Summary Notes from **Small Scale and Modular $CO_2$ Capture**

Lawrence Livermore National Laboratory, Livermore, January 18 -20, 2017

Cooperatively hosted by Department of Energy, Gassnova and LLNL under the bilateral MoU between Norway and the US.

Participation from a variety of companies/businesses also not specialized in $CO_2$ capture gave a new and different approach to the topics presented.

Objectives of workshop:

- Where to focus research and funding in the future
- Consider high vs low capture rate
- Specific technologies and solutions fit for specific flue gas sources

Heard during the presentations:

- The bigger the better (historically) vs small is beautiful (now)
- Small scale projects – facilitate a stepwise approach
- Economy of scale vs Economy of mass
- Higher energy efficiency => higher capital cost
- Prefabrication – stepwise equipment sizes/modules
- Adding modules may interfere freedom of dimensions/capacities
- Improve safety by more shop work - less field work
- Learning is faster for smaller things
- Technology sweet spots
    - Solvent – best capex at large size
    - Sorbents – best capex at medium size
    - Membranes – best capex at small size
- Partial capture – seasonal, part time, available energy internally, reduced capture rate, part of the flue gas, part of the stacks
- Membranes – modular in its nature, unit size small enough for one person to lift
- Opportunities – stranded resources and small scale resources

From the discussion:

- Large plants – high cost – high risk
- Do it stepwise – start small scale – reduce risk
- Retrofit on existing large power plants => parasitic load
- New-built integrated plant can be designed from scratch
- For large power plant there is an alternative – renewables
- For industry sources – capture is the only alternative
- Governments to take the initial action and do the infrastructure investment

Concluding remarks:

- Focus on going large by multiplication rather than by size
- Carry out market survey for smaller, modular systems
- Study balance of plant
- Small scale capture in combination with utilization