

Tjekket, d. 2. september 2020

Michael Holm,

Senior Scientist, Environmental Technology

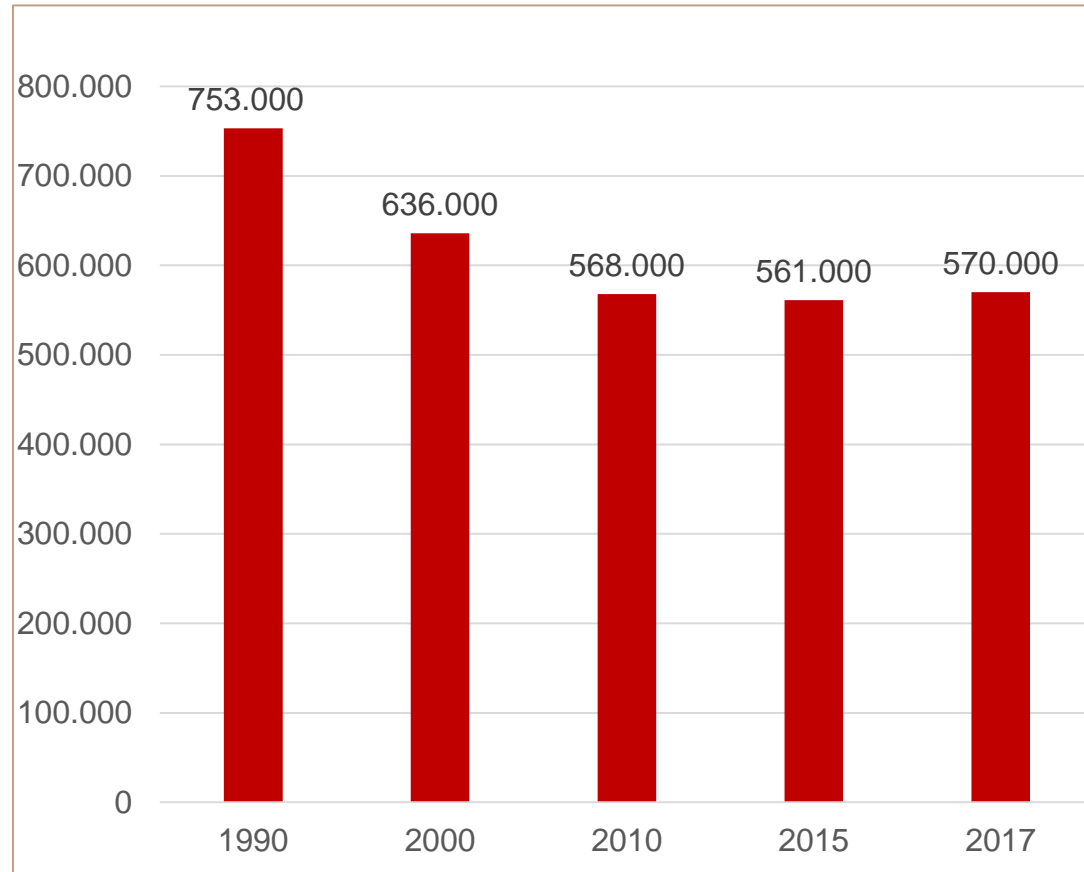
ENVIRONMENTAL LEGISLATION AND TECHNICAL SOLUTION IN THE DANISH LIVESTOCK SECTOR

Agenda

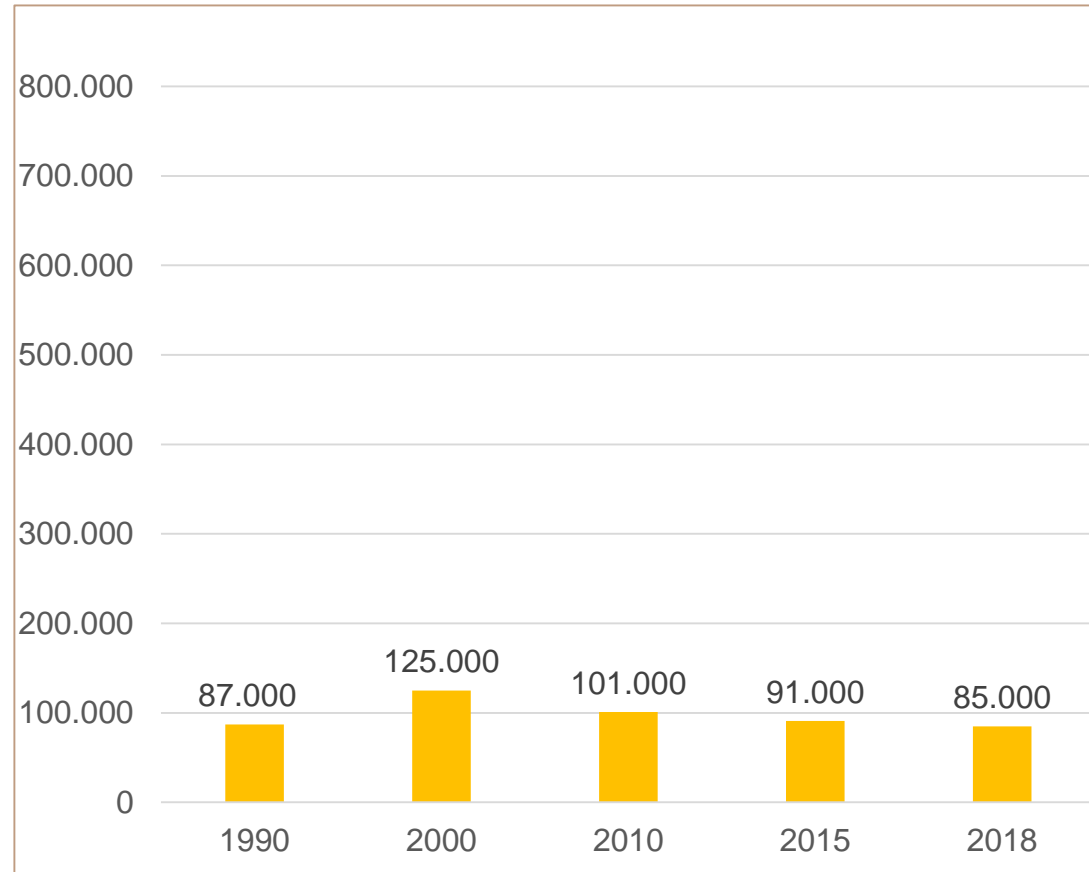
- Danish livestock production
- Environmental legislation in Denmark
 - Ammonia and odour
- The Danish List of Environmental Technologies
 - VERA-test - How to get an approval!
- Technologies for reduction of emissions from pig stables
- Technologies for reduction of emissions from cattle farms
- Storage and handling of slurry
- Conclusion

The danish Cattle production

Number of Dairy Cattle



Number of Suckling Cattle

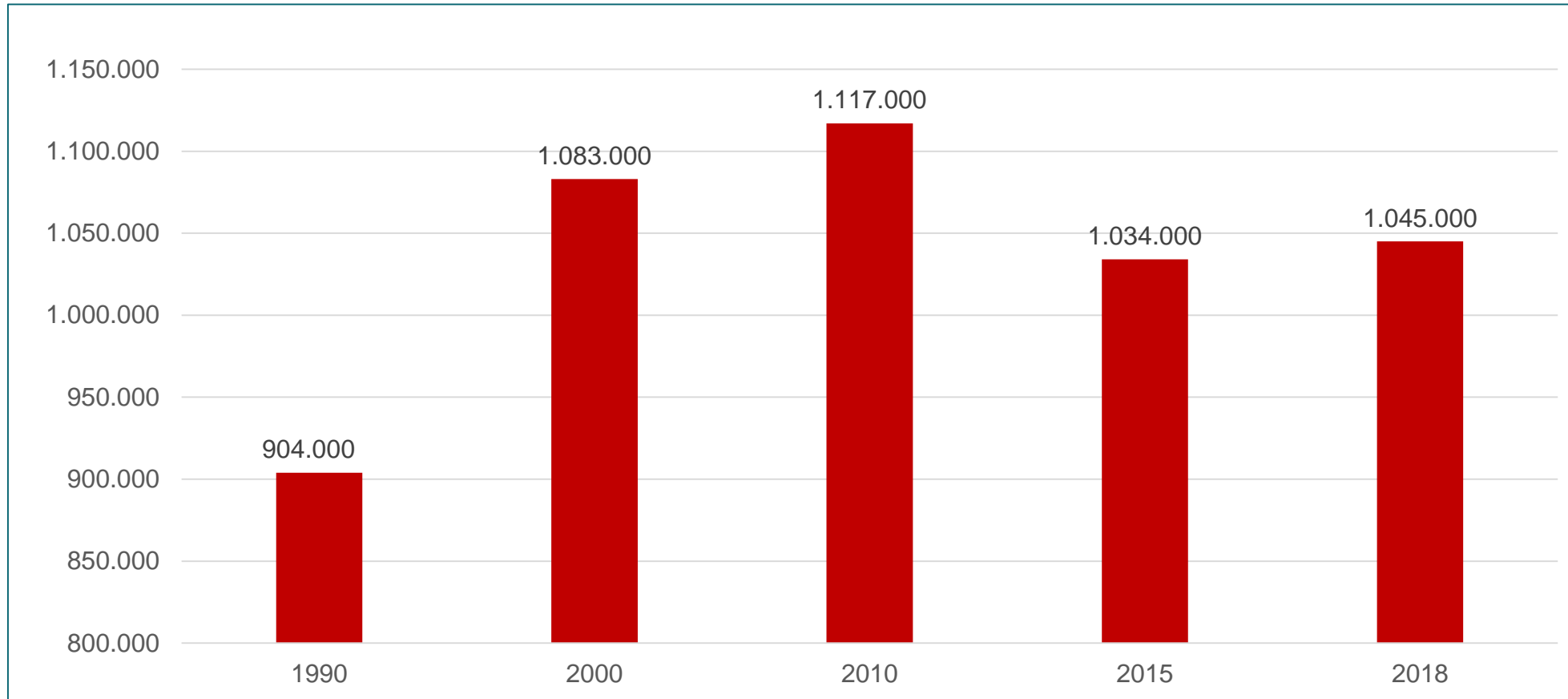


Noget at leve af. Noget at leve for.



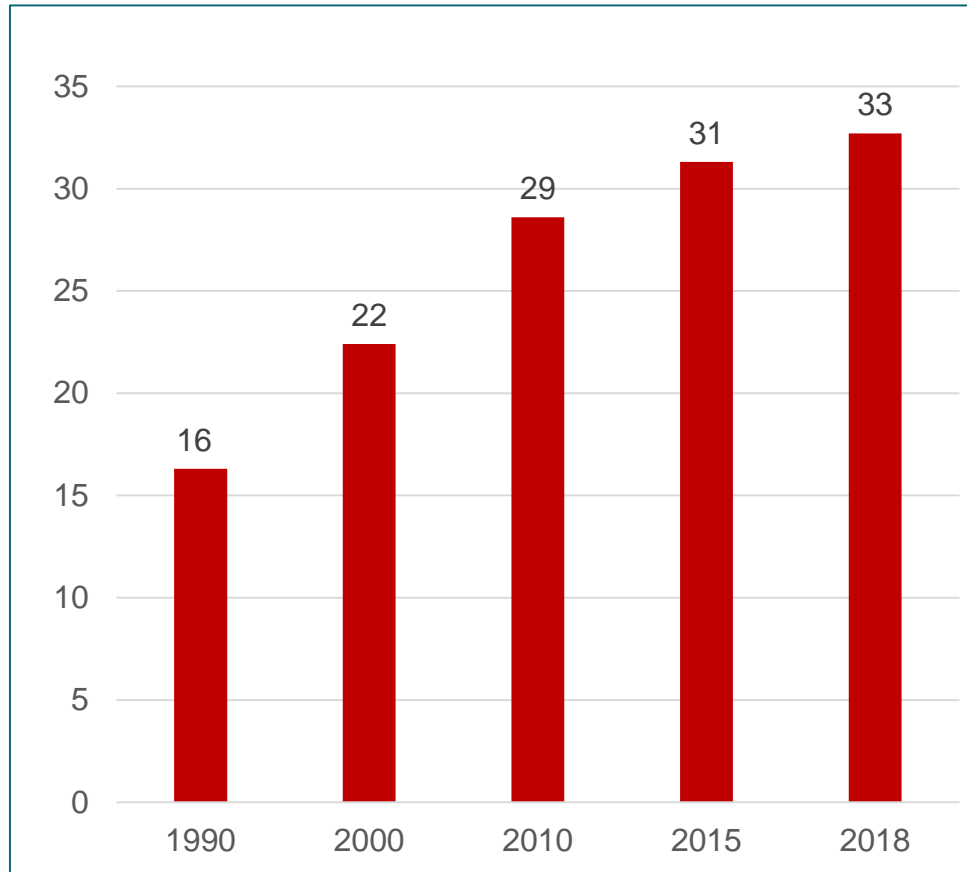
The danish Pig production

Number of sows

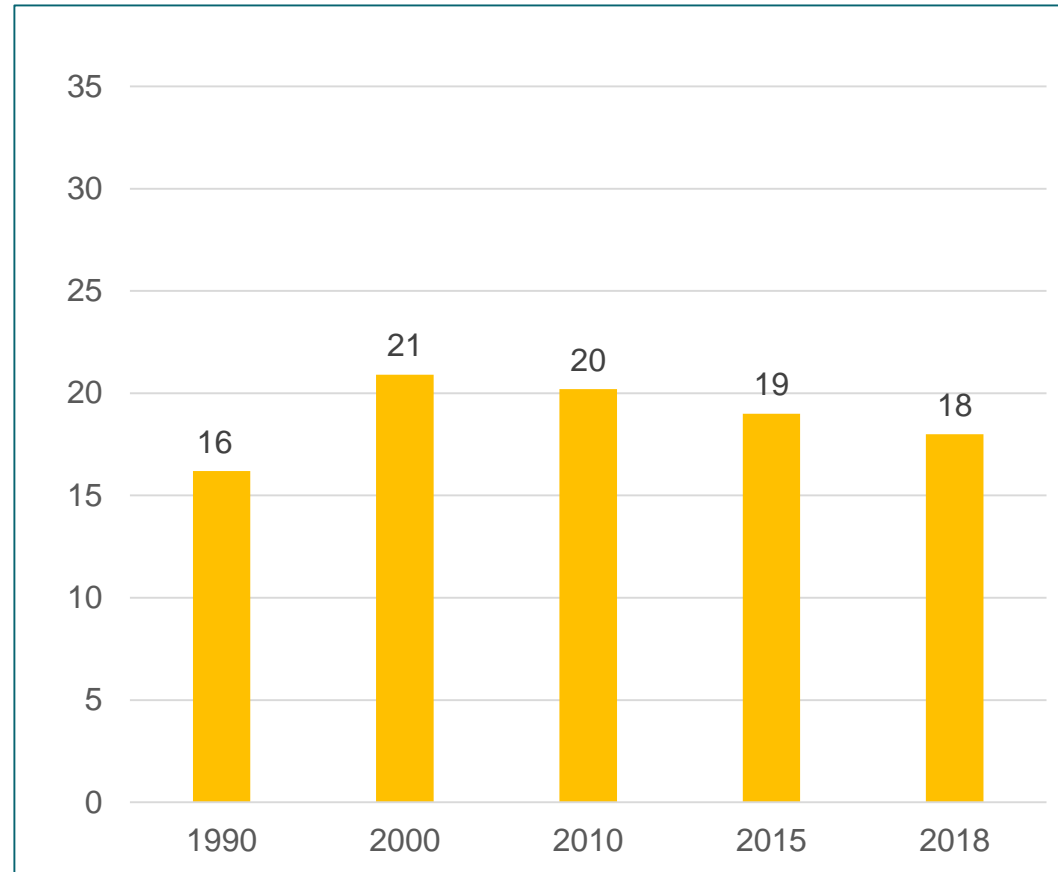


The danish Pig production

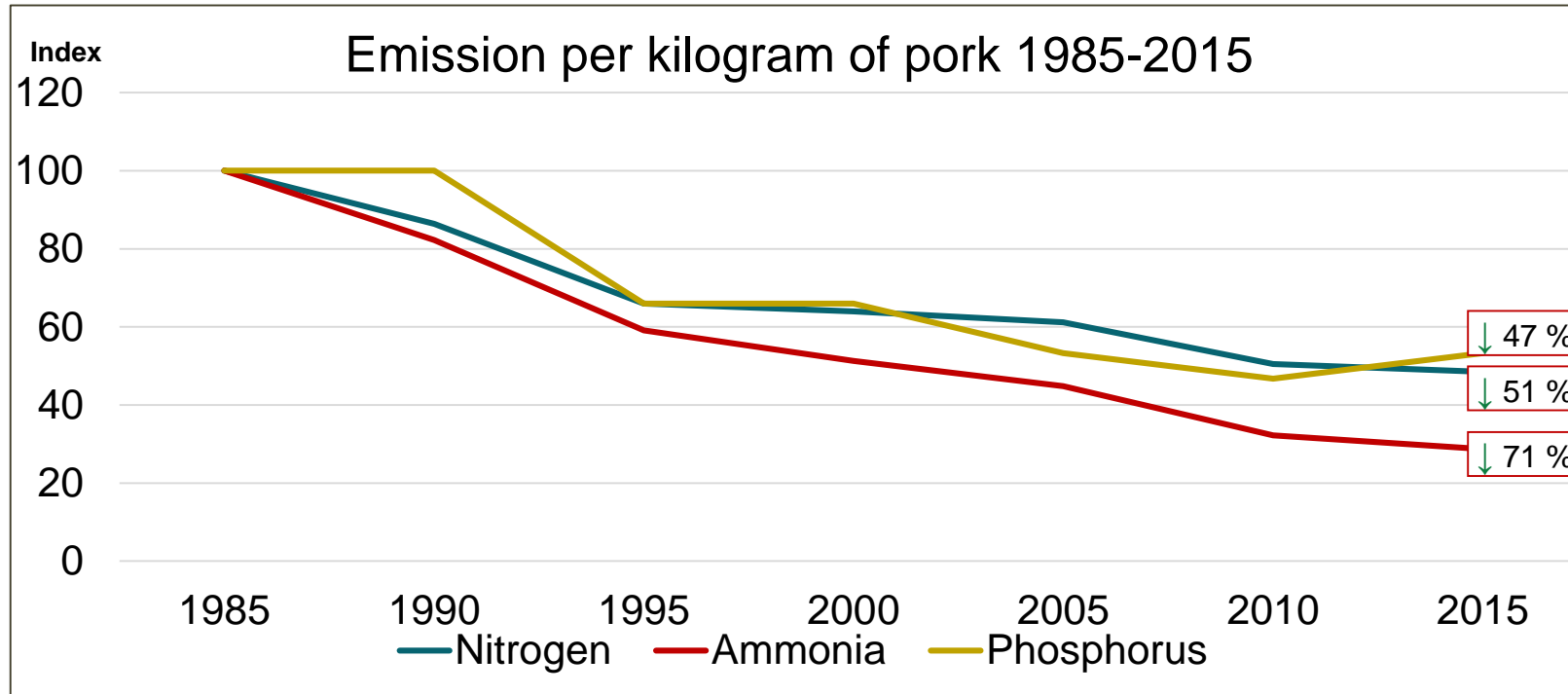
Produced piglets (mio.) per year



Produced finishers (mio.) per year



Pork: Sustainable development – more for less



Kilde: DCE, rapport nr. 250, 2017, Danish emission inventory for agriculture 1985-2015 and pork statistics etc.

Environmental improvement

“Today we can produce two pigs with same environmental impact as we produced a single pig in 1985.”



Environmental requirements



Specific ammonia deposition to sensitive nature areas

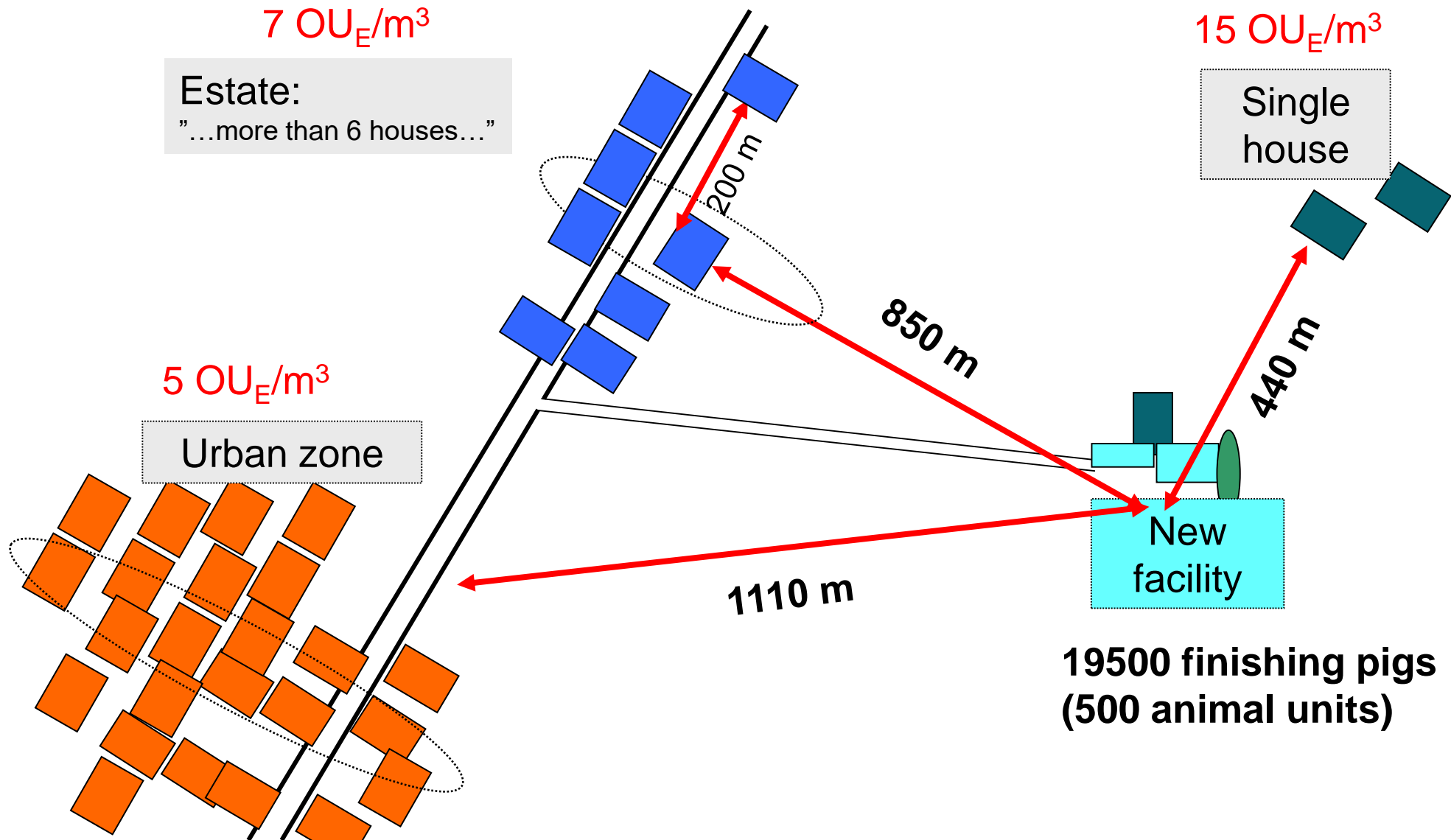
Odour requirements in relation to neighbours



General requirements for ammonia reductions - BAT



Odour regulation



Ammonia and BAT

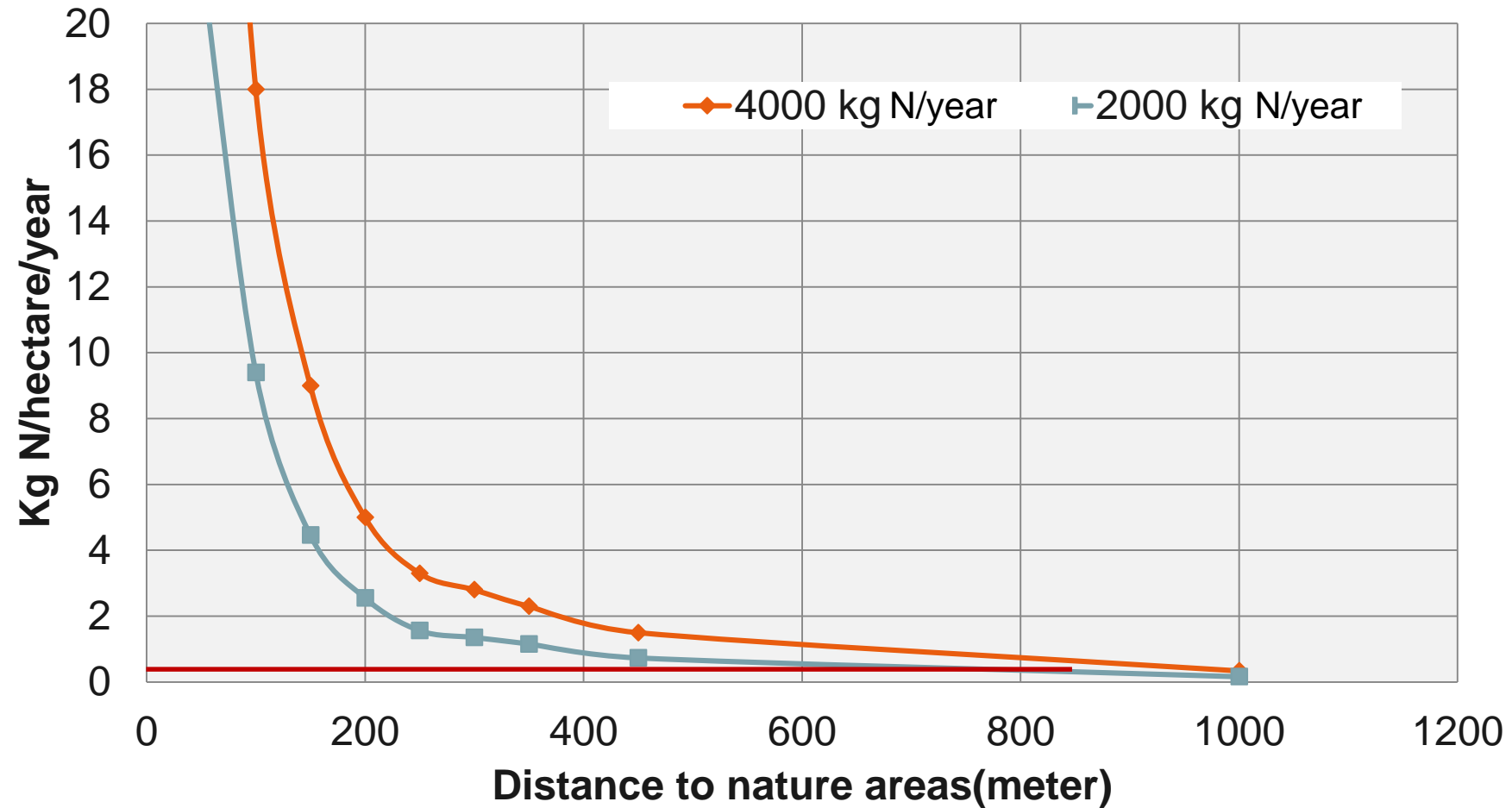
- **Ammonia emission from animal houses**
 - Standard numbers - updated every year
- **BAT – Best Available Techniques**
 - Emission limit values for new facilities

Pig stable	Floor	Standard Kg / m ² / year	BAT 2 Kg / m ² / year
Dairy Cattle	Slatted floor	1,16	0,89
Dairy Cattle	Drained solid floor	0,89	0,89
Pregnant sows	partly drained floor	1,2	0,70
Farrowing sows	partly drained floor	0,66	0,47
Weaners	partly drained floor	0,56	0,50
Finishers	full drained floor	2,3	1,06

Ammonia regulation for sensitive nature areas

- Maximum feasible emission depends on distance to sensitive nature areas
 - Category 1 (max. 0.2; 0.4 and 0.7 kg N/hectare in **total deposition**)
 - Natura 2000
 - Category 2 (max. 1 kg N/hectare in **total deposition**)
 - High moor, heath > 10 hectare, open grazing land > 2.5 hectare
 - Category 3 (max. 1 kg N/hectare from the **new facility**)
 - Additional ammonia sensitive areas

Ammonia deposition in distance from farm facilities



CO₂

- Denmark has decided to reduce CO₂ outlet by 70 % before 2030
- The agriculture in Denmark contribute to the Danish CO₂ outlet by 22 %
 - About 50 % of the agricultural CO₂ outlet comes directly from livestock production (methan from animals and manure)
- Yet no regulation

Approved technologies in Denmark

The Danish Environmental Protection Agency administrate the Danish **List of Environmental Technologies**

<https://eng.mst.dk/trade/agriculture/environmental-technologies-for-livestock-holdings/list-of-environmental-technologies/>

- [Manure Storage](#)
- [Land Applied Manure](#)
- [Air Cleaning](#)
- [Livestock Housing System](#)

VERA test

- The Netherlands, Germany and Denmark uses these test protocols to verify the effect of technologies
- The princip is, if the technology has been tested according to these protocols, it should be approved by the authorities

https://www.vera-verification.eu/app/uploads/sites/9/2019/05/VERA_Testprotocol_AirCleaner_V2_2018.pdf

https://www.vera-verification.eu/app/uploads/sites/9/2019/05/VERA_Testprotocol_Housing_v3_2018.pdf

VERA test

Air Cleaners

- Two air cleaners and two locations (A test and B test)
- Eight weeks summer and eight weeks winter
- Measuring consumption of electricity, chemicals/additives and water and operational function and stability over a year

Housing systems

- Trial/control test
 - Test at two different farm locations
 - Test period of one year per location
- Multi-farm test
 - Four different farm locations
 - Test period of one year per location

VERA test

Housing systems

- Primary measurement parameters
 - Ammonia
 - Odour
 - Particulate matter (PM2.5)
- Secondary measurement parameters
 - Ventilation rate
 - CO₂, CH₄, N₂O
 - Temperature
 - Humidity
 - Wind (only naturally ventilated buildings)
 - Data from production, i.e. number of animals, floor space, manure samples, feed composition, animal production parameters, date of emptying the pits, fouling of surfaces
 - Data from the technology, i.e. consumption of electricity, water and chemicals/additives, operational function and stability

Partly solid floor (FINISHERs)

Reduction	NH ₃	Odour
Finishers	17-34 %	33 %



- Can cause trouble with fouling in the laying area
- Need extra management and focus on climate control

Weekly manure removal (FinisherS)

Housing system for fattening pigs with drained floor in resting area



- Emptying of manure channels each week
- 20 % odour reduction
- No effect on ammonia

Cooling of slurry (PIGS)

- Up to 30 % reduction of NH_3
- Up to 20 % reduction of odour
- Reuse of heat



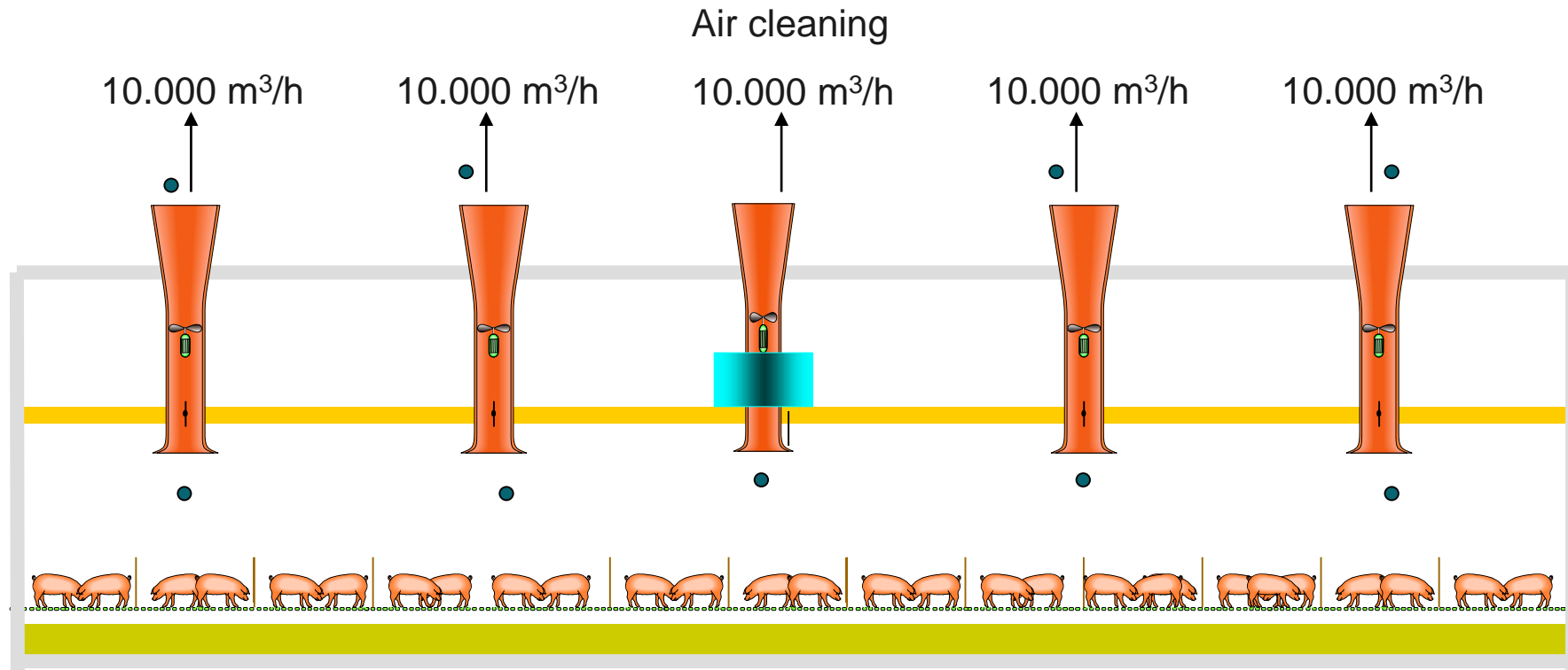
Air Cleaning (PIGS)

- Full air cleaning
- Partial air cleaning
- Point extraction



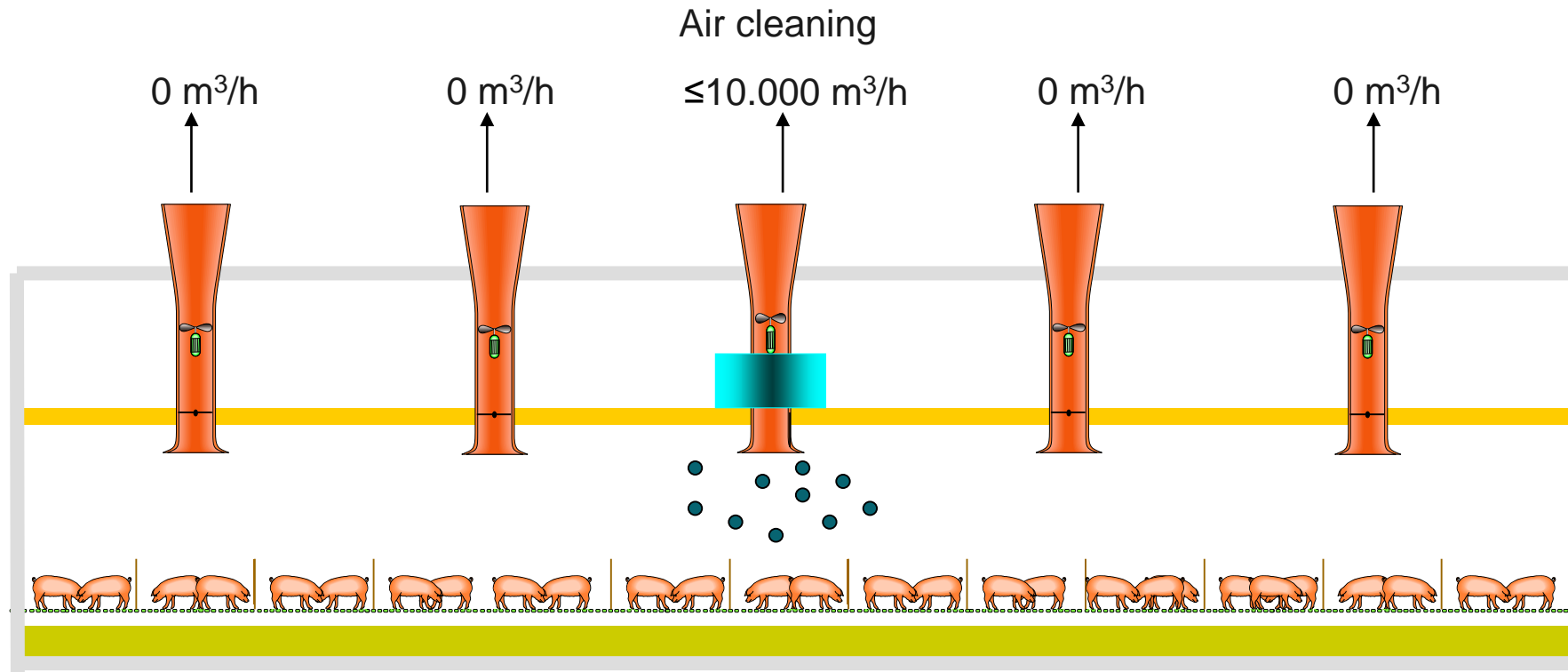
20 % partial air cleaning

- Summer air flow example: 100% of max. ventilation



20 % partial air cleaning

- **Winter air flow example: 20% of max. ventilation**
- **Total of the year: 65% of the ammonia emission through the air cleaner**

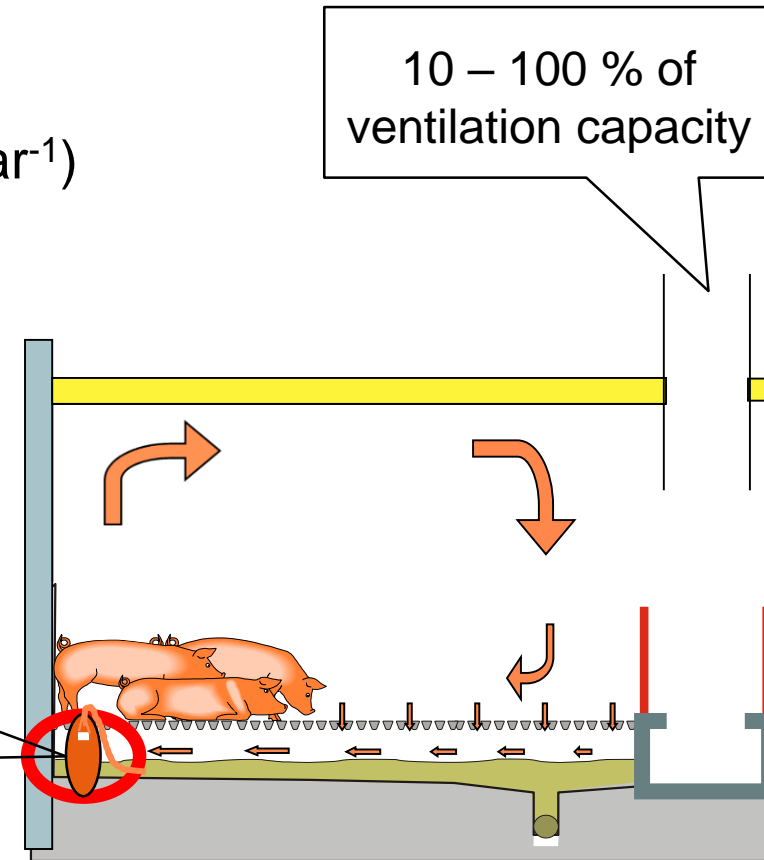


10% Point extraction

Finishing pigs

- Optimized partial air cleaning
- Cleaning the “dirtiest” part of the ventilated air volume
- Air from point extraction contains
 - 25% of total ventilated air volume ($\text{m}^3 \text{ year}^{-1}$)
 - 65% of NH_3 emission (kg year^{-1})
 - 50% of odour emission ($\text{OU}_E \text{ year}^{-1}$)
- Increased ventilation efficiency
- Improved working environment

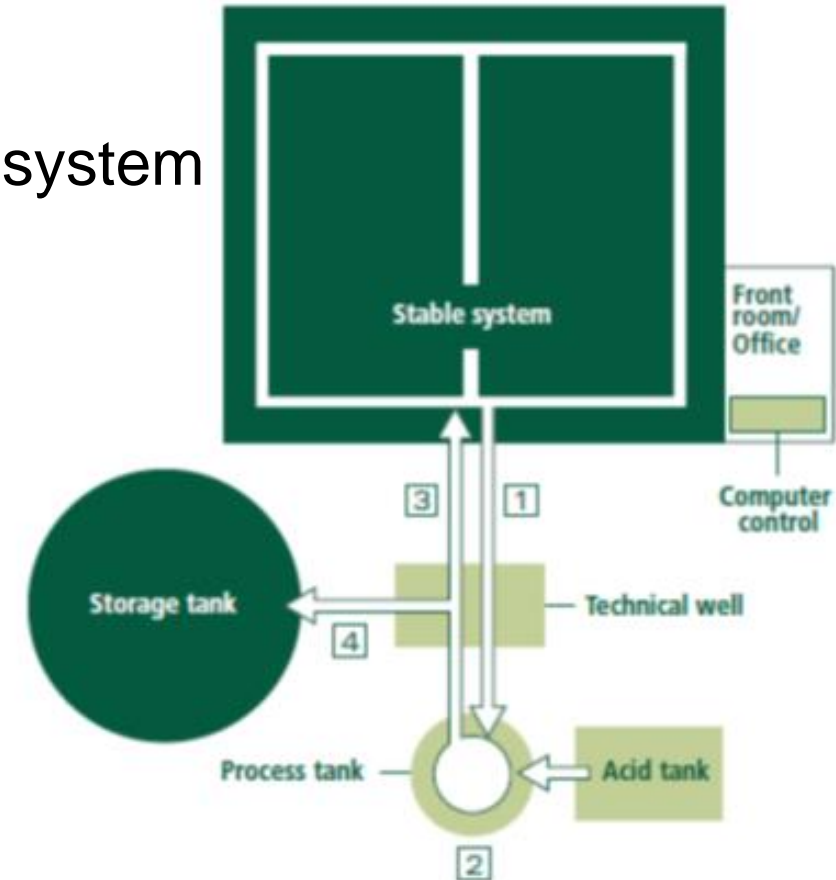
10 % of ventilation of capacity
– connected to an air cleaner



Acidification of slurry (pigs)

JH Agro A/S

- Acidification with H_2SO_4 , pH 5.5
- 64 % reduction of NH_3 from the housing system
- 50 % reduction from storage
- 60 % reduction from land spreading



JH Agro A/S – acidification of slurry

Trial (report)	NH ₃	Odour
683	70 %	0
932	71 %	32 %
1077	56 %	Not measured
1078 (VERA-test)	63 %	29 %
	66 %	0 %
Approval	64 %	0 %

JH Agro A/S – acidification of slurry plus SmellFighter



JH Agro A/S – JH Smellfighter in combination with JH acidification NH₄⁺

Trial (report)	NH ₃	Odour
1132 (VERA-test)*	60 % 52 %	53 % 49 %
Approval	64 %	51 %

*) not an official VERA report

Acidification of slurry (Cattle)

JH Agro A/S

- Acidification with H_2SO_4 , pH 5.5
- 50 % reduction of NH_3 from the stable
 - Not tested according to VERA test protocol and therefore a new test is now performed
- 50 % reduction from storage
- 60 % reduction from land spreading

Solid drained floor with scraping (Cattle)

- 23 % reduction of NH_3



Storage of slurry

- Requirement for 9 months storage capacity since 1986
- Covered slurry tanks to reduce ammonia emission compared to natural surface crust
- Covered slurry tanks can reduce ammonia emission by 50 %
(from 0.4 to 0.2 kg NH₃-N per m² of surface area)



Handling of slurry

- Compulsory yearly manure accounts
- Spreading of slurry only allowed from February to October (but not on frozen land)
- Maximum application of 170 kg nitrogen per hectare from pig slurry
- Utilization of nitrogen in slurry as fertilizer has increased five-fold from 1985 to 2012 from 15 % to 75 %
- No broad spreading of slurry allowed
- Stricter regulation for sensitive areas



Handling of slurry

33



Forbidden in Denmark



Trailing hose of slurry at acreage with plant growth



Injection of slurry at black soil

Conclusion

- Denmark has a strong and thorough environmental regulation
- New facilities needs reduction of ammonia and possible odour reduction
- Choice of technology depends on required reduction, location and type of facility, but have to be from:

The Danish EPA - List of Environmental Technologies

[\(http://eng.mst.dk/topics/agriculture/environmental-technologies-for-livestock-holdings/\)](http://eng.mst.dk/topics/agriculture/environmental-technologies-for-livestock-holdings/)

- Only a few technologies available to dairy farms
 - Drained solid floor with scraping
 - Acidification of the manure

Conclusion

- Many technologies available to pig farms
 - Housing systems
 - Floor design
 - Cooling of the manure
 - Weekly removal of slurry
 - Acidification of the manure
 - Several Air cleaning systems
- Manure storages
 - Solid Cover of the manure storages
- Field application
 - Injection of manure
 - Acidification of manure