CO_2 BUFFERING IN GEOLOGICAL FORMATIONS FOR RE-USE PURPOSES

BASRECCS-ENOS WORKSHOP, TALLINN, ESTONIA

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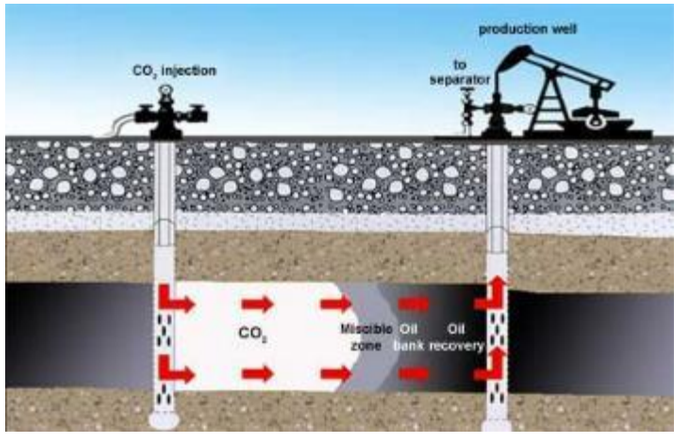
Contents of my presentation

- Rationale
- ENOS: Buffer design for Dutch case: Q16-Maas
- Key messages for geological buffering
- When, where and how is buffering of interest?



Rationale: why do we look at geological buffering?

The Dutch case:

- Use of waste CO_2 to enhance crop growth
- Increased use of geothermal energy in greenhouses
- Additional heat and CO_2 from CHP installations

Business case for buffering:

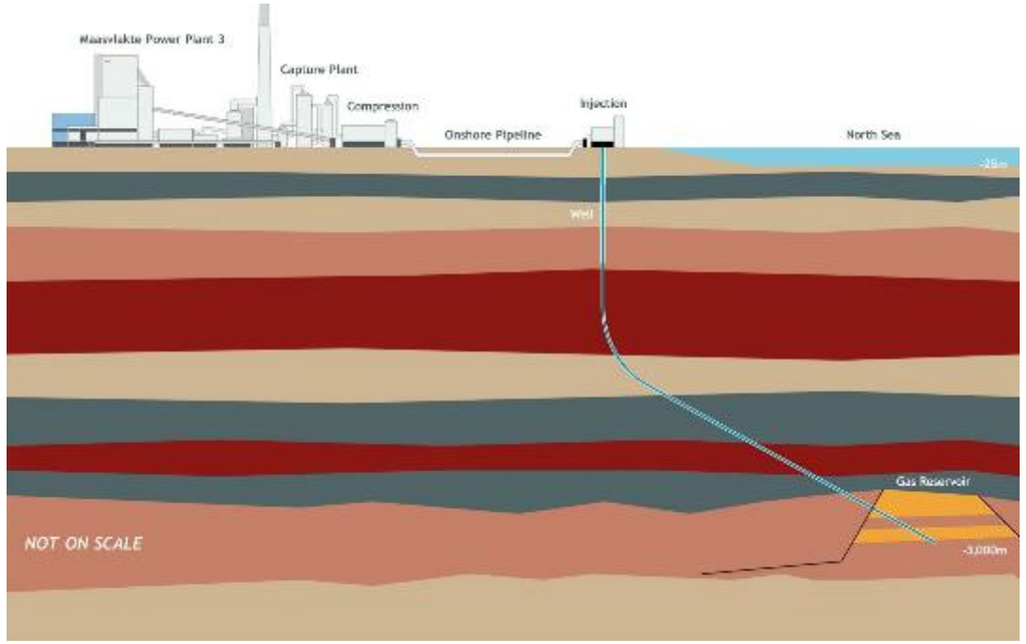
- Solve seasonal mismatch supply and demand
- Improve security of supply
- Serve more and more greenhouses

Additional benefits:

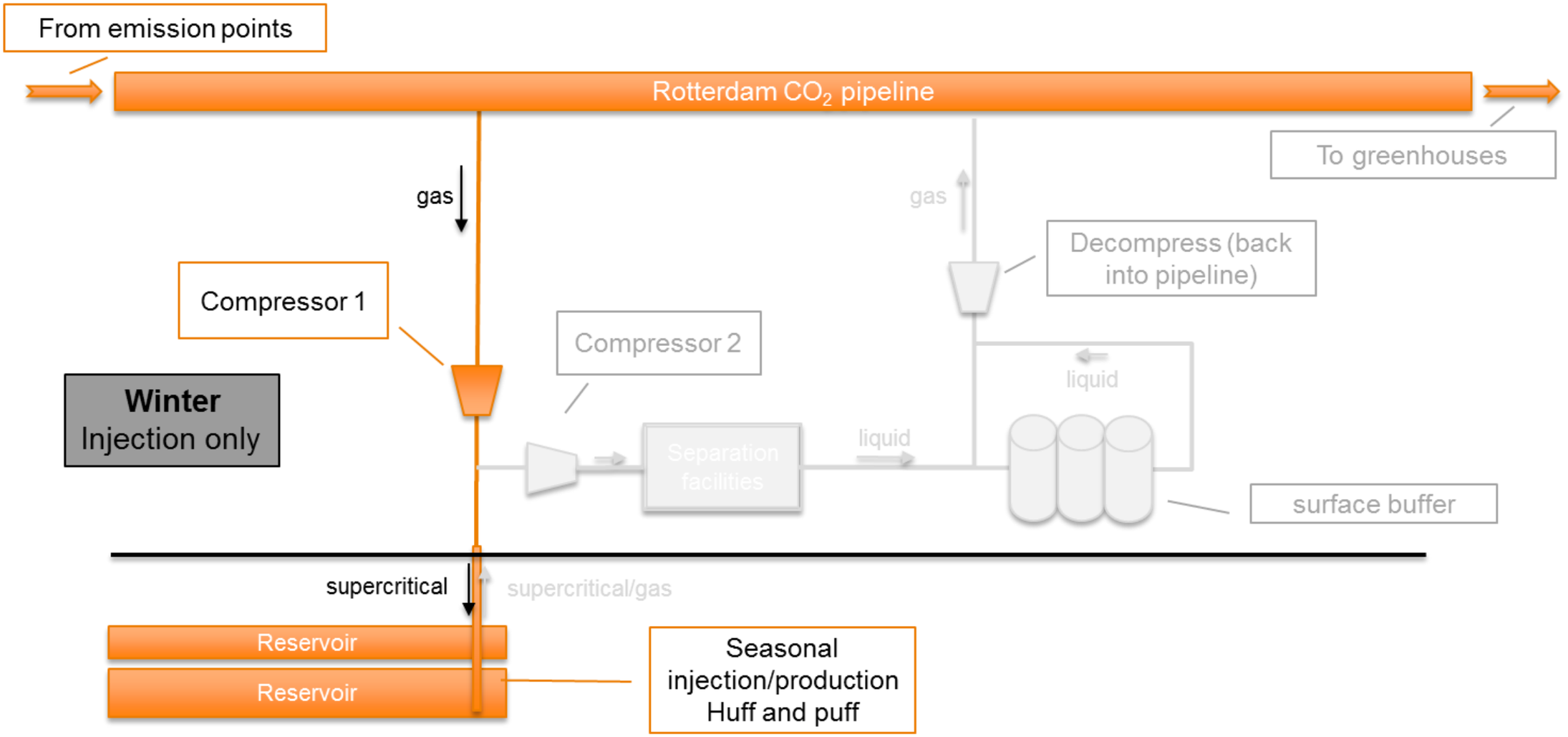
- Decrease dependence on natural gas
- Decrease CO_2 emissions
- Support development of geothermal energy in horticulture

Q16-Maas reservoir

- Technical and economic feasibility of seasonal buffering in Q16-Maas reservoir
- Triassic sandstone reservoir at 3 km depth, just offshore Rotterdam
- Currently producing gas and condensates
- Bounded by normal faults, large aquifer support



Schematic layout of buffer design



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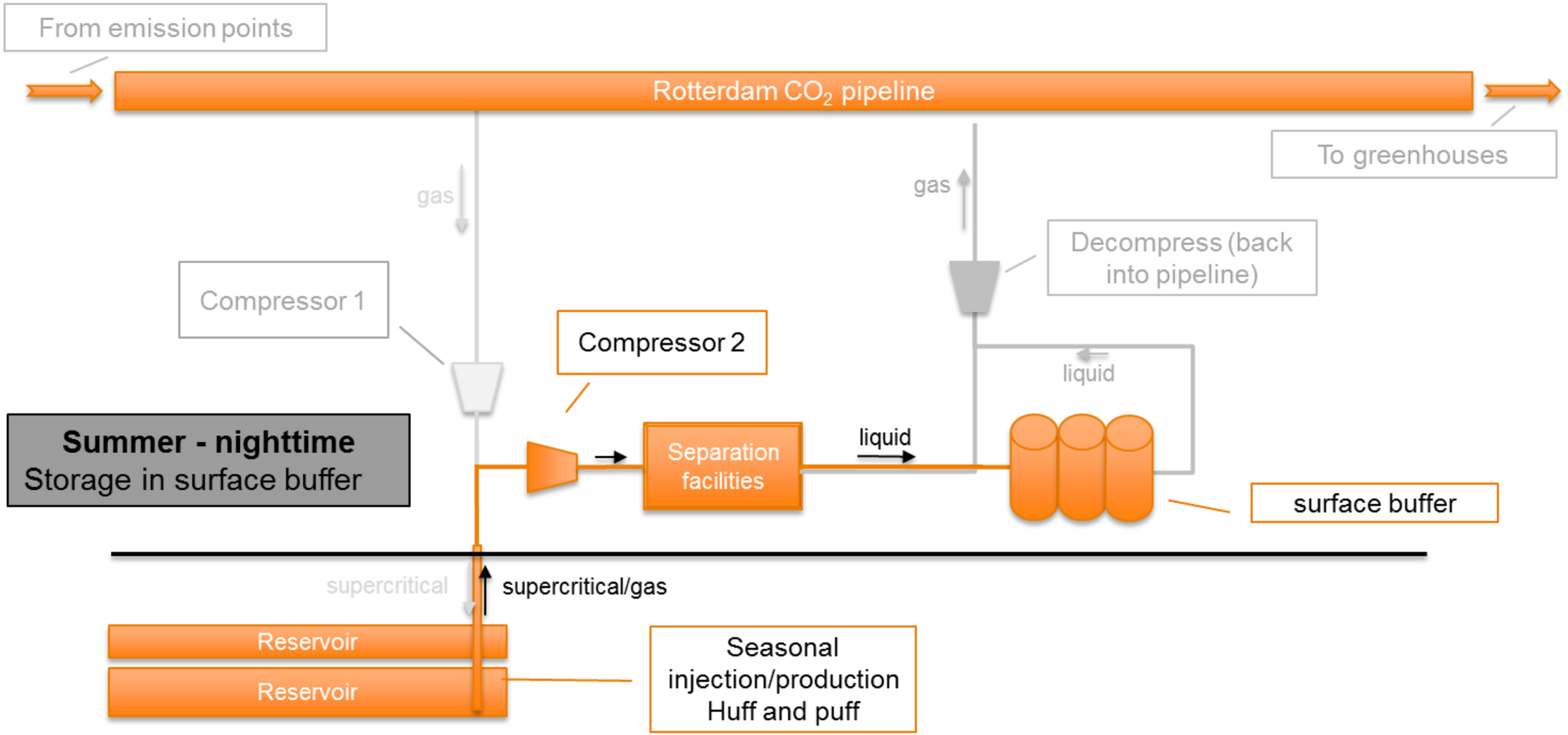

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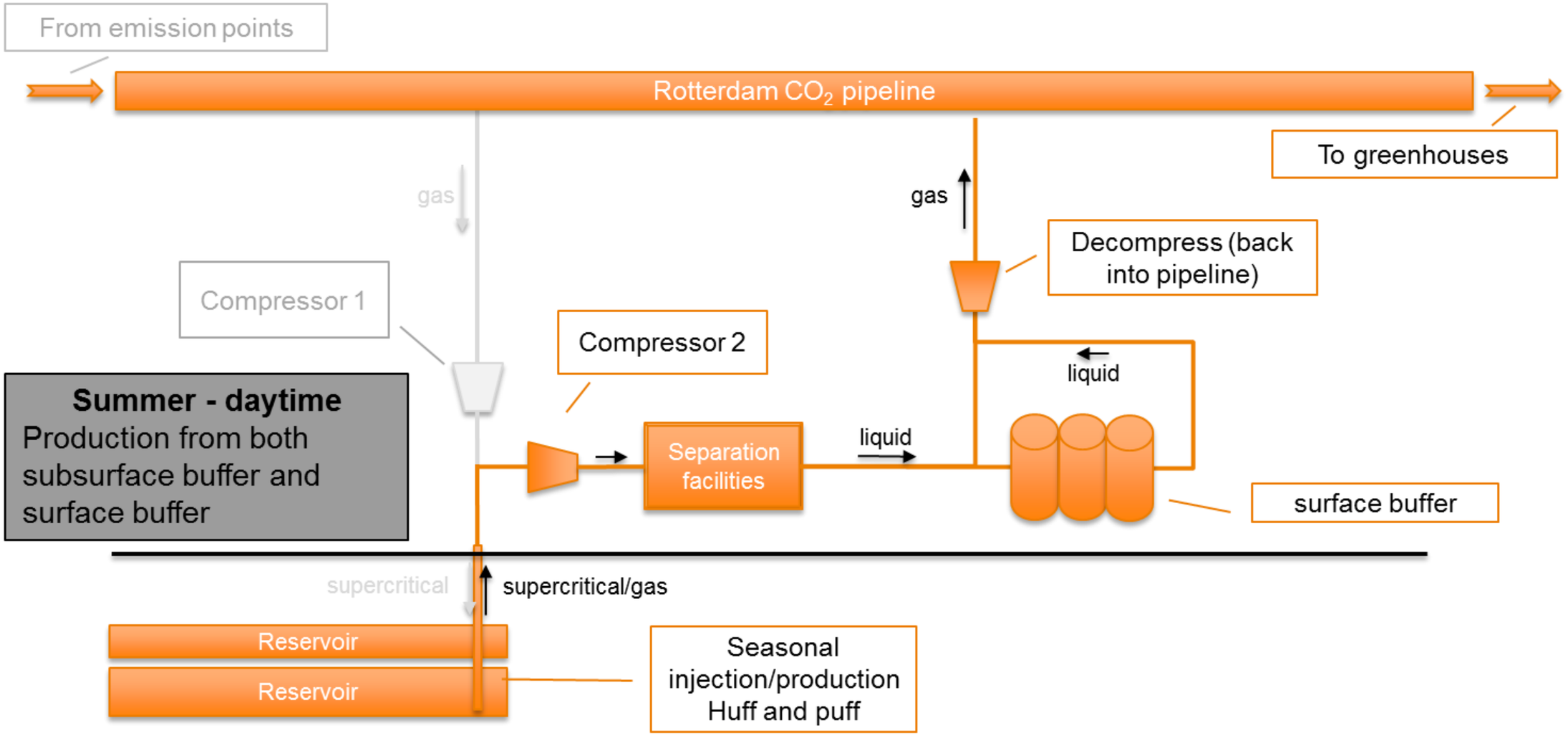
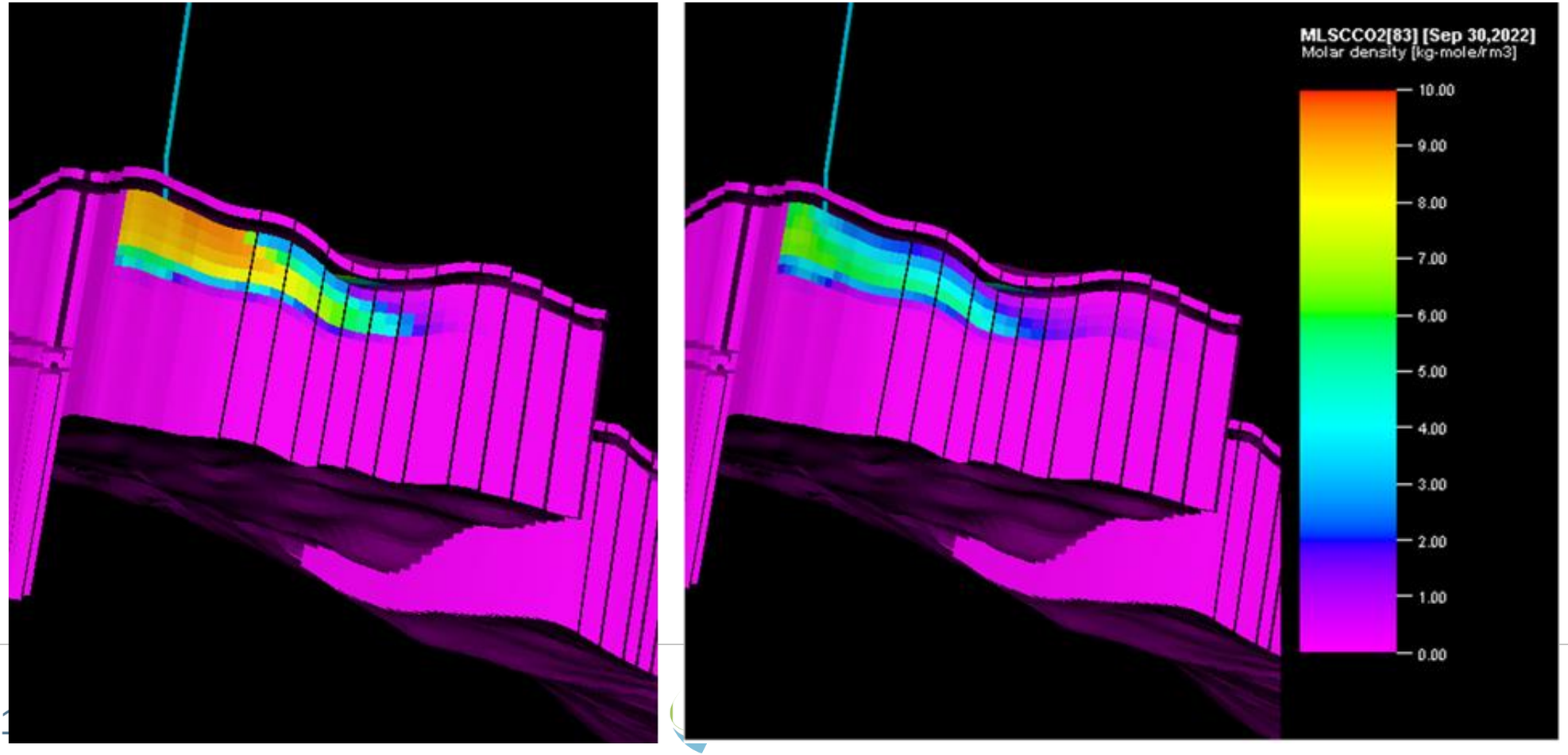


Reservoir simulations

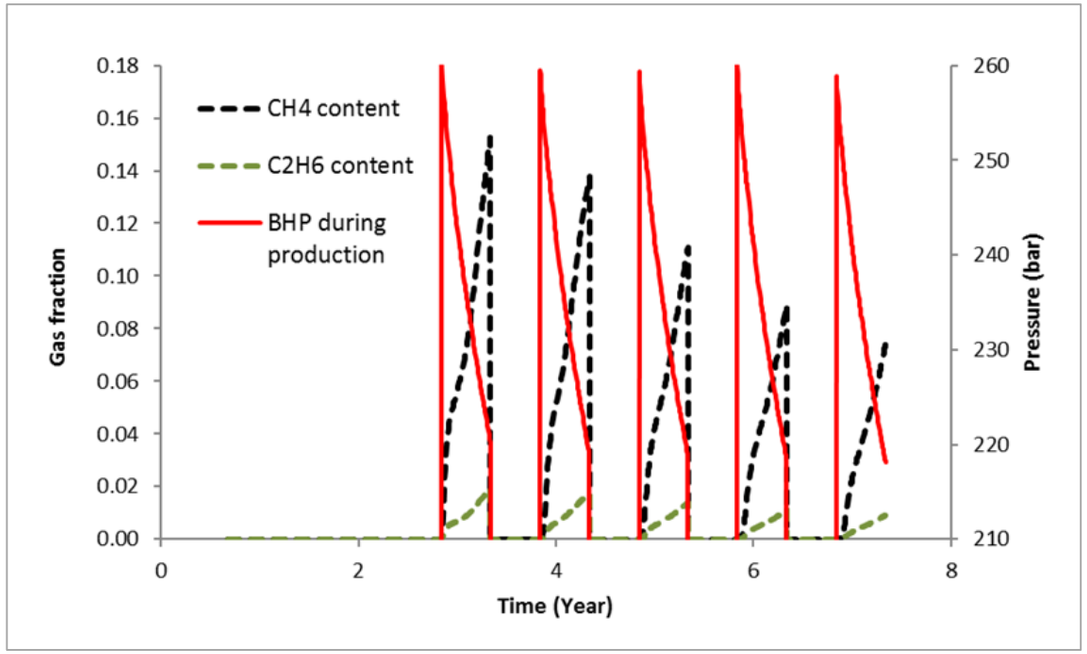
Injection and back-production cycles: continuous for six months

Huff and puff: injection and production using the same well



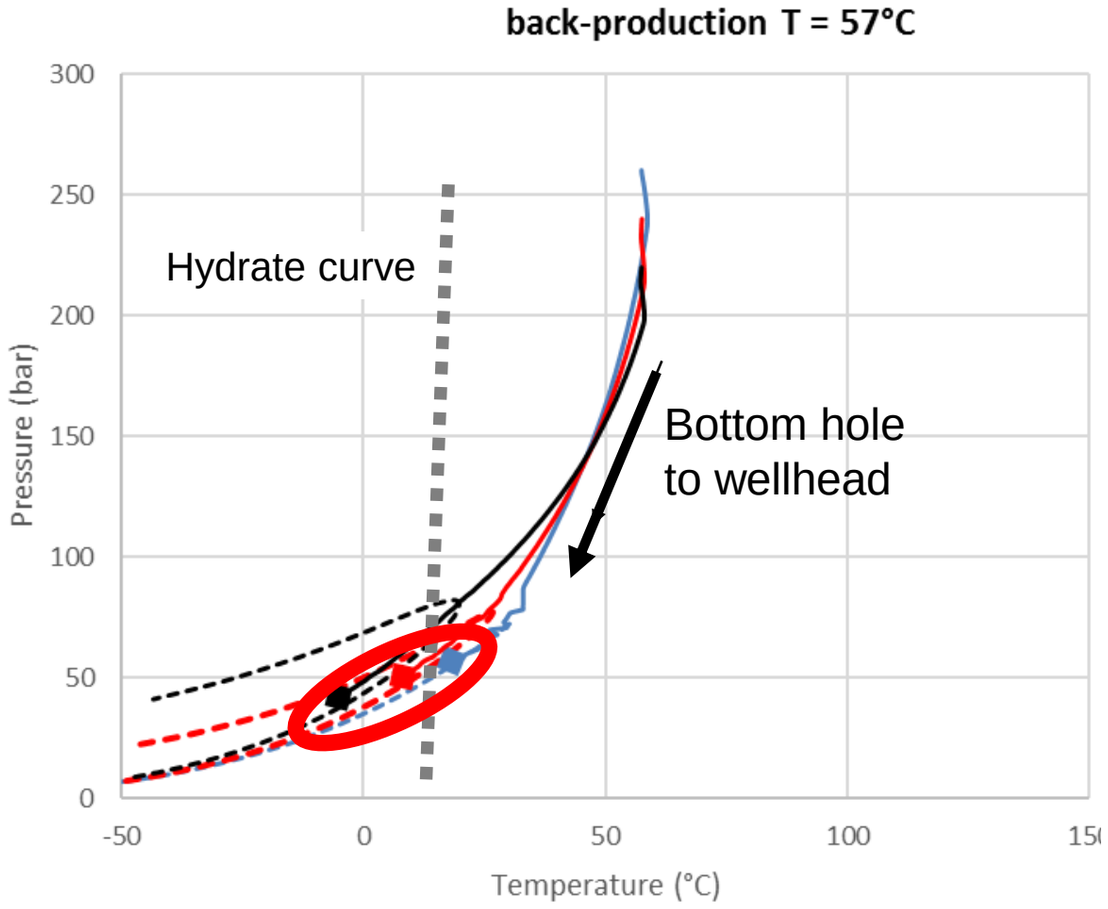
Reservoir behavior and back-production

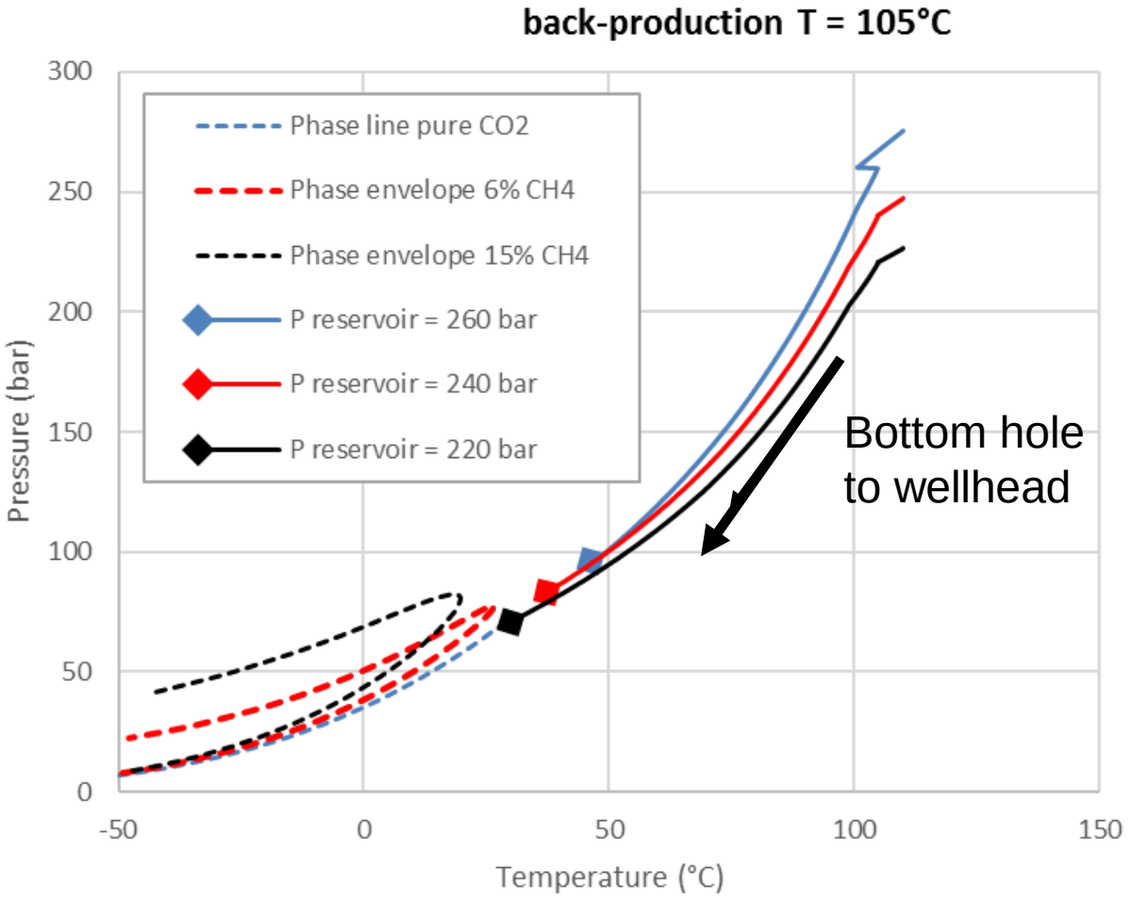
- Injection of cushion gas to reduce hydrocarbon impurities in the back-produced gas
- Back-production conditions change within each cycle and with each consecutive cycle
- Gas stream will be water-saturated
- Co-production of liquid water due to the aquifer support



Back-production conditions – in the well

- Assumption: back-production T of impure gas stream is equal to bottom hole injection T
- Higher gas temperature lowers risk of two-phase flow and hydrate formation at wellhead





Cost-benefit analysis – 20 kg/s of CO_2 back-production

CO_2 supply to greenhouses can be increased from 500 to 816 ktonne per year with the geological buffer

Rough cost estimates based on 10 cycles of back-production:

- Injection facilities: ~7 €/tonne
- Clean-up facilities and surface buffer: ~3 €/tonne

Total costs: 10 €/tonne of CO_2

Current OCAP CO_2 price ~50 €/tonne

Adding buffer costs >> ~60 €/tonne

Current commercial foodgrade CO_2 price 100 €/tonne

Key messages

- Seasonal injection and back-production is possible in Q16-Maas
  - Both from technical and economic point of view
- Maximum buffer potential is constrained by back-production well dynamics
- Temperature of CO_2 is key parameter
- Geological buffer design and optimization for re-use is highly case specific
- Presence and mobility of formation water and salinity play crucial role
- Both well dynamics simulations and *non-isothermal* reservoir simulations are needed to optimize buffer function

Geological buffering for re-use purposes

When, where and how is geological buffering of interest?

- Evaluation of re-use purposes: is there a need for CO_2?
  - >> Zero-emission horticulture: Greenhouse of the future??
  - >> Re-use in cement or chemical industry
- Evaluation of CO_2 sources

- Match temporal supply and demand: mismatch?
  - Short-term and small scale regulation of supply and demand: surface tanks
  - Long-term and high scale more expensive geological buffering becomes interesting
- Evaluate potential buffer reservoirs and perform feasibility study

Questions? Ask me now or email me later: marielle.koenen@tno.nl

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Enabling Onshore CO_2 Storage

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