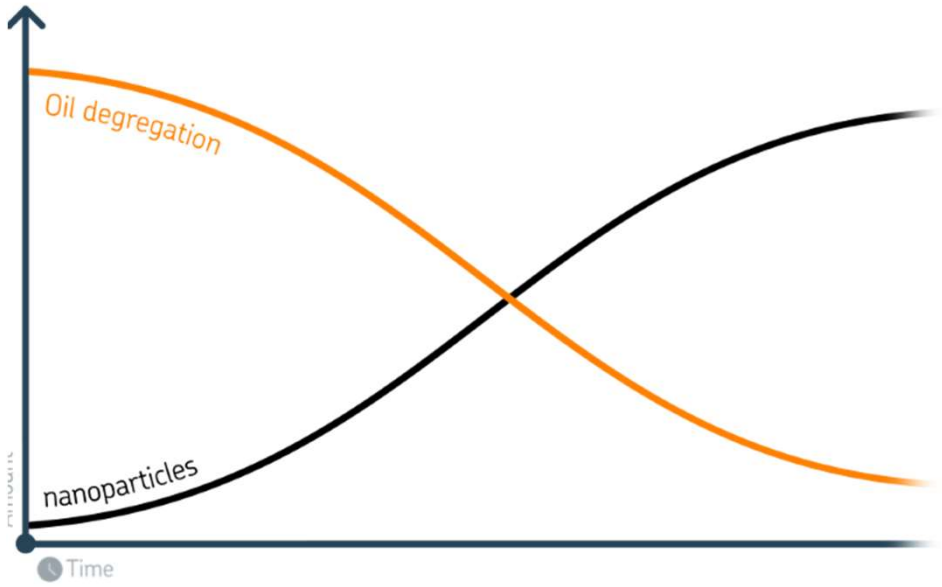
# Oil will degrade due to oxidation, caused mainly by accumulation of nano-particles




**Oxidation** – a chain reaction!

- Increase in viscosity
- Formation of varnish, sludge & sediment
- Reacting with additives →
- Affecting properties & functionality!
- Lead to rust & corrosion of equipment

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# Performance impact

## Life extension table

Source: Noria Corp.

| Current Cleanliness level (ISO 4406) | Expected Cleanliness level (ISO 4406) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21/19/16 | | 20/18/15 | | 19/17/14 | | 18/16/13 | | 17/15/12 | | 16/14/11 | | 15/13/10 | | 14/12/9 | | 13/11/8 | | 12/10/7 | |
| 24/22/19 | 2 | 1.6 | 3 | 2 | 4 | 2.5 | 6 | 3 | 7 | 3.5 | 8 | 4 | >10 | 5 | >10 | 6 | >10 | 7 | >10 | >10 |
| | 1.8 | 1.3 | 2.3 | 1.7 | 3 | 2 | 3.5 | 2.5 | 4.5 | 3 | 5.5 | 3.5 | 7 | 4 | 8 | 5 | 10 | 5.5 | >10 | 8.5 |
| 23/21/18 | 1.5 | 1.5 | 2 | 1.7 | 3 | 2 | 4 | 2.5 | 5 | 3 | 7 | 3.5 | 9 | 4 | >10 | 5 | >10 | 7 | >10 | 10 |
| | 1.5 | 1.3 | 1.8 | 1.4 | 2.2 | 1.6 | 3 | 2 | 3.5 | 2.5 | 4.5 | 3 | 5 | 3.5 | 7 | 4 | 9 | 5.5 | 10 | 8 |
| 22/20/17 | 1.3 | 1.2 | 1.6 | 1.5 | 2 | 1.7 | 3 | 2 | 4 | 2.5 | 5 | 3 | 7 | 4 | 9 | 5 | >10 | 7 | >10 | 9 |
| | 1.2 | 1.05 | 1.5 | 1.3 | 1.8 | 1.4 | 2.3 | 1.7 | 3 | 2 | 3.5 | 2.5 | 5 | 3 | 6 | 4 | 8 | 5.5 | 10 | 7 |
| 21/19/16 | | | 1.3 | 1.2 | 1.6 | 1.5 | 2 | 1.7 | 3 | 2 | 4 | 2.5 | 5 | 3 | 7 | 4 | 9 | 6 | >10 | 8 |
| | | | 1.2 | 1.1 | 1.5 | 1.3 | 1.8 | 1.5 | 2.2 | 1.7 | 3 | 2 | 3.5 | 2.5 | 5 | 3.5 | 7 | 4.5 | 9 | 6 |
| 20/18/15 | | | | | 1.3 | 1.2 | 1.6 | 1.5 | 2 | 1.7 | 3 | 2 | 4 | 2.5 | 5 | 3 | 7 | 4.6 | >10 | 6 |
| | | | | | 1.2 | 1.1 | 1.5 | 1.3 | 1.8 | 1.5 | 2.3 | 1.7 | 3 | 2 | 3.5 | 2.5 | 5.5 | 3.7 | 8 | 5 |
| 19/17/14 | | | | | | | 1.3 | 1.2 | 1.6 | 1.5 | 2 | 1.7 | 3 | 2 | 4 | 2.5 | 6 | 3 | 8 | 5 |
| | | | | | | | 1.2 | 1.1 | 1.5 | 1.3 | 1.8 | 1.5 | 2.3 | 1.7 | 3 | 2 | 4 | 2.5 | 6 | 3.5 |
| 18/16/13 | | | | | | | | | | | | | | | | | 4 | 3.5 | 6 | 4 |
| | | | | | | | | | | | | | | | | | 3.7 | 3 | 4.5 | 3.5 |
| 17/15/12 | | | | | | | | | | | | | | | | | 3 | 2 | 4 | 2.5 |
| | | | | | | | | | | | | | | | | | 2.3 | 1.8 | 3 | 2.2 |
| 16/14/11 | | | | | | | | | | | | | | | | | 2 | 1.8 | 3 | 2 |
| | | | | | | | | | | | | | | | | | 1.9 | 1.5 | 2.3 | 1.8 |
| 15/13/10 | | | | | | | | | | | | | | | | | 1.8 | 1.5 | 2.5 | 1.8 |
| | | | | | | | | | | | | | | | | | 1.6 | 1.3 | 2 | 1.6 |

| | |
|---|---|
| Hydraulics and Diesel engines | Rolling element Bearings |
| Journal Bearing and Turbo Machinery | Gear Boxes and other |

| | |
|---|---|
| >10 | 5 |
| 7 | 4 |

NORIA "Lubrication Enabled Reliability"

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# REFERENCE CASES

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# Results from SKF Cassino factory

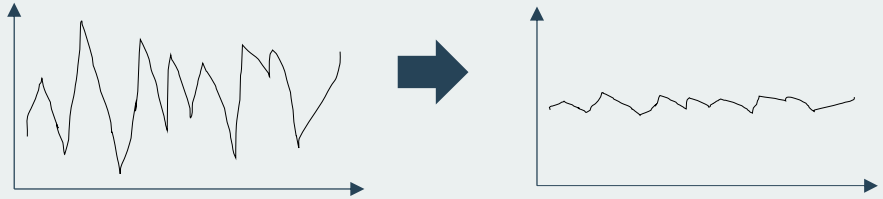

55 $m^3$ annual reduction of oil consumption

150 tonnes of CO2 per year (est)

~40% scrap reduction from final N&V-inspection

## Unexpected benefits with Ultra clean oil in honing:

**Reducing variability in production**



*Process stability is a factory manager's top priority.*

**Discovering redundant operations**


*Washing step suddenly redundant with super clean oil in honing! Overall process improvement, lowered cycle times, cost savings and less equipment used.*

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# SKF RecondOil case – Quenching oil


- Reduced oil and energy consumption ~ 15m$^3$ (one channel)

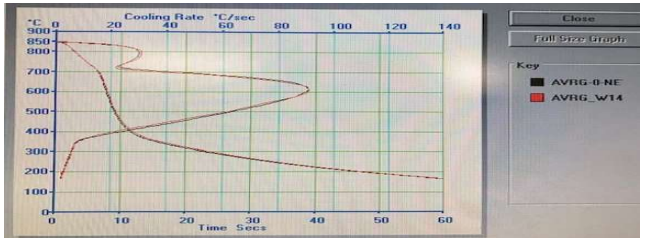
- Oil & filter savings ~ 0,3 MSEK / year
- Scrap reduction value ~ 1 MSEK / year
- Elimination of production stops ~ 0,8MSEK / year

- Improved quenching performance (cooling curve/rate)
- Homogeneous color of rollers without stains
- Increased up-time by decreased maintenance need

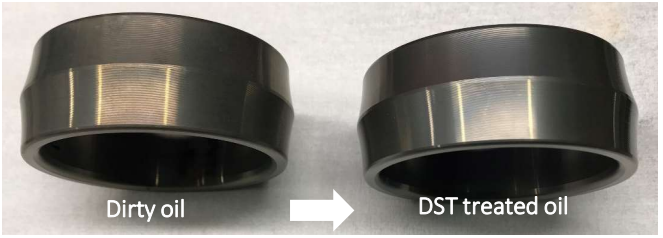
**DST Treatment results**

| | Used oil | DST treated | Reduction |
|---|---|---|---|
| Particle Counter (ISO 4406:99) | 24/22/18 (130488/ml) | 16/14/9 (482/ml) | 99,6 % |
| Water content (ppm) | 2561 | 120 | 95,3 % |

**Cooling curve/rate restored to virgin oil**




**Substantially improved visual appearance**



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# SKF RecondOil case – Wind Power gearbox oil

DST treatment of 5 liters of discarded gearbox oil for wind powe

→ Lowering of ISO code by 10 steps!

ISO CODE LOWERED BY 10 STEPS!

Particle cleanliness and water concentration in virgin, used and DST-treated Shell Omala S4 Gx150 gear oil

| | Particle Counter (ISO 4406:99) | Image Analysis (ISO 4406:87) | Water (ppm) |
|---|---|---|---|
| Virgin | 22/20/16<br>27 010/ml | 13/11/10<br>44/ml | 189 |
| Used | 26/24/21<br>466 260/ml | 18/17/17<br>2279/ml | 400 |
| Used + DST | 16/14/11<br>392/ml = 99,9% red | 12/11/10<br>40/ml = 98.2 red | 139 |


Virgin Used DST-treated

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# SKF RecondOil case – Wind Power gearbox oil

## CONCLUSIONS

- Possible to clean the gearbox oil down to low particle concentration
- Possible to decrease the content of nano-sized particles
- Drastic decrease in catalytical metal surface area
- No effects on additive content or viscosity characteristics

Improve the lubricating function

Increase lifetime of oil

Virgin: 10,8 mg/100ml  Used: 88,1 mg/100ml  Used + DST: 7,7 mg/100ml

**Figure 3: Filter appearance after passage of 100 ml oil sample with corresponding sediment concentration.**

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# SOLUTIONS

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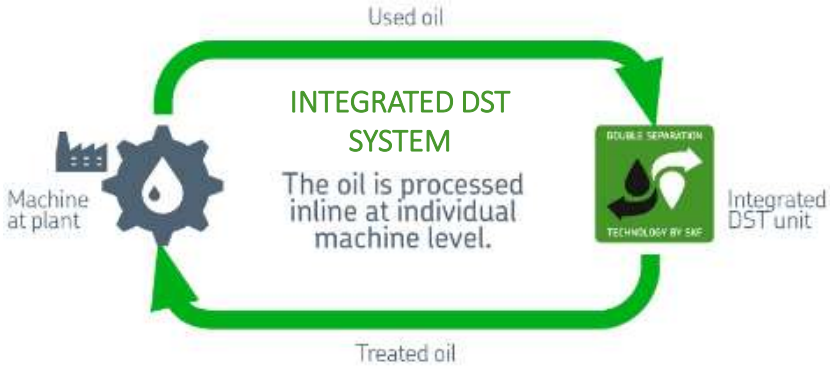
# Circular use of oil | Two process technologies

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# RecondOil Shoebox function and target applications

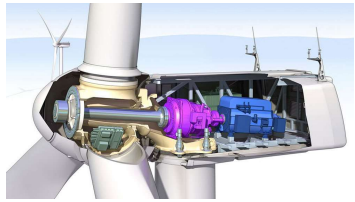
## Shoebox hardware principles:

- Very compact
- Standardized
- Robust and uncomplicated, yet sophisticated
- Enabling Circular use of Oil

## Typical use case:

- limited space
- light contamination
- small oil volume
- mobile or remote

Mobile/Stationary hydraulics



Wind turbine gearbox

Marine propulsion

Heavy duty diesel engine

Generally addressing market of small, stand-alone, closed oil systems

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# OIL AS A SERVICE

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# Oil as a Service

- Disruptive technology
- Innovative business model
- Pay per performance
- Making oil a reliability asset instead of a costly consumable

➡ We want to sell as LITTLE oil as possible!

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# Impact of regenerated super clean oil

## Environmental

- $CO_2$ emissions – from oil itself + transport
- Complying with waste handling regulations
- Safety: reducing leakages & contamination of soil

## Financial

- Oil purchase, use & disposal
- Oil Logistics drastically reduced!
- Pressure from society, shareholders & policy

## Performance

- Process efficiency
- Process reliability & stability
- Less planned and unplanned stops!
- Product quality

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