The Industrial Symbiosis at Kalundborg, Denmark

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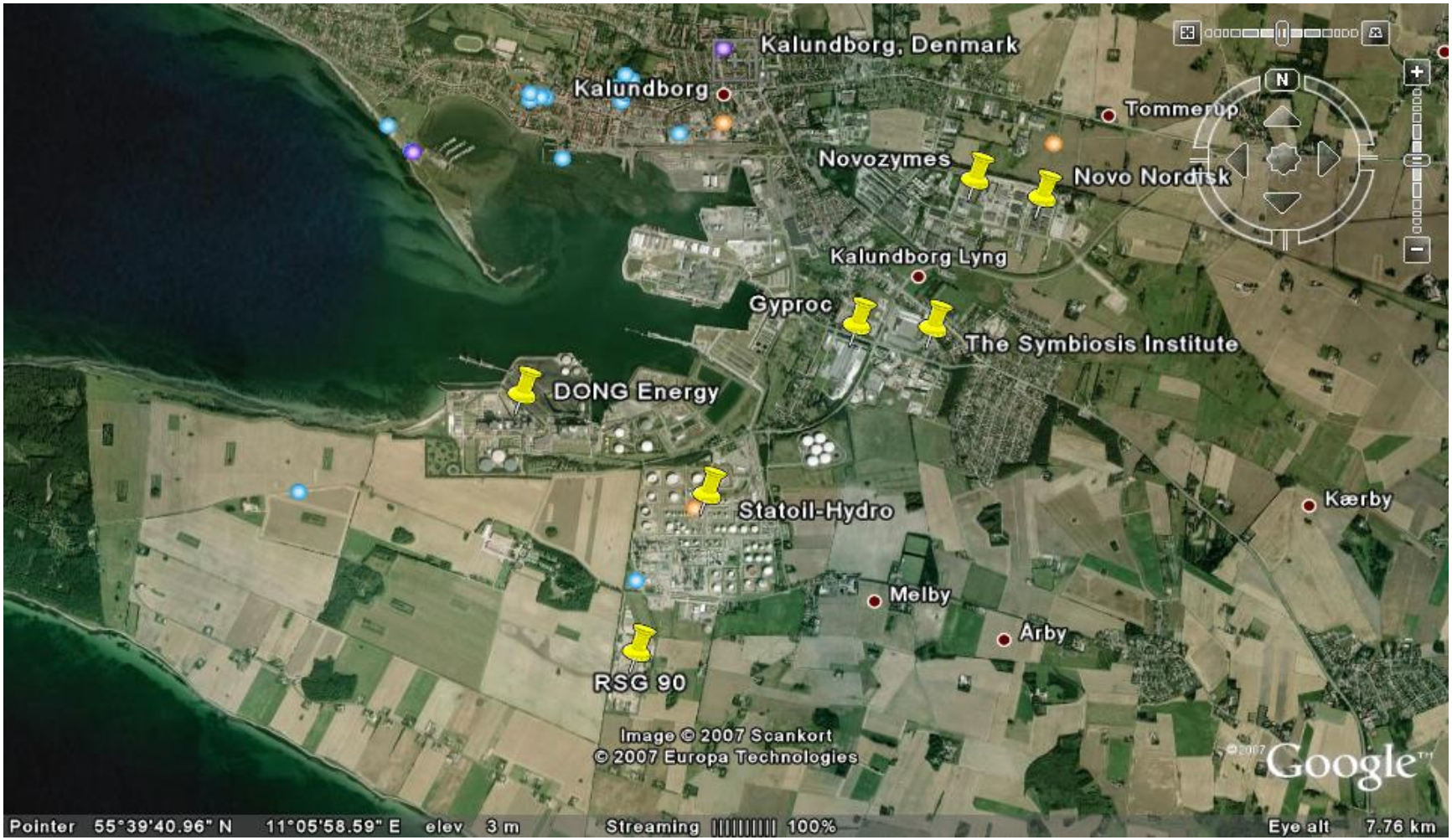
Kalundborg Symbiosis



THE INDUSTRIAL SYMBIOSIS

The Industrial Symbiosis at Kalundborg is a resource and environmental network, consisting of twenty-some bilateral, commercial agreements between five industries, two waste handling companies and the utilities department of the municipality.

Industrial Symbiosis

Industrial Symbiosis was relatively new in the 1960-ties and is common know-ledge to-day.

The systematic use of the Industrial Symbiosis concept as i Kalundborg is still not common practise in other industrial parks. Not in Denmark or world wide.

WHY KALUNDBORG?

- The industrial potential existed:
  - ⇨ Several large industries
  - ⇨ Limited physical distances
  - ⇨ ”A good fit”
- The economic incentive existed
- There were no legal barriers
- The communication was good

The Members

Asnæs Power Station

DONG energy

STATOIL

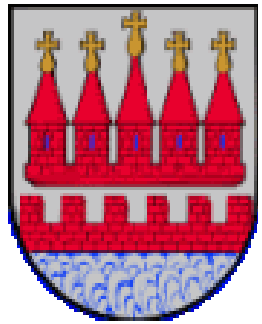
novo nordisk

novozymes

Gyproc

RGS90

KARA / NOVEREN
- SIKKERHED FOR MILJØET



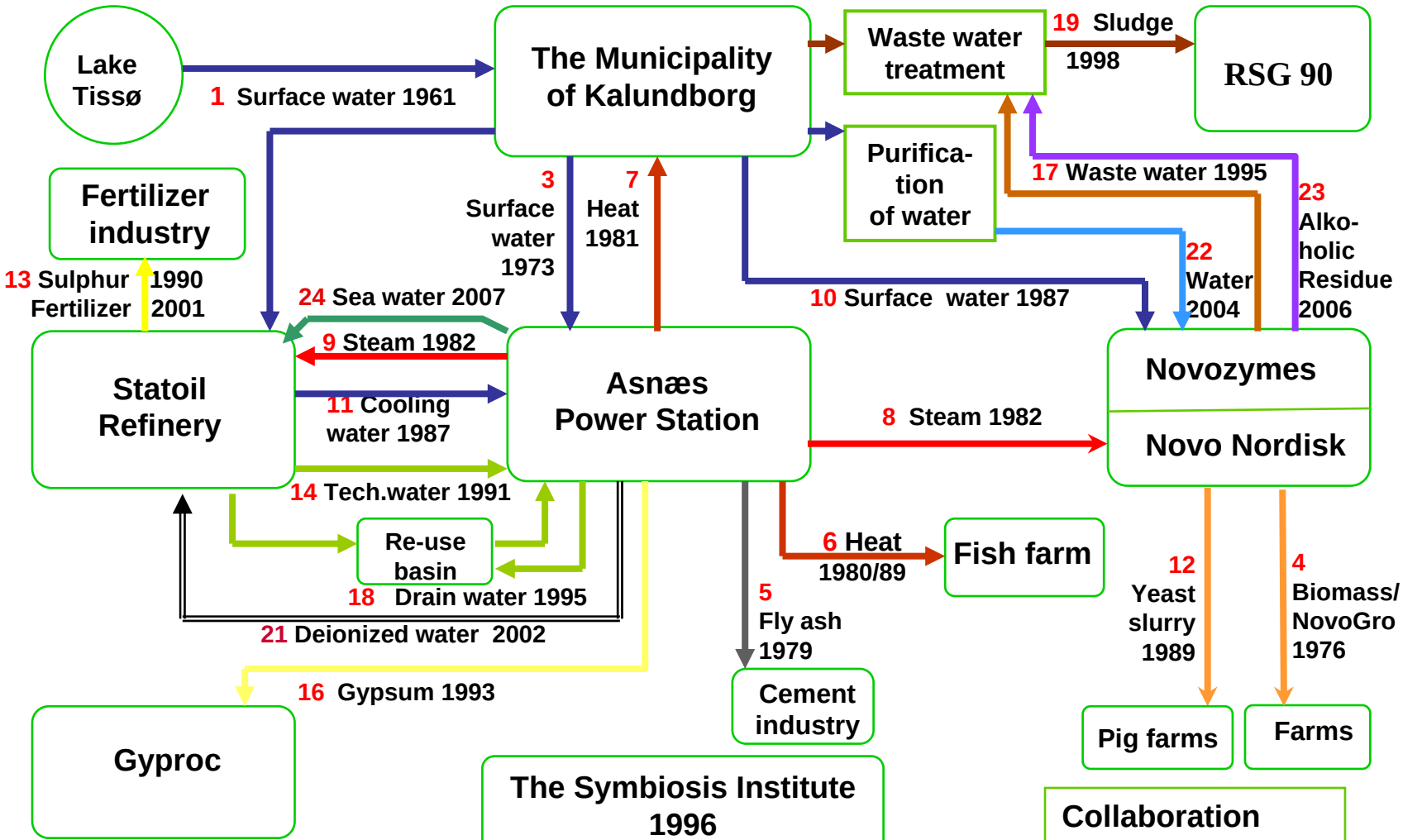
Symbiosis Activities

Three types of projects:

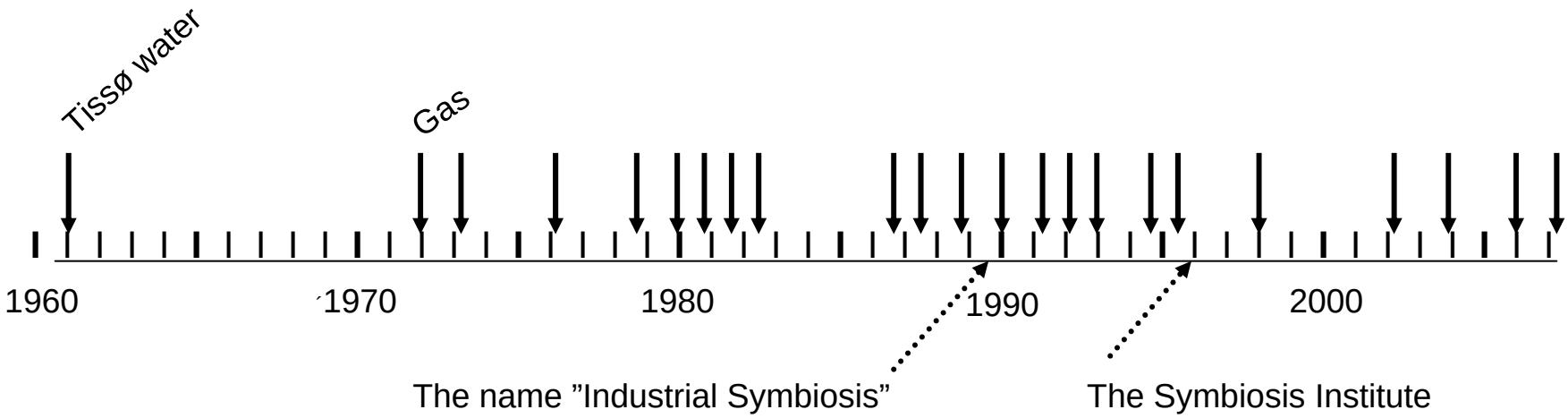
Recycling of water:	**12 Projects**
Exchange of energy:	**6 Projects**
Recycling of waste products:	**8 Projects**

+ The Symbiosis Institute

TOTAL SYMBIOSIS SYSTEM 2007



CHRONOLOGICAL DEVELOPMENT



Industrial Symbiosis

What has been achieved?

- Environmental aspects
- Economic aspects
- Social aspects

Environmental aspect

Resource savings.

Examples:

- Ground water ……..... 1,9 mill. m3/year
- Surface water …… 1,0 mill. m3/year
- Natural gypsum …… 200,000 ton/year
- Oil ……20,000 ton/year

Reduction of NOx and SOx emissions.
Reductions of COD and BOD emissions.

Environmental aspect

Future potential savings:

- Additional water savings of > 200.000 m^3 by recycling of steam condensate
- CO^2 reductions through efficient use of energy surplus and increased use of bio-mass as secondary fuel
- Involve SME's (non-members) in the symbiosis network – increase energy, waste and rawmaterial efficiency

Economic aspects

Economic Results:

Total investments in 18 projects:	~ 75 mio. US$
Annual savings:	> 15 mio. US$
Total savings until 2000:	~ 180 mio. US$

The economic results is much better to-day!

Social aspects

Examples of spin-off effects:

- Establishing of the Industrial Development Board of the Kalundborg Region
- Increased collaboration between neighbour municipalities in the region
- Collaboration in other issues, such as safety, training, human resources
- Added benefit to establish new production facilities in Kalundborg

Long Term Potential

- Improve the Kalundborg results
- Extend the Symbiosis Network to other regions in Denmark
- New innovative symbiosis projects e.g. use of alternative energy sources (biomass – biogas – solar and wind)
- R&D in new technologies for improved synergy and ZERO waste.
- Export of experiences and know-how world wide

What makes Industrial Symbiosis a success?

What is needed to implement, successfully, symbiosis among private industries?

- Awareness
- Willingness
- Feasibility

Lessons learnt

Systems makes it possible –

People makes it happen!