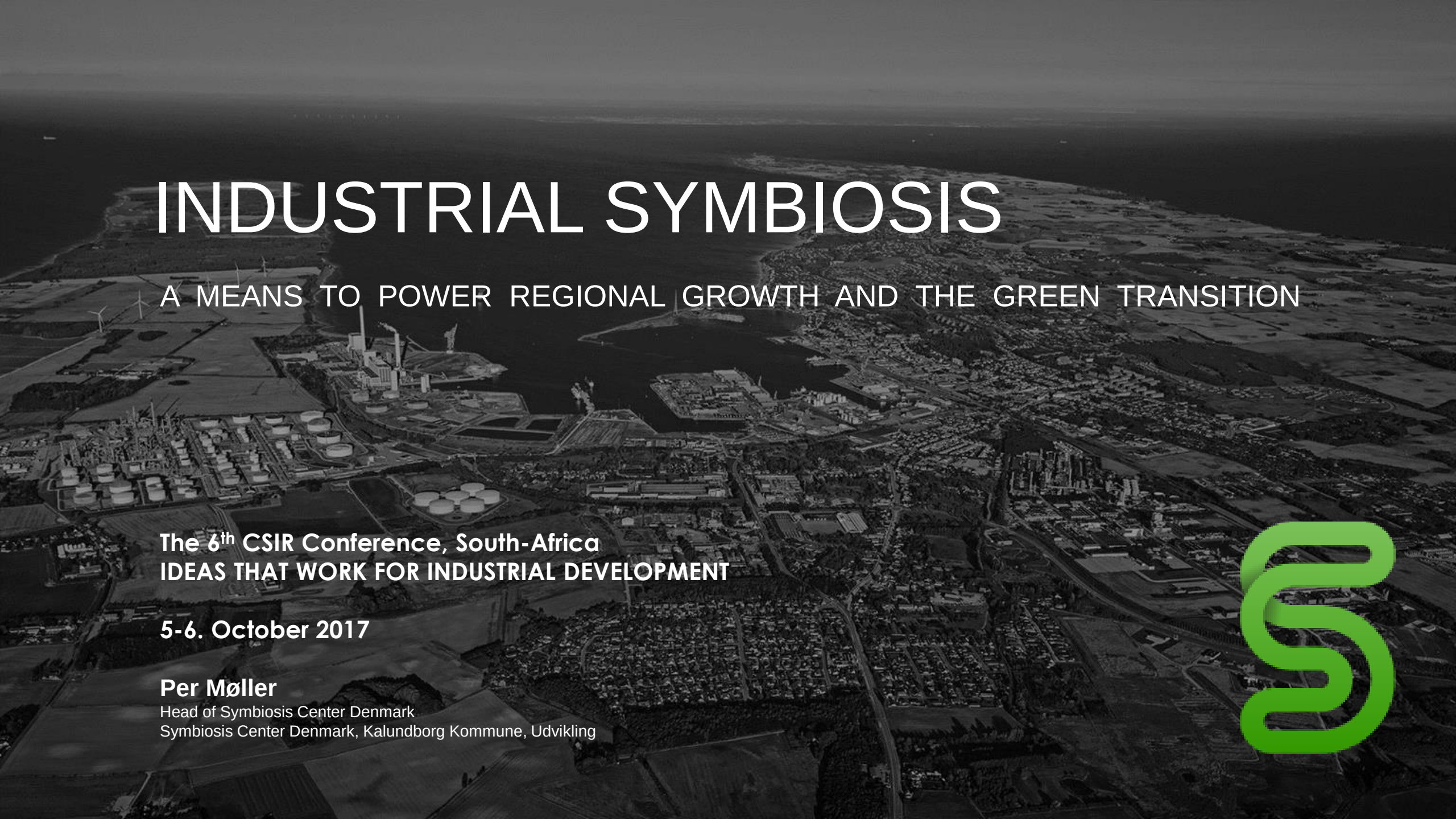


INDUSTRIAL SYMBIOSIS

A MEANS TO POWER REGIONAL GROWTH AND THE GREEN TRANSITION

The 6th CSIR Conference, South-Africa
IDEAS THAT WORK FOR INDUSTRIAL DEVELOPMENT

5-6. October 2017

Per Møller
Head of Symbiosis Center Denmark
Symbiosis Center Denmark, Kalundborg Kommune, Udvikling

A brief presentation

REGION SJÆLLAND – vi er til for dig

Symbiosis Center Denmark is a national knowledge center working to identify and facilitate industrial symbiosis projects between industrial partners.

Activities

Company programs

- Identifying & implementing Industrial Symbiosis

Marketing

- Promoting green solutions
- Attracting investments

Training

- Educational programs

Knowledge platform

- Research activities
- Test & demonstration
- Triple helix collaboration

Our process of facilitation

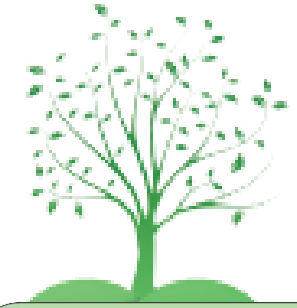
Industrial Symbiosis is an effective green business model that reduce production costs and increase competitiveness and growth potential for industries. But to implement an Industrial Symbiosis takes time and resources and requires data, mutual trust and knowledge sharing between the partners as well as network relations, facilitation and support.

Potential

- Screening
- Assessment

Match

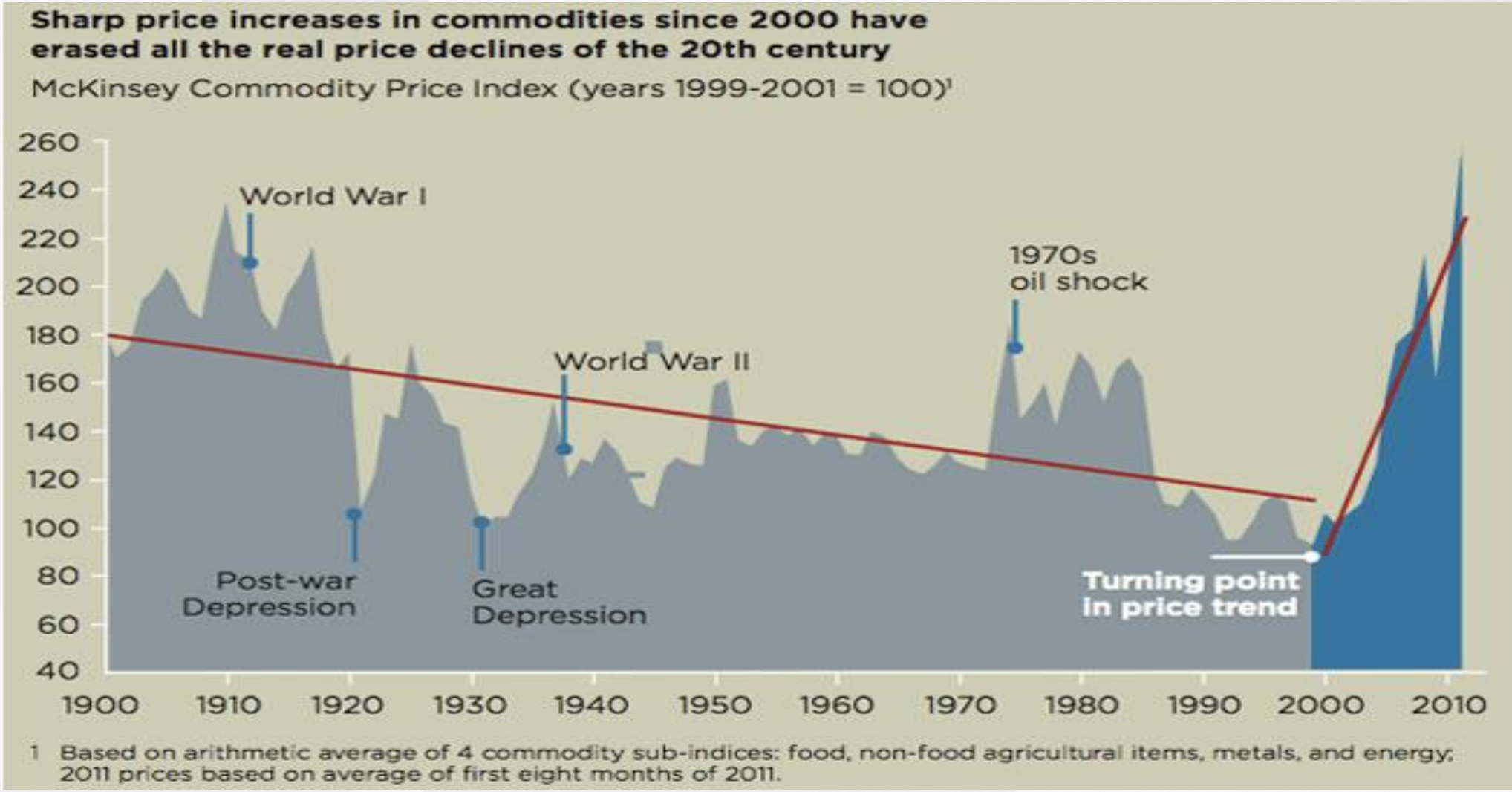
- Business case



Anchoring

- Partnership
- Network

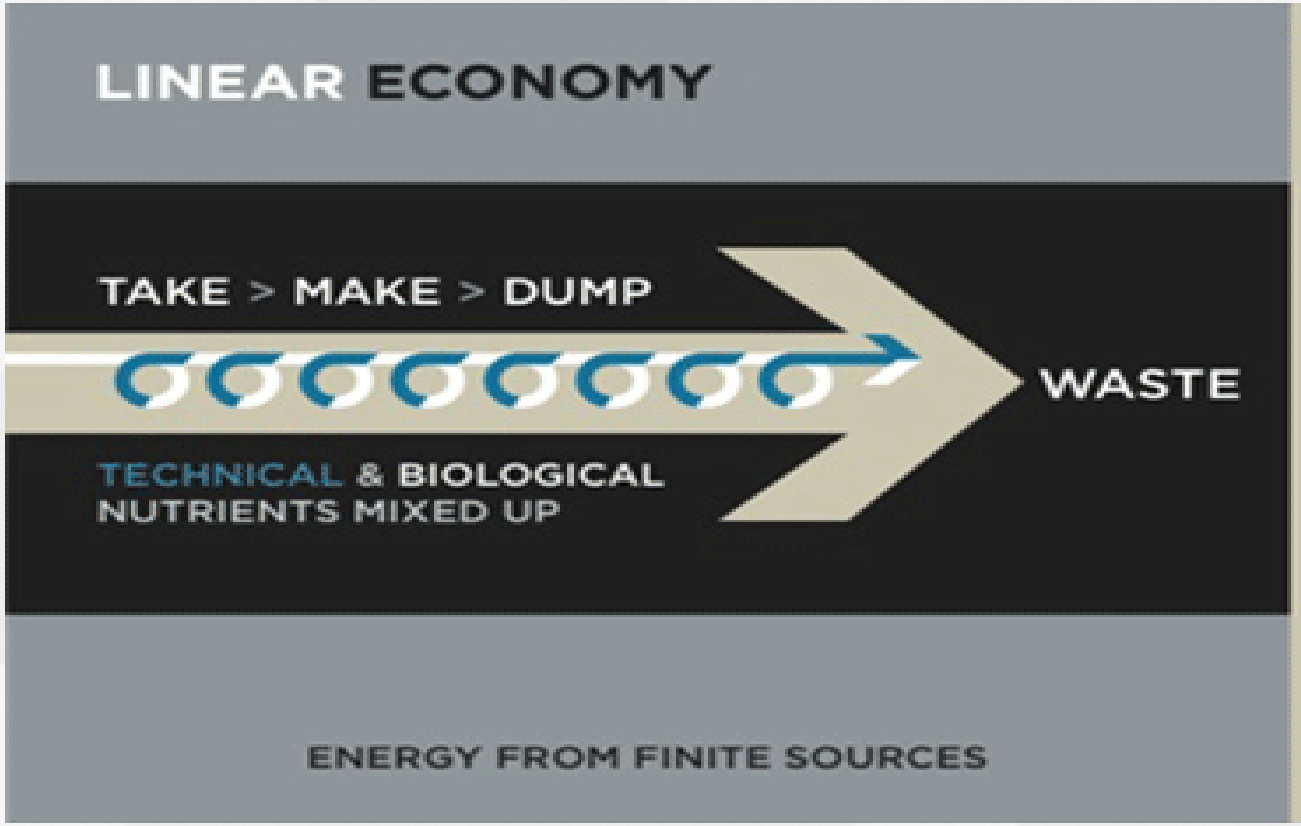
DRAMATIC INCREASE IN COMMODITY PRICES

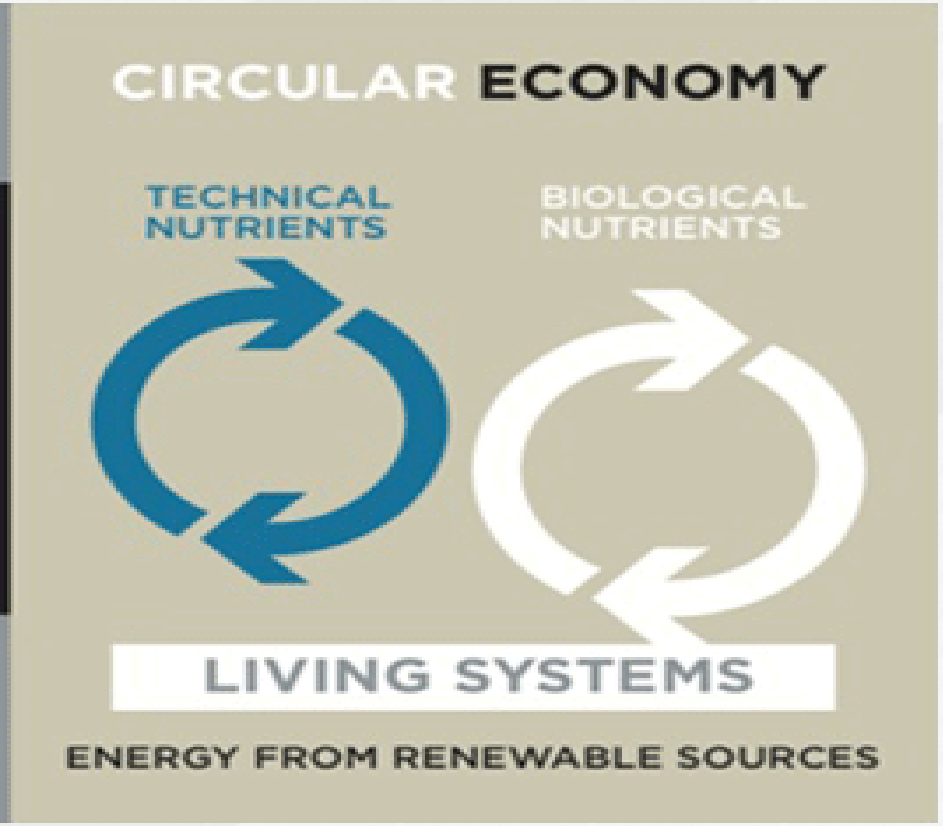


FROM LINEAR TO CIRCULAR ECONOMY

ELLEN MACARTHUR FOUNDATION

DELIVERING THE CIRCULAR ECONOMY
A TOOLKIT FOR POLICYMAKERS





CIRCULAR ECONOMY TRANSITION IN DENMARK BY 2035 COULD LEAD TO...

ELLEN MACARTHUR FOUNDATION

DELIVERING THE CIRCULAR ECONOMY
A TOOLKIT FOR POLICYMAKERS

- ↑ GDP — An increase in GDP by 0.8–1.4%
- ↑ FTEs — 7,000 – 13,000 additional job equivalents
- ↑ EXPORT — Increase in net exports by 3-6%
- ↓ RESOURCE — Reduction of consumption of selected resources by 5-50%
- ↓ CO_2 — Reduction of the country's carbon footprint by 3-7%

NEXT STEPS TOWARDS CIRCULAR ECONOMY

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27 RECOMMANDATIONS TO GOVERNMENT

Den cirkulære værdikæde

- **#1** Gøre cirkulær økonomi til en vækstmotor for danske virksomheder
- **#2** Etablere én indgang til det offentlige for virksomheder, der oplever barrierer for cirkulær omstilling
- **#3** Etablere cirkulære kommuner
- **#4** Indarbejde cirkularitet i de makroøkonomiske modeller og statistikker
- **#5** Udvikle standarder som understøtter cirkulær økonomi
- **#6** Indarbejde cirkulær økonomi i hele uddannelsessystemet
- **#7** Fremme forskning, udvikling, test, demonstration og markeds-modning af cirkulære løsninger og teknologier
- **#8** Styrke finansiering til acceleration af cirkulære virksomheder
- **#9** Udnytte den danske styrkeposition inden for digitalisering og ny teknologi til at understøtte den cirkulære omstilling

Design og produktion

- **#10** Styrke den cirkulære produktpolitik i bl.a. ecodesign-direktivet
- **#11** Indarbejde cirkulær økonomi i produktionsvirksomhedernes vilkår
- **#12** Udarbejde et cirkulært bygningsreglement
- **#13** Udvikle standardiserede bygnings- og produktpas
- **#14** Fremme rammevilkårene for bioraffinering
- **#15** Etablere nye værdikæder for landbrugsafgrøder, der udnytter fotosyntesen bedre
- **#16** Optimere udnyttelsen af animalske produkter

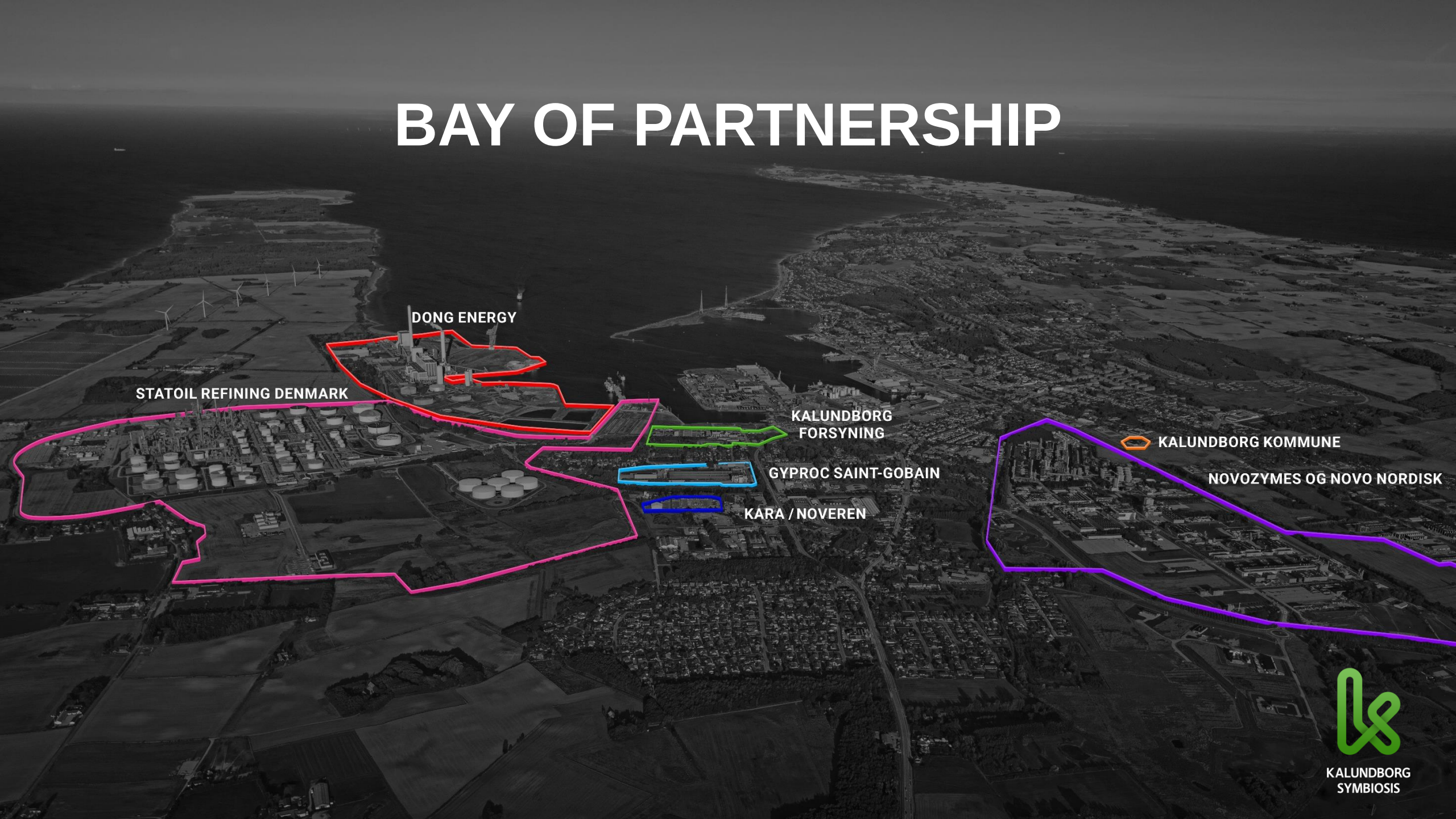
Forbrug

- **#17** Bygge og købe ind i det offentlige på baggrund af totaløkonomi og livscyklusberegninger
- **#18** Fremme cirkulær økonomi gennem virksomheders og det offentliges indkøb
- **#19** Udvikle de cirkulære aspekter ved relevante mærkningsordninger og udbrede brugen af dem
- **#20** Fremme udnyttelse af overskudskapacitet f.eks. gennem deleøkonomiske forretningsmodeller
- **#21** Forebygge madspild
- **#22** Fremme reparation og genbrug

Genanvendelse

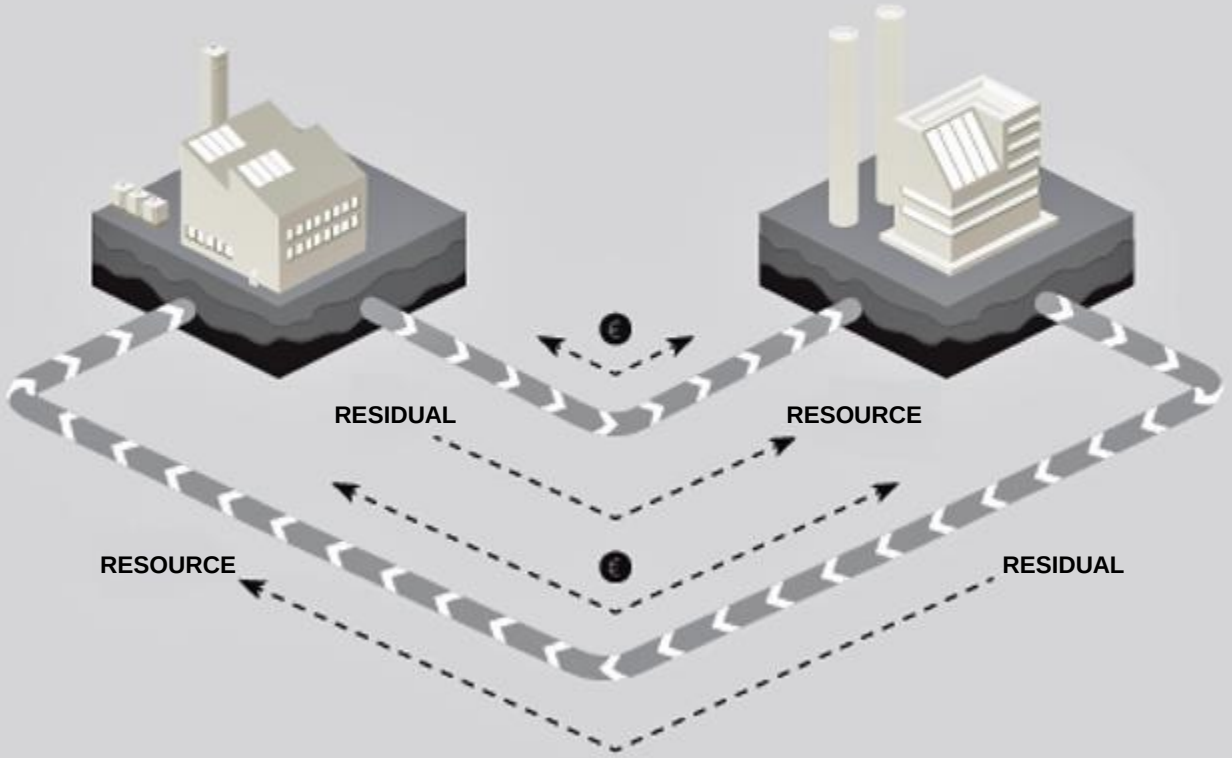
- **#23** Ensrette den kommunale indsamling af husholdningsaffald for at fremme genanvendelse
- **#24** Skabe klarhed om affaldssektorens rammevilkår og et bedre udbud af genanvendte råvarer
- **#25** Forbedre konkurrencevilkårene på markedet for affald og genanvendte råvarer gennem ensartet klassificering og et styrket risikobaseret affaldstilsyn
- **#26** Udbrede selektiv nedrivning af byggeri
- **#27** Indføre et mere cirkulært producentansvar for elektronikaffald

BAY OF PARTNERSHIP



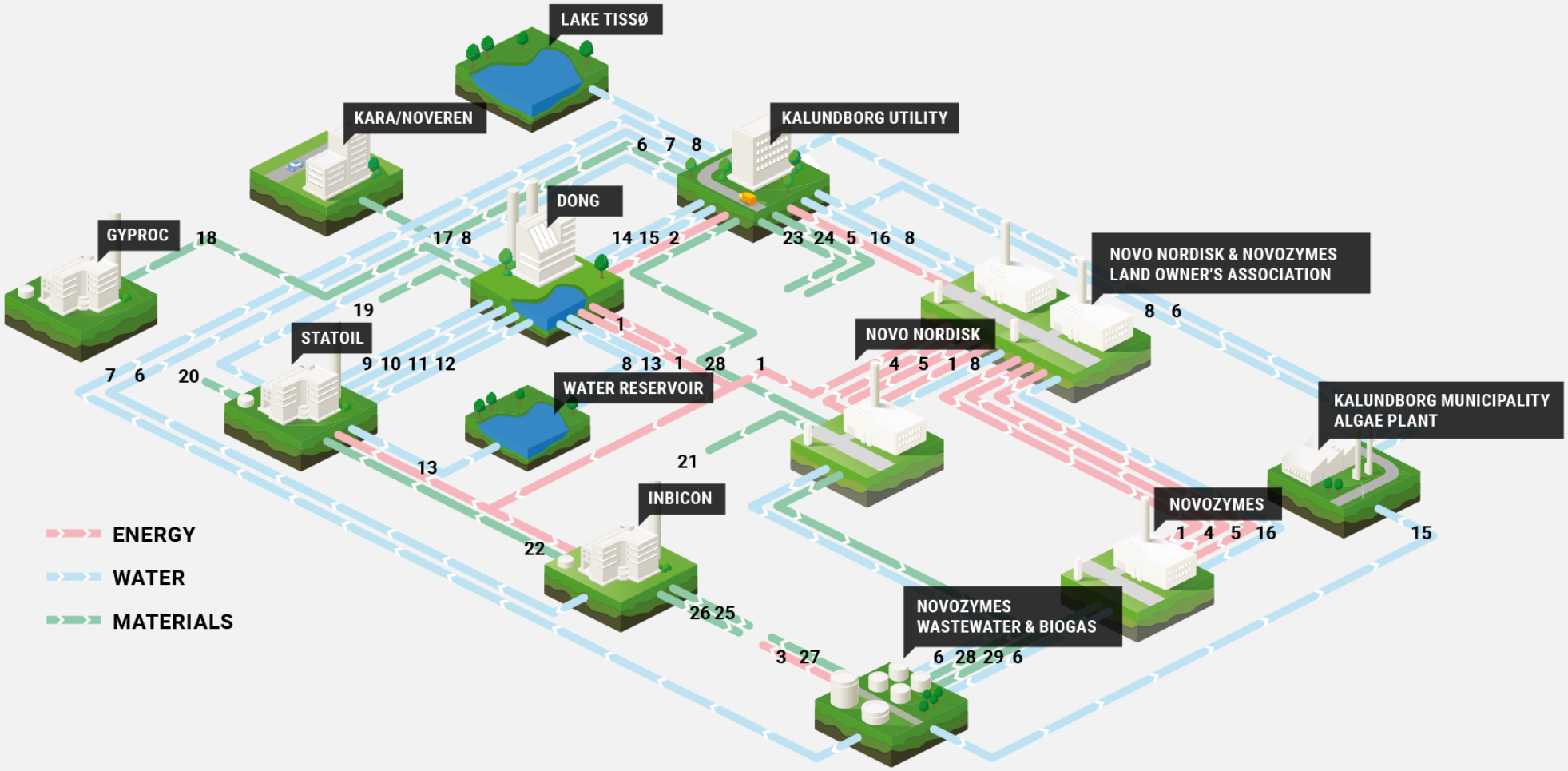
KALUNDBORG SYMBIOSIS

INDUSTRIAL SYMBIOSIS FOR MUTUAL BENEFIT



KALUNDBORG SYMBIOSIS

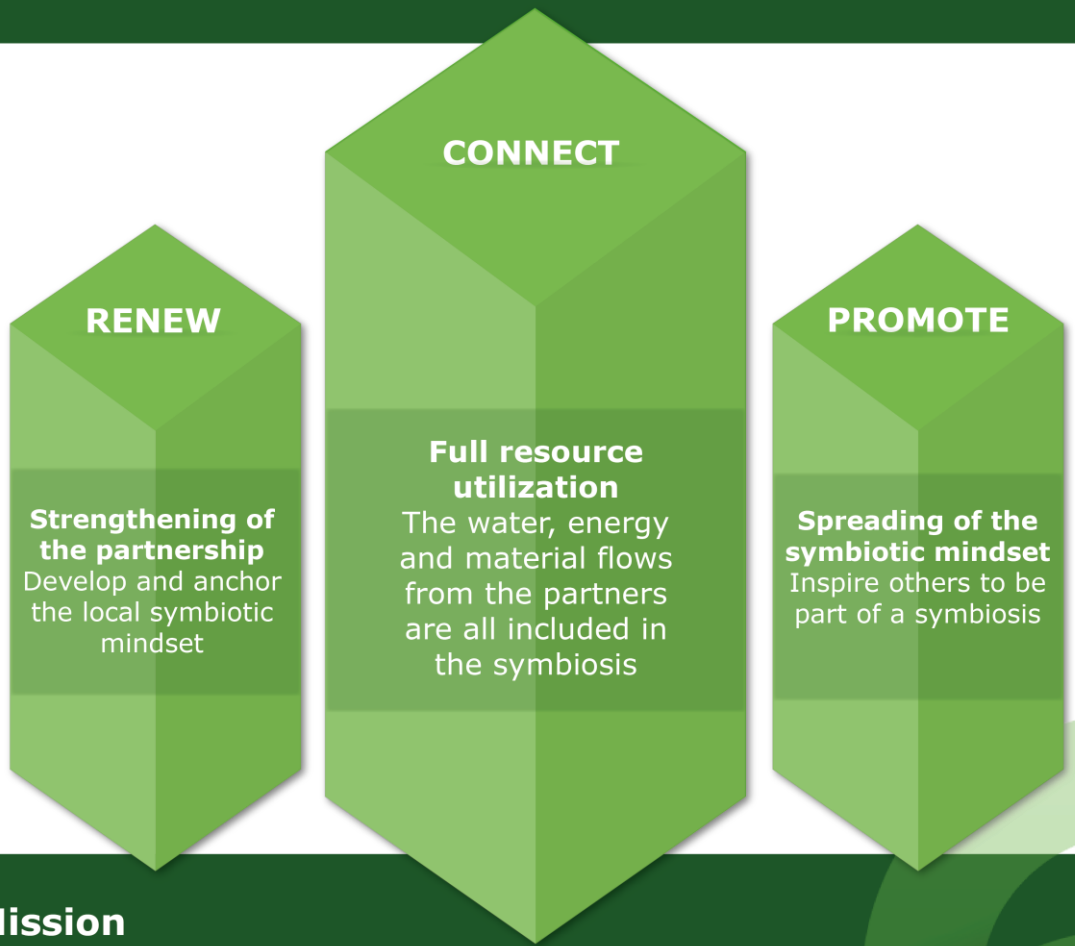
STREAMS OF AGREEMENTS



KALUNDBORG SYMBIOSIS

Vision

Kalundborg Symbiosis wants to be the world's leading industrial symbiosis with a circular approach to production.
By symbiosis we understand a local partnership where you provide, share and reuse resources to create a shared value.

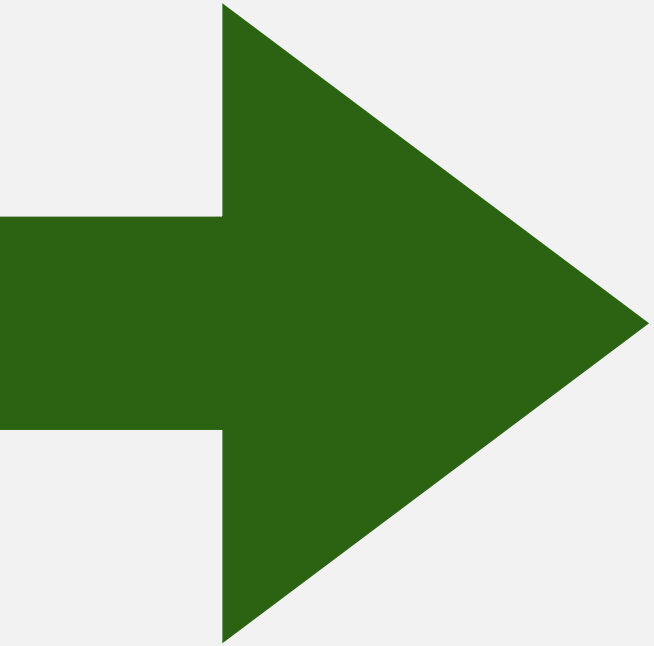


Mission

Kalundborg Symbiosis creates a sustainable development in our companies through joint projects.
By sustainability, we understand the long-term responsible use of resources, in balance with economic, environmental and social considerations.

KALUNDBORG SYMBIOSIS

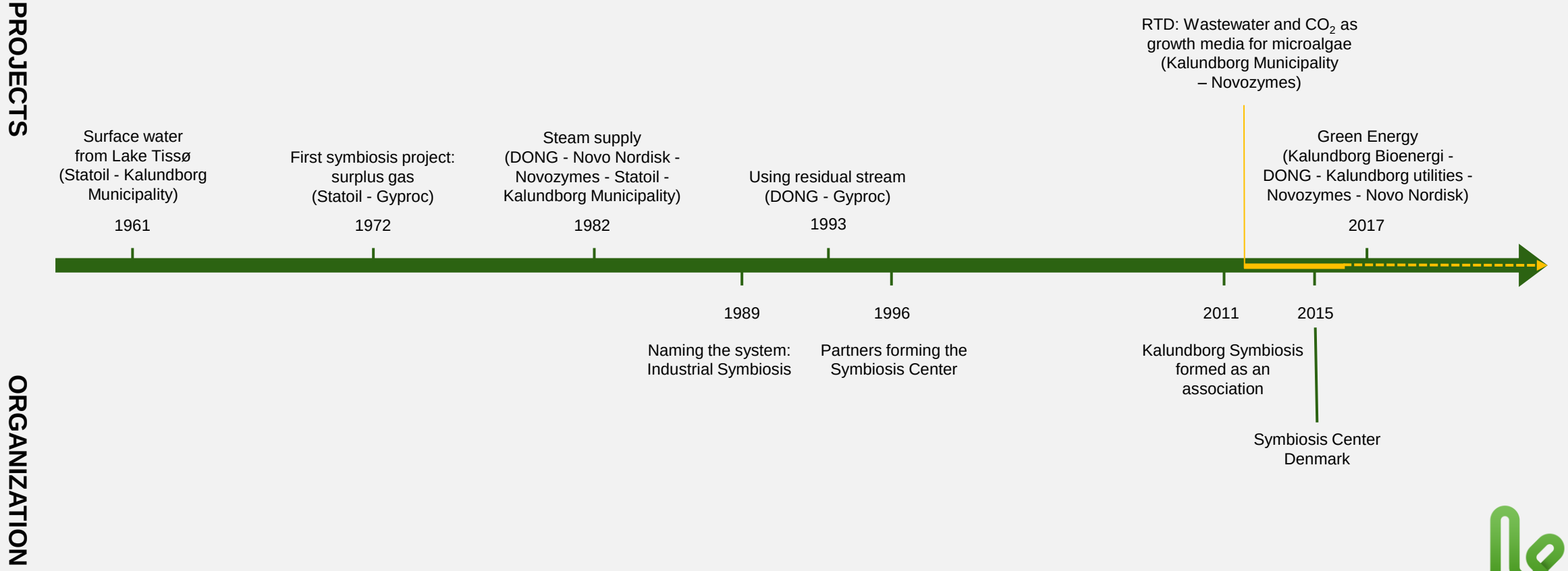
GOING FORWARD: FUTURE PROJECTS



- A new overview of the savings
- A new biogas plant (from 2018)
- A green steam, power and heat production (from 2019)
- New member: Avista Oil (Unibio, ….)
- A new MBA education within Biotech
- A knowledge hub for interdisciplinary and international test and demonstration

KALUNDBORG SYMBIOSIS

MORE THAN 40 YEARS OF COOPERATION



KALUNDBORG SYMBIOSIS

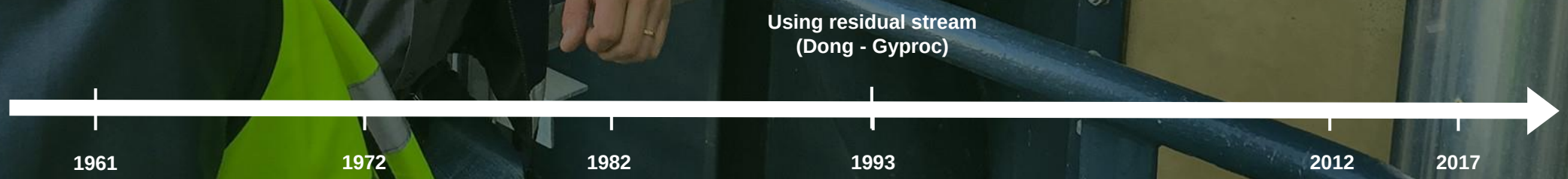
WORKING TOGETHER:
SURFACE WATER SPRINGS IN 1961

GOOD BUSINESS CASE: FROM FIRST STREAM IN 1972

ADAPTABLE: NEW BUSINESS MODEL GAINING STEAM FROM 1982

KALUNDBORG SYMBIOSIS

MINDSET:
MATERIALIZED IN GYPSUM FROM 1993

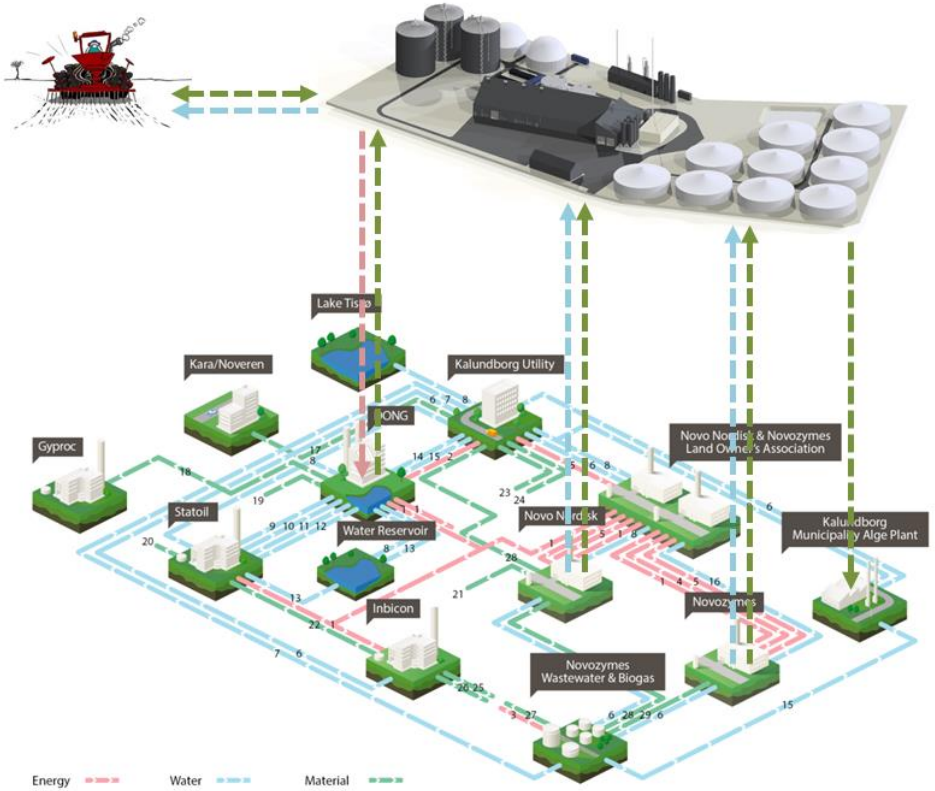


KALUNDBORG
SYMBIOSIS

GREEN ENERGY: BIOGAS, HEAT, STEAM AND ELECTRICITY FROM 2017

FROM BIOMASS TO NATURAL GAS

- Biogas plant (Kalundborg Bioenergi)
- Start-up 2018
- Will treat 300.000 ton biomass pr year
- Producing natural gas (upgraded biogas) and fertiliser
- Energy = 4.000 households
- CO_2 savings = 17.000 tons/y



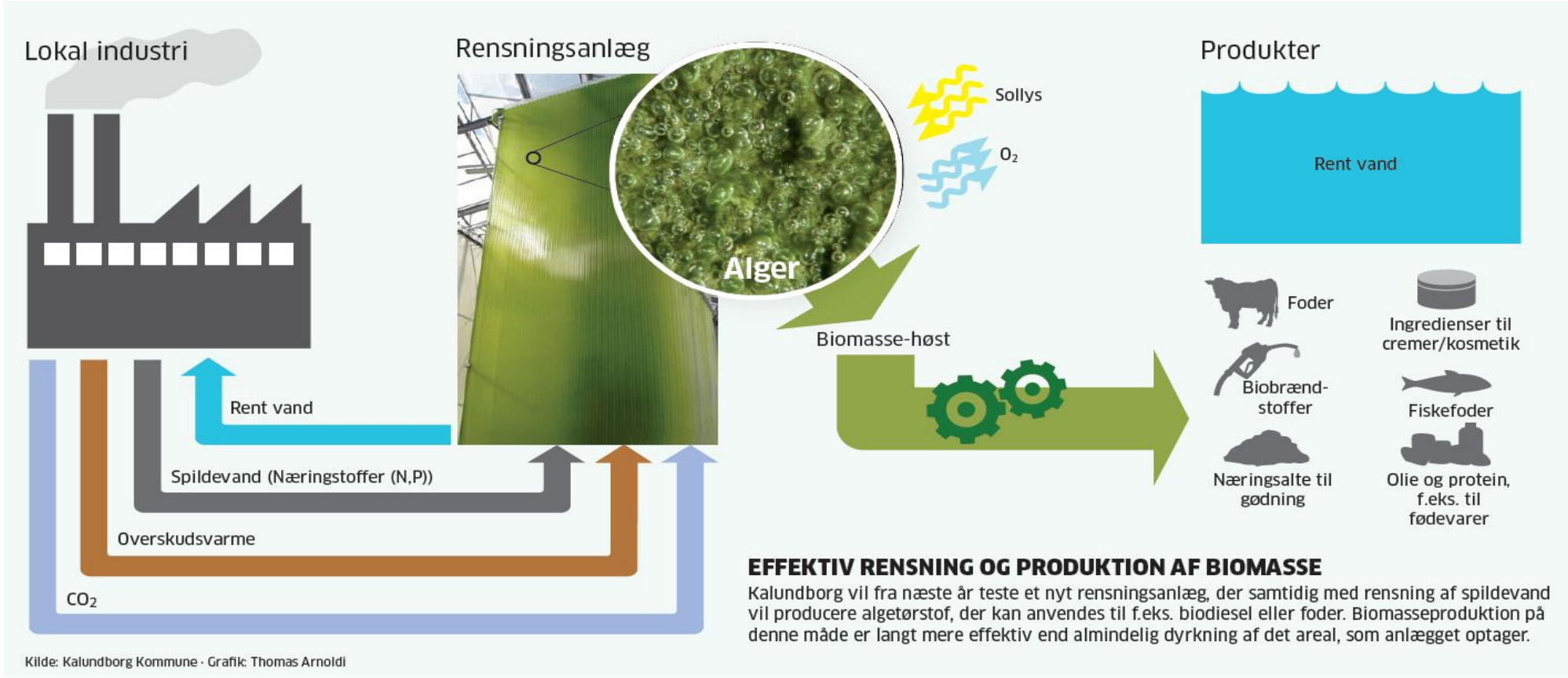
BIOMASS BASED POWERPLANT (2019)

- Wood chips replacing coal
- Yearly saving: 800.000 ton CO_2 (400.000 cars)
- green steam, electricity and heat

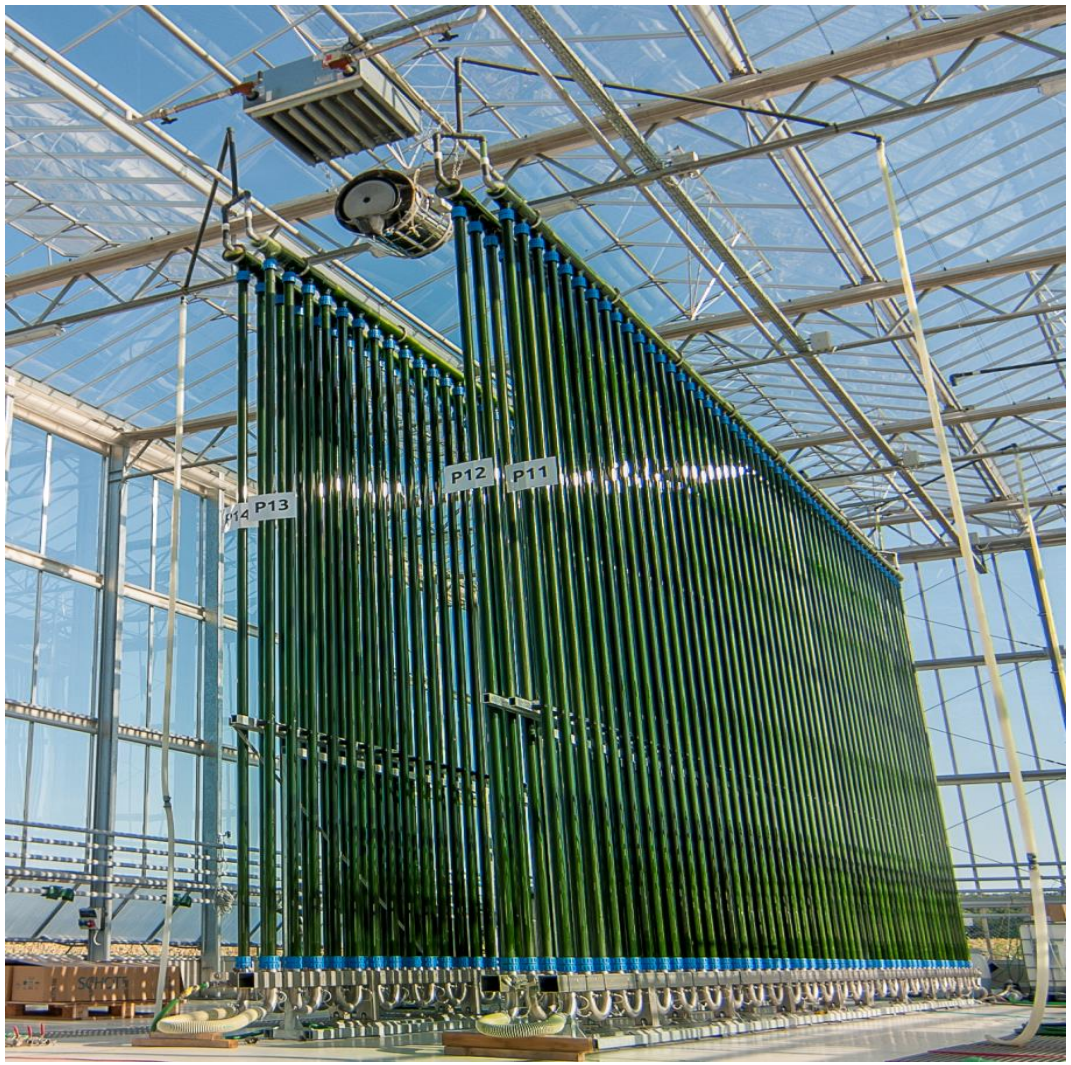
TEST & DEMONSTRATION: WASTEWATER AND CO_2 FOR MICROALGAE FROM 2012

FROM WASTEWATER TO HIGH VALUE BIOMASS

Ressource efficiency and added value

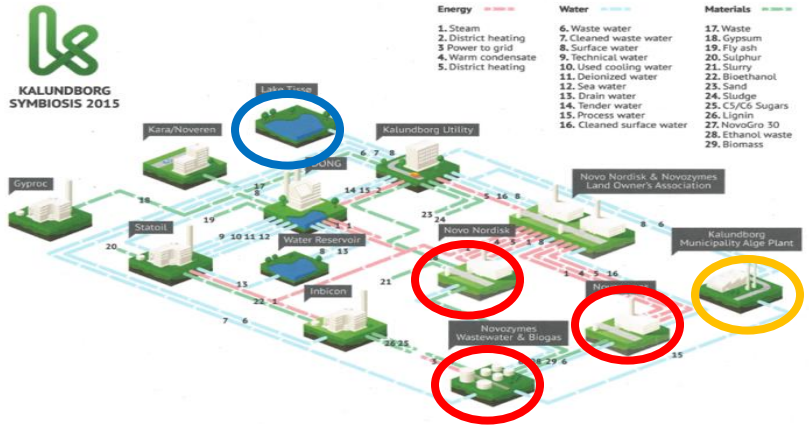


NEXT GENERATION PHOTOBIOREACTOR

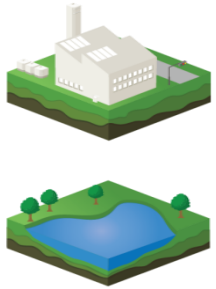


ALGAE PRODUCTION IN A SYMBIOSIS CONCEPT

- Industrial symbiosis potential
  - Algae production can use and benefit from residual streams from industry
  - Industry can use and benefit from algae Production



- Local increase in resource efficiency and decrease in water stress
  - Water: 2 mill m^3/y
  - Phosphor: 30 ton/y
  - Nitrogen: 700 ton/y
  - CO_2: 7.200 ton/y
  - High quality biomass: 4.000 ton/y



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WORLD LEADER IN BACTERIAL PROTEIN FERMENTATION

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WHAT IS UNIPROTEIN®?

UniProtein®, the end-product resulting from Unibio's U-Loop technology, addresses the world's growing need for animal protein...

→

NATURAL GAS TURNED INTO FOOD

About 140 billion cubic metres (5 trillion cubic feet) of natural gas are being flared and vented annually...

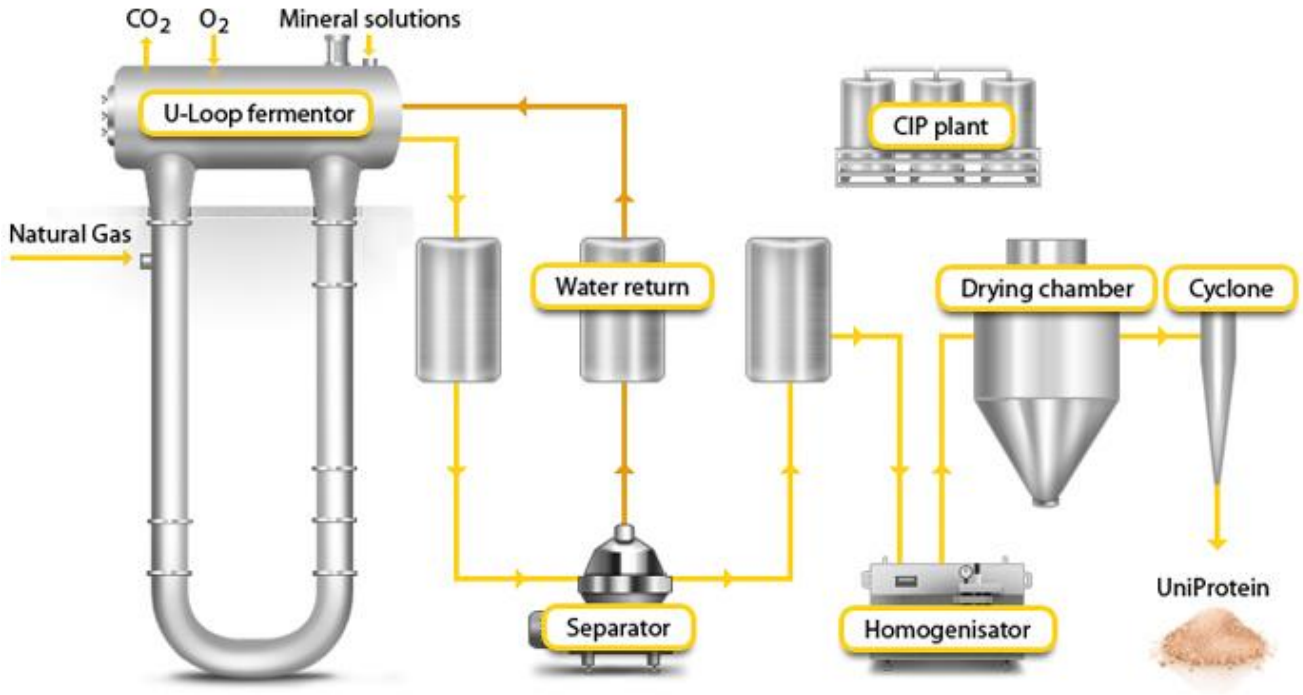
→

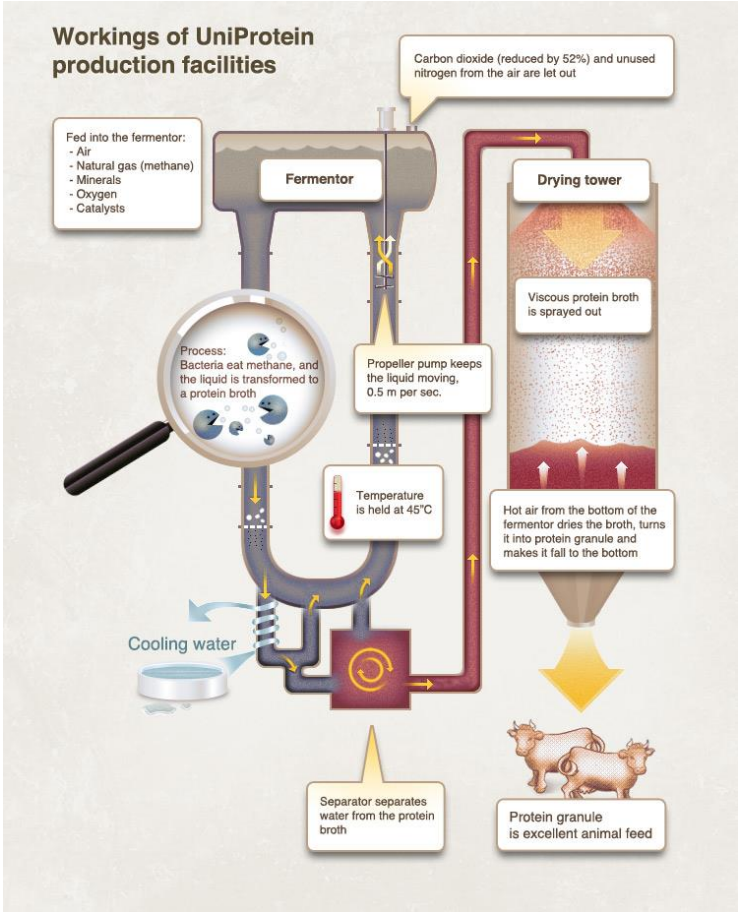
52% CUT IN CO_2 EMISSIONS

When methane (which is the principal component of natural gas – about 92%) is flared at whichever temperature...

→

FROM METHANE TO PROTEIN (RTD)
UNIBIO – CONCEPT AND PROCESS





BENEFITS FROM INDUSTRIAL SYMBIOSIS

Increased growth and competitiveness

- Lower production costs with fewer expenses for purchasing and disposal
- Income from by-products

Decoupling of growth and resource consumption

- Growth, with improved resource efficiency and reduction in waste
- Lower CO_2 emissions

BENEFITS

Better control and adaptability

- Wider choice of suppliers and increased energy security with multi-pronged strategy (by creating and utilising one’s own local resources, one obtains less dependence on imports and world markets)

- Increased resilience by acting in partnerships that, for example, secure local resources in the long term and are less exposed to the instability and fluctuations of world markets

- Increased control and management of the flow of resources and materials

BENEFITS

Better innovation and business development

- Development and innovation strength achieved by connecting different competences both internally at the companies and between companies
- Increased possibility of employee innovation Development of new products, customer groups and markets
- New business models based on the utilisation of resources in the residual flows
- New export opportunities

BENEFITS

Increased motivation and market value

- Increased PR and CSR value locally and globally
- Opportunity for shared marketing and investor efforts
- Increased motivation, job satisfaction and pride among the employees involved

BENEFITS

- **Increased growth and competitiveness**
- **Decoupling of growth and resource consumption**
- **Better control and adaptability**
- **Better innovation and business development**
- **Increased motivation and market value**

SYSTEMS MAKE IT POSSIBLE
PEOPLE MAKE IT HAPPEN

For more information please contact:
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