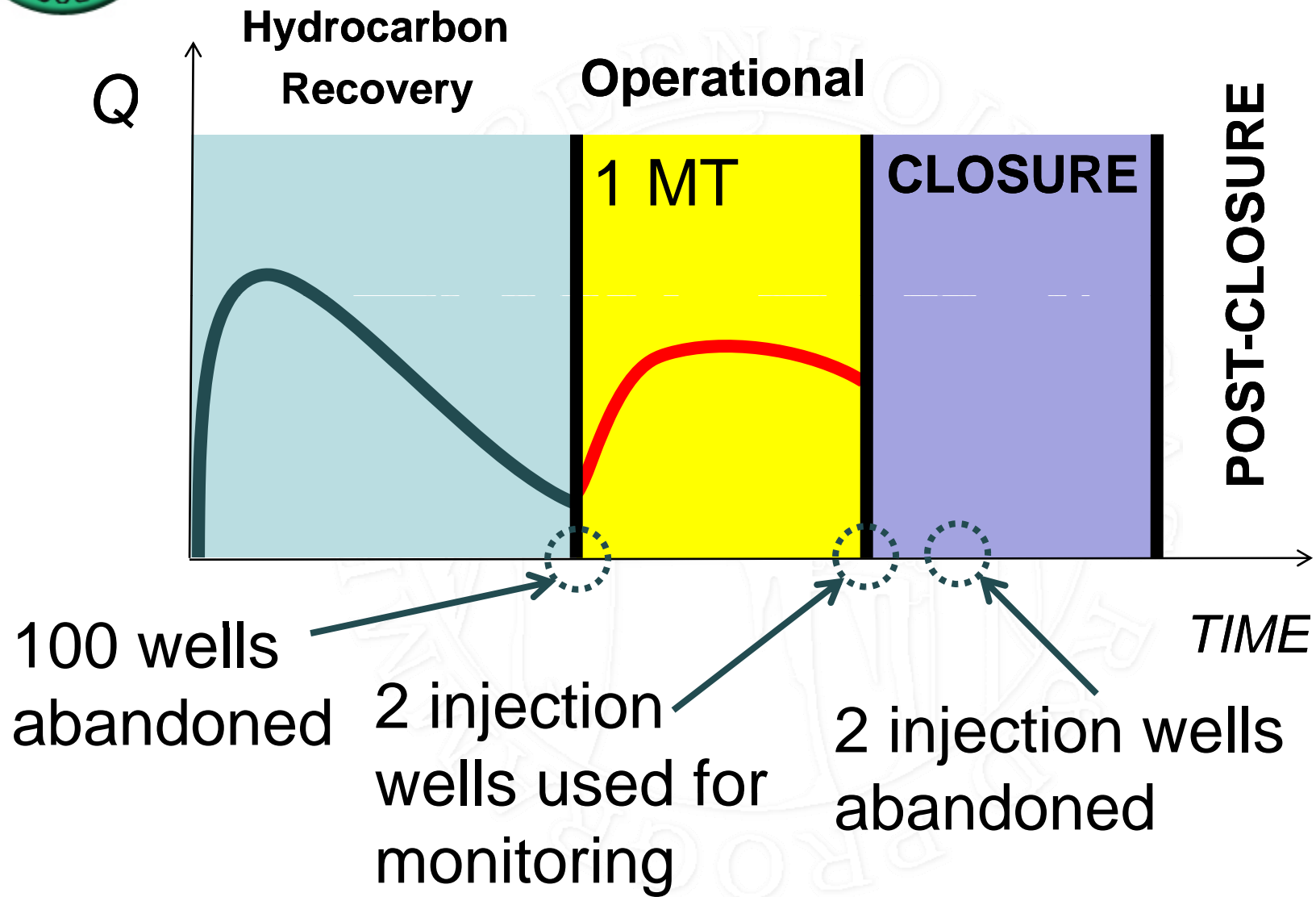




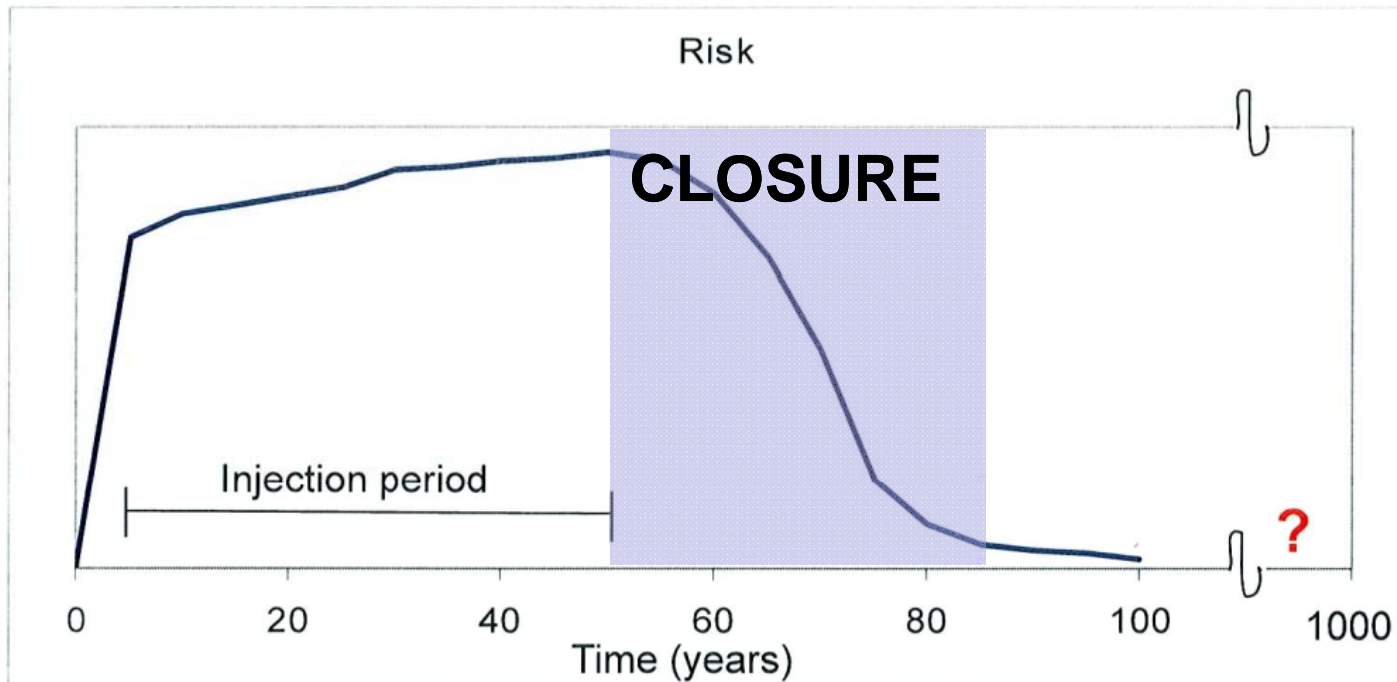
Breakout 3 – Closure

- Definition of closure:
 - Injection ends & up to abandonment and handover
- Aim of closure:
 - Provide sufficient information to the regulator to allow hand over
 - Demonstrate that the risk is within acceptable limits
 - Pressure stability
 - Plume stability (not moving or moving predictably)
 - Leaking or not leaking (if it does leak we will see it)





The risk timeline for leakage is heavily-laden in early times.





Scenario assumptions

- 2 operational wells to be abandoned
- 100 abandoned wells (of various ages)
- Reservoir model has been updated during the operational phase
- The operational model is large enough for long-term migration modelling and risk assessment
- A thorough monitoring programme was implemented during operation
- Abandoned wells have been approved for CO₂ storage



Data

- Pressure distribution at the end of CO₂ injection
- Evolving pressure during transient reductions
- Update operational dynamic model as transient response disappears
- Partitioning between the CO₂ and oil
- Demonstrate area of influence estimates for post-closure time period
- Review the performance records of the 100 abandoned wells
 - At the onset of closure – post closure, do we need to reassess well integrity. Well integrity issues at closure are controversial. Some believe that pressure in the abandoned wells should be monitored during operation and closure. Some believe that you will get your abandoned wells signed off before operation begins therefore no more monitoring is required.
- Demonstrate that the CO₂ is not leaking through the cap rock



Data acquisition

- Use injection wells to monitor pressure falloff
 - There was discussion about handover and whether or not the well will be abandoned
- Sufficient monitoring during the closure period to ensure that the modelled plume behaviour is confirmed
- Simulation/monitoring to ensure storage complex is below “regulated” risk thresholds
- The risk assessment must be updated to establish the monitoring schedule and the duration of the closure period
 - This would initially use the monitoring data from the operation and will be updated with monitoring data from the closure period
- Risk reduction measures may be necessary if closure monitoring identifies risk exposure
 - This may mean additional wells or intervention to bring the risk back within the accepted threshold www.ieagreen.org.uk



Data acquisition

- Risk reduction measures may be necessary if closure monitoring identifies risk exposure
 - This may mean additional wells or intervention to bring the risk back with in the accepted threshold



Conclusions

- Closure success is completely dependent on the operational phase
- You cannot recover in the closure period from failures to collect data in the operational period
- The more you inject and the longer you inject, the more reliant you are on a good model and good validation



Network Gaps

- Integration of modelling is not addressed in networks
- We could have designated modelling individuals embedded within the other networks
- There needs to be a better discussion of operational risk vs. long-term risk
- Well integrity network needs to better understand what will be required, if anything, during closure to validate well integrity
- Well integrity network need to address the uncertainty associated with well integrity
- Someone needs to look at the monitoring of abandoned wells
- Which network should look at the impacts of fracturing the caprock



Network Gaps continues

- What details are required to feed into the geochemical model
- We need far improved communication between all the networks
- The monitoring network needs to look more at closure monitoring and how to prove security before handover when the sensitivity of the tools decreases
- The risk assessment needs to establish criteria for the duration of the closure period
- The networks should get more specific on issues as we go forward and improve our knowledge
- The monitoring and risk assessment networks need to look more at history matching and what we mean by it and what we want from it