HiPerCap Project: Assessment of CO2 Capture Technologies

Melbourne Workshop

Jock Brown

26.03.2015

Global reach – local competence

150
years

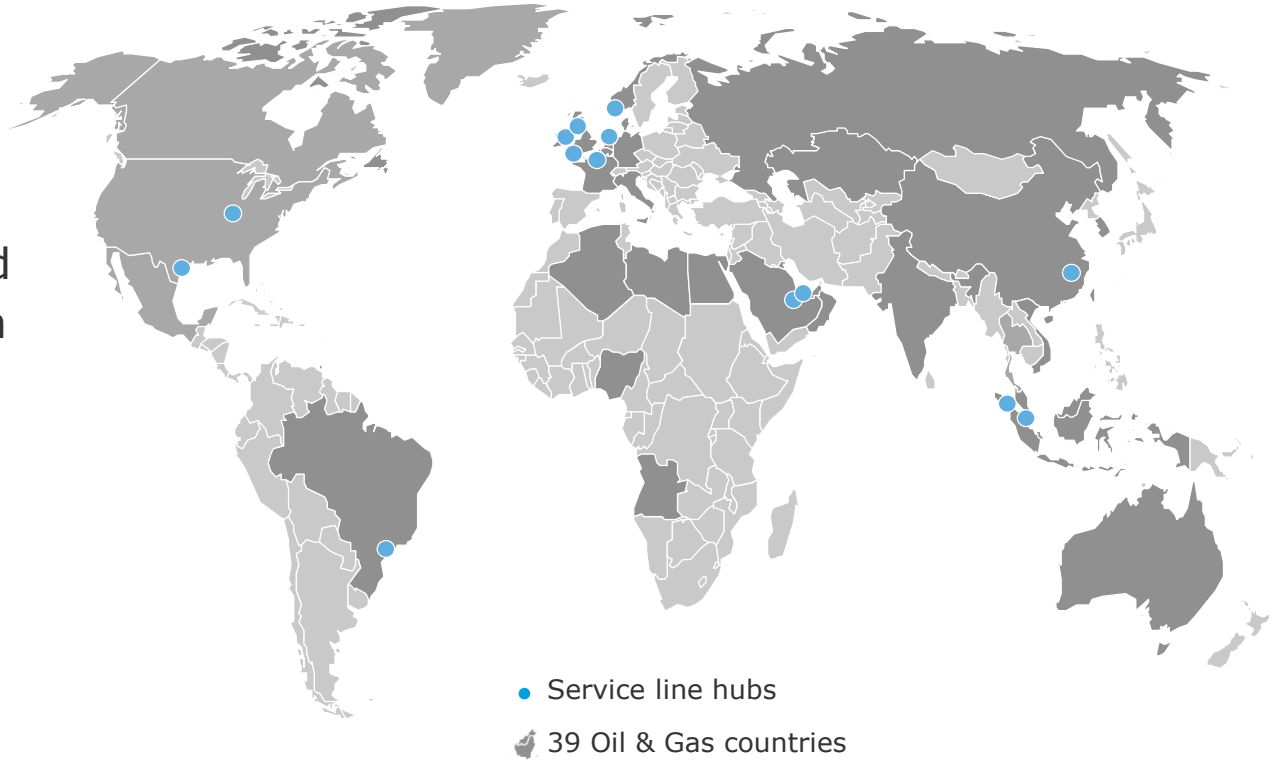
400
offices

100
countries

16,000
employees

DNV GL Oil and Gas

- 5,500 exceptional people who care about making the industry safer, smarter and greener
- Combining industry and domain knowledge with project and operational expertise
- A global network of experts, working together to solve local customer challenges.



HiPerCap Objectives

1. To develop high-potential novel and environmentally benign technologies and processes for post-combustion CO_2 capture leading to real breakthroughs.

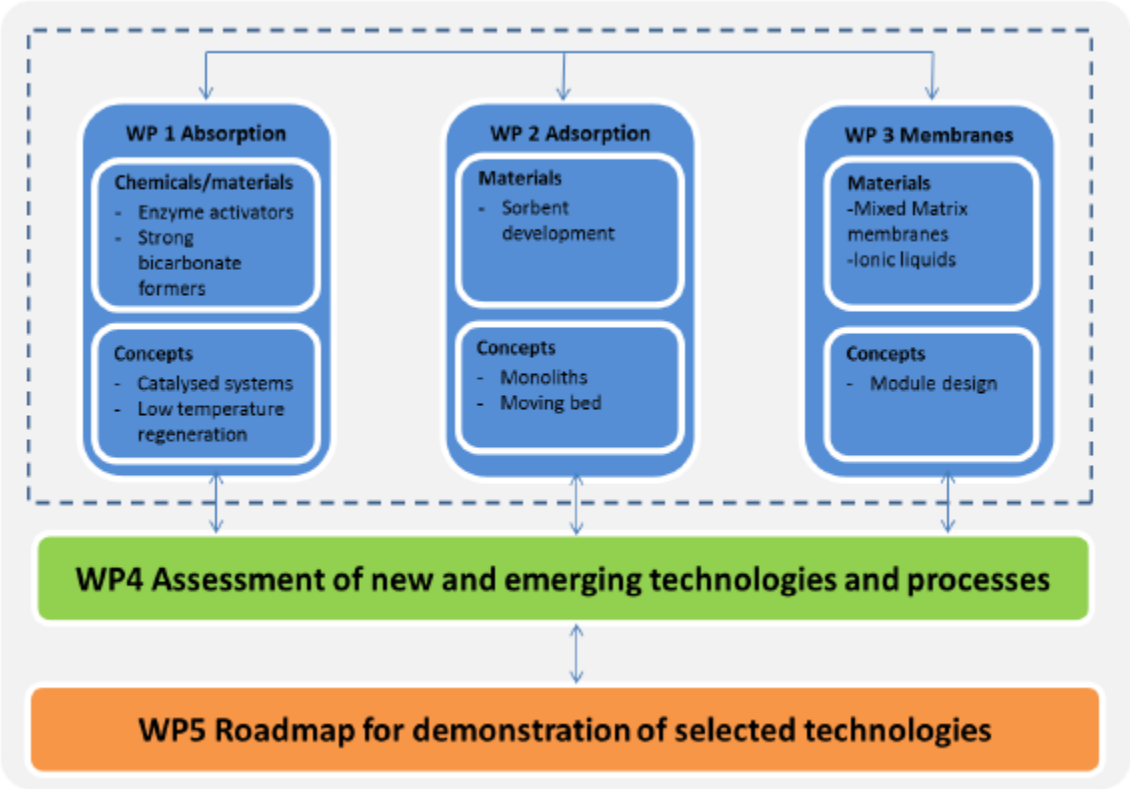
2. To achieve 25% reduction in efficiency penalty compared to a demonstrated state-of-the-art capture process

3. Deliver proof of concept for technologies

4. Develop a fair methodology for comparing capture technologies

5. Develop technology roadmaps for the two most promising technologies

HiPerCap Project



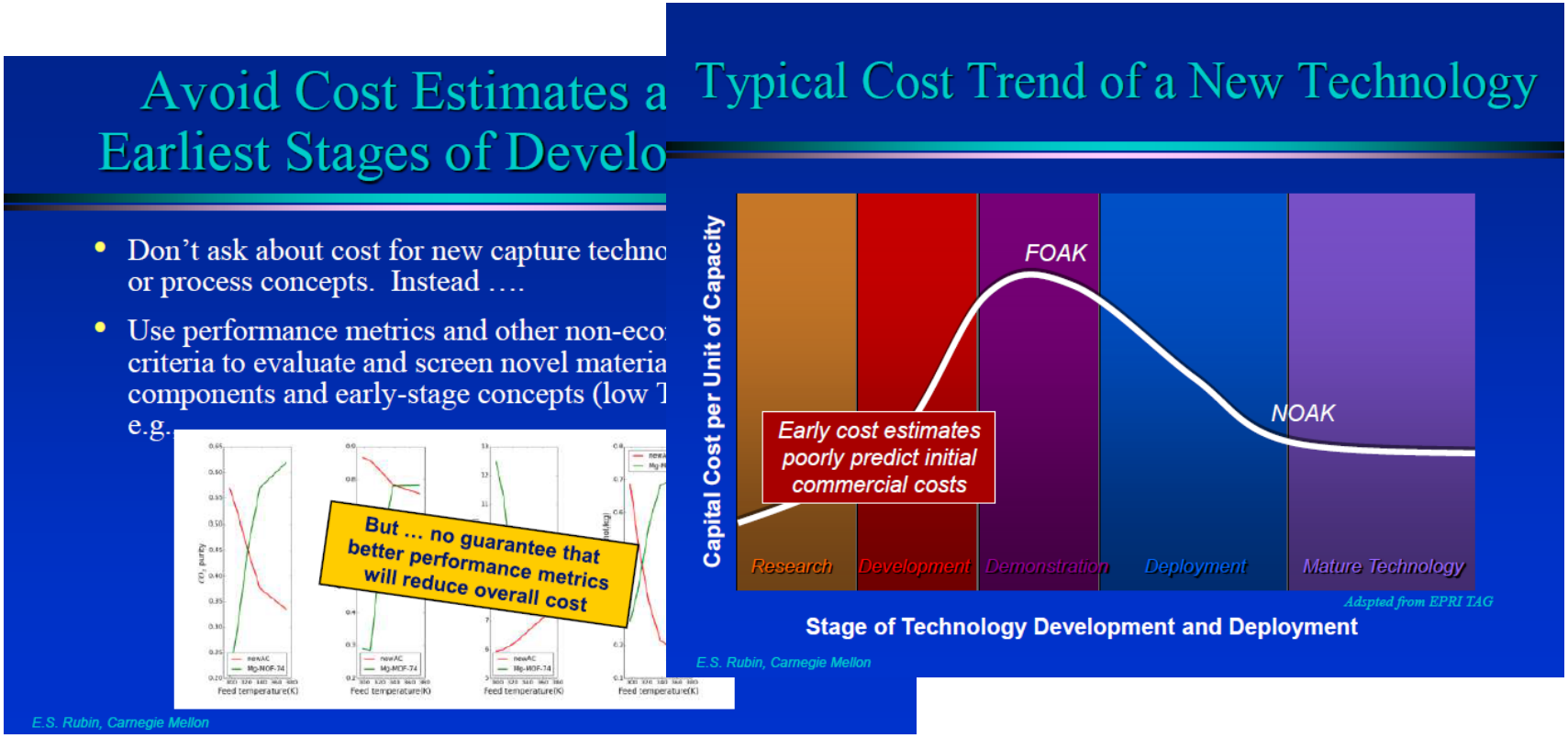
WP4 Overview

- Activities:
  - Task 4.1 – Establishment of Methodology (**DNV GL**, SINTEF, EDF, EON, AEE, GNF)
  - Task 4.2 - Data collection of capture technologies studied in WP1-3 (**SINTEF**, DNV GL, EON)
  - Task 4.3 - Assessment of capture technologies studied in WP1-3 (**DNV GL**, SINTEF, EDF, EON, AEE, GNF) – Not started
  - Task 4.4 - Guidelines for selection and benchmarking of two breakthrough technologies to be studied in WP5 (**EDF**, DNV, SINTEF, TNO, EON, AEE, GNF) – Not started

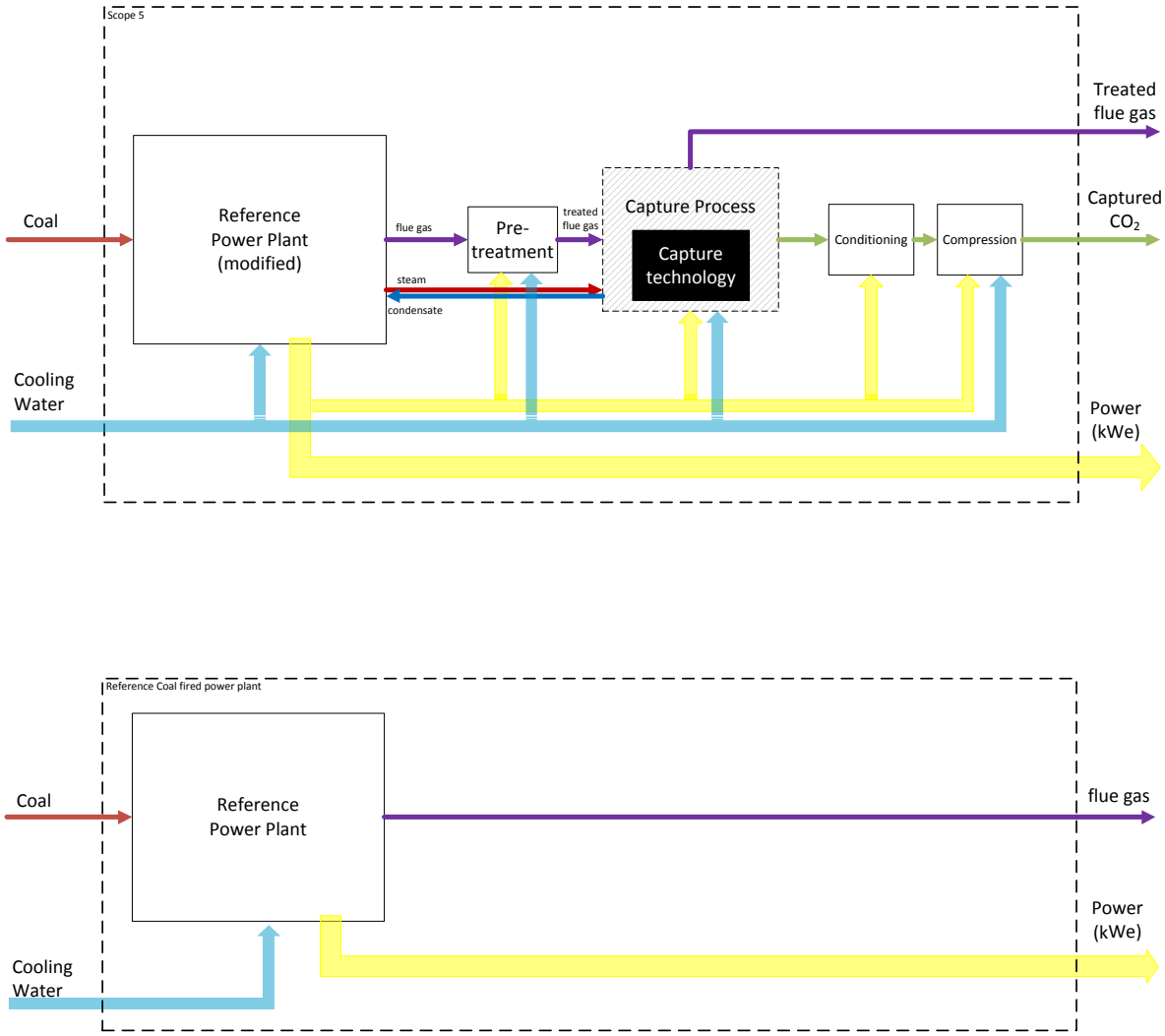
Assessment Methodology

The Final Assessment

- Ultimately the impact of CCS on the COST of the product produced will be how future CCS investment decisions are made



Scope of the assessment



Overall comparison

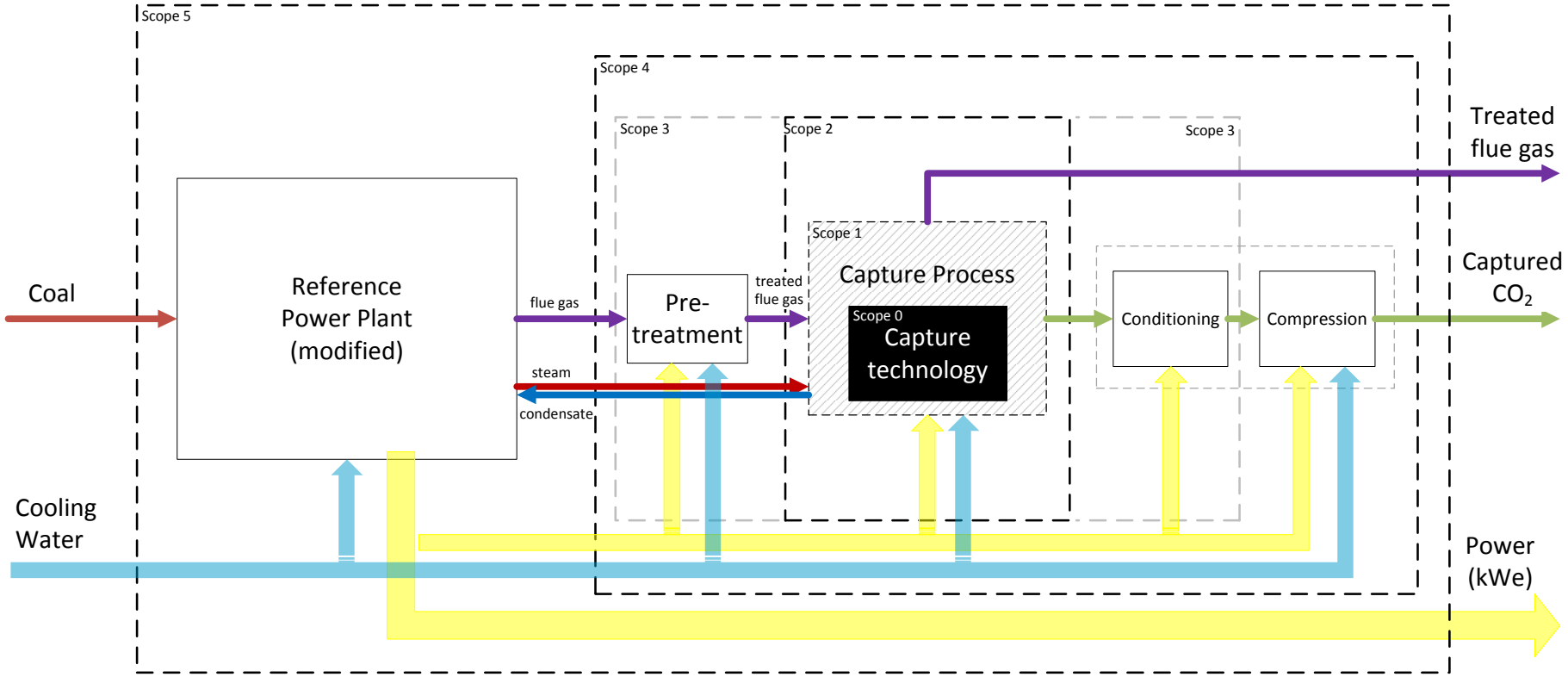
On level of key indicators the following performance can be determined:

Indicator Energy

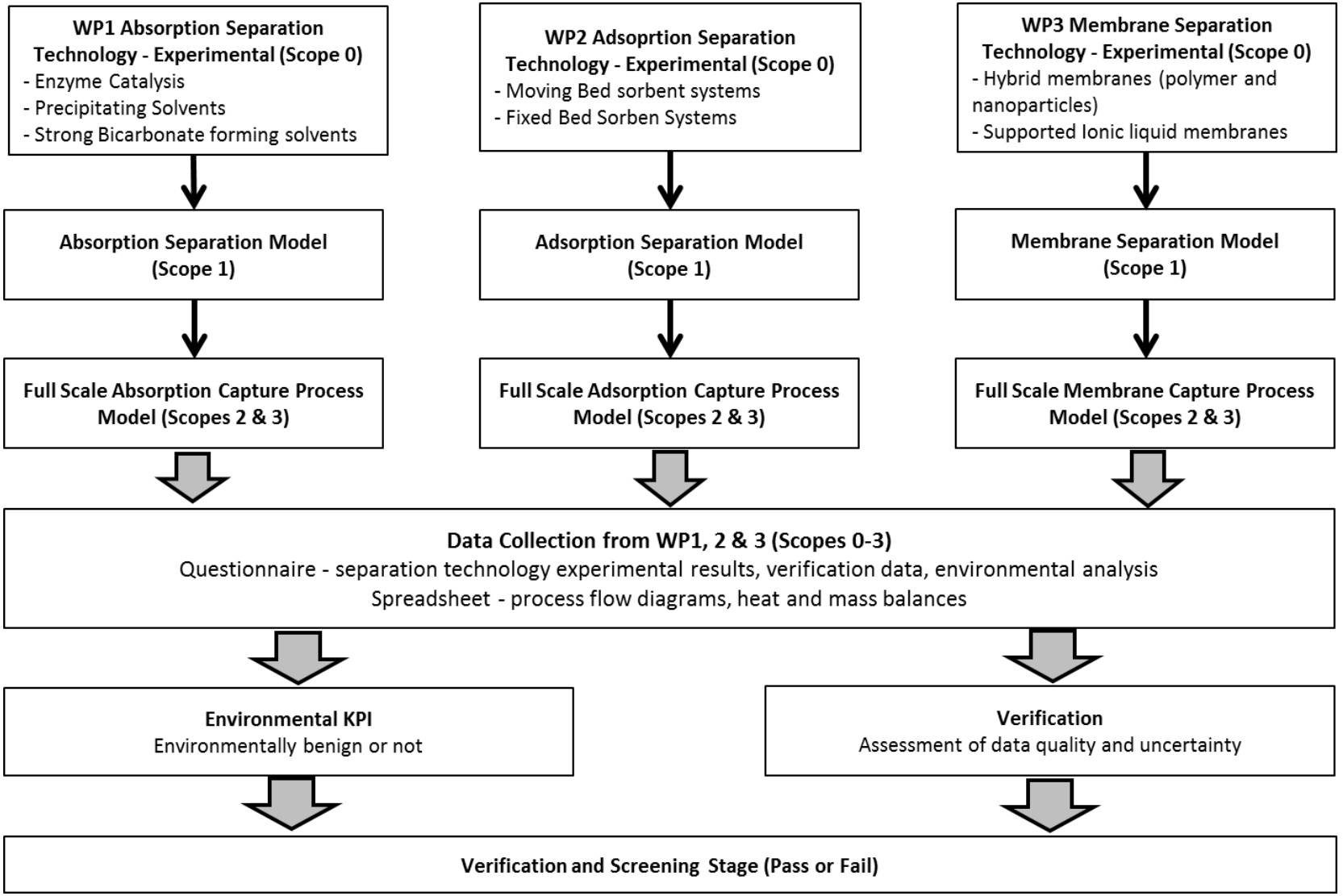
Indicator Environmental

Indicator Cost

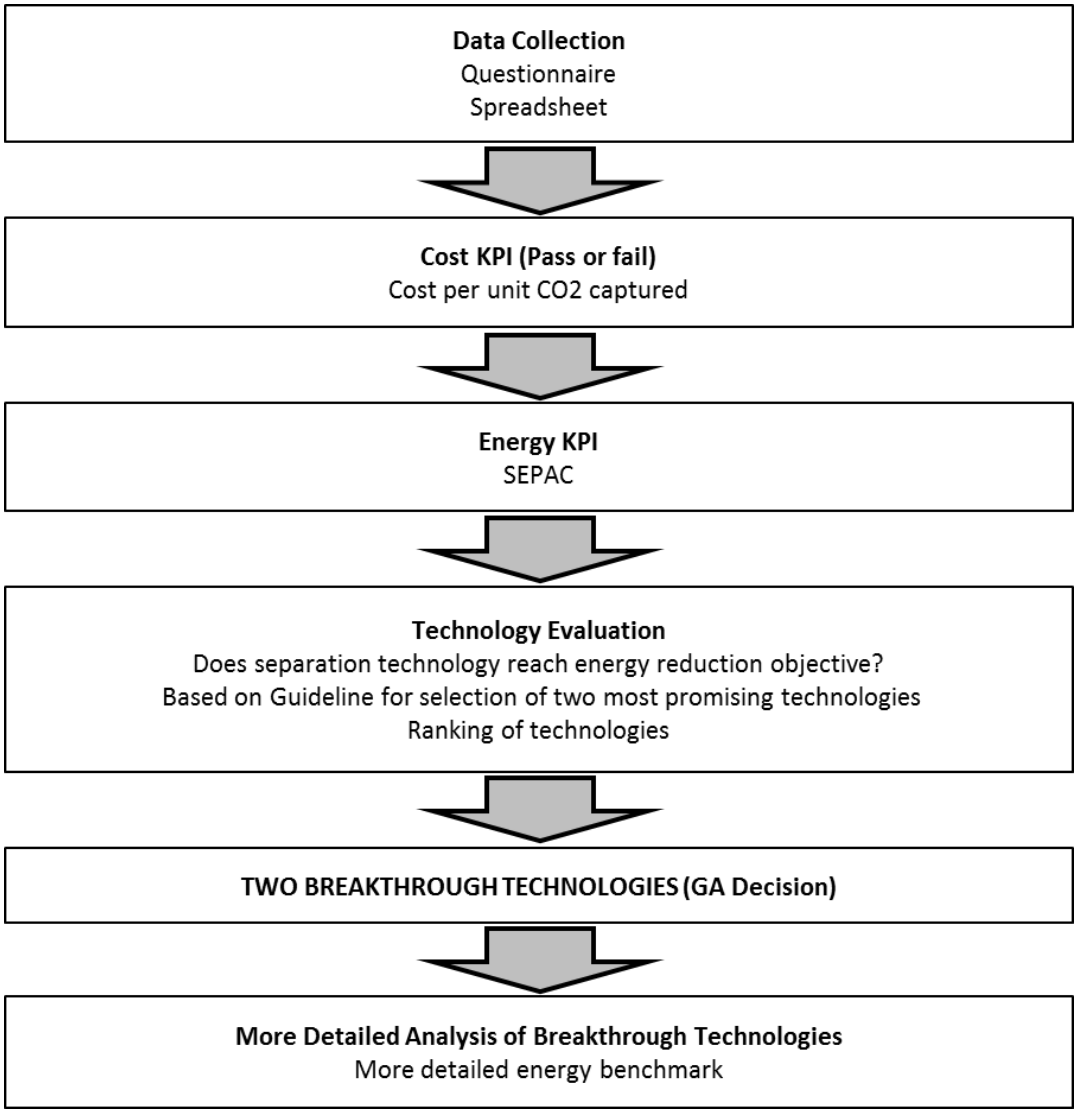
WP4 Approach and Workflow



WP4 Approach and Workflow



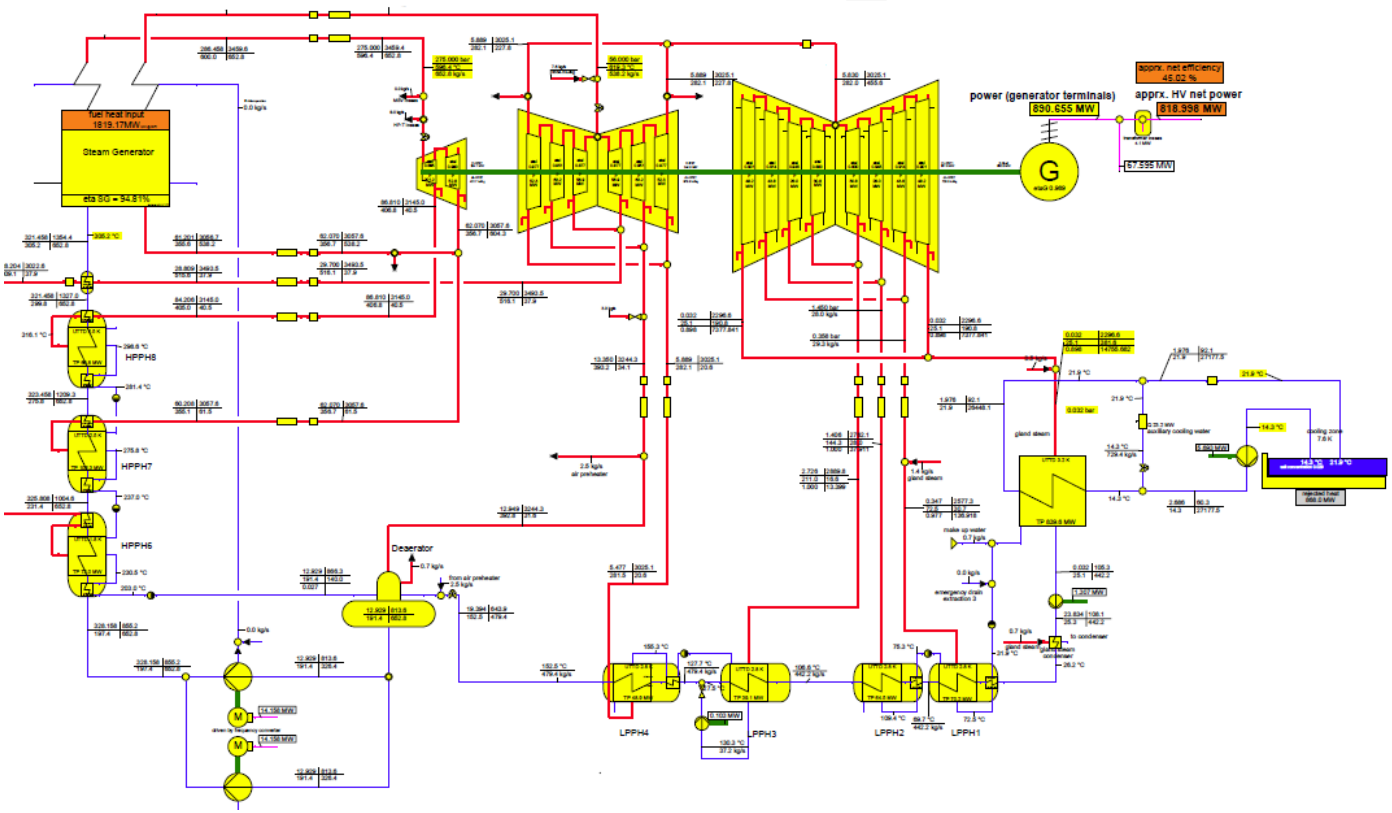
WP4 Approach and Workflow



Reference Coal Fired Power Plant and State of the Art Capture

Reference Coal fired Power Plant

- Updated EBTF Case
- 820MW Advanced supercritical (ASC) pulverised coal (approx. 600 °C/280 bar)



State of the Art Capture Technology

- Criteria
  - Technology needs to be installed on coal power plant
  - Full set of data and details need to be publicly available
  - The largest available reference should be used
  - CESAR 1 case

Environmental

Approach

- Objective: To show that given the best available information, the capture technology is environmentally benign.
- Pass or Fail assessment
- Traffic Light Assessment for each polluting component:

Will produce

Uncertain. Might produce

Will not produce

Categories

- Air Pollution and Other Emissions
  - Eg. SOx, NOx, PM, metals, acid and organic chemicals
- Water
  - Eg. Water consumed and produced, nutrients and organic pollutants in water
- Materials of construction and consumed by process
  - Eg. Metals for construction, sorbent materials, minerals, membranes, solvents
- Wastes
  - Eg. Soild and liquid waste such as reclaimer waste

Energy KPI

Background

- Objective:
  - Show that capture processes have reached goal of a reduction in energy penalty by 25% compared to current state of the art technology.

- Boundary conditions
  - Minimal capture rate 85%

- What to benchmark
  - Impact of capture processes on the reference power plant output

Preferred energy KPI

Specific energy penalty of avoided CO_2 (SEPAC) [MJ_e/kg CO_2]

- $$SEPAC = \frac{P_{ref} - P}{\phi_{CO_2,ref} - \phi_{CO_2}}$$
  - P = net electric output of the power plant in MW_e
  - φ_{CO2} = the emitted flow of CO_2 in kg_{CO_2}/s

Cost

Approach

- Objective: To show new technology is cost competitive with existing technologies and costs have not been sacrificed in pursuit of a reduction in energy consumption.
- Pass or Fail assessment
- Estimate CAPEX and OPEX (excluding Energy)

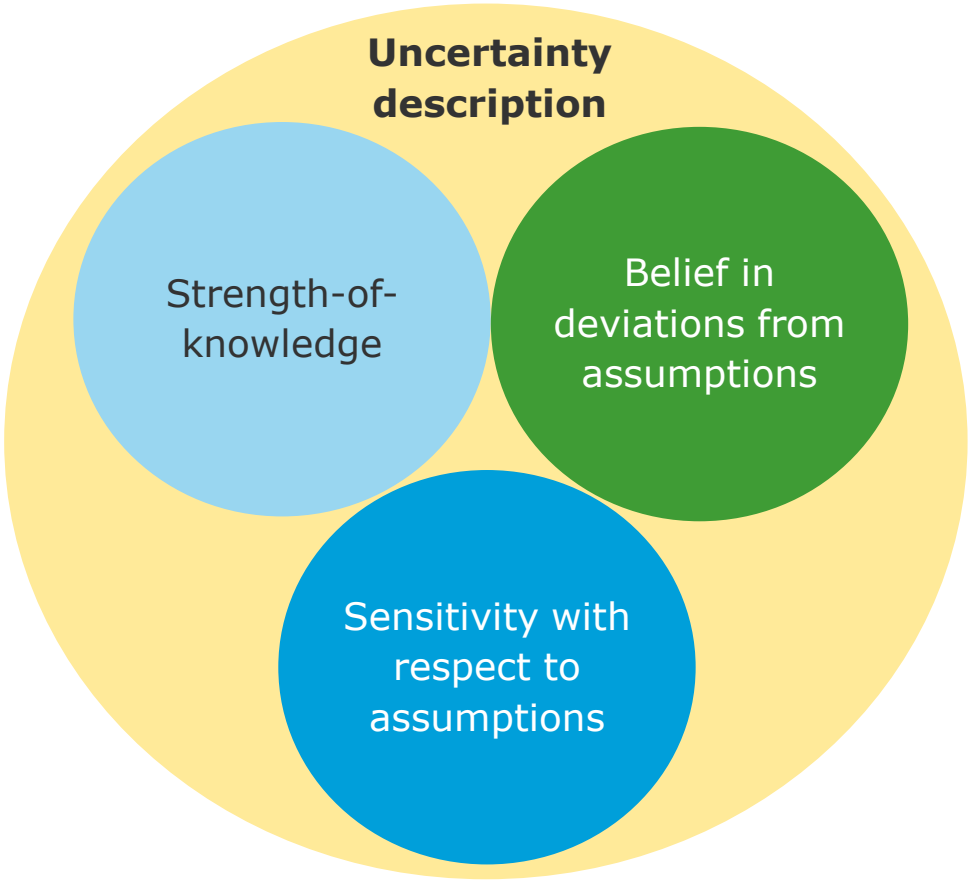
Uncertainty and Data Quality

Uncertainty

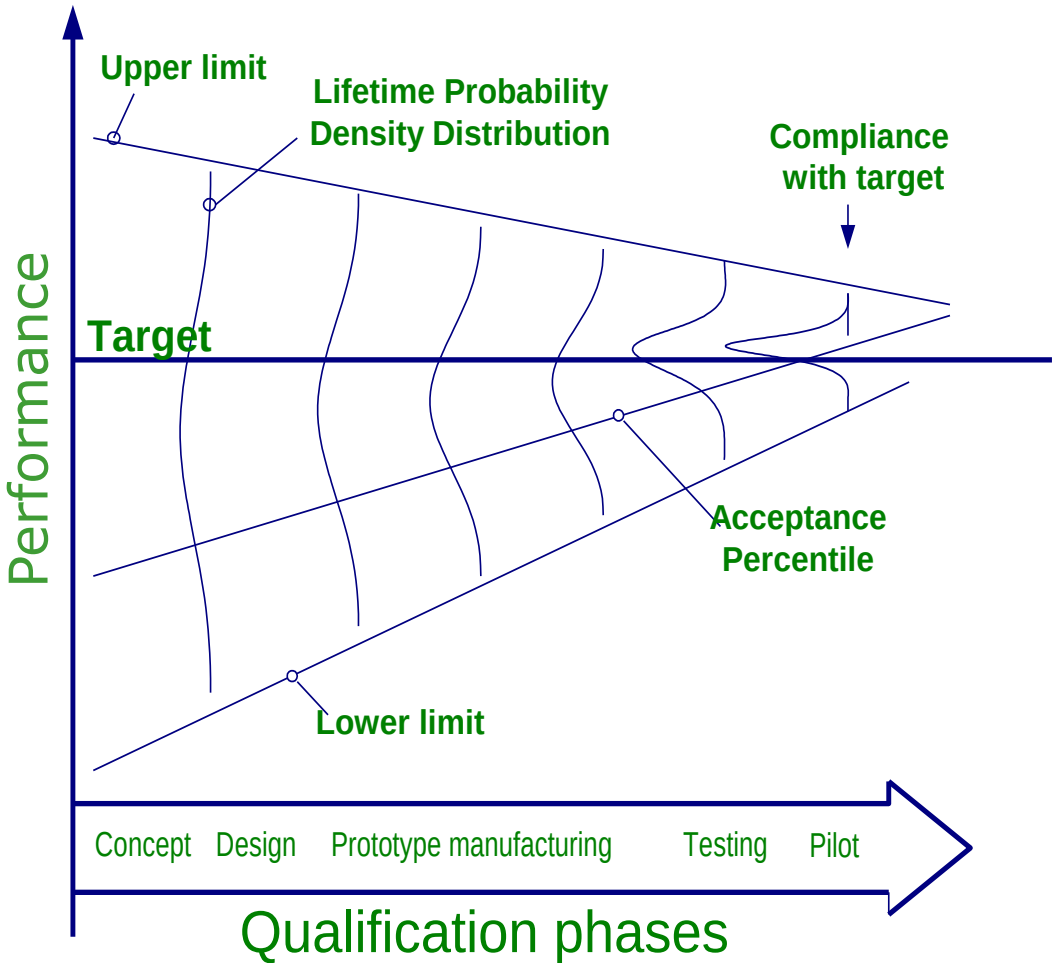
- Two types of uncertainty:

- Parameter Uncertainty
  - Uncertainty in experimental measurements made
- Model Uncertainty
  - Uncertainty related to assumptions in model and physics behind the models
  - Want to understand which assumptions the model is most sensitive to
  - Aim to reduce the influence of assumptions made

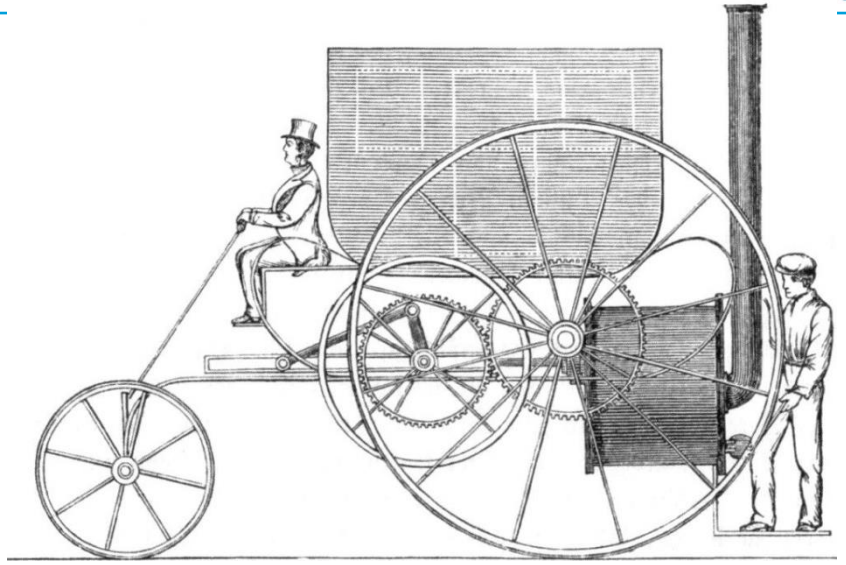
Summary of Uncertainty Drivers

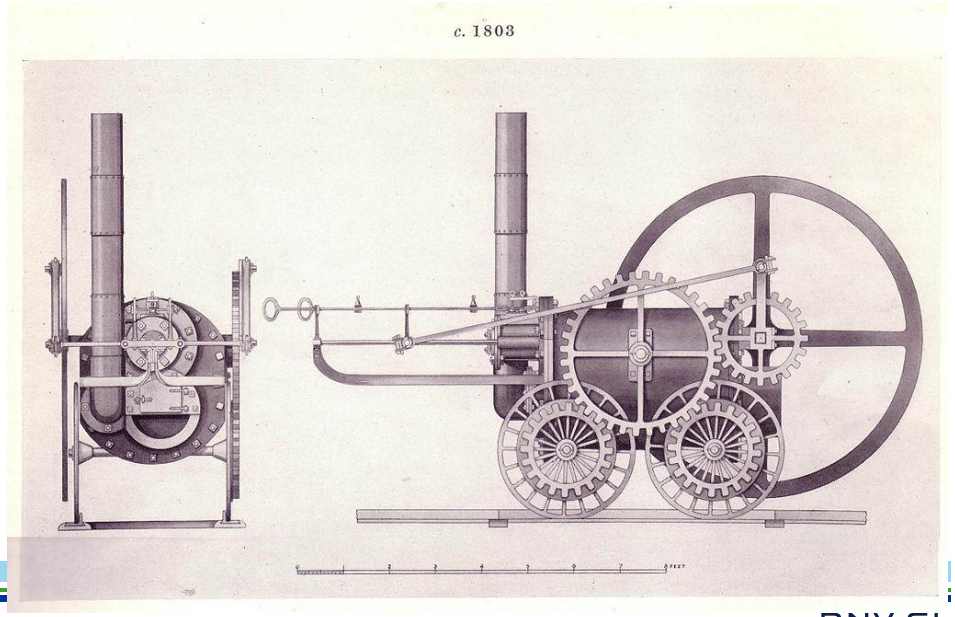


Uncertainty – A double edged sword



Seeing the Potential of Novel Technologies





Thanks very much

Jock Brown
jock.brown@dnvgl.com
+47 907 35453

www.dnvgl.com/ccus

SAFER, SMARTER, GREENER