Composting of sewage sludge and study of possible future options

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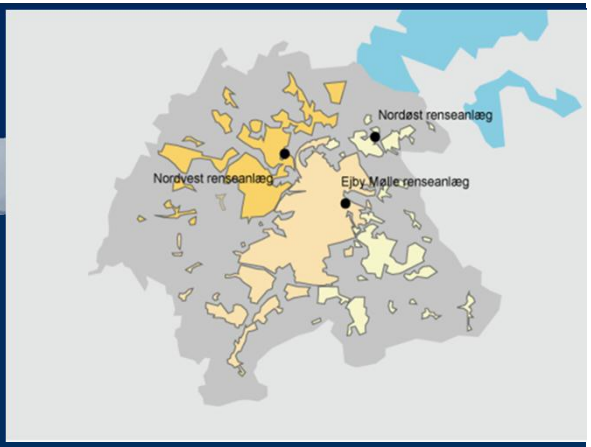
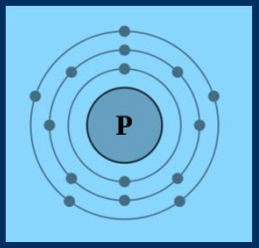


Presentation of Odense City

- Political wish of a sustainable municipality
- Approx. 190.000 inhabitants
- 3 central wastewater treatment plants
- 99 % of the wastewater is treated in the wastewater treatment plants
  (capacity of approx. 100.000 m3/day)
- 31.000 tons sewage slugde per year
  (22 % dry matter)

Legislation related to sewage sludge



- Is considered a valuable fertilizer (high phosphorus content)
- If limit values of certain heavy metals and organic xenobiotics in the legislation is complied it can be directly spread onto agricultural land
- Is considered as a wasteproduct
- The statutory sectorplan for handling of waste must also include the handling of sewage sludge

Challenges related to the handling of sewage sludge in Odense City

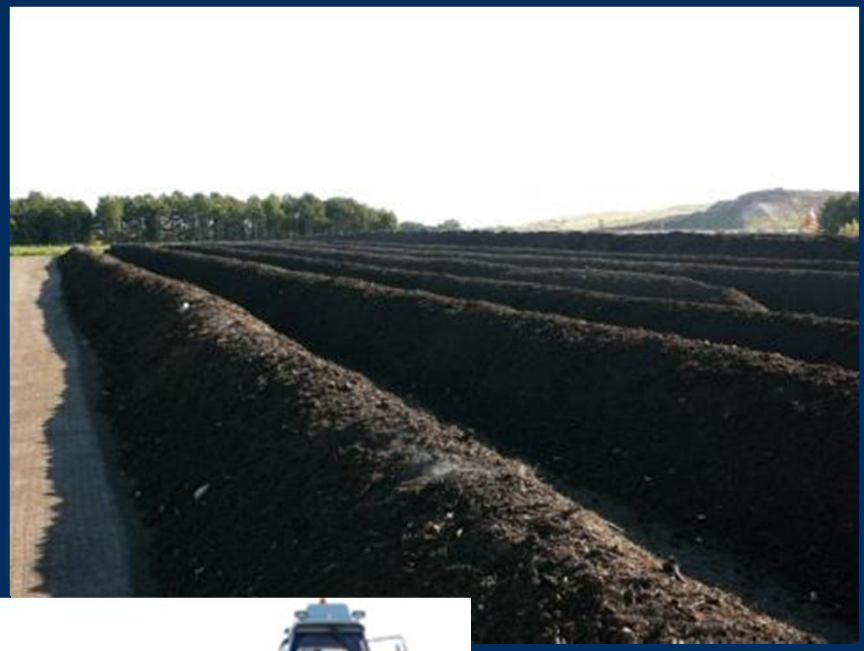
- Because of the content of certain organic xenobiotics it can't be directly spread onto agricultural land without prior treatment
- Environmental Policy:
  "Handling and disposal of sewage sludge shall be reviewed and analyzed, including an evaluation of possible future alternatives"

How do we handle sewage sludge to day? (composting of sewage sludge)

- Sewage sludge is currently composted along with straw and cuttings from parks and gardens

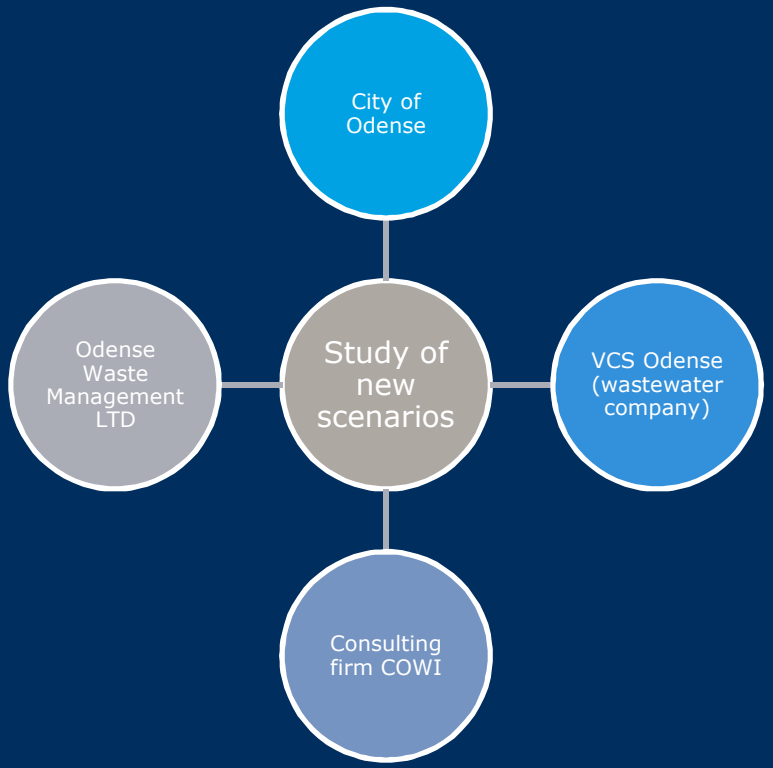
How do we handle sewage sludge to day? (composting of sewage sludge)

- The treatment plant was established in 1999, Denmarks biggest
- Covers 62.000 m^2
- Can treat the total sewage sludge volume from Odense, in 2009 31.000 tons



Study of possible future options

- Environmental policy indicates reviewing and analysing, including evaluation of possible future alternatives (economy and environment)



Results of the study

Composting of sewage sludge

Drying of sewage sludge into fuel pellets

Incineration of sewage sludge (with and without flue gas condensation)

Composting of sewage sludge at Odense Environmental Center

The composting process is a process in which naturally occurring micro-organisms are used to decompose concentrated organic matter by the use of atmospheric oxygen, whereby the decomposition process is considerably accelerated

The plant has got a capacity to treat the total sewage sludge volume from Odense, which in 2009 was approx. 31.000 tons, (22 % dry matter).

Energy consumption in the form of diesel and electricity for machines and equipment causes some CO2-emissions from the composting process

Annually a total of approx. 21.000 tons of composted sewage sludge, bio-compost, is spread on agricultural land. Improves the soil structure and this structure-enhancing quality is particularly clear in soils with very high clay content

Drying of sewage sludge into fuel pellets at Kommunekemi

This scenario comprises that Kommunekemi is considering to expand their current hazardous waste treatment plant with a facility for drying of sewage sludge into fuel pellets (approx. 90 % dry matter). Fuel pellets may be used in waste incinerators and possible biomass heatplants.

The facility is planned to have a total capacity of 100.000 tons of sewage sludge (25 % dry matter). Approx. 25 % should come from Odense, and the rest from other municipalities.

The internal energy consumption at the drying plant would consist of steam and power, the steam being produced in the existing incinerators at Kommunekemi.

It may be a future possibility to utilize the phosphorus contained in the ash from the incineration of sewage sludge pellets as fertilizer and hereby replace phosphorus from traditional sources. However, this applies only if the pellets are incinerated at a plant where they are not mixed with other wastes (biomass plant).

Incineration of sewage sludge (with and without flue gas condensation)

This scenario comprises a modern incineration facility with circulating fluidized bed furnace and boiler installations. Use of flue gas condensation gives a better exploitation of the surplus heat.

It is anticipated that such a facility can handle approx. 50.000 tons of sewage sludge, of which half (30 % dry matter) would come from Odense.

Use of energy inside the plant will mainly be in the form of electricity and gas. Due to the location of the plant it will be assumed to use natural gas (in the future it could be gas produced from surplus wind energy).

Surplus heat from the plant will be used in central heating network and therefore provides a positive contribution to both economic and environmental calculations.

It may be a future possibility to utilize the phosphorus contained in the ash from the incineration of sewage sludge if it is not mixed with ash from other fuels.

Treatment costs after sludge digestion and dewatering

	Composting	Drying* (biomass plant)	Incineration** (flue gas condensation)	Incineration** (no flue gas condensation)
Treatment Euro/ton (incl. disposition of residuals)	68	74-107	98 (94)	99 (97)
Transport Euro/ton	6	8	6	6
Mio. euro/year	1,5	2-3	2,4 (2,3)	2,4 (2,4)
Euro/household/year	8	9-13	12 (11)	12 (11)

* The lower price requires sale of fuel pellets without extra costs, while the higher price includes costs for sale i Germany

** Values in parenthesis indicates the costs, if the tax on incineration of sewage sludge is removed

Total results of disposition of sewage sludge

Negative values is an avoidable effect

mPE/t sewage sludge	Greenhouse effect	Acidification	Nutrient enrichment	Smog forming
Composting	2,0	0,1	-79	0,6
Drying (Biomass plants)	-24	-6,9	-133	-1,3
Drying (waste incineration)	-8,1	-0,6	0	-0,9
Incineration (flue gas condensation)	-2,6	1,8	-129	0,1
Incineration (no flue gas condensation)	5,2	3,9	-127	0,2

The difference in the emissions of greenhouse gasses between the best and the worst scenario is about 26 mPE/ton sewage sludge or about 5.000 ton CO2-equivalents per year for the whole amount of sewage sludge from Odense City.

This corresponds to that the annual emissions of greenhouse gasses can be reduced equivalent to emissions from up to approximately 600 citizens.

Barriers for the various treatment alternatives

Composting	*Drying*	*Incineration (with and without flue gas condensation)*
• Spreading of heavy metals to agricultural land • No surplus energy	• Difficult source tracking due to mix of sewage sludge • High technology processes • Risk of loose of P • Resistance to combustion of organic material that can be used on agricultural land • Troubles in marketing the fuel pellets • High investment costs	• Difficult source tracking due to mix of sewage sludge • High technology processes • Risk of loose of P • Resistance to combustion of organic material that can be used on agricultural land • High investment costs

What will happen next?

The future depends on newest scientific results concerning the safe application of composted sewage sludge and application of new LCA based evaluation tools as well as new technologies for improved energy recovery from sewage sludge

What may today be the most acceptable solution for treatment of sewage sludge, will not necessarily be tomorrow's best alternative

Thank you for your attention