The Sleipner CCS experience

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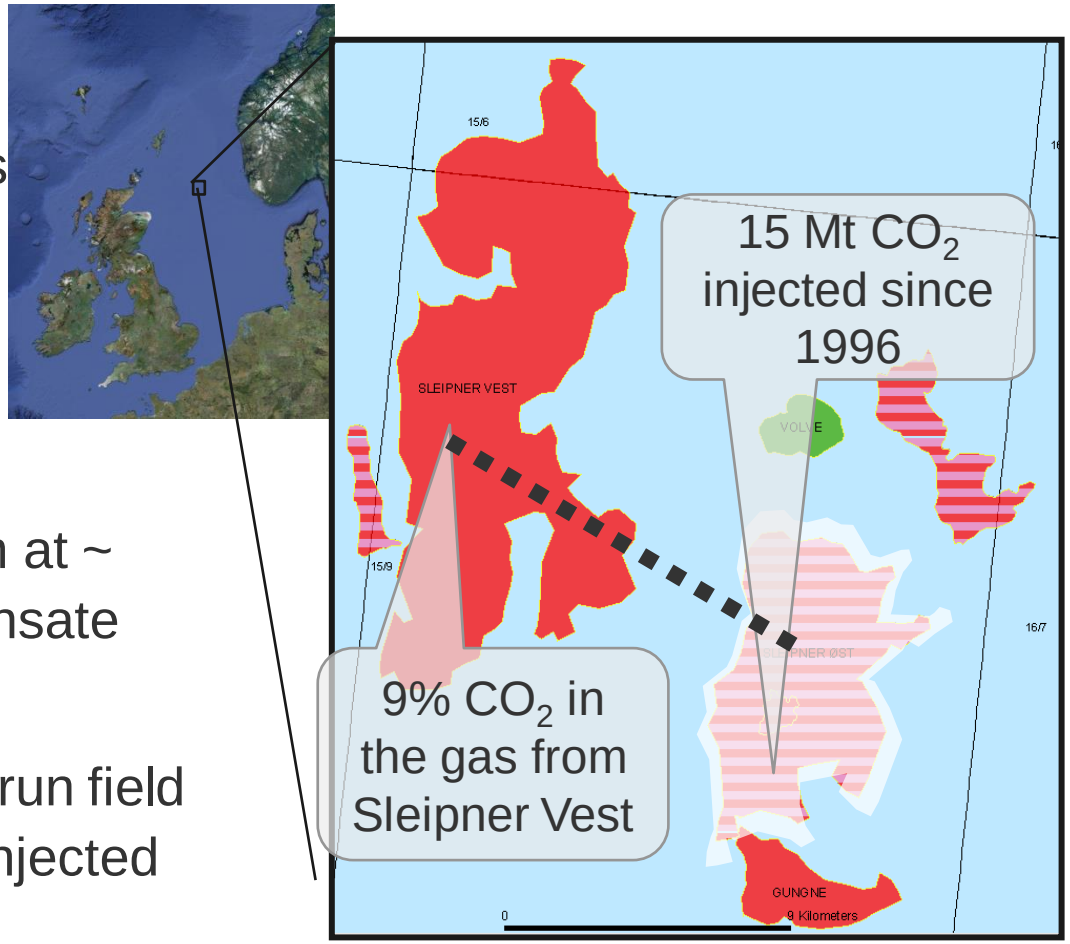
18 years of successful CCS operations at Sleipner

- CO_2 storage is feasible and safe

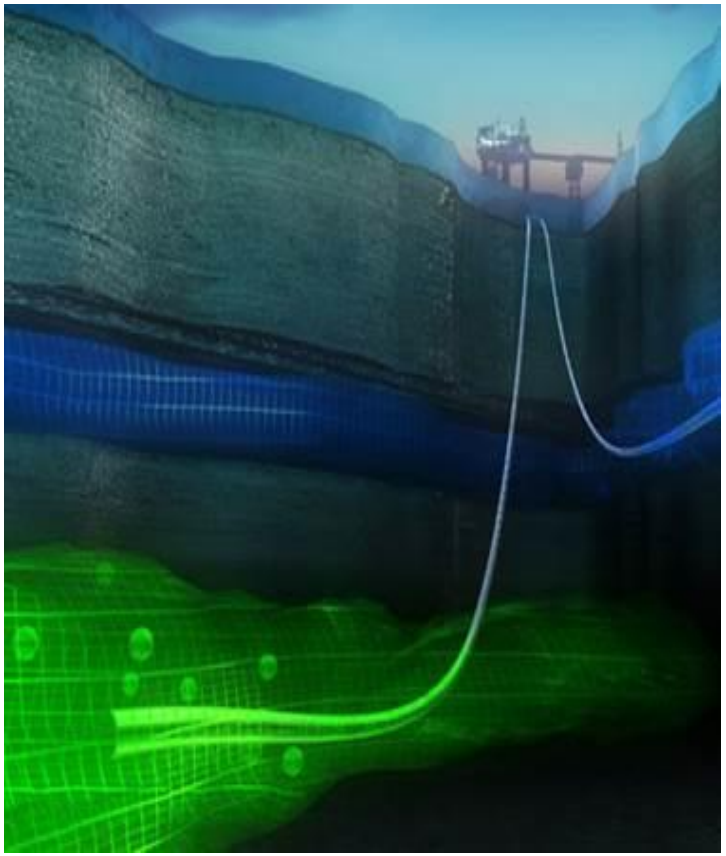
Sleipner CCS project overview

- Sleipner gas/condensate field
- Amine capture from natural gas
- 0.9 Mtpa CO_2 stored
- 15Mt stored by end 2014
- Injection started in Sept. 1996
- CO_2 is injected in the Utsira Fm at ~ 900 m depth (above the condensate reservoir)
- From April 2014 CO_2 from Gudrun field gas (north of Sleipner) is also injected

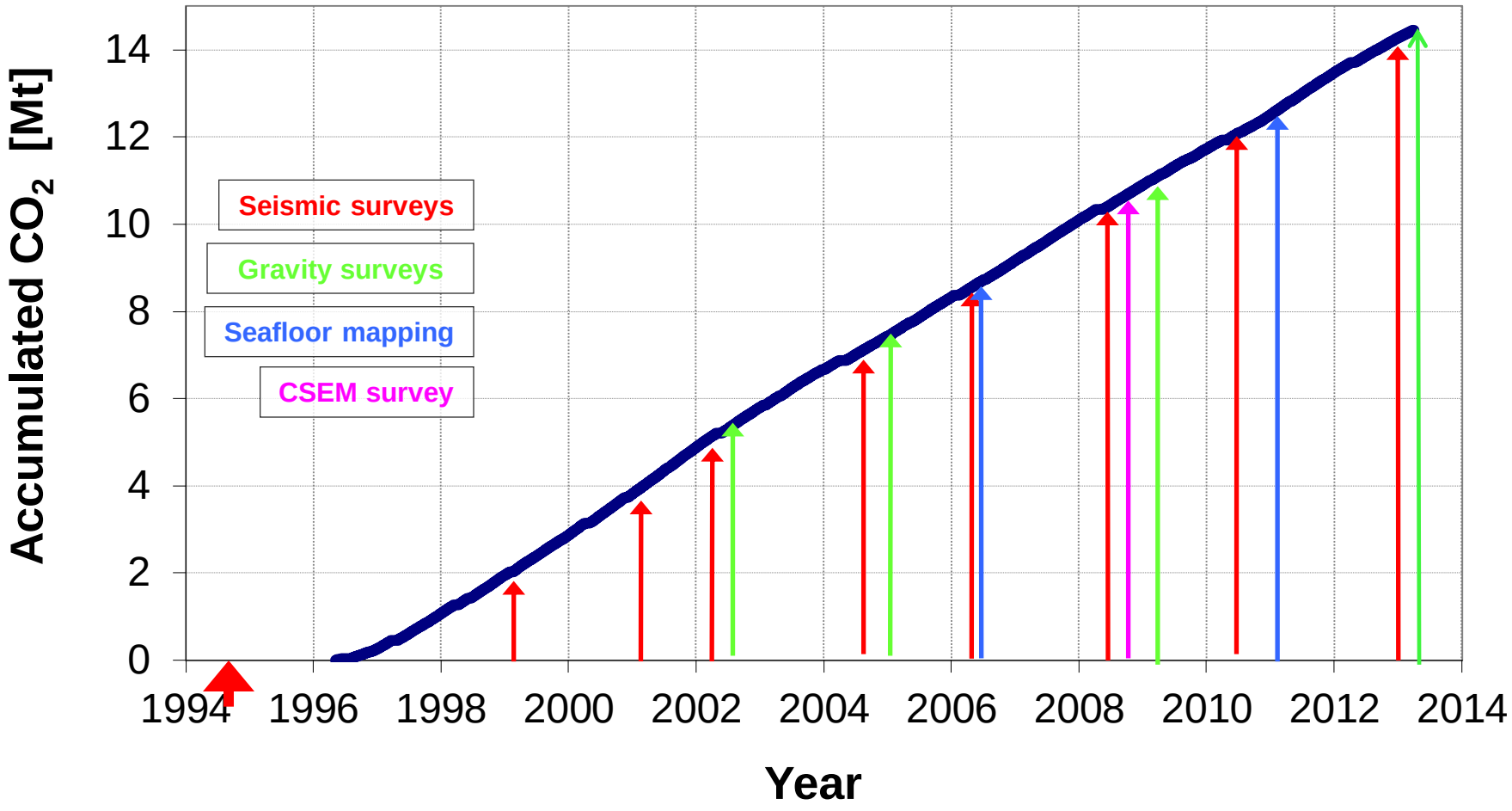


Main achievements

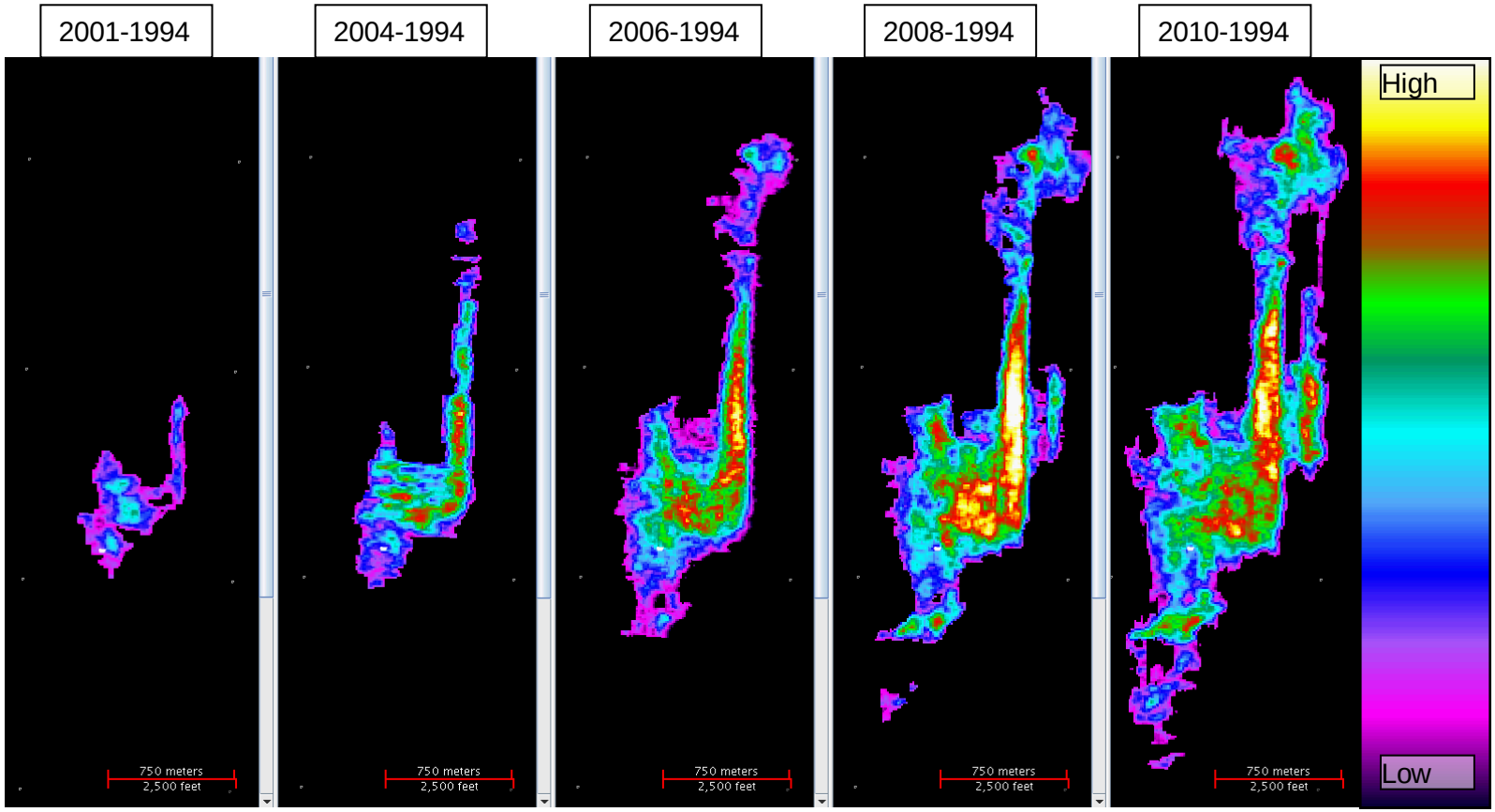
- Significant contribution to Norway's emissions reductions
- Important learnings for science and technology of CO_2 capture, transport and storage
- Used to pioneer and demonstrate a range of monitoring technologies:
  - Time-lapse seismic
  - Gravity monitoring
  - Seabed mapping



Injection and monitoring history



CO_2 plume - 4D seismic



Seismic time-lapse monitoring shows that CO_2 stays in place in the Utsira Fm at Sleipner and gives a detailed description of where the CO_2 is

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Regulatory framework and knowledge building

- Project permitted under Norwegian Petroleum law
- Other relevant conventions
  - OSPAR
  - EU CCS Directive
- External interest – data sharing and technical clarifications
- Geophysical monitoring – improved understanding of CO_2 flow behaviour and storage capacity
- Experience on how much and what monitoring data is needed for CO_2 storage sites in general

EU CCS Directive

- Implementation may impose some additional requirements
  - Increased requirements on future monitoring plan
  - Liabilities
    - Long term liabilities after injection stop
    - Financial security for leakage risk

Key learnings

- Operational and monitoring experiences
  - Geophysical monitoring has proven essential for site management
  - Monitoring of pressures is as important as saturation
  - Practical learnings about capacity and injectivity from well operations experience
  - Monitoring the overburden is as important as the reservoir
  - Time-lapse seismic imaging of CO_2 plume development gives much improved understanding of flow processes
- Well defined governmental framework and regulations have contributed to the stable and predictable operation

There's never been a better time for good ideas

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