

Module 5 Lesson 3— Industrial Ecology

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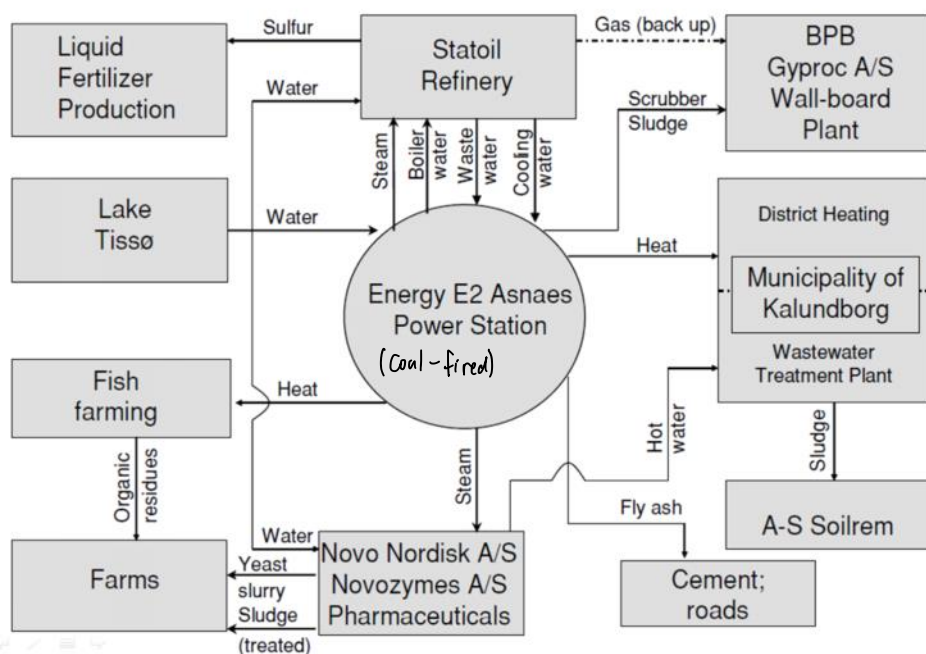
5.3.1 Introduction

- Industrial Ecology *also known as symbiosis* operationalizes on the idea of thinking of a factory as an industrial organism, and thinking of a set of factories (& other human activities) as an industrial ecosystem
- Kalundborg Symbiosis
 - first well-functioning example of industrial ecology
 - textbook example of effective resource saving & cycling of materials in industrial production
 - public & private companies buy & sell waste from each other in a closed cycle of " "
- The by-product of one company is the raw material of another company

5.3.2 Material Exchange

- Incentive of Kalundborg Symbiosis
 - driven by resource scarcity, increased costs of materials & energy for businesses
- Incentivisation based on individual project's commercial value & any exchanges b/w companies are initially assessed & established on the basis of economic gain in a savings, &/or resource gains, &/or money

Kalundborg Symbiosis Eco-Industrial Park, Denmark



• Some exchanges:

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- > 1 million tons/year of sludge from Novo Nordisk used as fertilizer in farms
 - 5000 tons/year of surplus yeast from Novo Nordisk (producing insulin) used as pig food in farms
 - 1500 MW power station uses refinery gas from Statoil to generate electricity & steam, which is then supplied to both Statoil & Novo Nordisk for heating of their processes
 - 135,000 tons/year of fly ash from power station sent to cement plant as substitute for calcium carbonate
- Reduced needs for resources, including reductions of:
- overall water demand by 20-25%
 - oil consumption of $\sim 19,000$ tons/yr
 - coal " of $\sim 30,000$ tons/yr
 - CO_2 emissions of 131,000 tons/yr
 - SO_2 " of 25,000 tons/yr

5.3.3 IE in the City

- IE is a methodology of clustering manufacturing, processing, & assembly plants such that the waste stream of one industry becomes feed stock of another industry.
- Can be used in cities, known as **Material Flow Analysis (MFA)**

