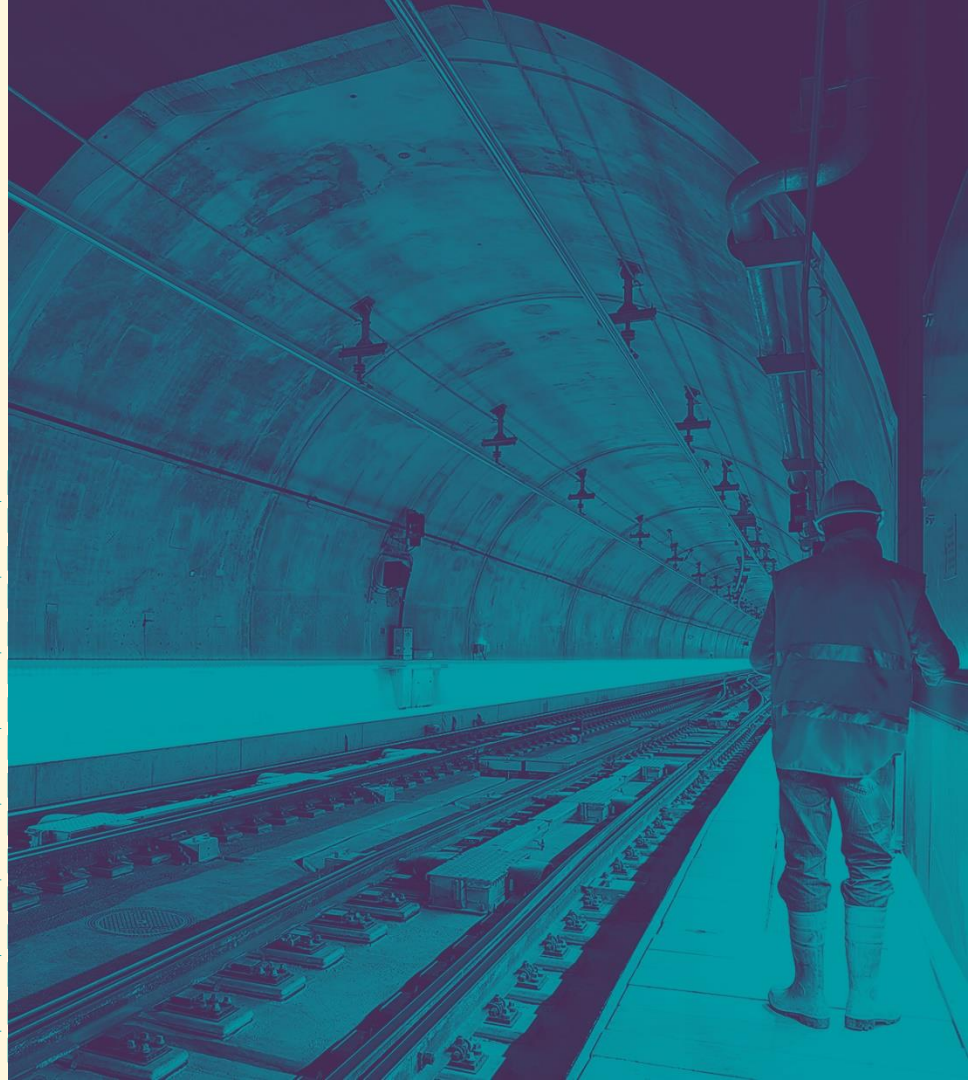


# Green Lean

Miljövärdeflödesanalys  
Resursslöserier  
Hållbar tillverkning

MARTIN KURDVE

DOCENT, RISE





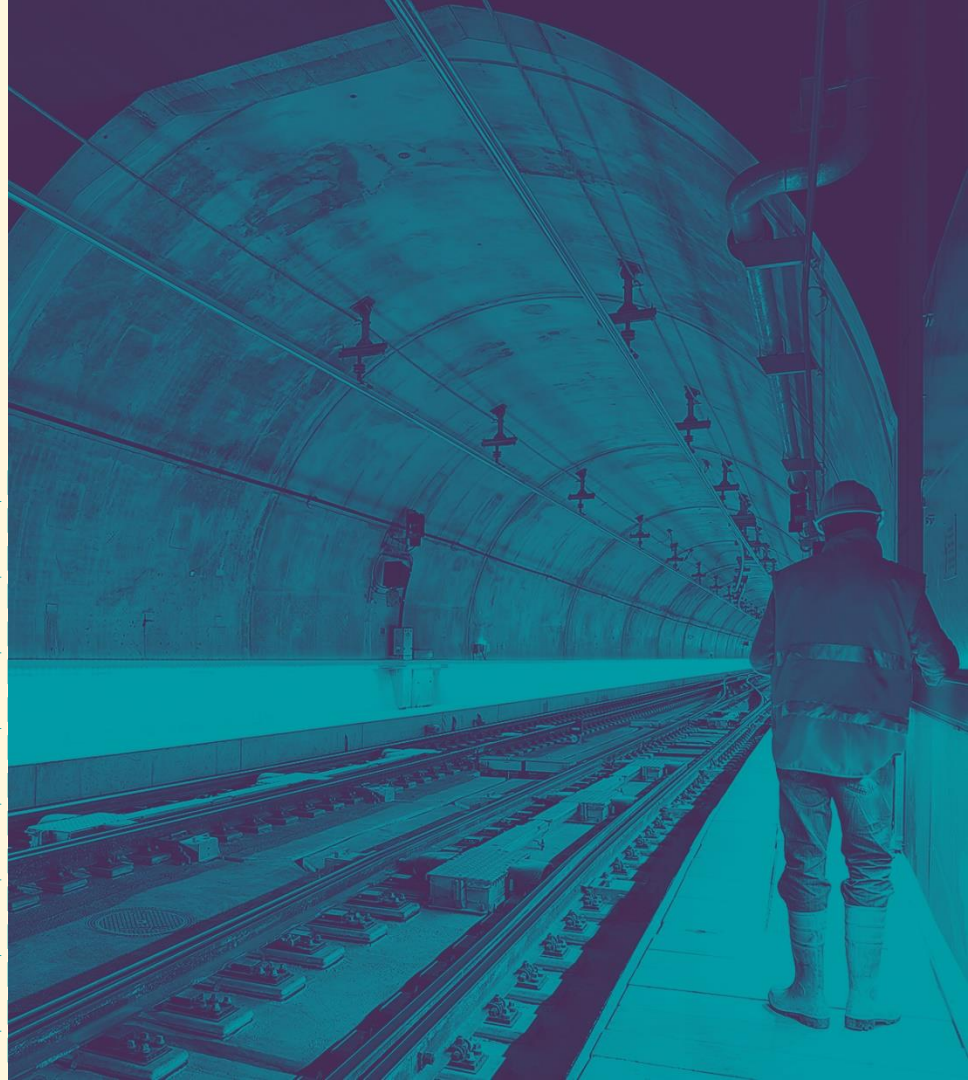
## Martin Kurdve

- Docent,  
Forskare, projektledare, coach i  
Produktionslyftet och omställningslyftet
- Hållbara produktionsystem, Cirkulär  
ekonomi, Resilienta leverantörskedjor
- RISE division Material och Produktion,  
enhet produktion och arbetsmiljö

produktionslyftet **RI  
SE**

# Introduktion Resurseffektiv tillverkning

MARTIN KURDVE

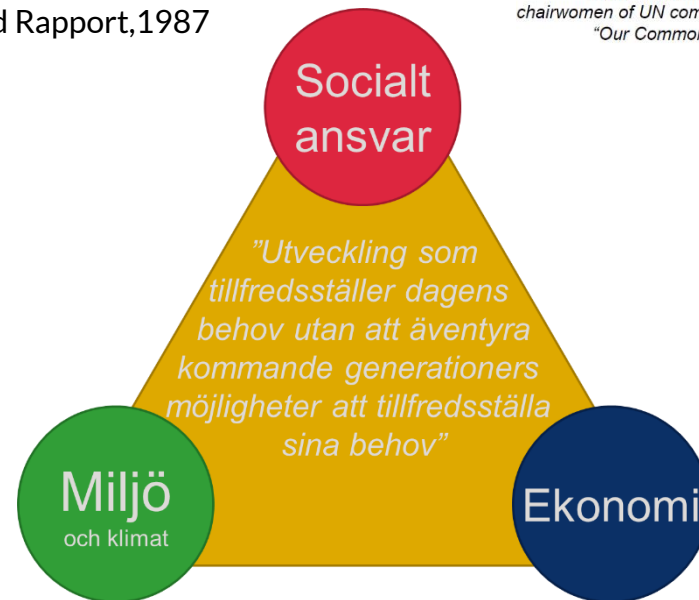


# Hållbar utveckling



Dr. Gro Harlem Brundtland  
former PM of Norway,  
chairwomen of UN commission,  
"Our Common Future"

*"Utveckling som tillfredsställer dagens behov utan att äventyra kommande generationers möjligheter att tillfredsställa sina behov"* Bruntland Rapport, 1987  
(United Nations, 1987)

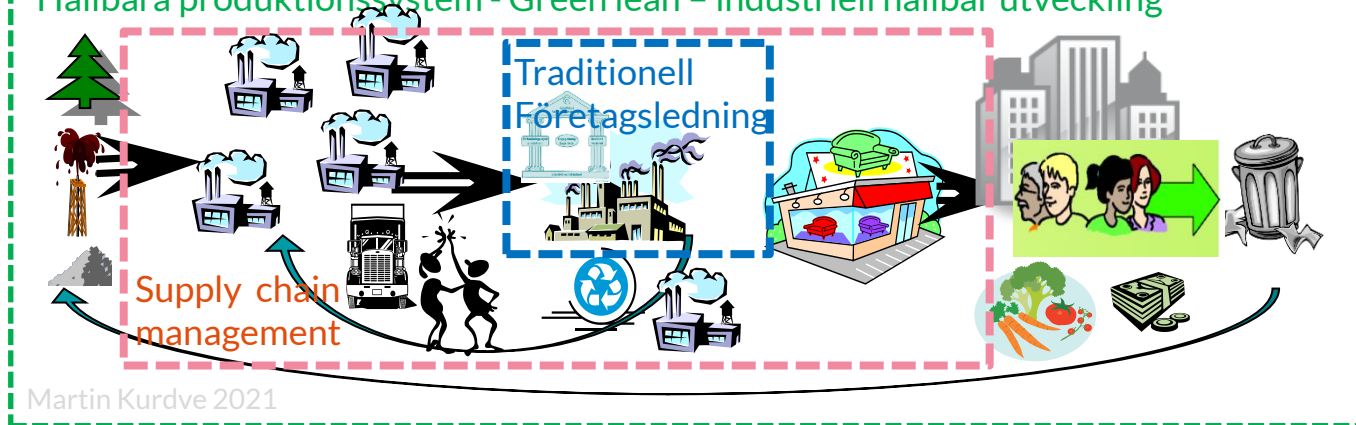


United Nations (1987). Our Common Future - Brundtland Report. Oxford University Press.

# Hållbar produktionsledning

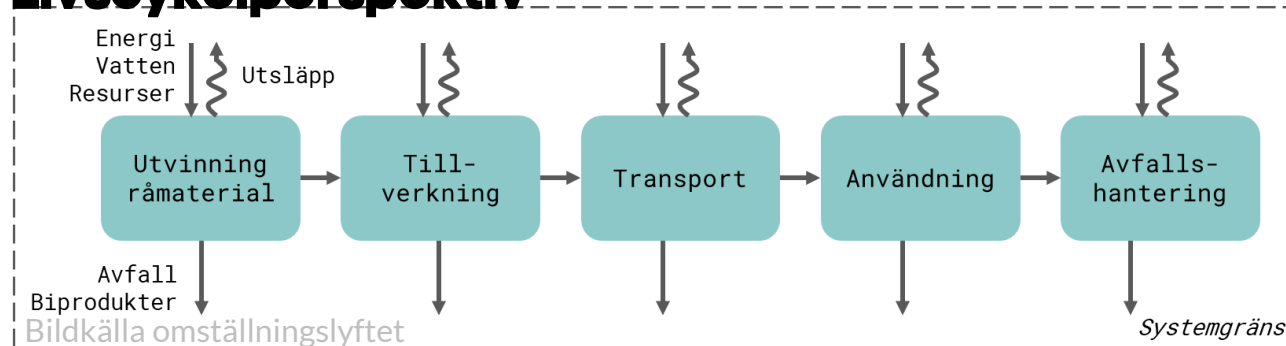
Hållbara produktionssystem - Green lean - industriell hållbar utveckling

Utökad social  
hållbarhet

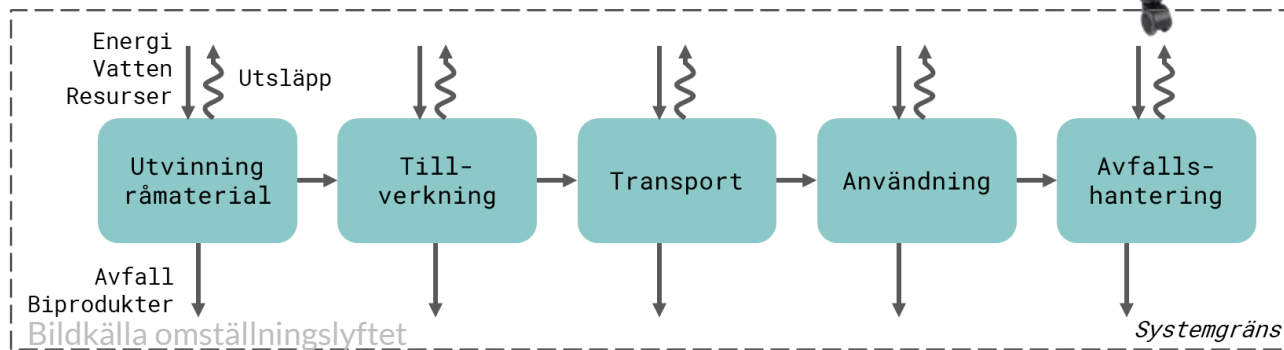


Beaktar effekter i alla livscyklfaser

## Livscykelperspektiv

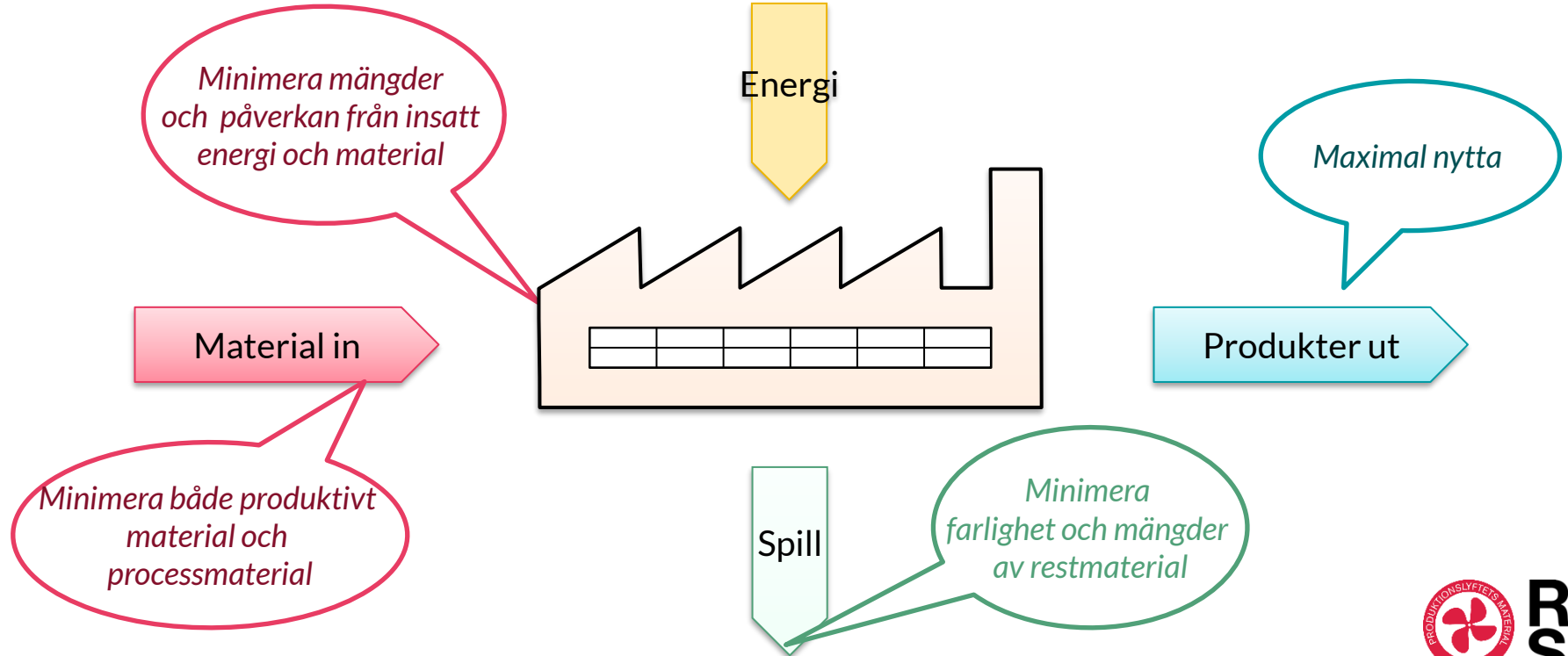


# Jämför Livscykel





# Resurseffektivitet: maximera nytta/input

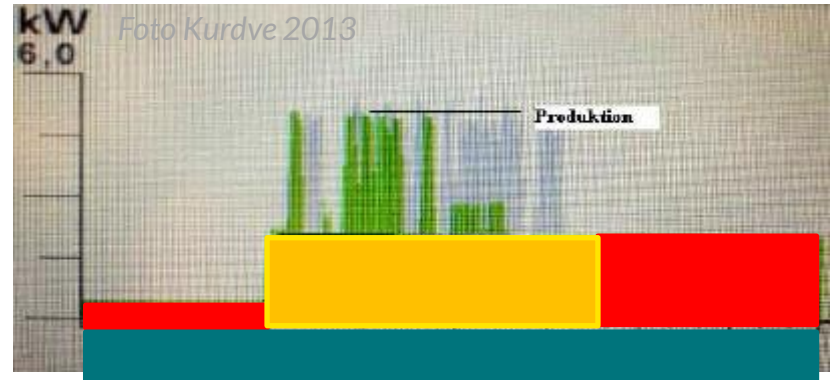


# Resursslöserier

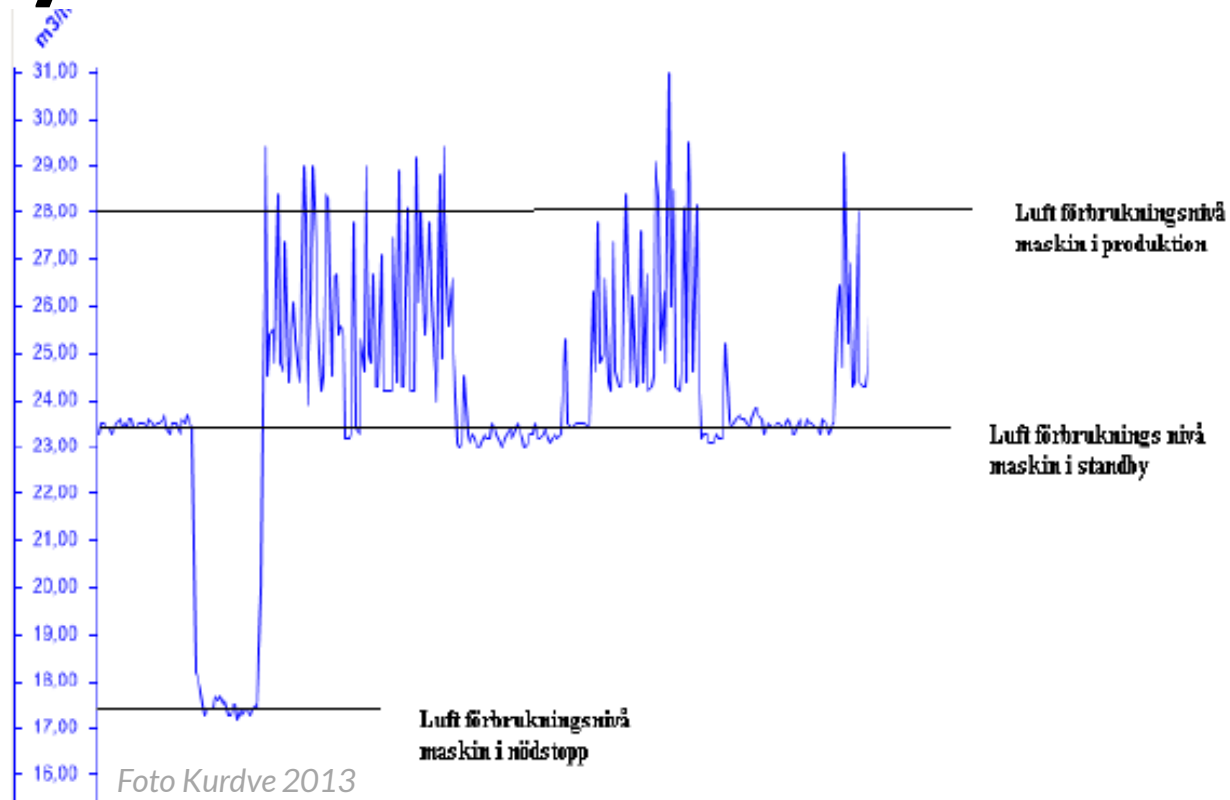


# Typexempel energiförbrukning

- Värdeadderande energi 1/10
- Energi för maskinrörelse 3/10
- Tomgångsförbrukning 3/10
- Kyla, ventilation etc. 3/10



# Tryckluft



# Ineffektivitet i enhetsoperationer

- Tomgångsförbrukning
- Överdimensionering
  - Strypning av överskottsenergi
  - Kylning (pga värmeförluster)
  - Onödig rörelseenergi (egenrörelse)
- Periferi:
  - Infrastruktur (t.ex Tryckluft, hydraulik, transportsystem)
  - Stödfunktioner

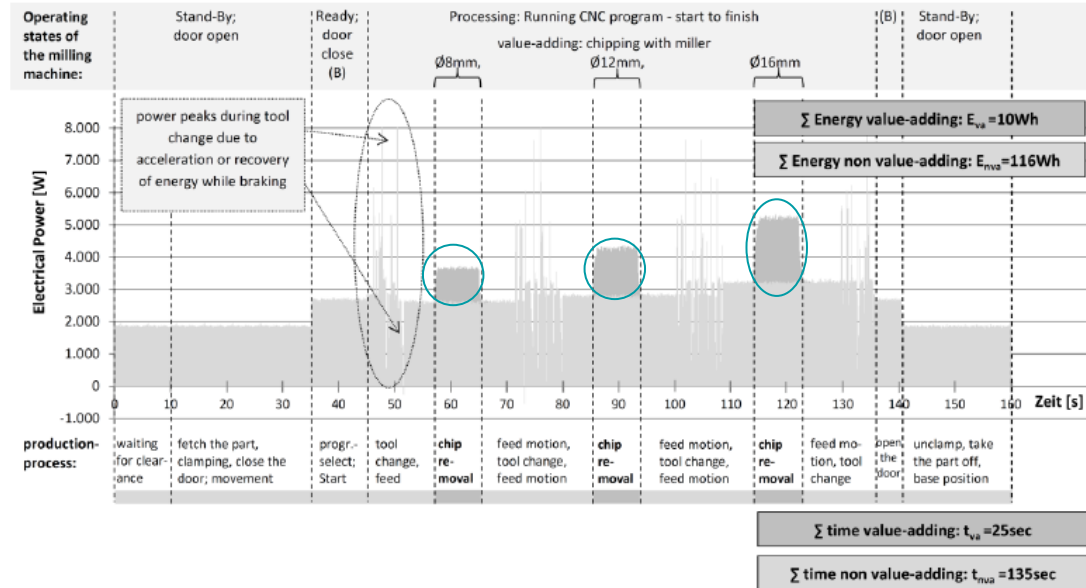


Figure 3: Dual energy and time signature of a chip removal process.

# Material effektivitet

- Enskilda operationer effektiva
- Långa värdekedjor
- Globalt ca 7% material som utvinns blir värdeadderande hos slutkunder

## Produktmaterial

1. Kvalitetspill
2. Processpill
3. Designspill



## Processmaterial

1. Konsumtionsmaterial (engångsmaterial)
2. Konsumtionsmaterial (flergångsmaterial)
3. Underhållsmaterial
4. Investeringsmaterial



# Lean är en bra grund för operativt miljöarbete

- Toyota - CO<sub>2</sub> / producerat fordon 2010

We have a role to exercise in relation to the society. We don't think we can manufacture what we want to manufacture independently of the impacts on the wider society. Our philosophy is that we are an integral part of the environment and we are fulfilling a need of society which is the desire for personal transportation[3].

Year 2010	No. of staff	Revenue in US\$m	No. vehicles mnfg	Tonnes CO <sub>2</sub> e	T CO <sub>2</sub> /vehicle mnfg	T CO <sub>2</sub> /US\$m sale
Toyota	320,808	222,000	8,557,351	7,334,000	0.86	33.0
GM	209,000	135,592	8,476,192	7,863,406	0.93	58.0
Fiat S.P.A.	190,014	72,200	2,716,286	2,663,645	0.98	36.9
Volkswagen	399,381	162,851	7,341,065	7,700,000	1.05	47.3
Ford	164,000	128,954	4,988,031	5,300,000	1.06	41.1
Honda	181,876	120,270	3,643,057	4,000,000	1.10	33.3
Daimler (Mercedes)	260,100	130,900	2,410,021	3,699,102	1.53	28.3

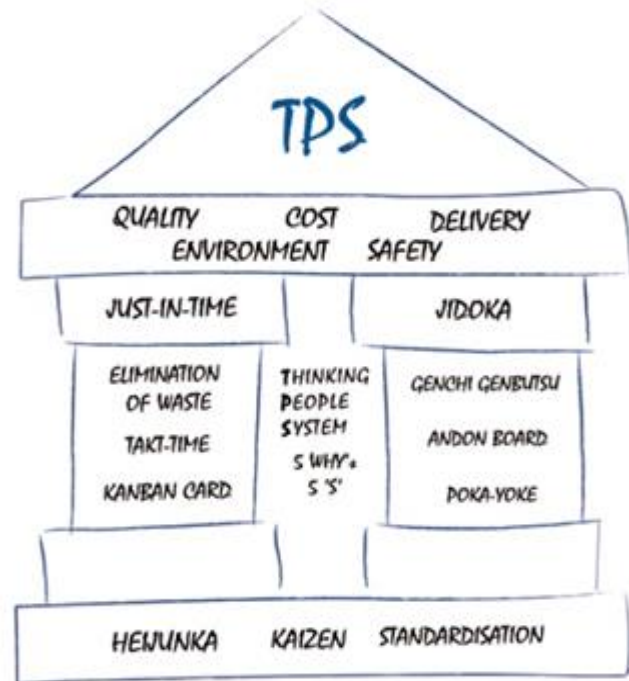
Source: Zokaiei *et al.* (2013, p. 90)

**Table II.**  
Benchmarking  
Toyota's  
environmental  
performance v. Main  
competitors

# Toyota Production System

- the answer to the challenge of shortening leadtime and increase cash flow

- A necessity to get capital for economic sustainability

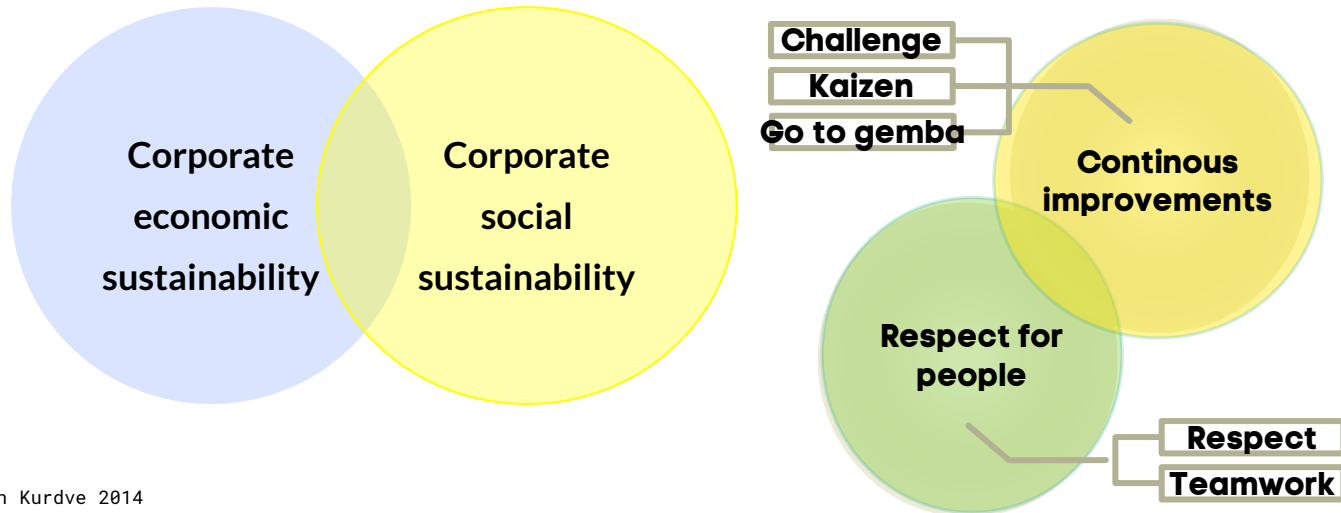




# Toyota Way

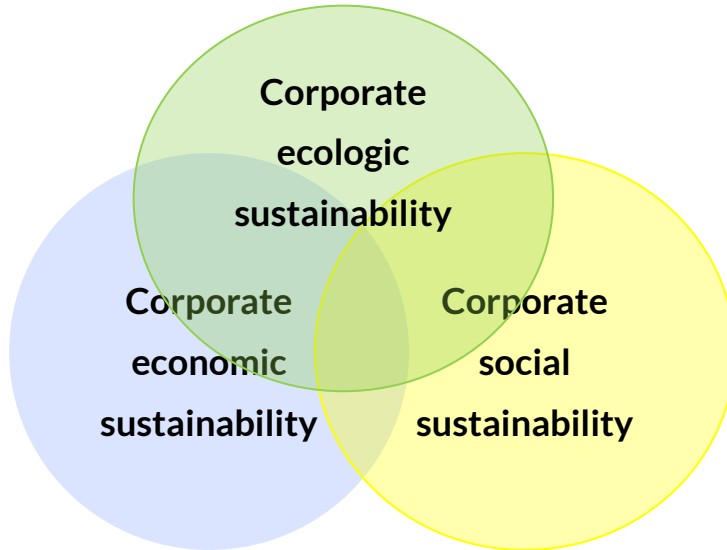
- answers the challenge of having humans in the production system

- A necessity of sociotechnical improvements.  
This **contributes** to social sustainability.



# Green Lean

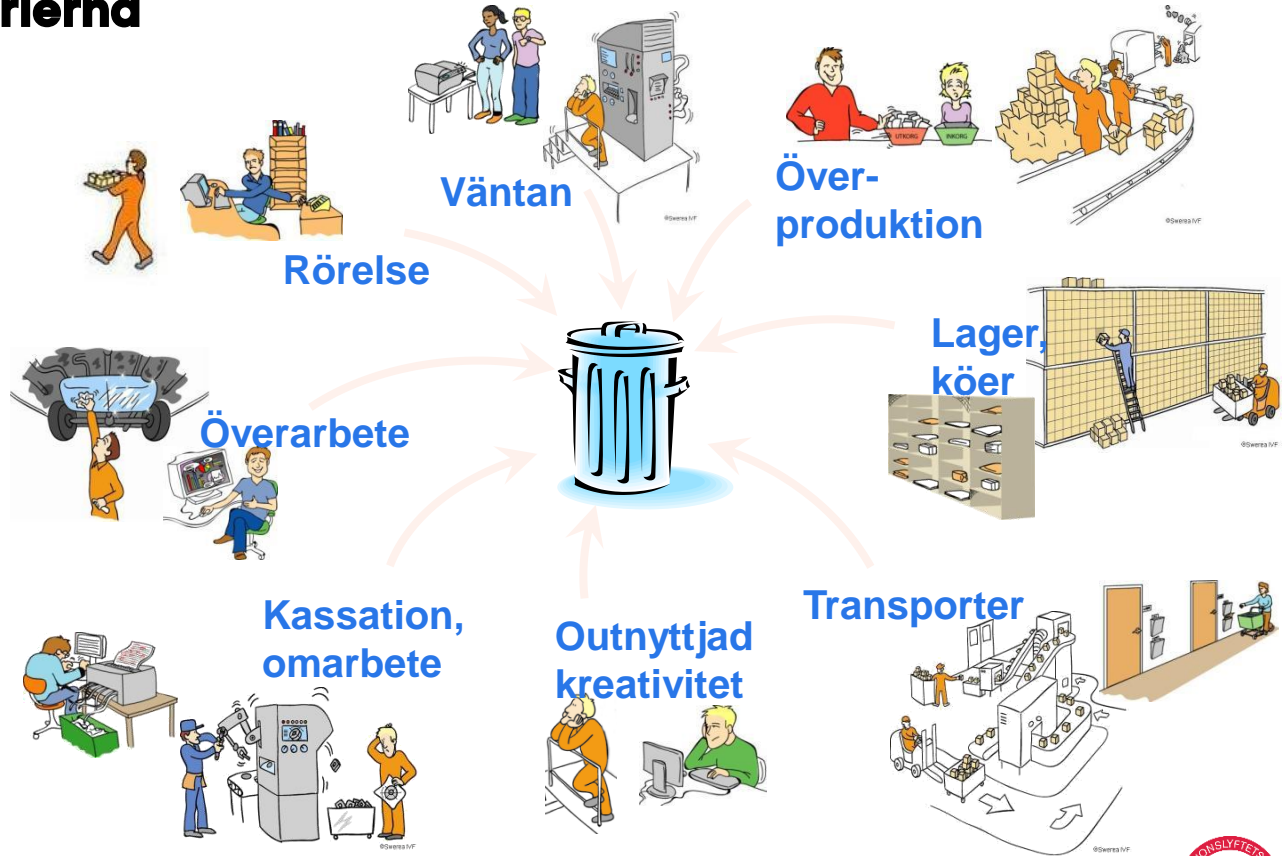
■ answers the challenge of maximising natural resource efficiency in a production system



- A necessity in a limited world with limited natural resources.



# De 7+1 Lean-slöserierna

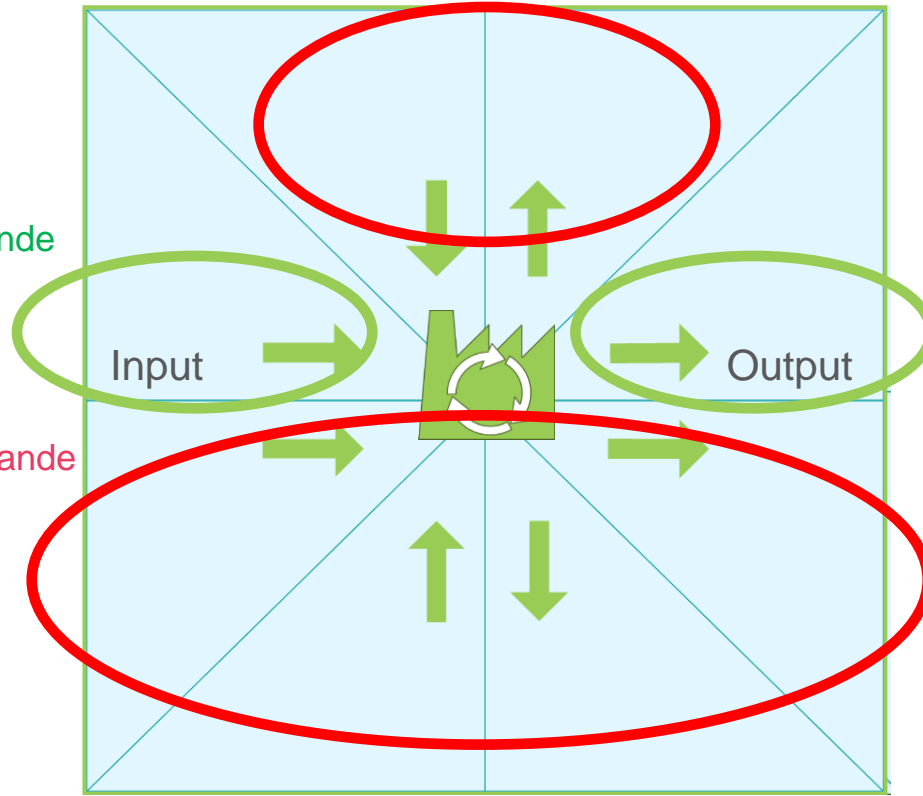


Muda is “anything other than the *minimum* amount of *equipment, materials, parts, space, and worker’s time* which are absolutely necessary to *add value* to the product.”

- Shoichiro Toyoda, President, Toyota

# Gröna slöserier

Värdeadderande

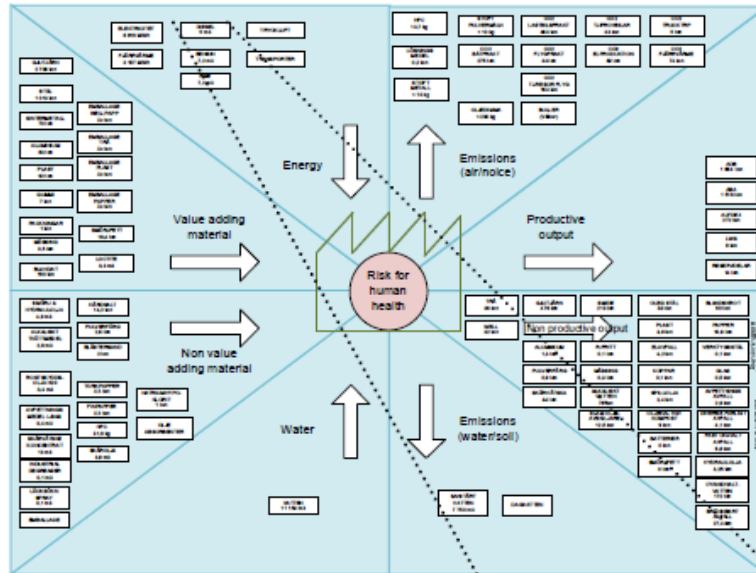


Ej värdeadderande

Muda is “anything other than the *minimum* amount of *equipment, materials, parts, space, and worker’s time* which are absolutely necessary to *add value* to the product.”

- Shoichiro Toyoda,  
President, Toyota

# Identifiera miljöslöserierna (miljöaspekterna)

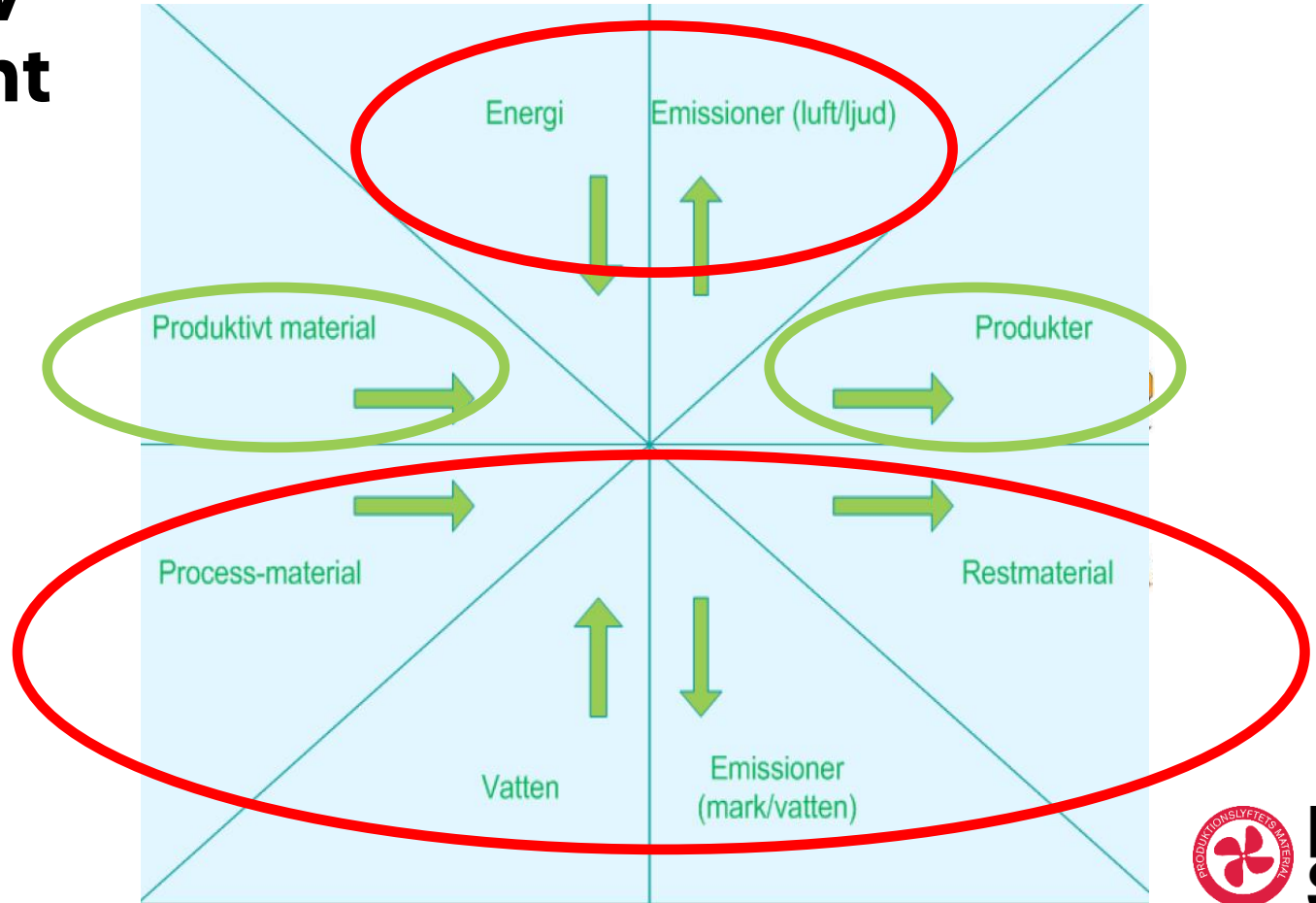


Kvantifiera om möjligt

<ol style="list-style-type: none"> <li>1. Environmental Impact</li> <li>2. Amount</li> <li>3. Cost</li> </ol>	<p><b>ELECTRICITY</b> 8 819 MWh 4 409 500 SEK</p>
---	---

Illustration Kurdve 2011

# Två sidor av samma mynt



Muda is “anything other than the *minimum* amount of *equipment, materials, parts, space, and worker’s time* which are absolutely necessary to *add value* to the product.”

- Shoichiro Toyoda,  
President, Toyota



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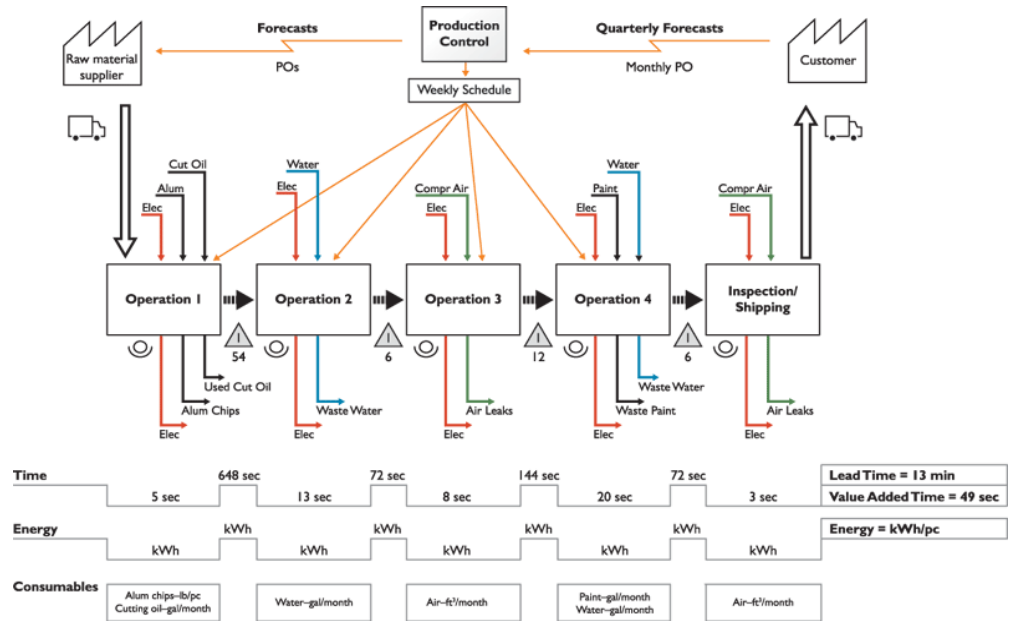
# Miljövärdeflödesanalys +2 Exempel



# Miljövärdeflödesanalys

Environmental – VSM

Ett lean-verktyg som anpassats för att även värdera, kvantifiera och visualisera olika miljöaspekter i en process.



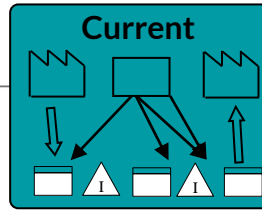
Environmental Value Stream Mapping (EVSM) as Sustainability Management Tool, (2009)

# Värdeflödsanalys – Value Stream Mapping

## Current state diagram

**Rigorous, fact based**

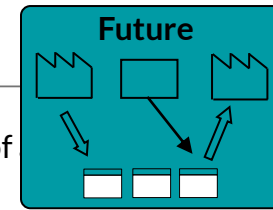
- Detailed visual description of the current value stream



## Future state diagram

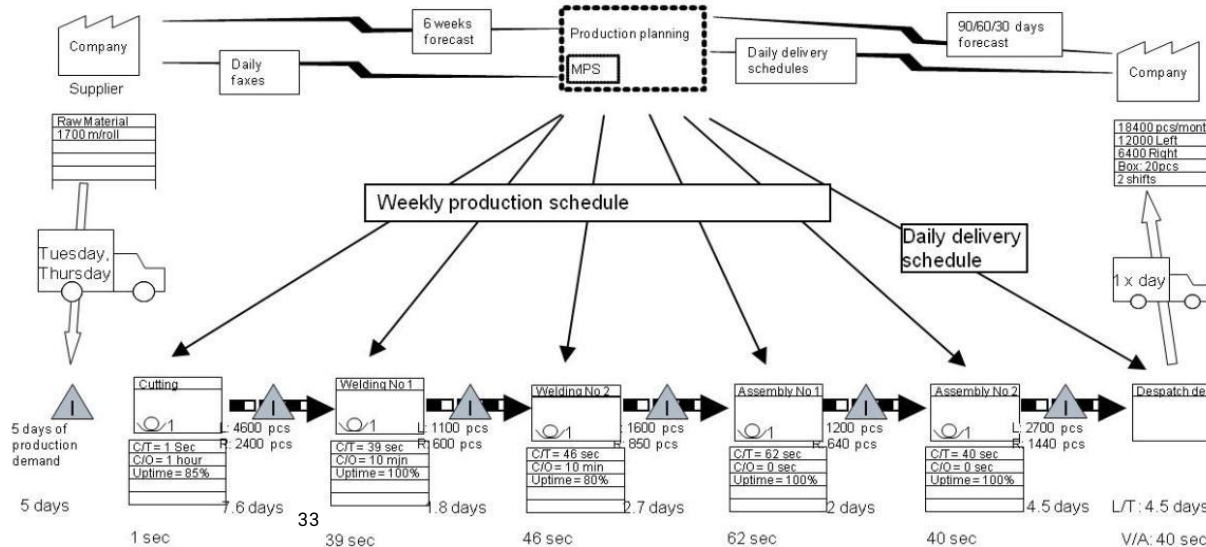
**Creative, synthesized**

- Provides a detailed visual description of redesigned value stream

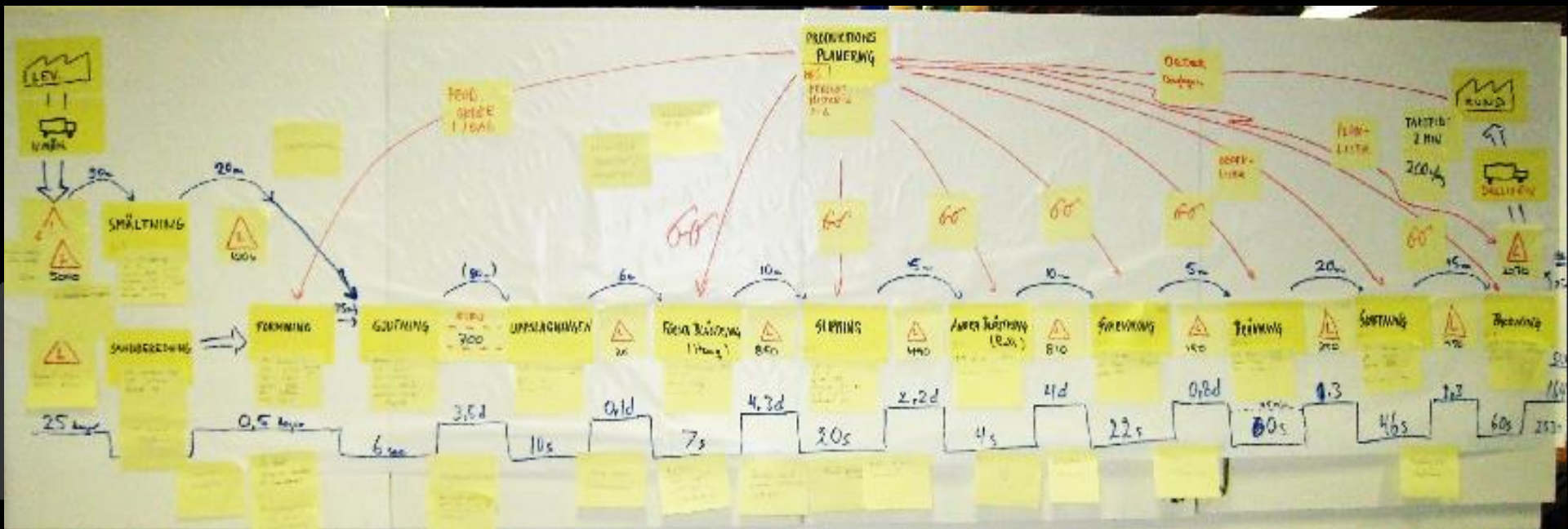


Mike Rother

M. Rother & J. Shook (2005)



# Den färdiga kartan – så här kan det se ut



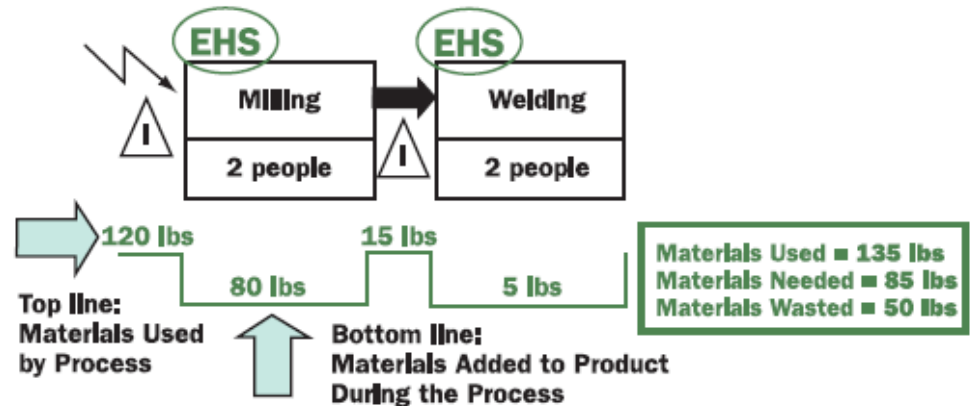
Nulägeskarta, Skeppshult



# Miljövärdeflödesanalys

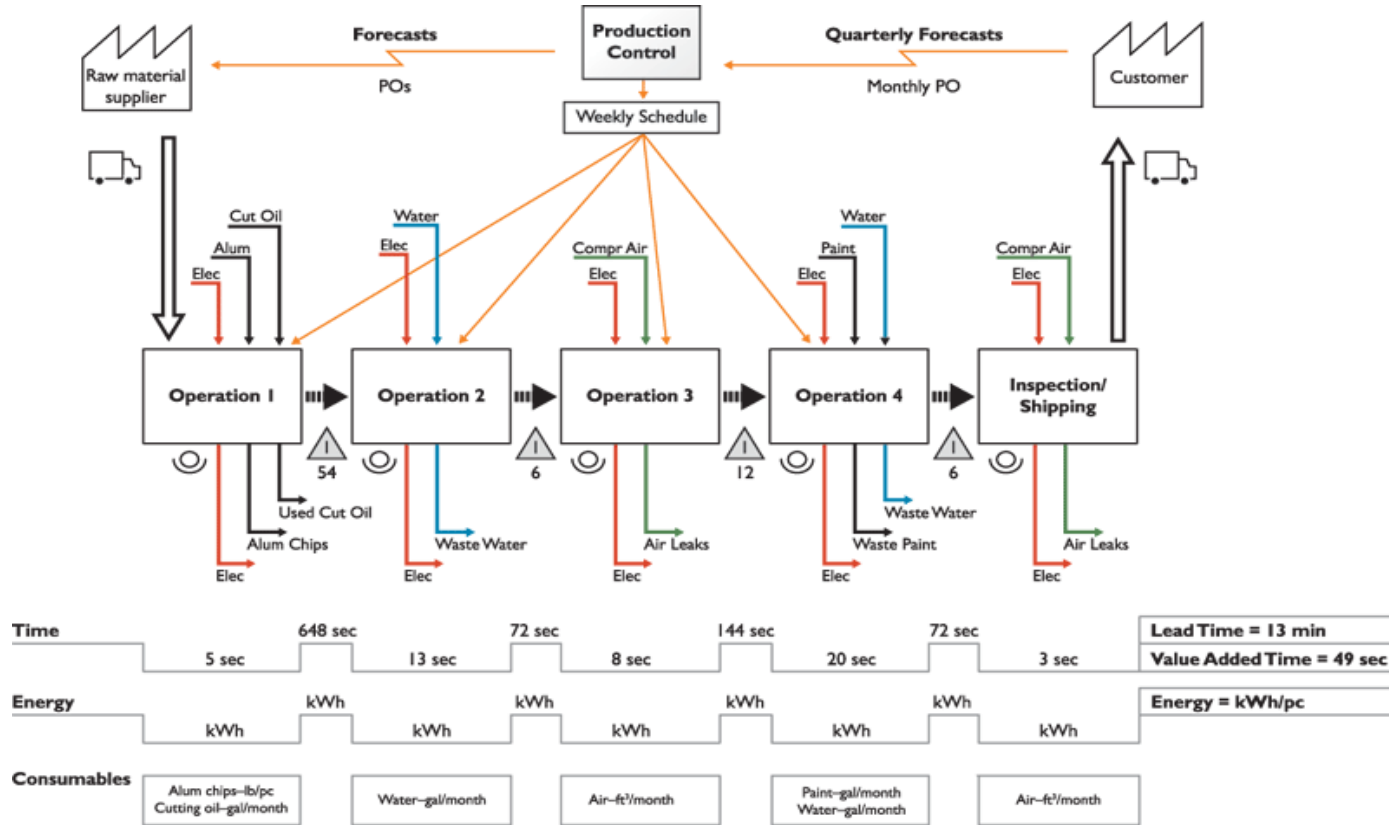
## Environmental Value Stream Map

- Lägg till en eller flera miljöaspekter
- Ritas t.ex på samma sätt som "tidslinjen"



US, EPA

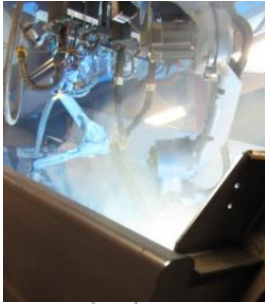
# Environmental VSM (EVSM)



Environmental Value Stream Mapping (EVSM) as Sustainability Management Tool, (2009)

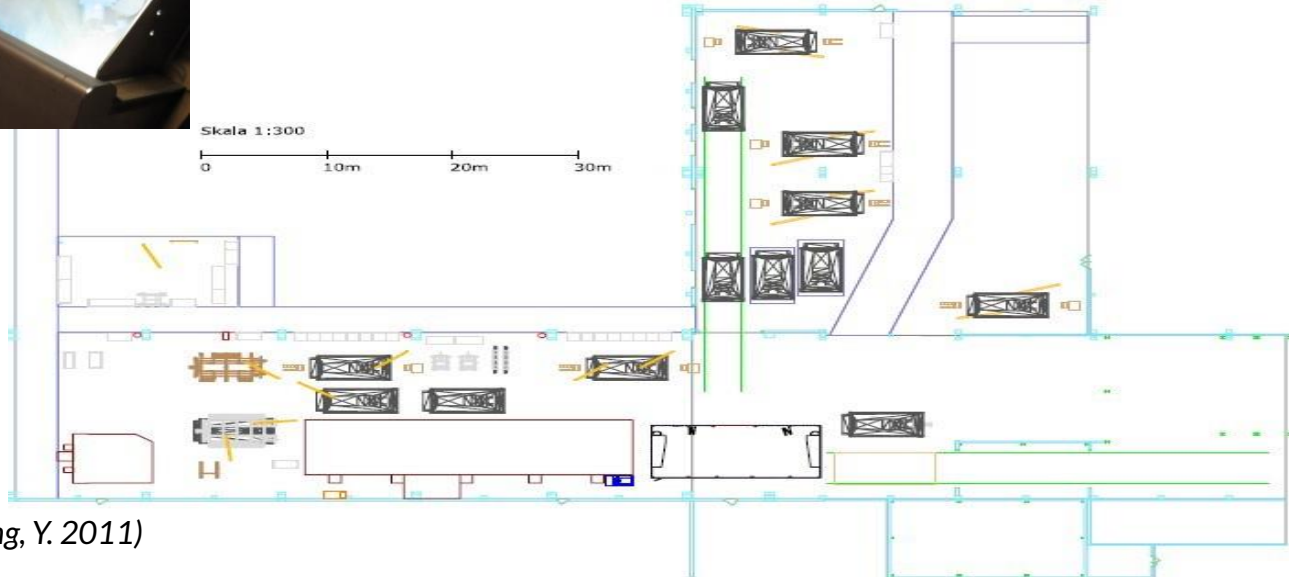
# Exempel energifokus

- Body Welding Line



Skala 1:300

0 10m 20m 30m



(Zhang, Y. 2011)

**Inbound logistics**  
Material handling, re-packaging and transportation

**Internal logistics**  
Material handling, re-packaging and transportation

**Station 1**  
Manual welding

**Station 2**  
Automated welding

**Station 3**  
Manual welding

**Station 4**  
Automated welding

**Station 5**  
Manual welding

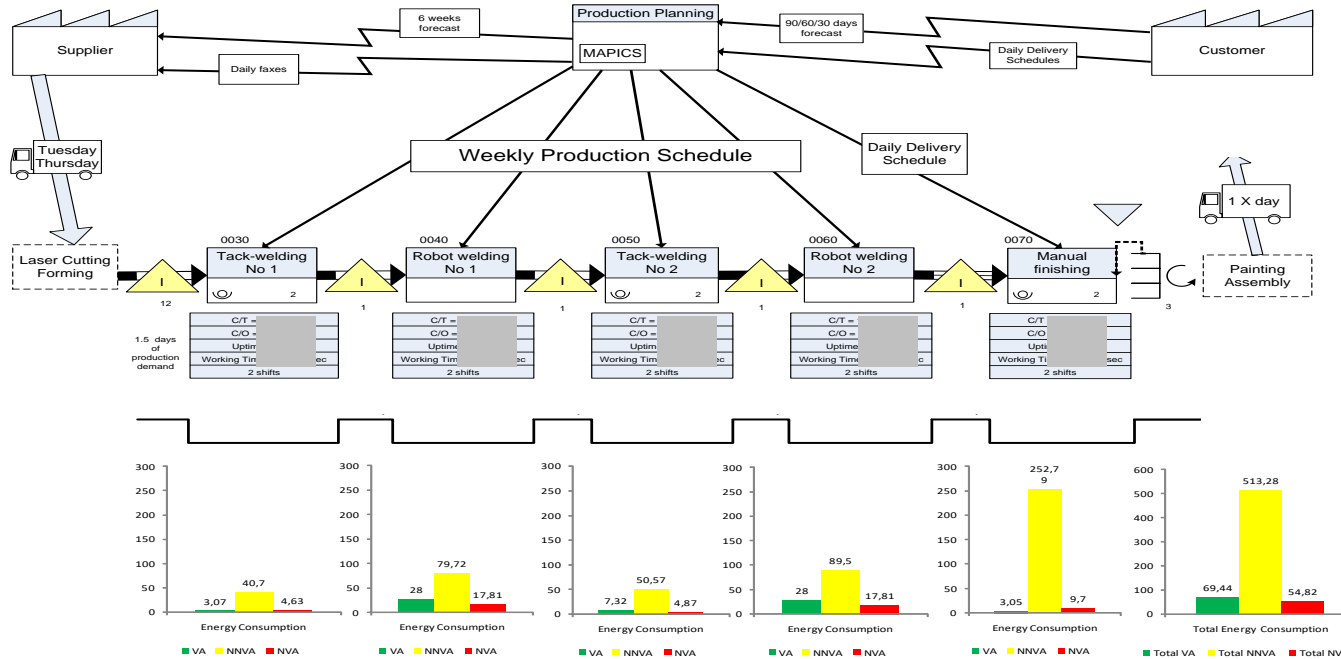
Boundary

# Resultat

Current State Value Stream Map for  
Body Shop at Volvo Construction  
Equipment, Braås

Item no 11194273 KORG A40E

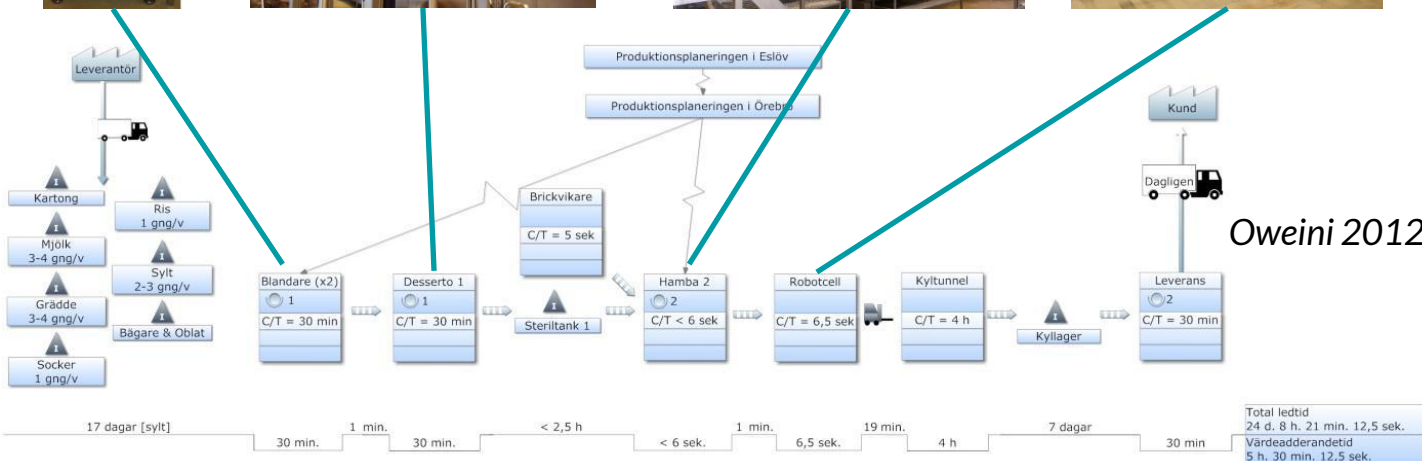
Environmental Targets and Goals in 5 years:



(Zhang, Y. 2011)

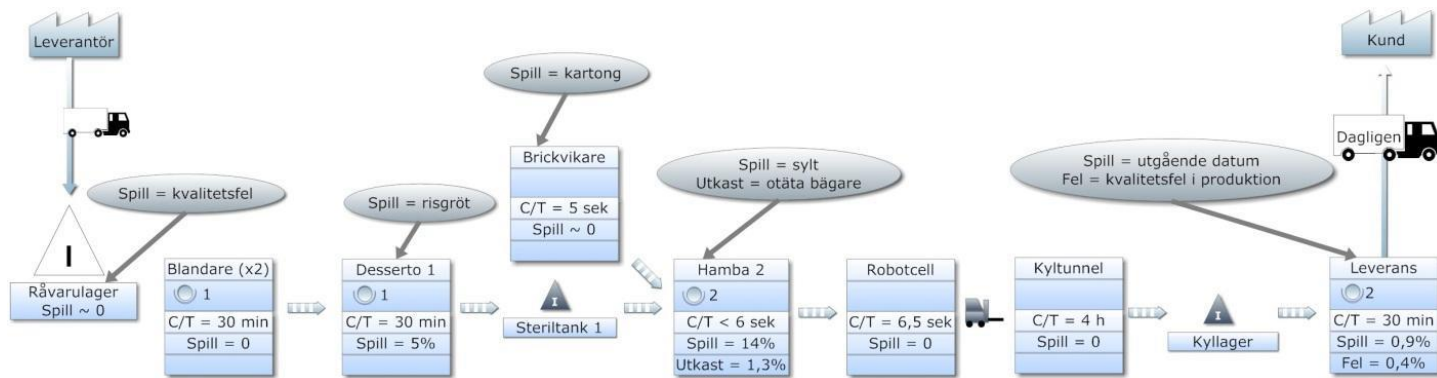


# Livsmedel

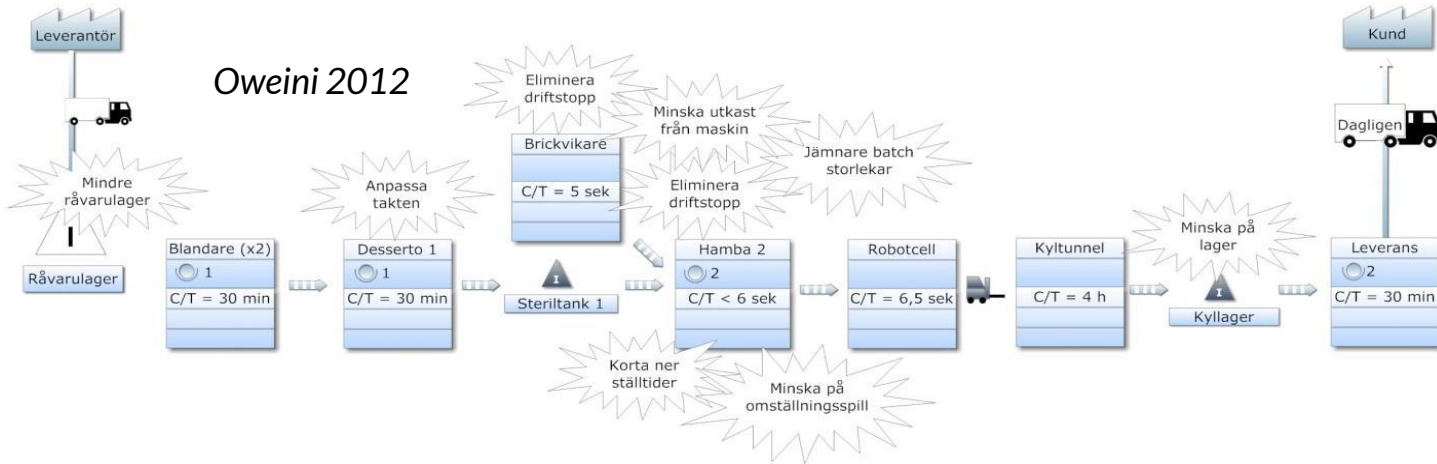


Oweini 2012

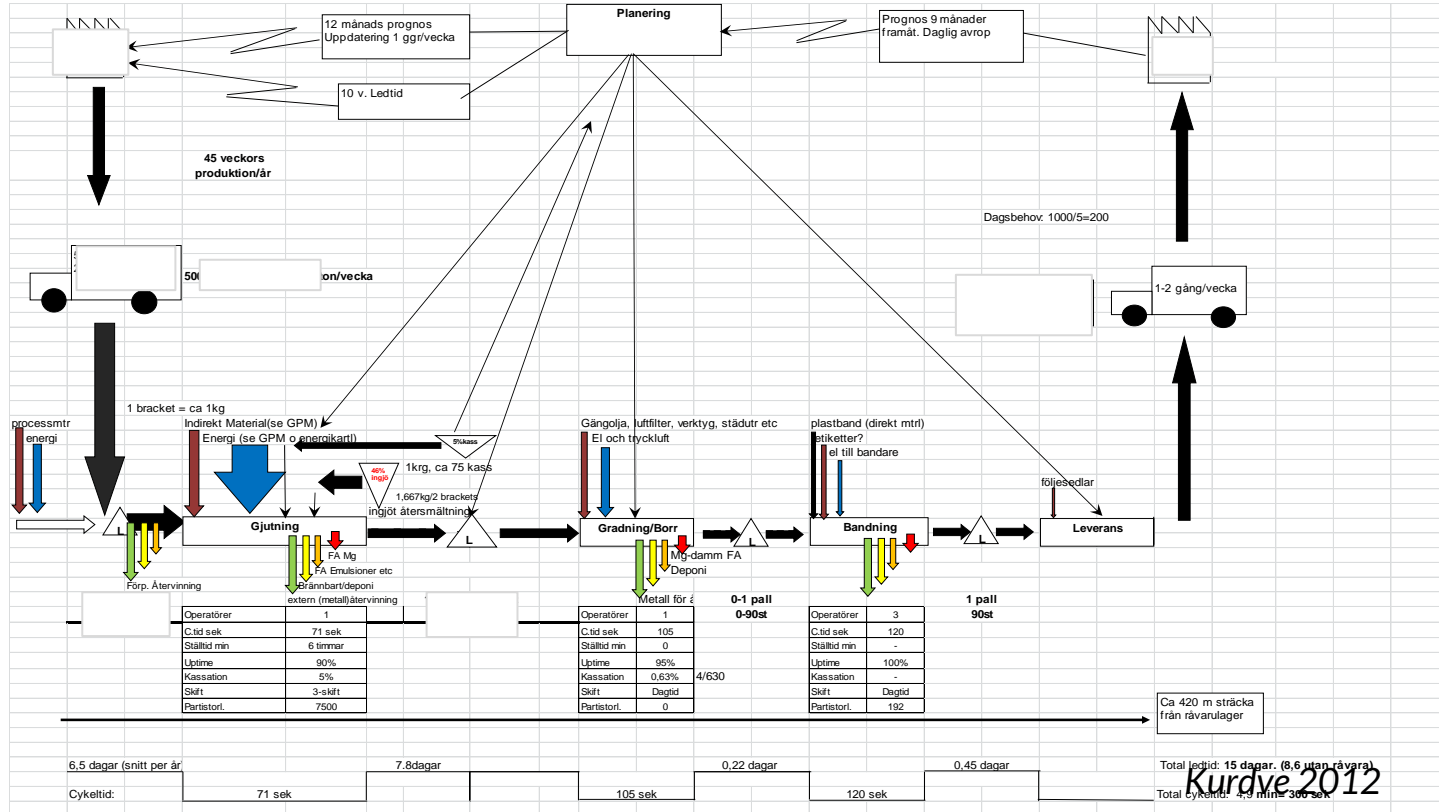
# Miljövärdeflödesanalys livsmedel



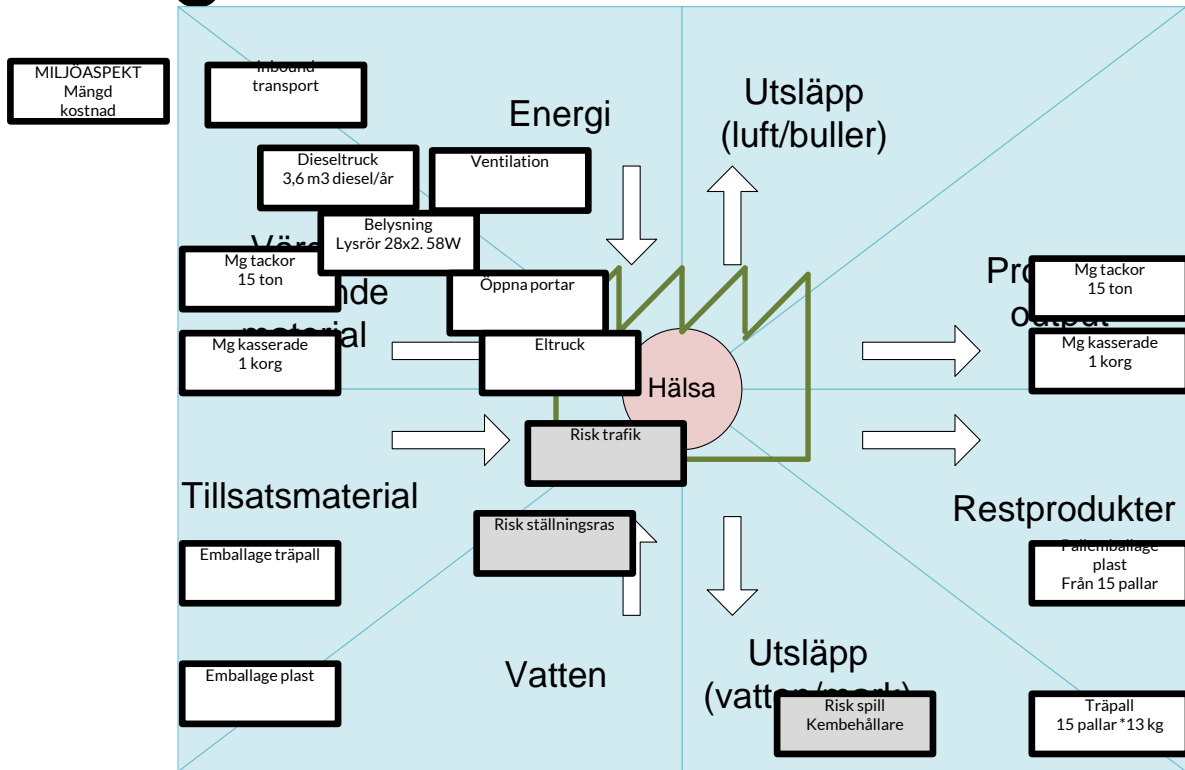
Oweini 2012



# Miljövärdeflödesanalys gjuteriexempel



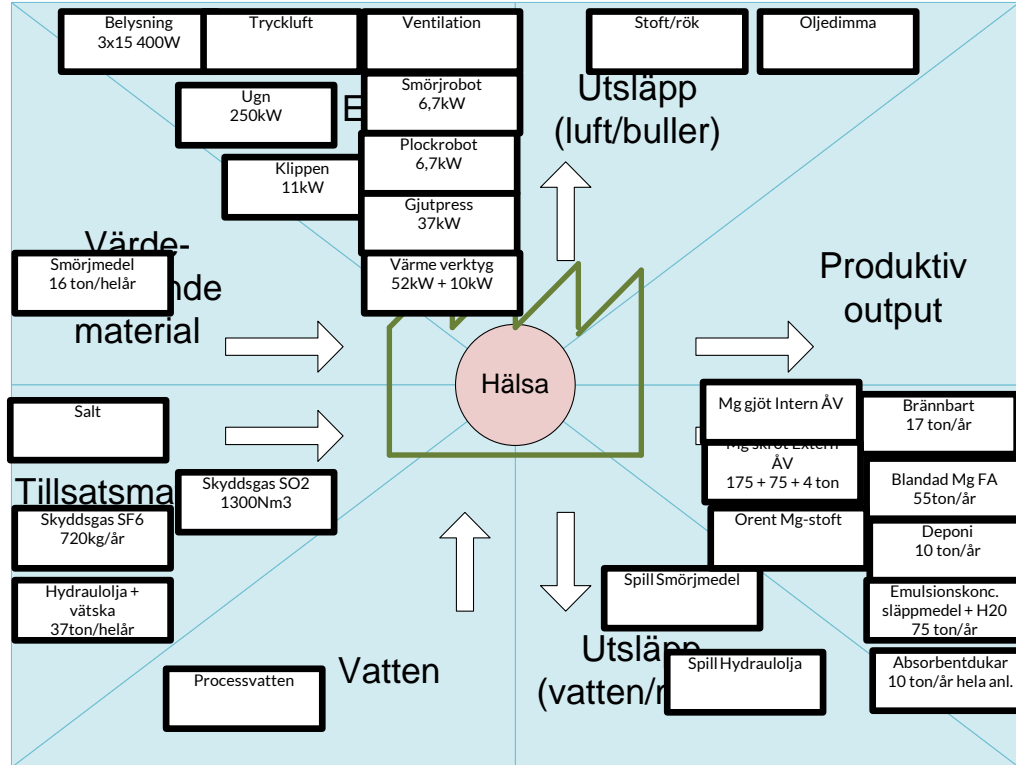
# Inlager



**RISE**

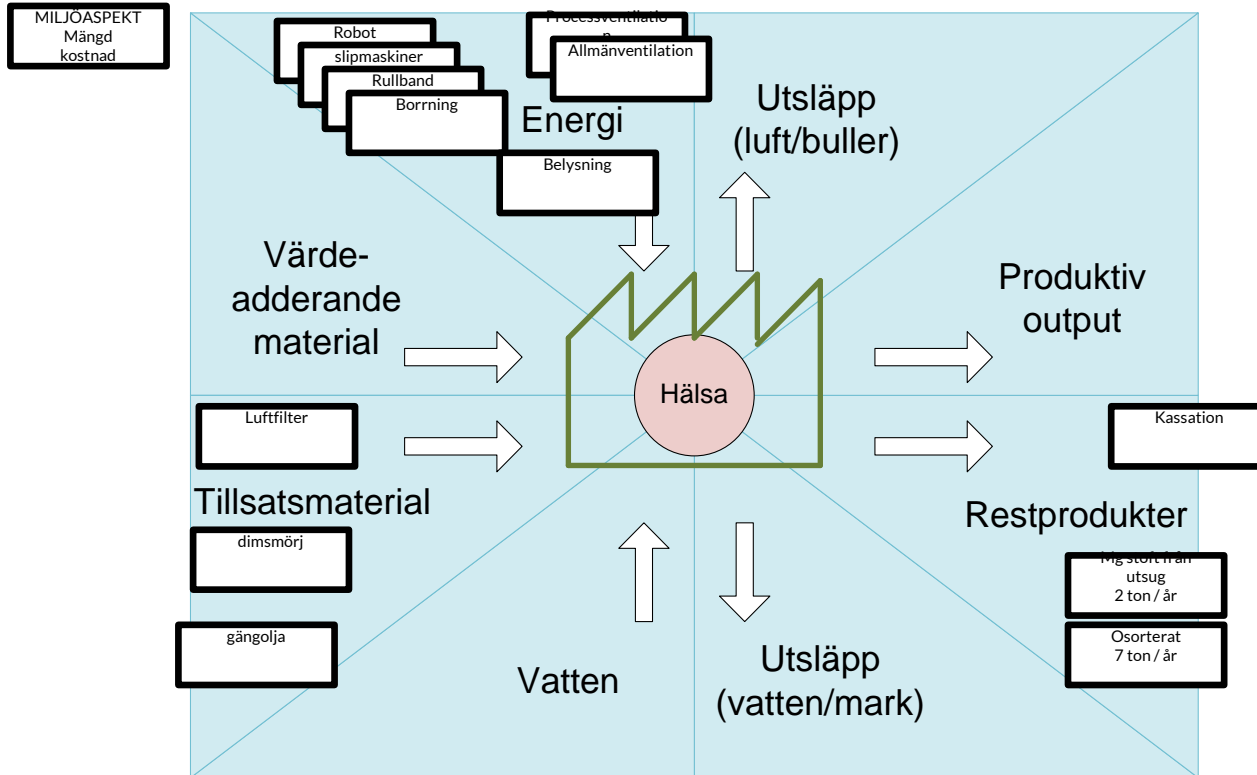
# Gjutning

MILJÖASPEKT  
Mängd  
kostnad

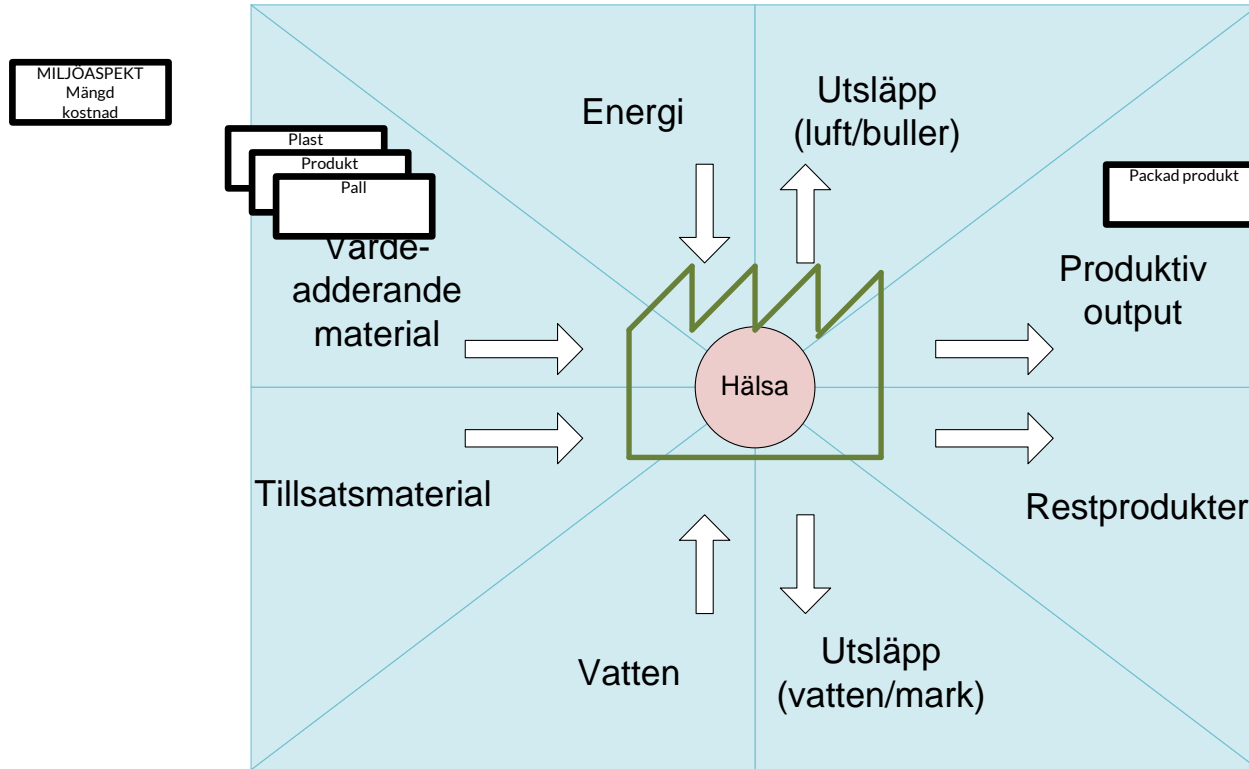


RI  
SE

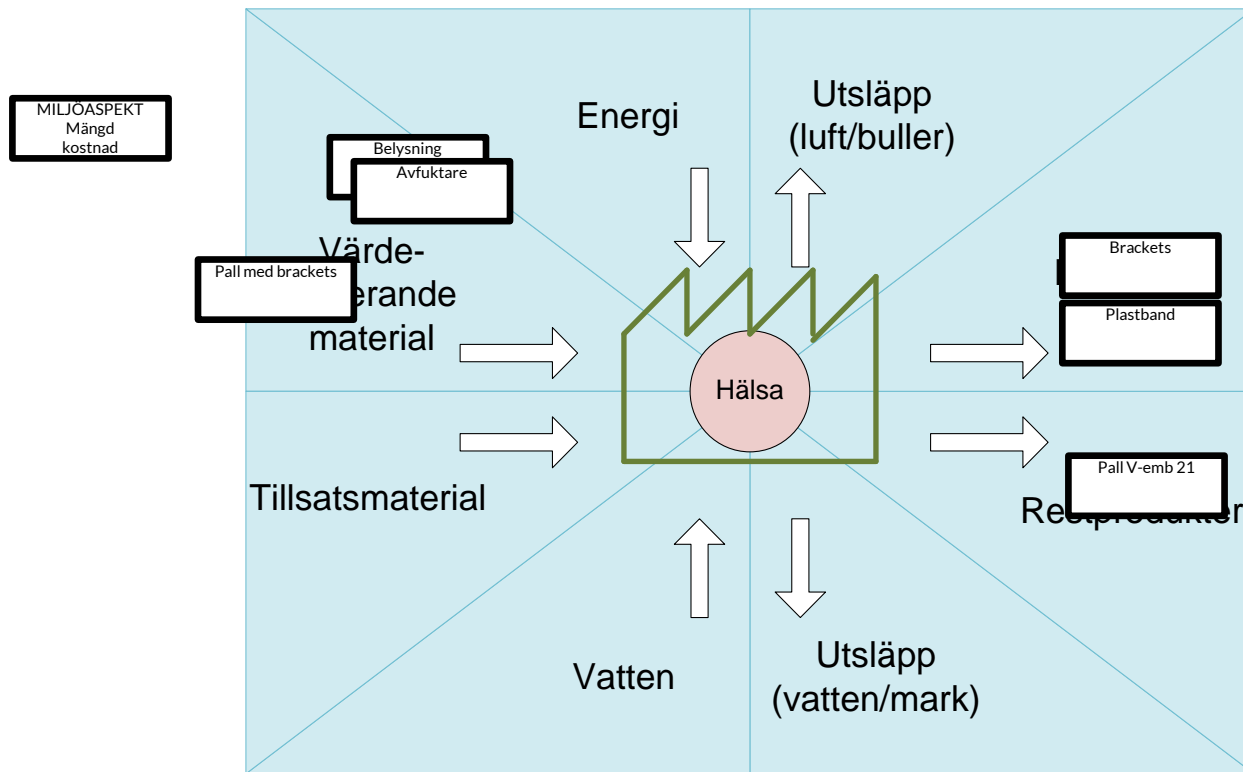
# Gradning



# Bandning



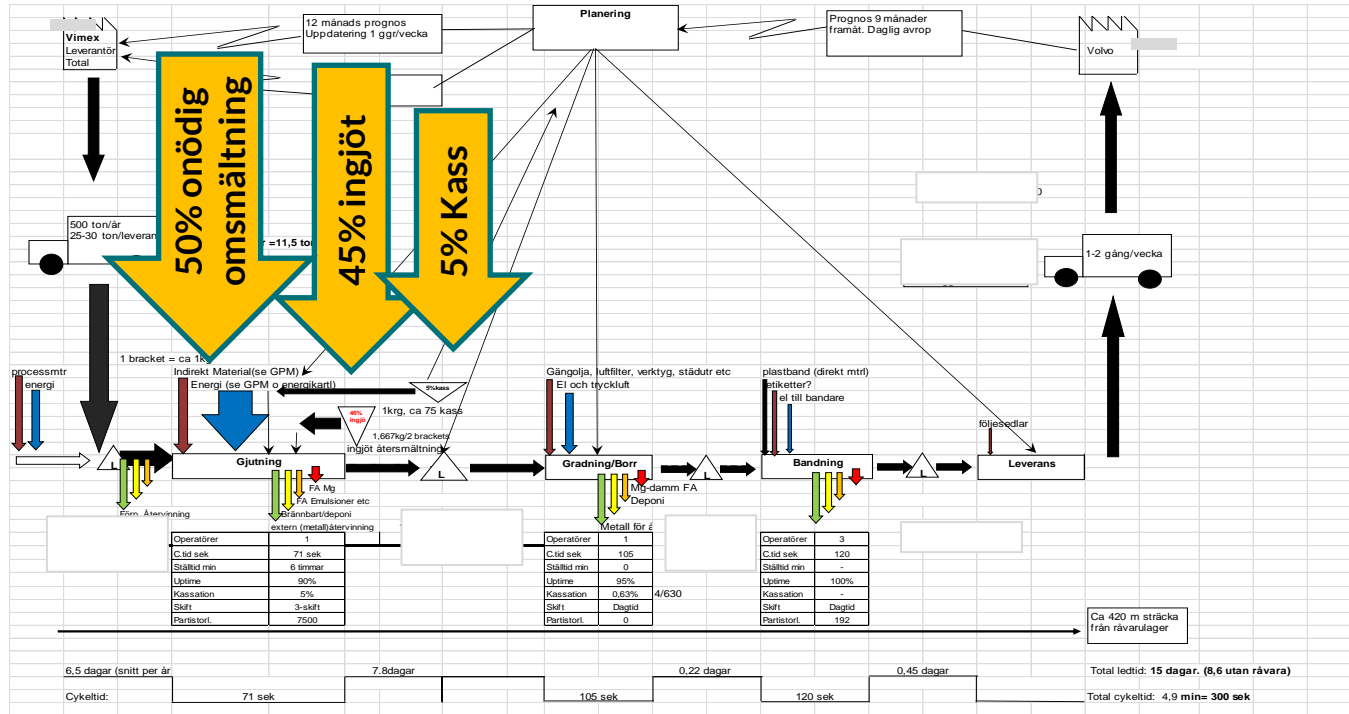
# Utleverans





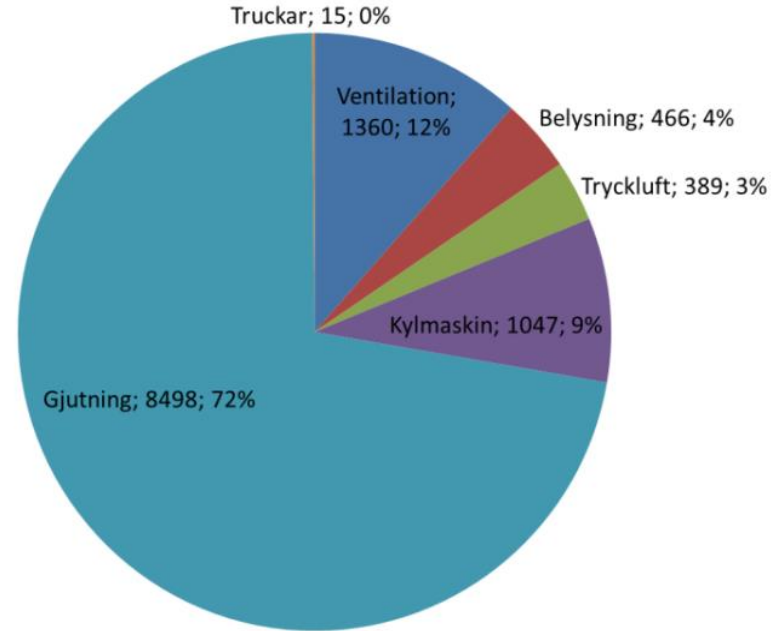
# Miljövärdeflödesanalys (MVFA/EVSM)

## Gjuteriexempel



# Energiförbrukning

Minskningspotential  
upp till 50% av  
energin till gjutning  
= 1/3 av totalenergin



Green-lean material att ladda ner:

- Omställningslyftet: [Energi- & Miljöförbättringsarbete | RISE](#)
- GPM - Green Performance Map: [HANDBOK\(Swe\) Film](#)
- EVSM - Environmental Value Stream Mapping [TOOLKIT](#)
- WFM - Waste Flow Mapping: [HANDBOOK](#)
- DVM - Daily Visual Management [HANDBOK\(Swe\)](#)
- LCA - Life Cycle Assessment [Introduktion\(Swe\)](#)



**Tack för  
uppmärksamheten  
Frågor?  
Svara gärna på  
Menti**





# Mer att läsa

Zokaei, K., Lovins, H., Wood, A., & Hines, P. (2013). *Creating a lean and green business system: techniques for improving profits and sustainability*. CRC press.

US EPA (2007) *The Lean and Environment toolkit*:

<https://play.google.com/store/books/details?id=Bfck2EnetDMC&rdid=book-Bfck2EnetDMC&rdot=1>

Kurdve, M., Shahbazi, S., Wendin, M., Bengtsson, C., Wiktorsson, M., & Amprazis, P. (2017). *Waste flow mapping: Handbook*. <https://www.diva-portal.org/smash/get/diva2:1199453/FULLTEXT01.pdf>

Kurdve, M., & Wiktorsson, M. (2013). Green performance map: visualizing environmental KPI's. *European Operations Management Association (EurOMA)*. [https://www.researchgate.net/profile/Magnus-Wiktorsson-2/publication/259217823\\_Green\\_performance\\_map\\_visualizing\\_environmental\\_KPI's/links/0f317538f69f01ba32000000/Green-performance-map-visualizing-environmental-KPIs.pdf](https://www.researchgate.net/profile/Magnus-Wiktorsson-2/publication/259217823_Green_performance_map_visualizing_environmental_KPI's/links/0f317538f69f01ba32000000/Green-performance-map-visualizing-environmental-KPIs.pdf)



