Bridging the scenario-implementation gap: the role of technological innovation

“Well below 2 degrees scenarios” Analysis Workshop
International Energy Agency, Paris
20 June 2016

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The scenario – implementation gap: how do we get from here....
.....to there......and beyond?
Homework questions raised by the Paris Agreement

- The dynamics of long-term emissions pathways
- Short-medium term actions (2020-2030) and optionality for the long-term (2050-2100)
- Mid-century, long-term low greenhouse gas emission development strategies
- Peaking of emissions - when and how do we know we’ve got there
- Balancing sources and sinks – energy and other sectors
- Strengthening cooperative action on technology development and transfer
- Global stocktake and the aggregation of efforts
  - Emission inventories (TFI)
  - Aggregation of NDCs
  - NDCs and the long-term aims
Can we tell when emissions peak? Aggregate fossil fuel CO₂ emissions of 12 countries whose emissions peaked in the period 2001-2010

Source: based on IEA data
Balancing sinks and sources and long-term low greenhouse gas emission development strategies (Article 4)

Note: one illustrative scenario with a 65% probability of getting below 2°C warming

*Source:* derived from AR5 database
Long-term aims and benchmarking against least-cost mitigation pathways

What does “least-cost” imply?

Source: UNFCCC synthesis of INDCs
What do deep dives into the AR5 scenarios tell us about pre- and post-2030?

- This single scenario is: likely (65% probability) to get below 2°C by 2100; unlikely to get below 1.5 °C (20% probability)
- The mix of mitigation measures beyond 2030 is different from that before 2030
- The level of effort, as measured by carbon price, needs to increase exponentially beyond 2030

Source: derived from AR5 database
On what path do the NDCs take us? What aspects of socio-economic development and ambition persist beyond 2030?

Source: Fawcett et al., Science, 2015
Beyond headline emission indicators
A bridge to implementation?

Possible macro-indicators
- Sectoral emissions (e.g. AFOLU v energy)
- Regional emissions
- Decomposition of effort
  - Energy/GDP ratios
  - “Zero-carbon” energy supply
  - Fossil fuel mix
  - CO₂ Removals

Technology indicators
- Deployment of key technologies
  - First use
  - Market share indicating “commercialisation”
- Demonstration activities
- Investment in R&D

Financial flows

Policy formation and implementation
Phases of the innovation timeline

Development
('A means to develop', 'Exploration', 'Emerging' and 'Installation')

Market formation
('Acceleration', 'A means to deliver', 'Deployment' and 'Growth')

Growth & diffusion
('A means to market', 'Maturation' and 'Maturity')

Invention, development and demonstration

Market deployment and commercialisation

Source: UKERC, 2015
Timeline and duration of innovation for various technologies

Source: UKERC, 2015
Development and commercialisation timelines

Source: UKERC, 2015
CCS roadmap milestones

Technology

- Prove technologies at large scale
- Identify industrial applications
- Demonstrate retrofit at 85% capture
- Fund R&D for biomass CO₂ capture

- Reduce CO₂ capture energy penalty to 7% points
- Demonstrate H₂ combustion with high-efficiency CCGTs
- Widespread availability of commercial plant (new and retrofit)
- Reduce capital costs by at least 10%

- All power plants operating over 45% efficiency (low heating value, including CO₂ capture)
- Reduce capital costs by further 10%
- Demonstrate chemical looping for coal and gas, pressure and electrical swing absorptions, cryogenics

- Commercial systems with gas separation membranes
- Continue to reduce energy penalty
- Continue to review and refine legal and regulatory frameworks in all regions as CCS experience increases

Regulatory

- Regulatory frameworks in place for CCS demonstration
- Comprehensive regulatory frameworks in place for commercial deployment

Finance

- Provide an average of USD 3.5-4 billion annually for CCS demonstration in OECD countries
- Provide USD 1.5-2.5 billion annually for CCS demonstration in non-OECD countries

- Continue to monitor and adopt CCS financing strategies as experience increases

Public engagement

- Provide greater governmental resources
- Develop and apply a toolkit of best practice public engagement techniques to CCS demonstration projects

- Refine public engagement strategies in all regions as CCS experience increases

Source: ETP, 2010
Final technology questions

→ Balancing deployment (short-medium); demonstration (medium) and R&D (medium-long term)

→ Pushing water uphill (CCS?) and technologies that surprise (PV, electric vehicles?)

→ Mission Innovation, Breakthrough Coalition and the Technology Mechanism

→ It may not all be about technology – changing growth strategies
Thank you!