



Center for Green Growth

# *Grønn Vekst og Sirkulær økonomi:* *Fra gamle travere til fremtidens supermaterialer*



Per Espen Stoknes, twitter: [@estoknes](https://twitter.com/estoknes)

# Oversikt Sirkulær-økonomi

1. Litt historie
2. Noen norske eksempler
3. Grønn Vekst og Sirkulær-økonomi?
4. Fra gamle travere til fremtidens supermaterialer



# Sirkulær økonomi

The closed economy of the future might similarly be called the "spaceman" economy, in which the earth has become a single spaceship, *without unlimited reservoirs of anything, either for extraction or for pollution*, and in which, therefore, man must find his place in ***a cyclical ecological system...***

Kenneth E. Boulding, 1966, "The Economics of the Coming Spaceship Earth"

# Industriell Økologi

1989



Frosch, R.A.; Gallopoulos, N.E.  
(1989). "Strategies for Manufacturing".  
*Scientific American*. **261** (3): 144–152.

Per Espen Stoknes, BI

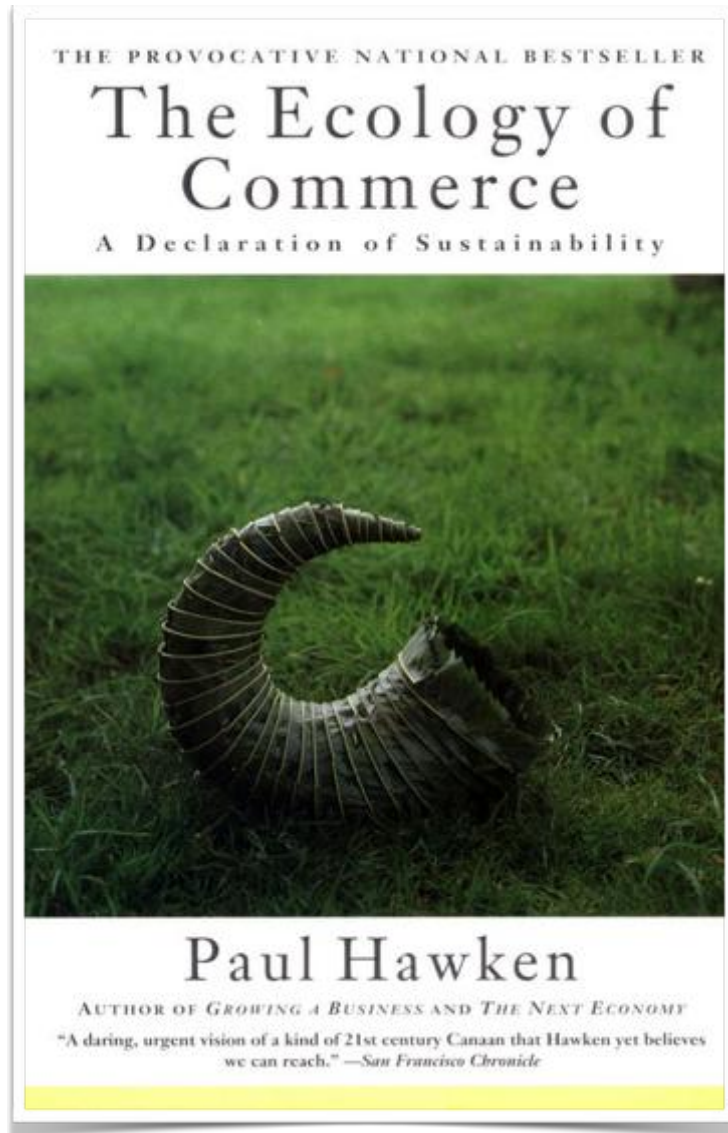
NTNU NO, Kalundborg - DK



1975-1995

By Mr3641 (talk)

1993



## Paul Hawken







## The “first” Green Executive?

- 1985: “I never gave one thought to what we took from or did to the Earth, except to be sure we obeyed all laws and regulations.”
- 1994: Was asked about his vision. Read *Ecology of Commerce*, “Hawken’s message was a spear in my chest that remains to this day.”
- “Only 3% of products we manufacture have value after 6 mnths!... We’ve built a disposable world. While business is part of the problem, it can also be part of the solution”
- 2000: To be the first company that, by its deeds, shows the entire industrial world what sustainability is in all its dimensions: people, process, product, place, and profits – by 2020 – and by doing so we will become *restorative* through the power of influence.



Ray Anderson, Interface

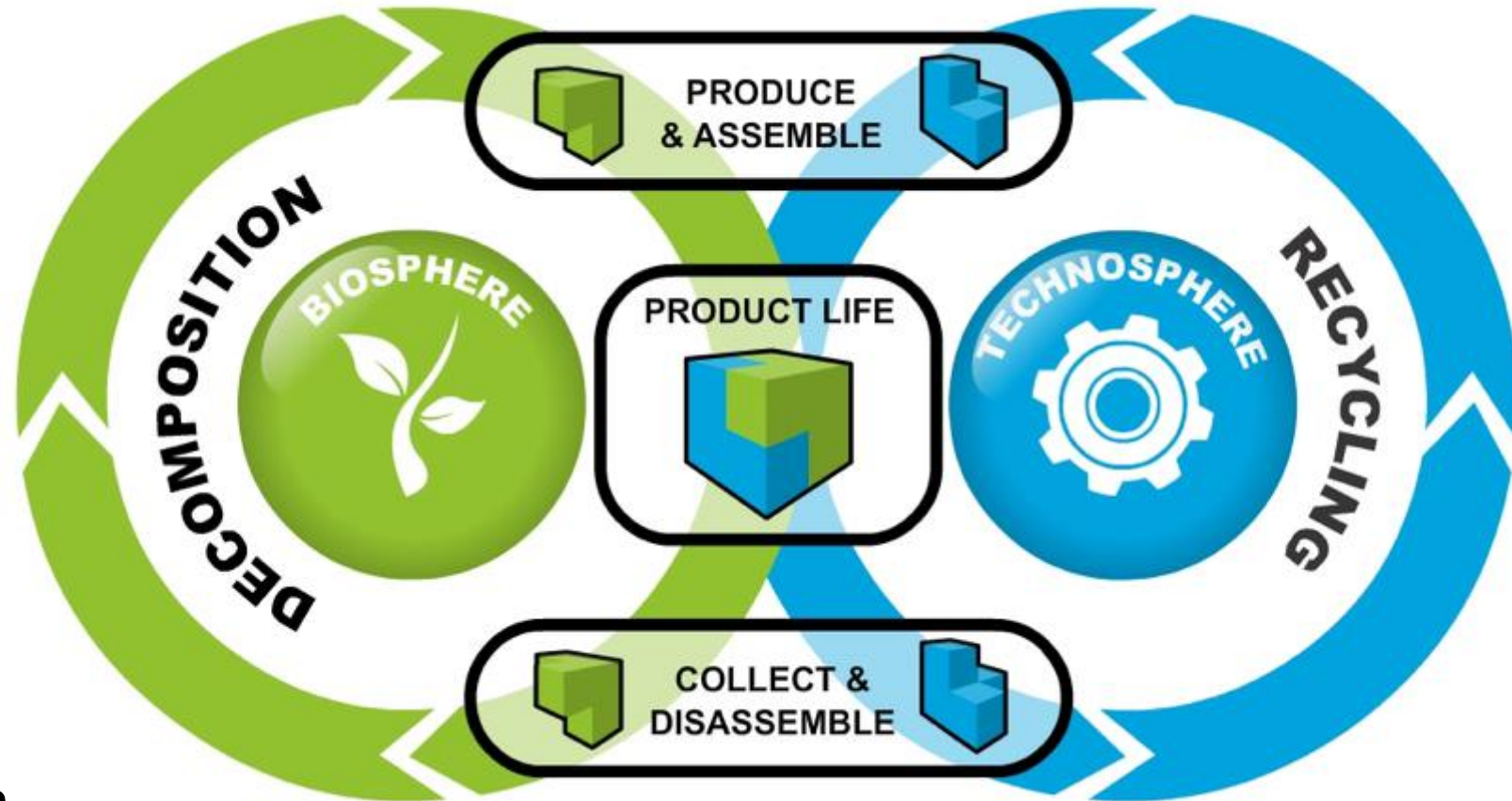


# Cradle-2-Cradle

2002

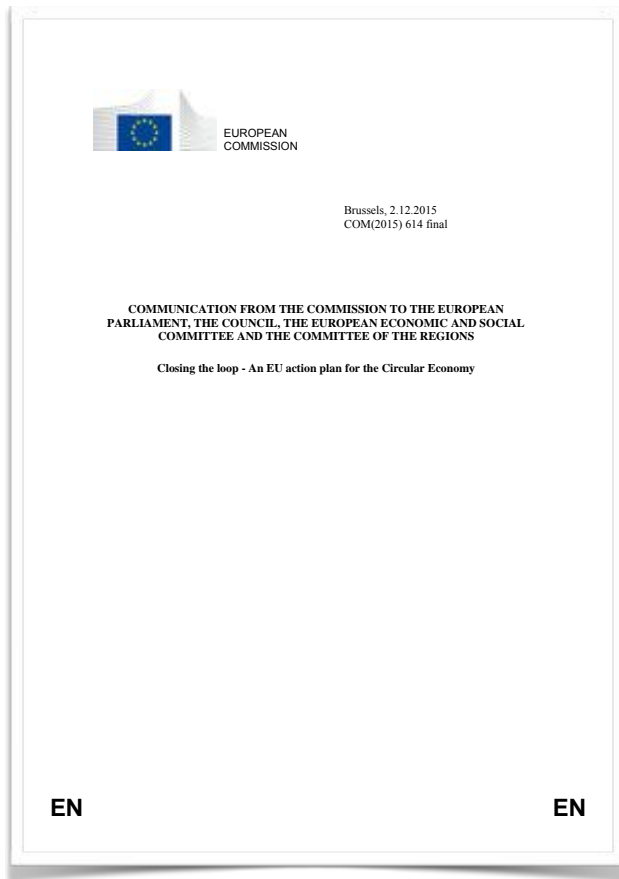


Michael Braungart,  
William McDonough





# Hva er nytt nå???



## EU 2030:

- recycling 65% of municipal waste;
- recycling 75% of packaging waste
- binding landfill target to reduce landfill to maximum of 10% of municipal waste

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# Tomra: Driving the resource revolution

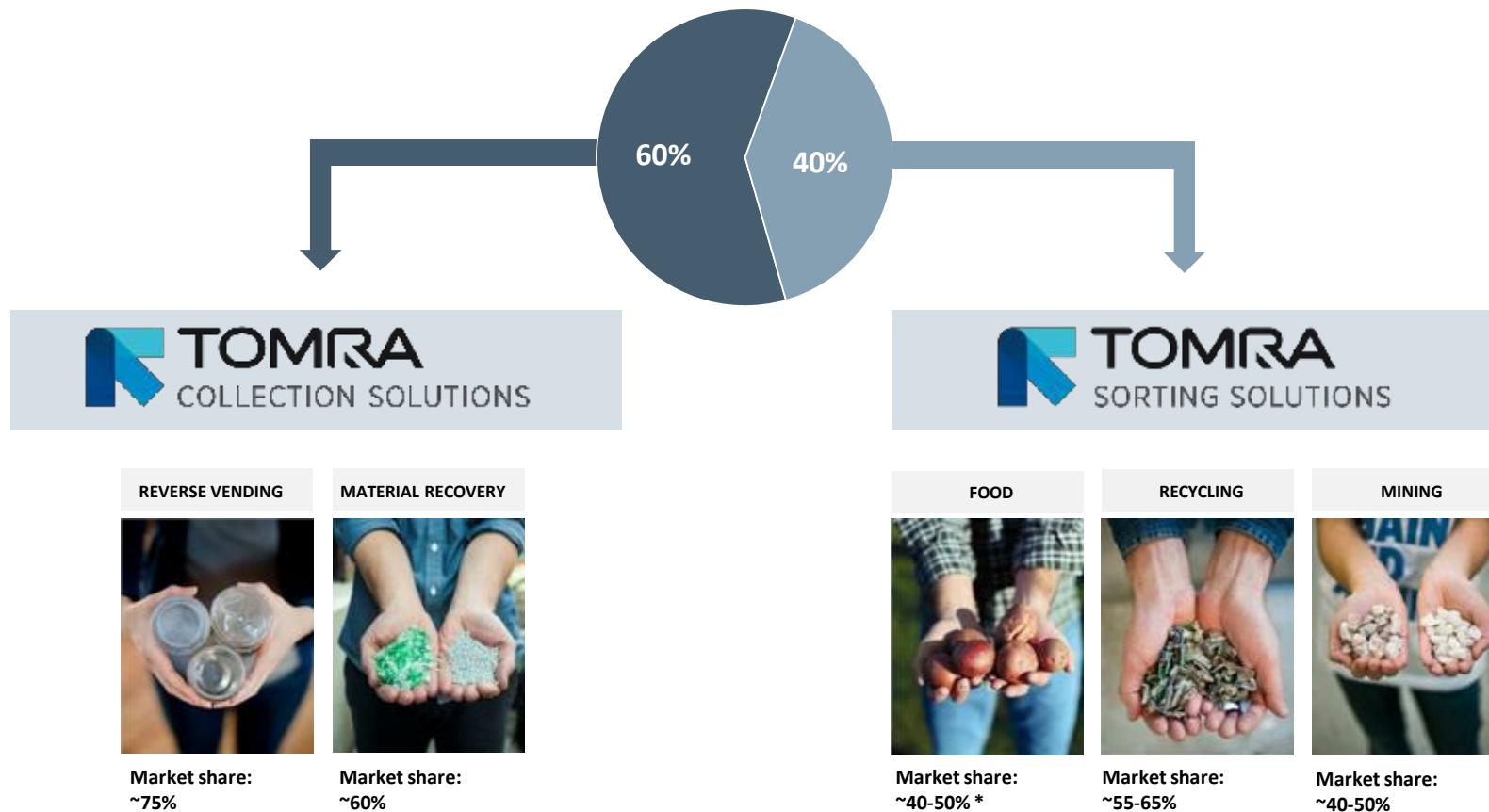


WINNER OF THE INC **AWARD FOR EXCELLENCE**  
**IN RESEARCH AND INNOVATION** AT THE INC  
CONGRESS AWARD 2015





# A MARKET LEADER IN ALL ACTIVE MARKETS...



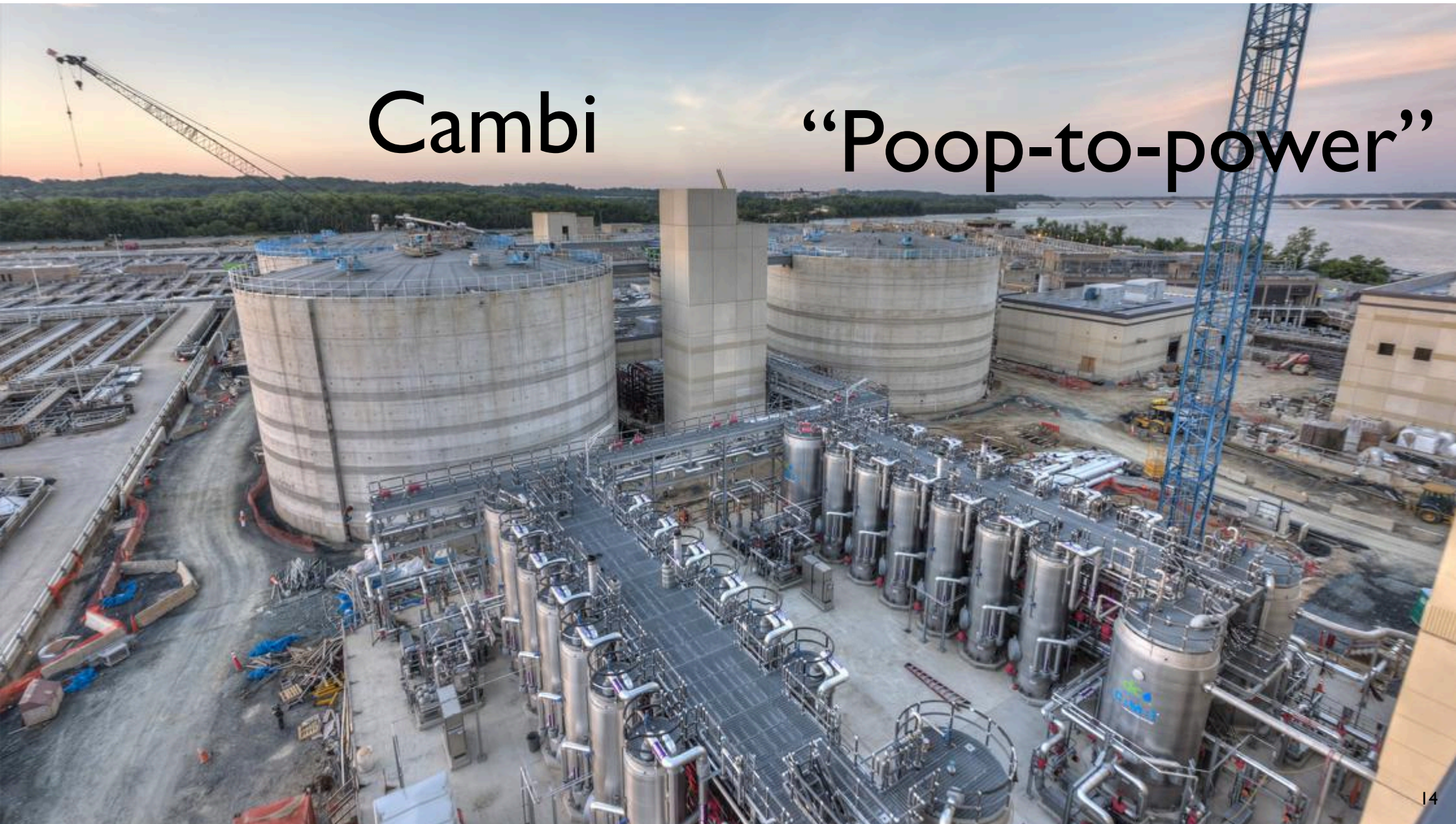
\* In total food (incl. rice and lane sorting): 12-15%



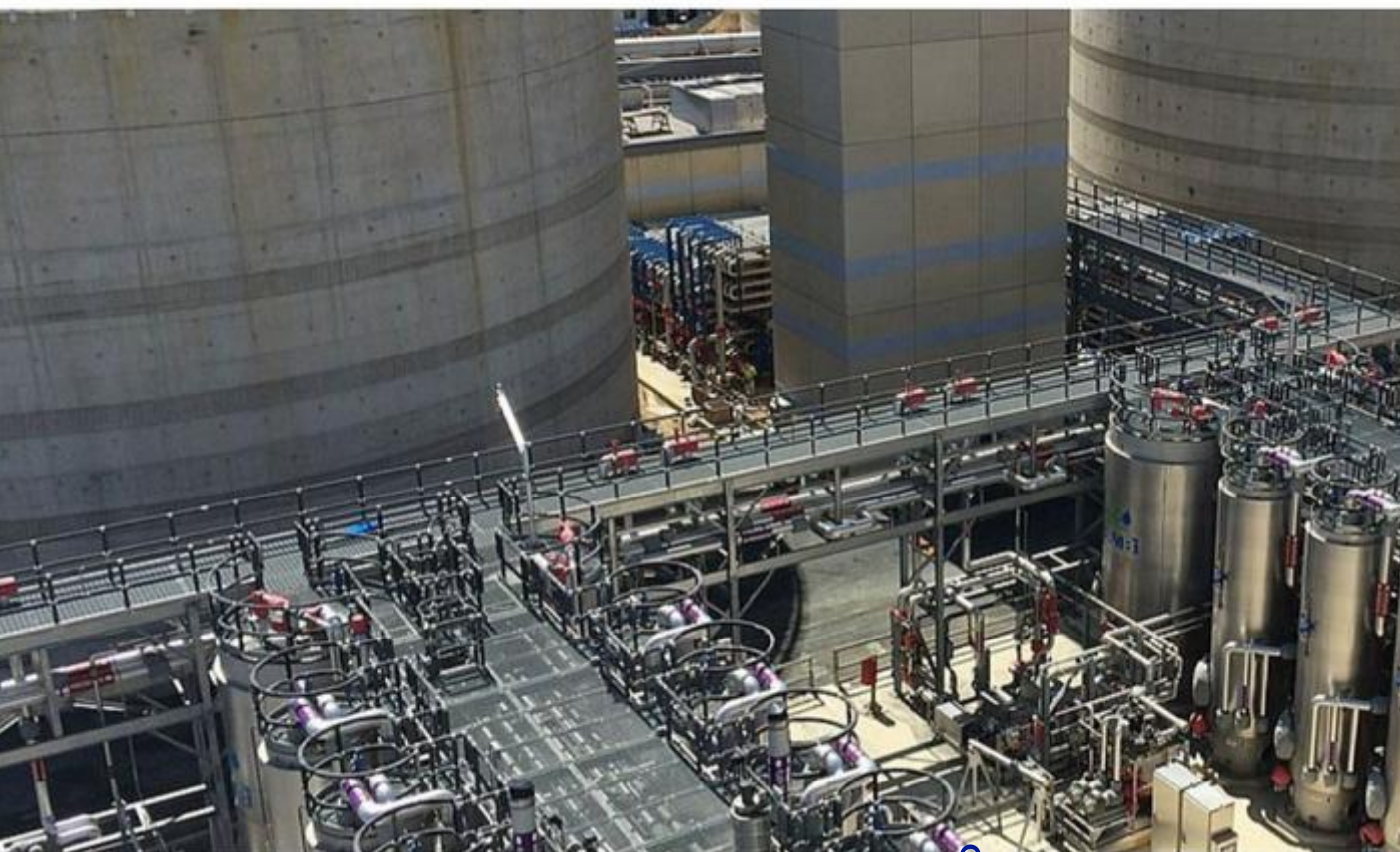


Cambi

“Poop-to-power”







ca 400mNOK/år

Per Espen Stoknes, BI

## Green Growth Årsresultat kNOK



Source: [www.purehelp.no](http://www.purehelp.no)

# Agrinos' biologicals products improve farmers' productivity, profitability and sustainability



## Agrinos' HYT™ products:



**HYT™ A**  
Microbial ecosystem  
with naturally occurring  
beneficial microbes



**HYT™ B**  
L-amino acid complex  
biologically extracted  
from a natural source



**HYT™ C**  
Micronized chitin  
biologically extracted  
from a natural source

## HYT™ products applied to soil and plant improve:

- Crop yield and quality
- Crop resilience
- Fertilizer and other agricultural input efficiency
- Soil fertility





## Inexpensive, effective and scalable raw material supply allows for low product cost!

Eggshell membrane is now available at industrial scale



400+ egg cracker plants  
world wide

Producing an estimate of  
**600.000 t**  
of eggshell residue / year



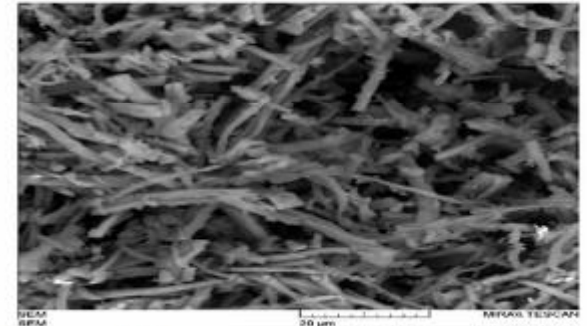
Biovotec has acquired the IP rights and know how to a unique, low cost in line egg membrane/egg shell separation process presently erected in Norway at Nortura



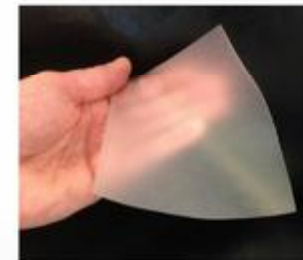
Supplying  
eggshell residue/year



Biovotec activates the “raw egg shell membrane” in its facilities in Ireland



Activated  
membrane



100 million  
Wound dressings  
From one Eggcracker

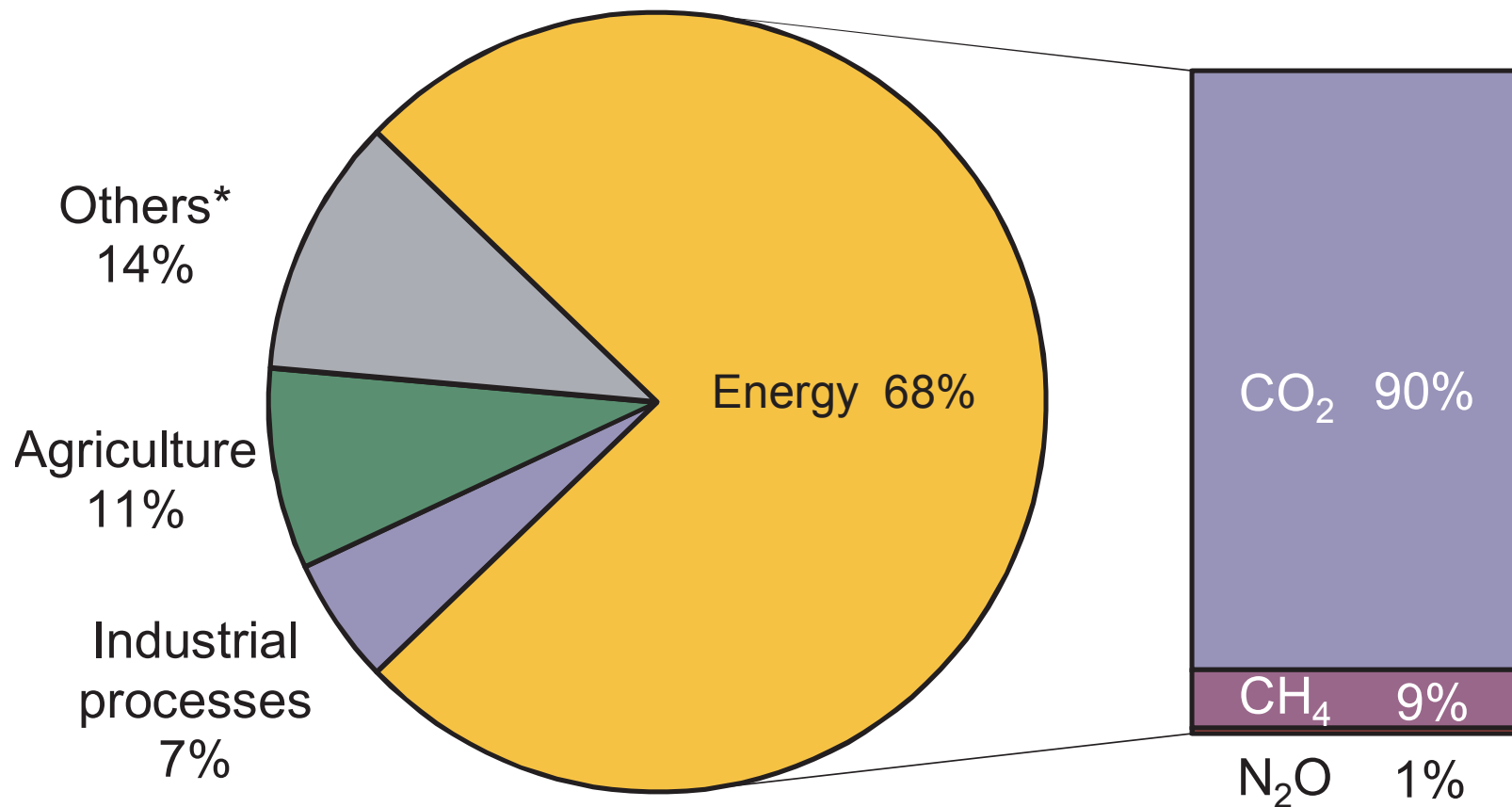




# Oversikt Sirkulær-økonomi

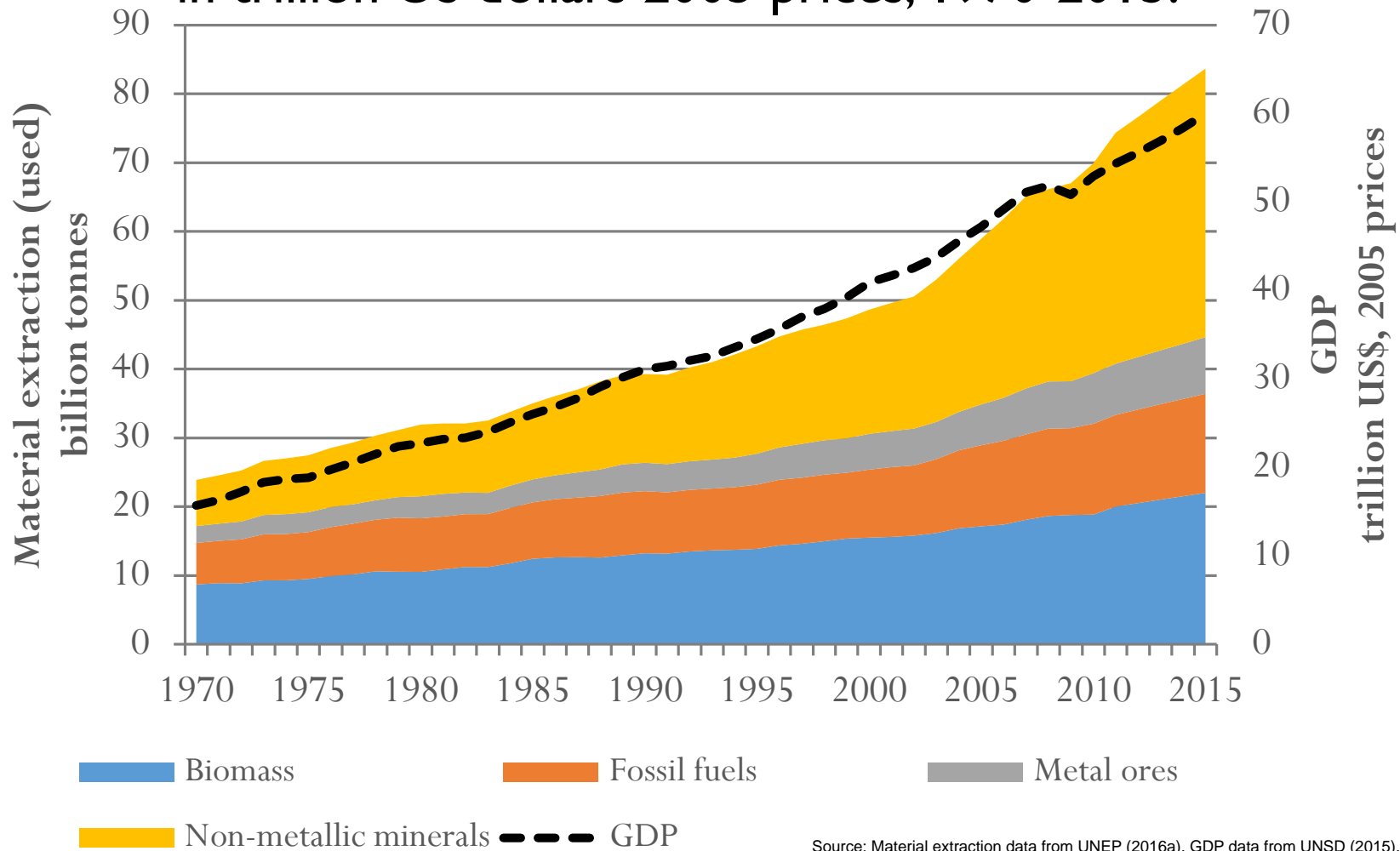
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# Sirkulær økonomi er én del av løsningen



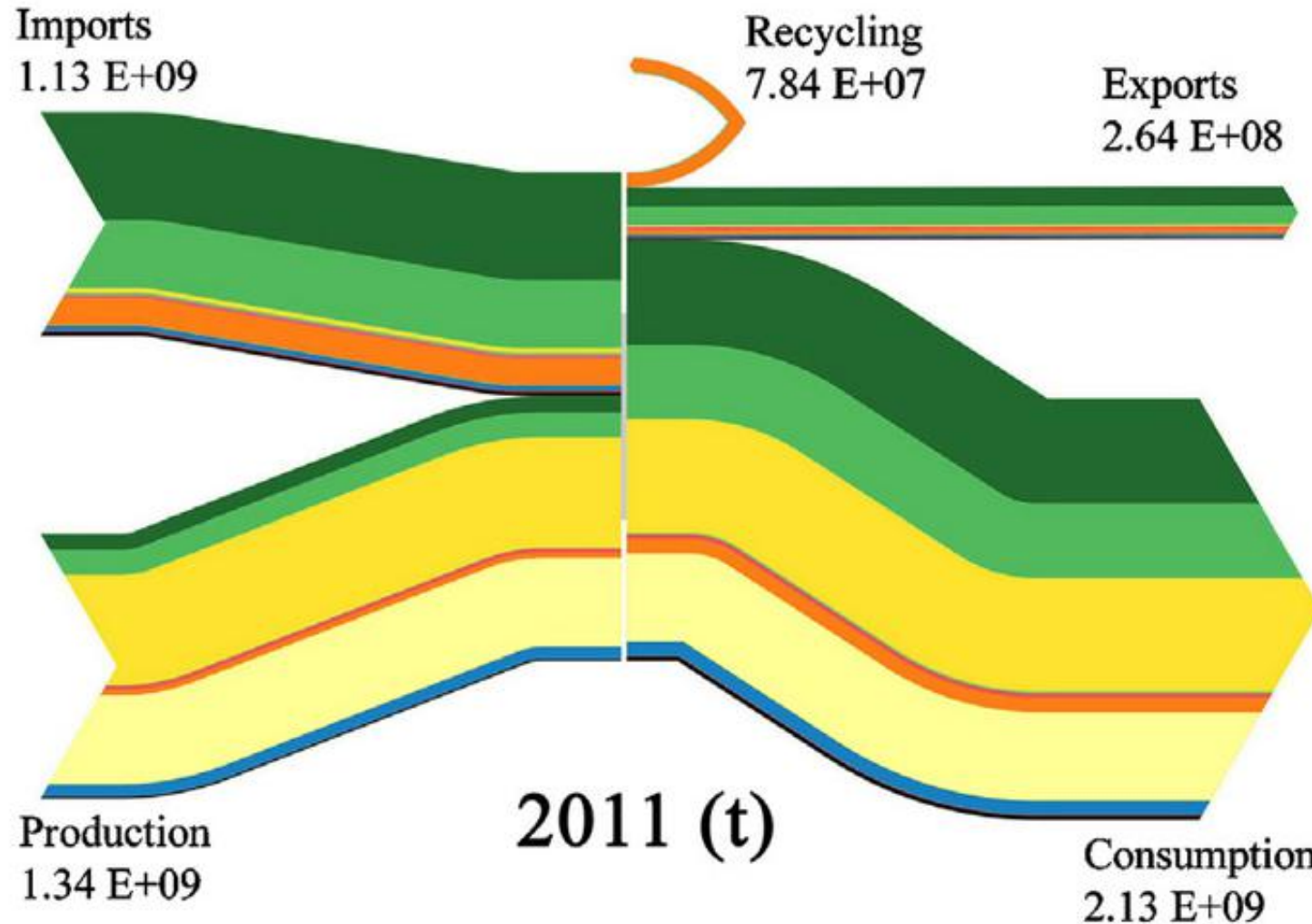
Globale CO2-utslipp etter sektor

## Global material extraction in billion tons, and global GDP in trillion US dollars 2005 prices, 1970-2015.





# Materialflyt i EU: Mineraler Green Growth



Source: Calvo & Valero (2016)  
"Material Flow for Europe"



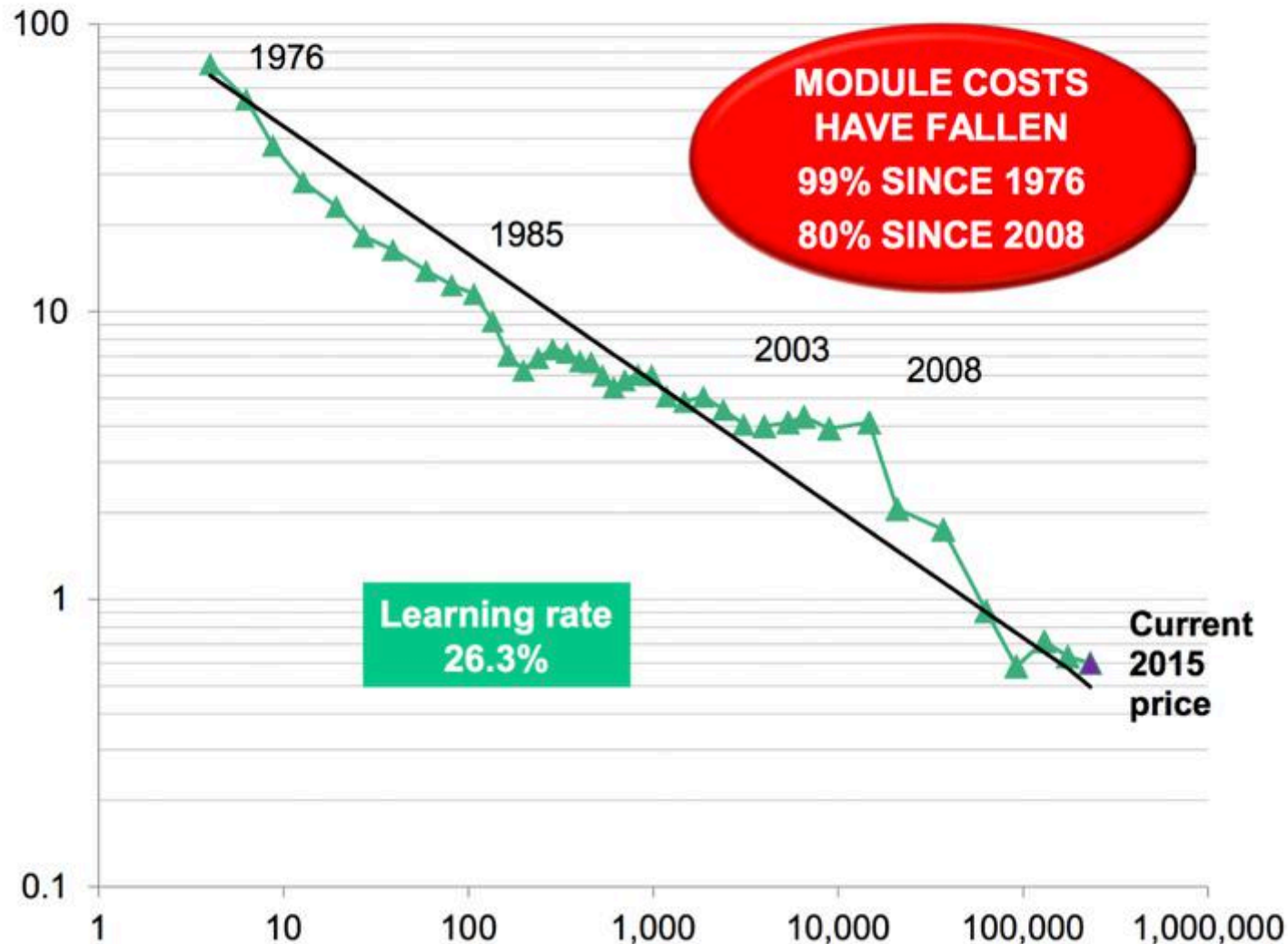
En Sol-rik Fremtid!



# The Beautiful Math of Solar Power

Green Growth

Every time the world's solar power doubles, the cost of panels falls 26%

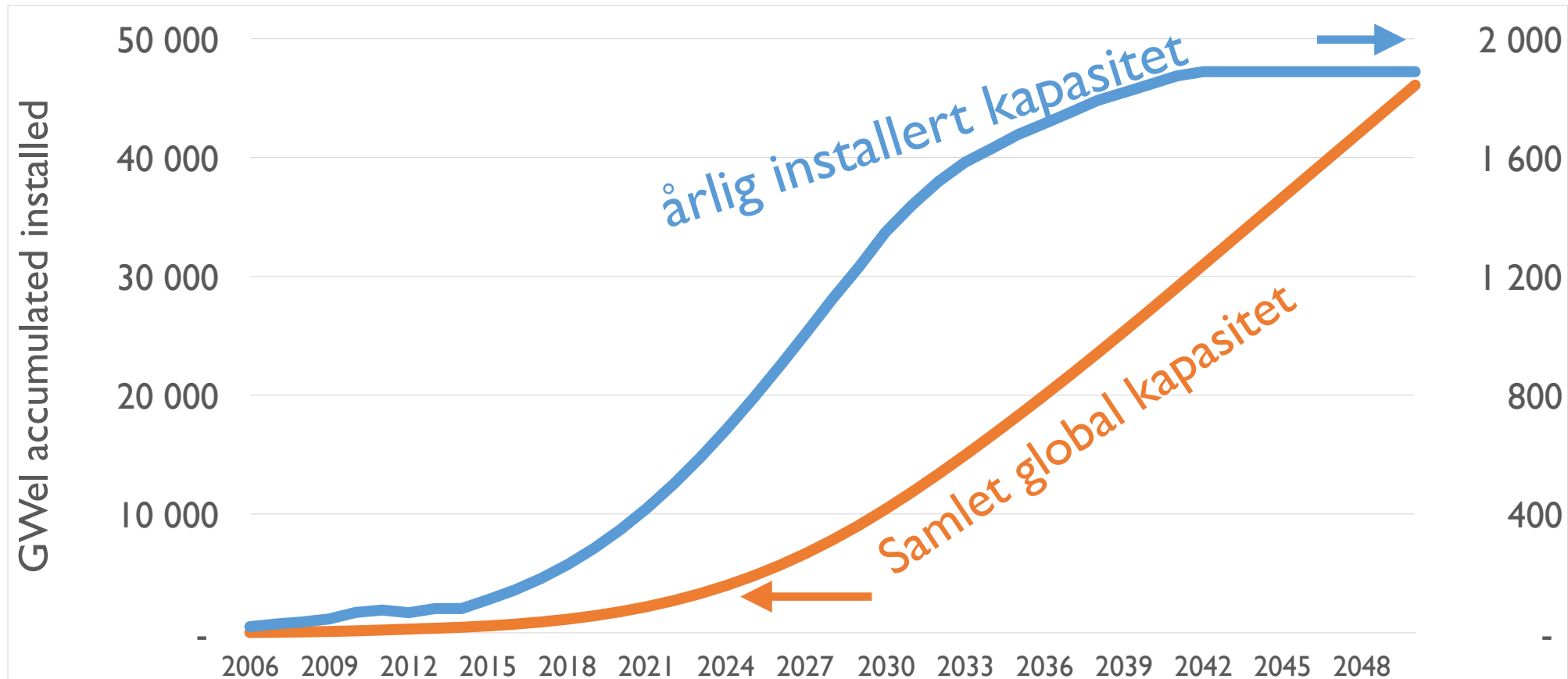






# En Sol-rik Fremtid

**Grønn Vekst**



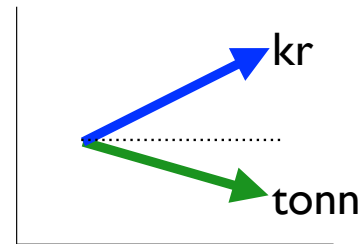
## Sol & vindkraft 2006 - 2050, i GWel

# 5 store grep mot 2050

1. All kraft fra sol & vind til kraft!
2. Elektrifisere all transport!
3. Isolasjon og el-varme til bygg & industri!
4. Overgang til karbon-bindende landbruk og skog-fornyelse
5. Sirkulær industri (inklusive CO<sub>2</sub>-fangst)

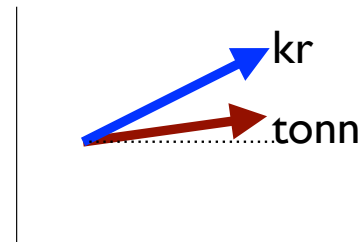
# Hva er *grønn vekst*?

- “**Grønn** vekst” er økning i den type økonomisk verdiskaping som gir lavere samlede miljøbelastninger



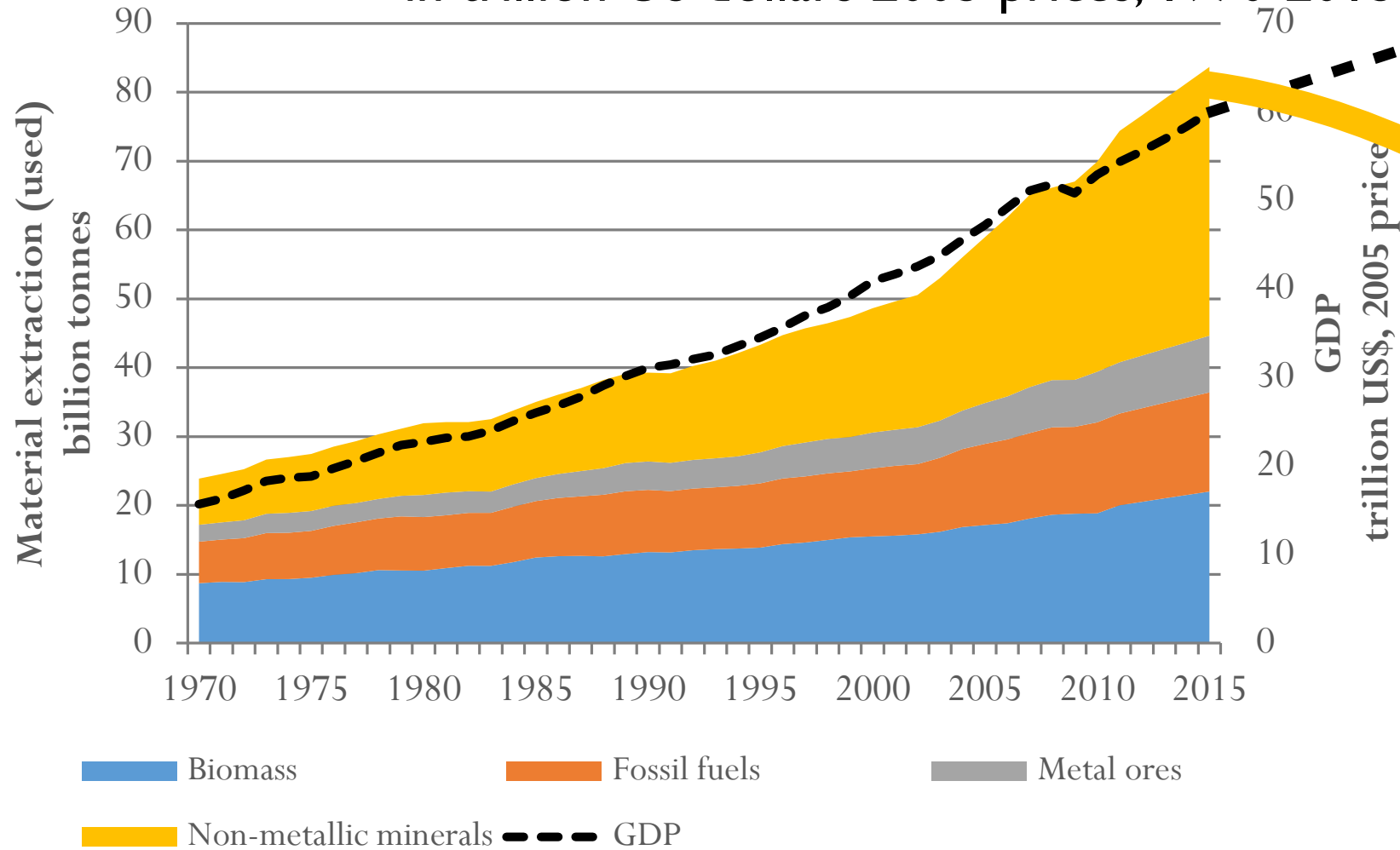
$$R_p > G$$

- “**Brun** vekst” er produktivetsforbedringer hvor samlet miljøbelastning øker på tross av effektivisering



$$R_p < G$$

## Global material extraction in billion tons, and global GDP in trillion US dollars 2005 prices, 1970-2015.



Source: Material extraction data from UNEP (2016a), GDP data from UNSD (2015).



# More good not just less bad!

Grønn Innovasjon-2



McDonough & Braungarten, 2013 The Upcycle

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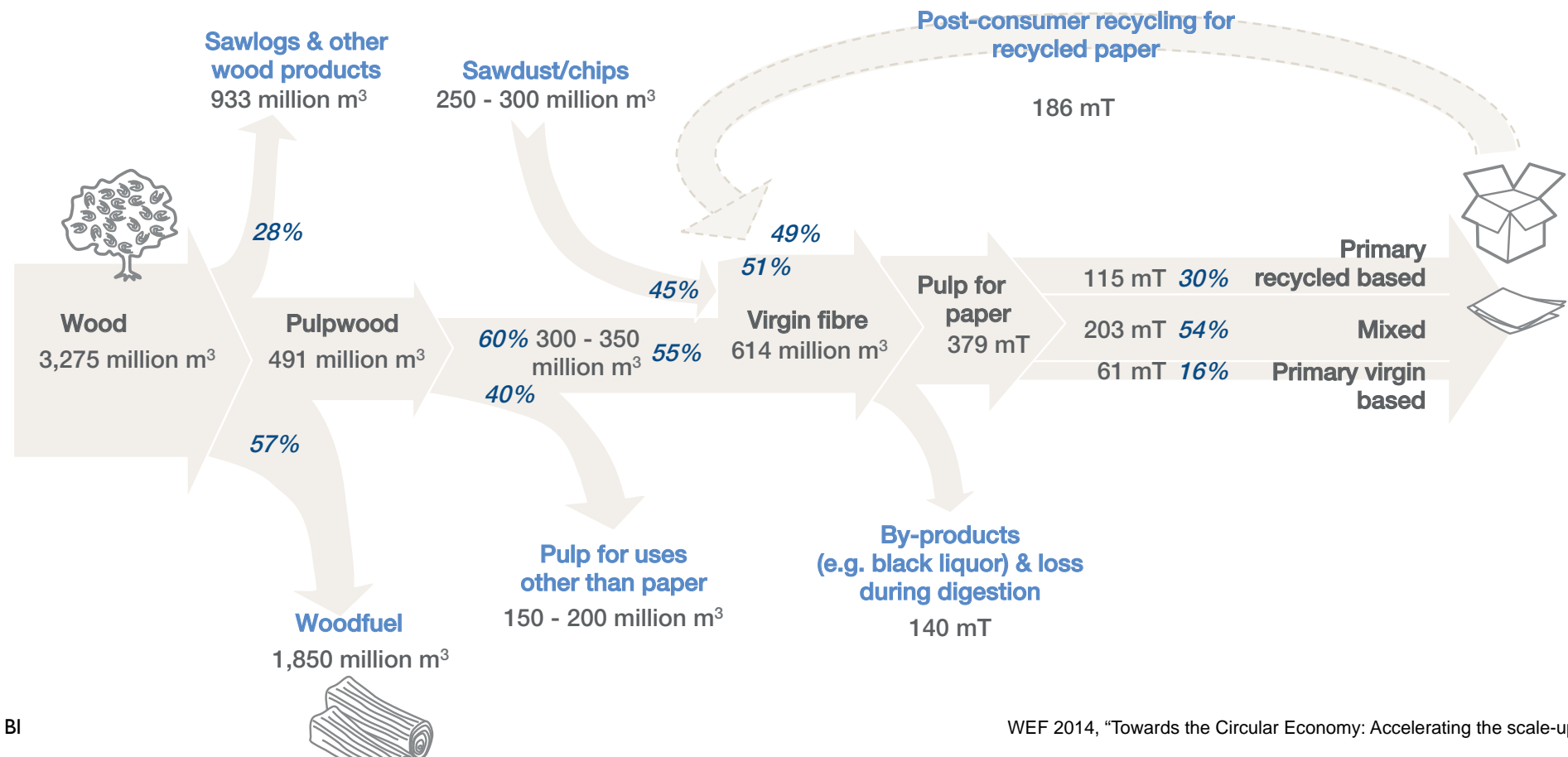
# Gamle travere - I

Growth



# Circular Case: Global Paper flows

Figure 25: Fibre flows in the pulp and paper value chain—recovered fibre is responsible for almost 50% of pulp supply for paper and cardboard





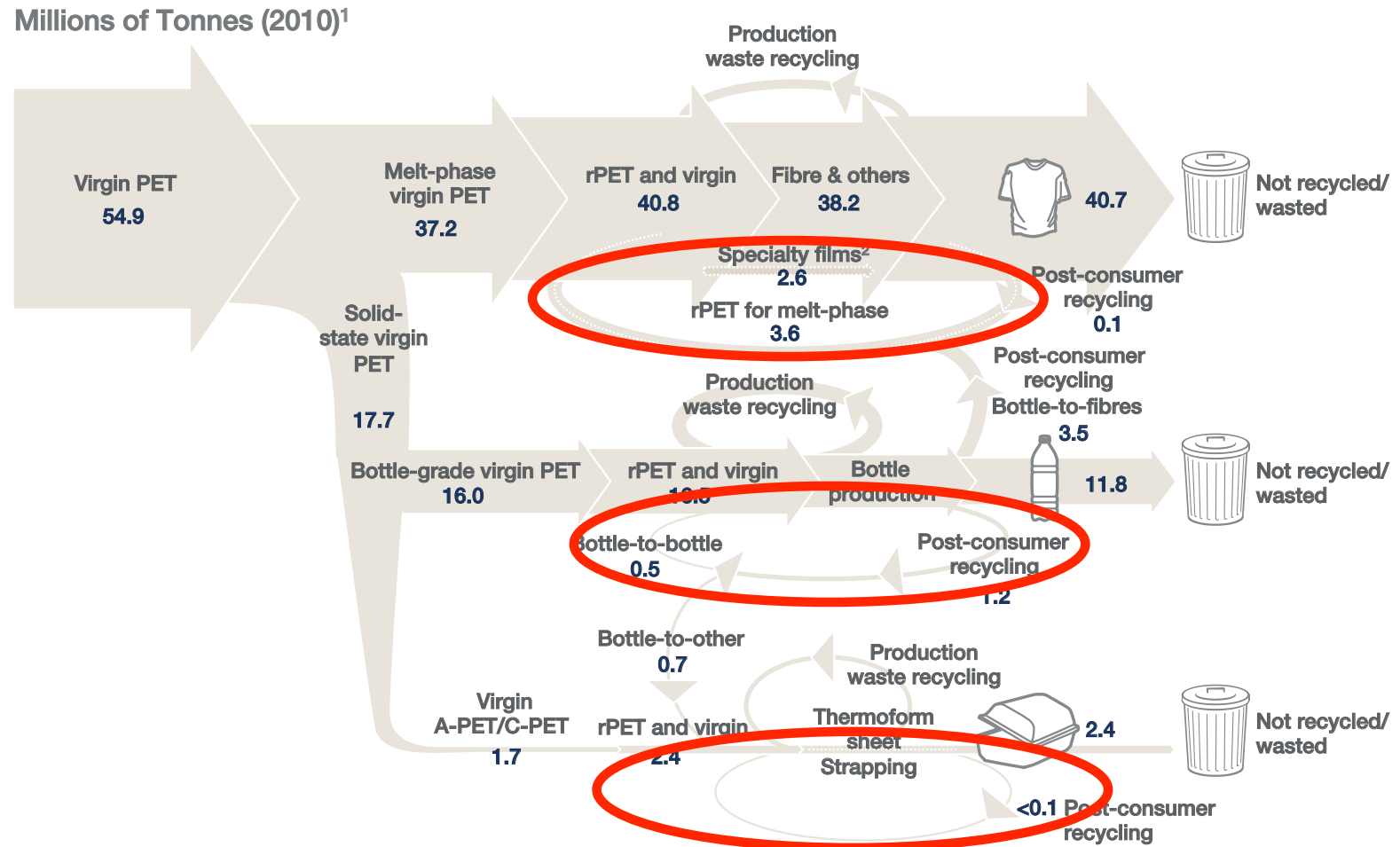
# Gamle travere - 2



# Circular case 2: Plastics

Green Growth

Figure 20: Global PET flow—a large amount of PET collected from bottles is used in other applications



<sup>1</sup> PET is grouped into 3 main categories based on IV grade

<sup>2</sup> Some speciality films (X-ray films) have a dedicated reverse supply chain

Source: McKinsey analysis; SRI; CMAI; TECNON; expert discussion



# 4 typer materialer

## 4 kriterier:

		Green Growth			
		High volume	High collection rate	High quality of recovered materials	Emerging technologies <sup>1</sup>
Example		Trigger points			
Golden Oldies	<ul style="list-style-type: none"> <li>PET</li> <li>Metals</li> <li>Paper</li> <li>Glass</li> </ul>	✓	✓	(✓)	(✓) <ul style="list-style-type: none"> <li>Enhancing purity of recovered materials</li> </ul>
High Potentials	<ul style="list-style-type: none"> <li>Other polymers including PP and PE</li> </ul>	✓	(✓)	x	(✓) <ul style="list-style-type: none"> <li>Improving collection rate</li> <li>Enhancing recovery quality</li> </ul>
Rough Diamonds	<ul style="list-style-type: none"> <li>Concrete</li> <li>Carbon dioxide</li> <li>Food waste</li> </ul>	(✓)	x	x	(✓) <ul style="list-style-type: none"> <li>Scaling up technologies and applications</li> <li>Embedding in reverse system</li> </ul>
Future Block-busters	<ul style="list-style-type: none"> <li>3D printing materials</li> <li>Bio-based materials</li> </ul>	x	x	x	✓ <ul style="list-style-type: none"> <li>Standardizing emerging materials</li> <li>Scaling up technologies and applications</li> <li>Embedding in reverse system</li> </ul>

<sup>1</sup> Technologies for recovering quality that are able to scale up quickly

Source: World Economic Forum and Ellen MacArthur Foundation circular economy team

# What is 3D Printing?

## How Does 3D Printing Work?







## Protoprint Fair Trade Filament

We partner with waste pickers in India to recycle waste plastic to produce price competitive, ethically sourced, 3D Printer Filament for your FDM printer.

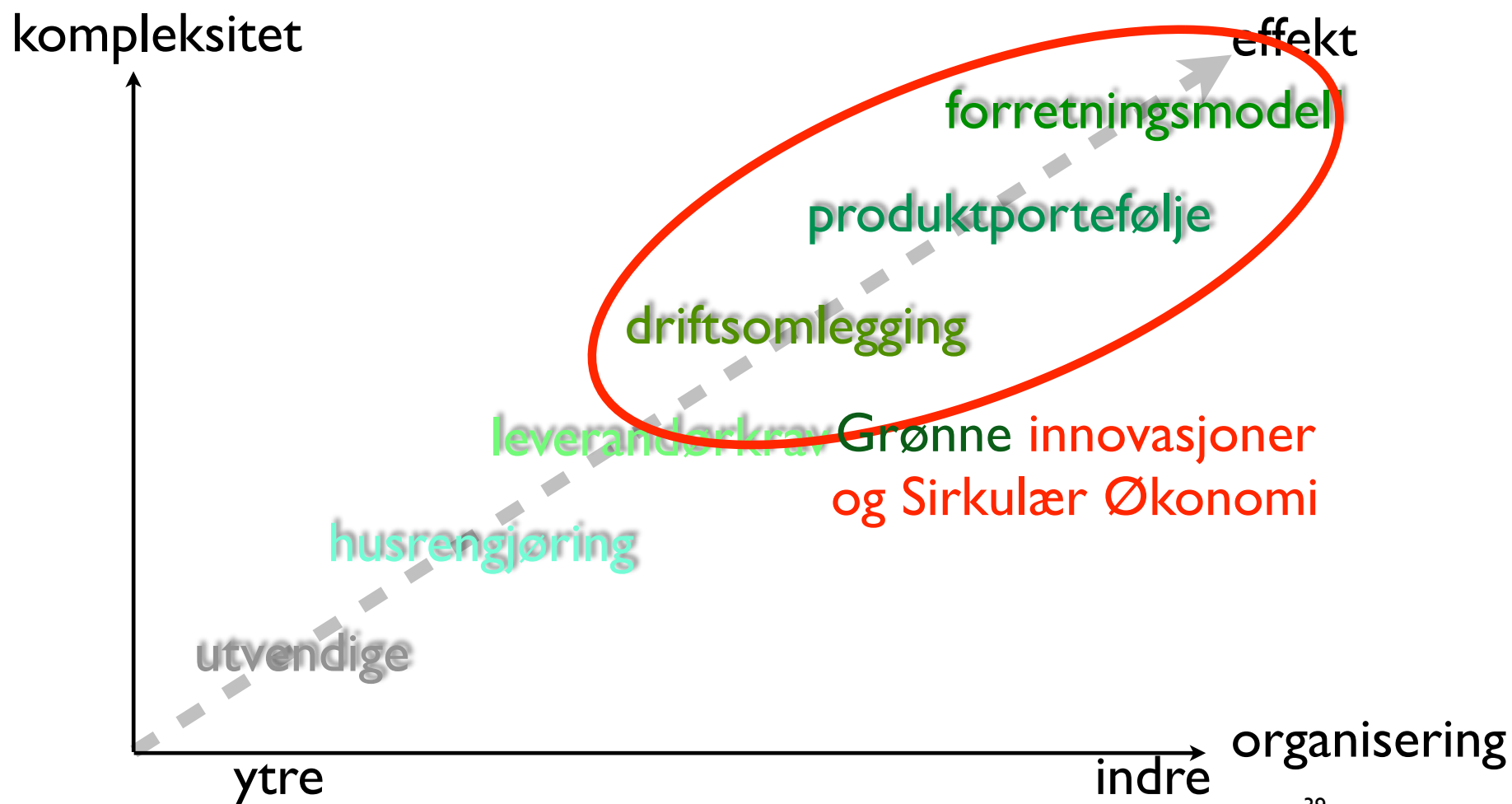
[Learn More](#)

### The World's First Fair Trade Filament for 3D Printing



<http://www.protoprint.in/index.php>

# Grønn strategi-trappen





# “Biggest business opportunity”

- The resource revolution represents the biggest business opportunity in a century.
- Businesses that can deliver dramatic resource-productivity improvements at scale will become the great companies of the 21st century
- However, success requires new approaches to management.

McKinsey v/ Heck & Rogers, 2014





# Konklusjoner Sirkulær Økonomi

1. Er ikke nytt, men tar av først nå i EU.
2. Fins flere lønnsomme norske selskaper allerede
3. Sirkulær-økonomi er viktig del av overordnet grønn-vekst løsning
4. Økt lønnsomhet fra gamle travere til fremtidens supermaterialer



## Lære mer om Grønn Vekst?

mer info: [www.bi.no/grve](http://www.bi.no/grve)

følg på twitter: @estoknes

