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

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

Sharp price increases in commodities since 2000 have erased all the real price declines of the 20th century.

McKinsey Commodity Price Index (years 1999-2001 = 100)

1 Based on arithmetic average of 4 commodity sub-indices: food, non-food agricultural items, metals, and energy; 2011 prices based on average of first eight months of 2011.
FROM LINEAR TO CIRCULAR ECONOMY

LINEAR ECONOMY

TAKE > MAKE > DUMP

TECHNICAL & BIOLOGICAL NUTRIENTS MIXED UP

WASTE

ENERGY FROM FINITE SOURCES

CIRCULAR ECONOMY

TECHNICAL NUTRIENTS

LIVING SYSTEMS

ENERGY FROM RENEWABLE SOURCES

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

- An increase in GDP by 0.8–1.4%
- 7,000 – 13,000 additional job equivalents
- Increase in net exports by 3-6%
- Reduction of consumption of selected resources by 5-50%
- Reduction of the country’s carbon footprint by 3-7%
NEXT STEPS TOWARDS CIRCULAR ECONOMY

---

27 RECOMMANDATIONS TO GOVERNMENT
BAY OF PARTNERSHIP
INDUSTRIAL SYMBIOSIS FOR MUTUAL BENEFIT
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.
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
MORE THAN 40 YEARS OF COOPERATION

First symbiosis project:
surplus gas
(Statoil - Gyproc)
1972

Steam supply
(DONG - Novo Nordisk - Novozymes - Statoil - Kalundborg Municipality)
1982

Using residual stream
(DONG - Gyproc)
1993

Naming the system:
Industrial Symbiosis
1989

Partners forming the
Symbiosis Center
1996

Kalundborg Symbiosis
formed as an association
2011

Symbiosis Center
Denmark
2015

Green Energy
(Kalundborg Bioenergi - DONG - Kalundborg utilities - Novozymes - Novo Nordisk)
2017

RTD: Wastewater and CO₂ as growth media for microalgae
(Kalundborg Municipality – Novozymes)

Surface water
from Lake Tisåe
(Statoil - Kalundborg Municipality)
1961

Projects

Organization
WORKING TOGETHER: SURFACE WATER SPRINGS IN 1961

Surface water from Lake Tissø (Statoil - Kalundborg Municipality)
GOOD BUSINESS CASE: FROM FIRST STREAM IN 1972
ADAPTABLE: NEW BUSINESS MODEL GAINING STEAM FROM 1982

Steam supply
(DONG - Novo Nordisk
Novozymes - Statoil
Kalundborg Municipality)
MINDSET: MATERIALIZED IN GYPSUM FROM 1993

Using residual stream (Dong - Gyproc)
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
- CO₂ 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

Wastewater and CO$_2$ as growth media for microalgae
(Kalundborg Municipality – Novozymes)
FROM WASTEWATER TO HIGH VALUE BIOMASS

Ressource efficiency and added value

EFFEKTIV RENSNING OG PRODUKTION AF BIOMASSE
Kalundborg vil fra næste år teste et nyt rensningsanlæg, der samtidig med rensning af spildevand vil producere algentørstof, der kan anvendes til f.eks. biodiesel eller foder. Biomasseproduktion på denne måde er langt mere effektiv end almindelig dyrkning af det areal, som anlægget optager.
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
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 CO₂ 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:
per.moller@kalundborg.dk