Challenges and opportunities for CO_2 transport and storage

Dr Thomas Berly, Energy Analyst – CCS Unit, IEA

IEA Global Technology Roadmap for Iron and Steel (Paris, 20 November 2017)

IEA

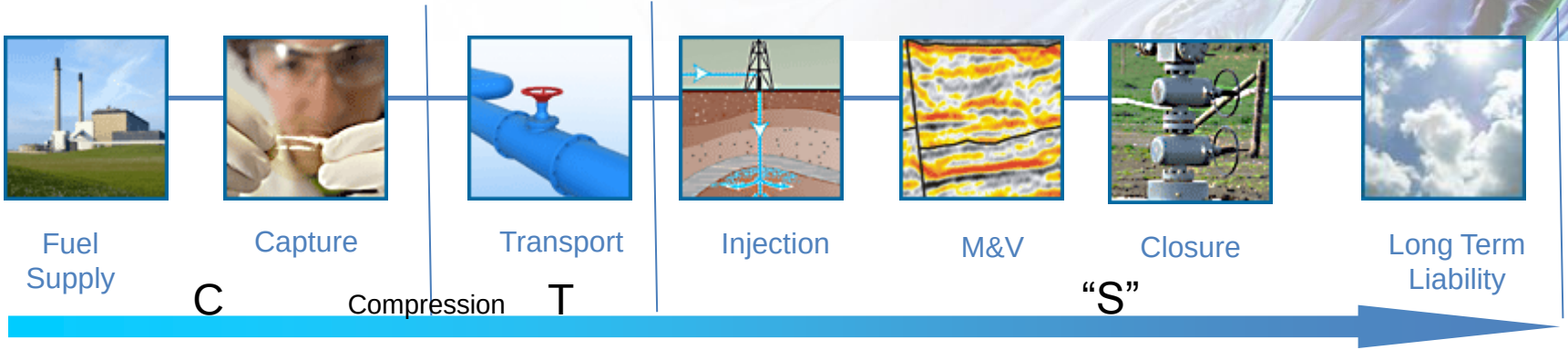
Outline of the presentation

- **CCS role**
- **CO_2 storage**
  - ***Fundamentals***
    - CO_2 storage assessment
    - CO_2 storage development (including storage costs)
  - ***Challenges***
  - ***Opportunities***

The role of CCS

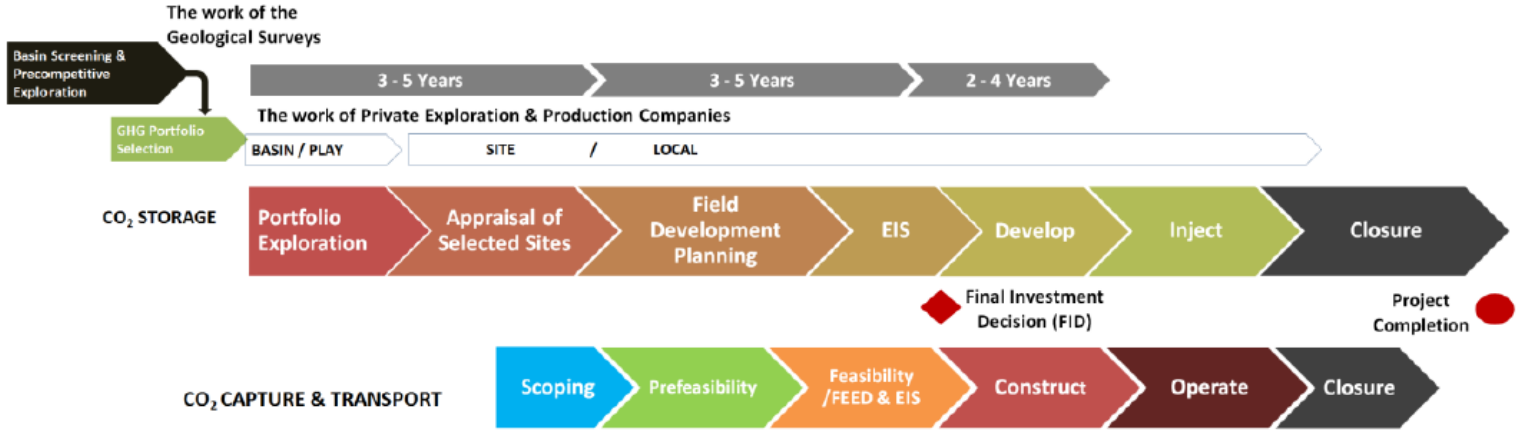
- **Recognising that:**
  - CCS is a key technology for achieving the Paris Agreement ambitions across various sector of the economics (power, industrial processes, heat and transport)
  - CCS is essential for 'negative emissions'
  - CCS has additional societal benefits (grid stability, energy security, job preservation and creation)
- **CCS is "not optional" in implementing the Paris Agreement**
  - CCS will be essential in delivering a 2°C and well-below 2°C target
  - Greater emphasis on BECCS and negative emissions
  - Future emissions reductions are dependent on CCS investment today
- **CCS is not on track** for 2DS or even more to meet well below Paris Agreement

Focus on CO_2 Transport and Storage



- CO_2 storage is not all about injection, it involves:
  - CO_2 storage assessment/characterisation (prior to injection)
  - CO_2 injection operations
  - CO_2 monitoring operations (before, during and after injection)
  - CO_2 decommissioning (& rehabilitation) and post-closure monitoring

CCS sequencing



- For an "Integrated CCS Project" to go ahead, FID capture must coincide with FID storage
- Storage assessment and characterization process must start early (over a portfolio of stores) as this process can take up to 10 years

Key questions to focus for CO_2 storage:

- Whether you have any significant sustainable injection *rate*
- Where it is
- How much confidence you have in its performance - rate and cost ($/T)
- When CO_2 will become available for storage

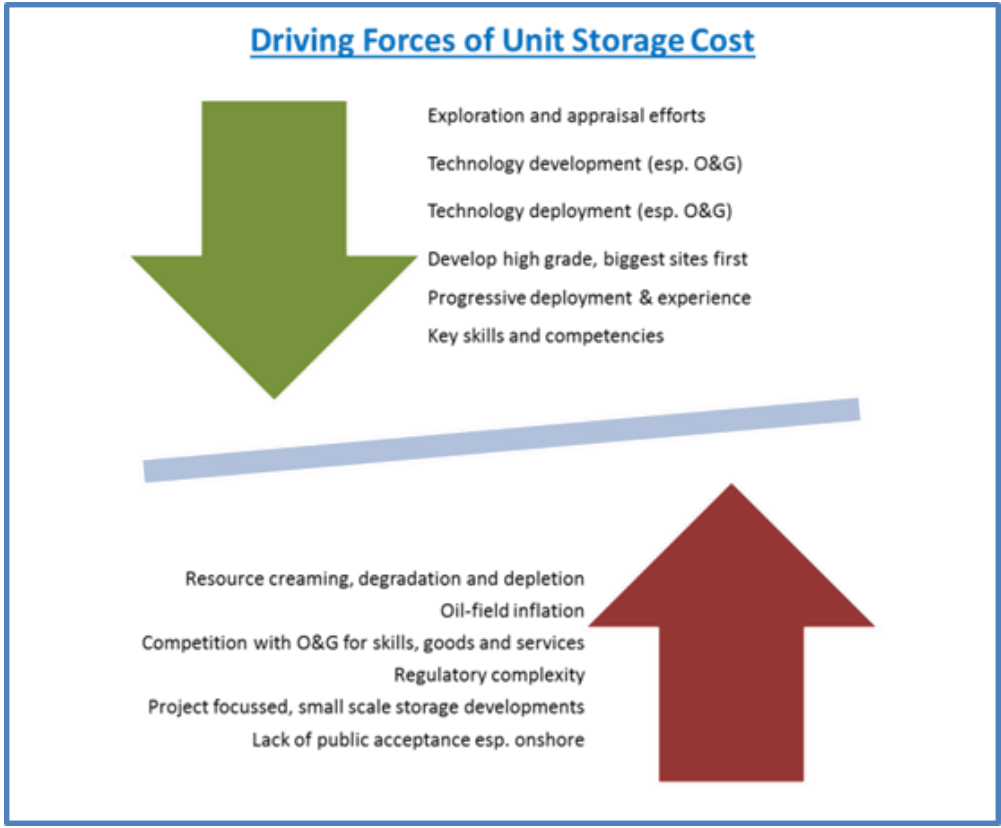
Way forward:

⇒ Site search, screening and selection process

⇒ A regional appraisal program with dynamic calibration and matched source-sink scenario analysis

CO_2 storage cost

- Defining unit cost ($/t)
- UTC = break even CO_2 price
  - **UTC =** $\frac{PV\,[Capex(t)+Opex(t)]}{PV\,[Injection(t)]}$
- E&A in UTC or not?
- Cost estimation - methodology and drive
- Characteristics of CO_2 storage resource plays
  - Location (offshore, onshore), depths
  - Size, configuration
  - Maturity
  - Connectivity
- Drivers & levers
- Trade offs
  - Front End Loading (E&A)
  - CAPEX vs. OPEX
  - Transport vs. Storage
  - Early deployment vs. long term development

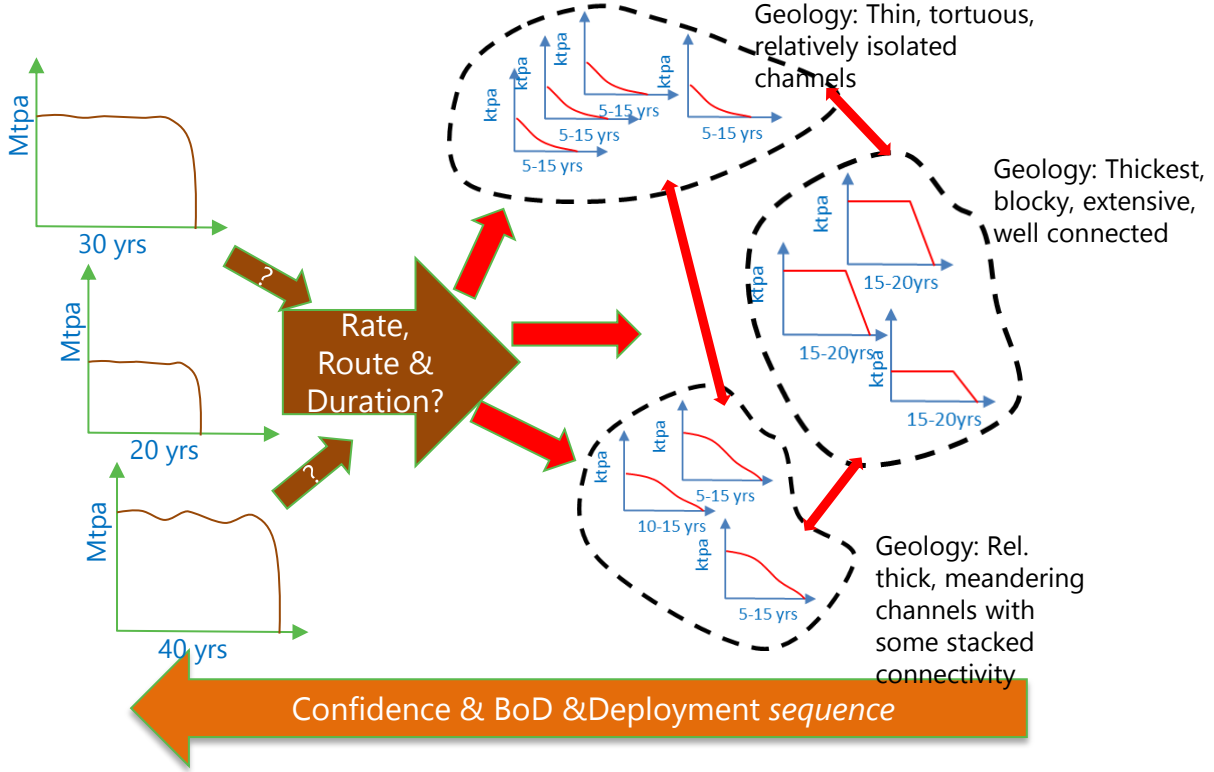


Reference: Alf Garnett (UQ) @IEA CTS infrastructure workshop (May 2017, Paris)

CTS development plan

CO_2 sources

- Power stations
- Industrial processes
- Other Transformation

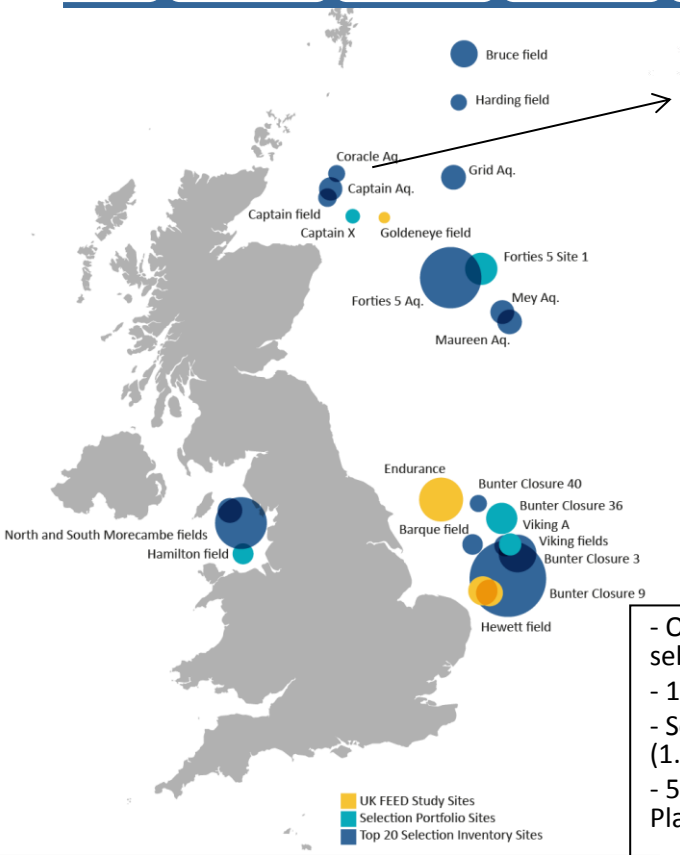


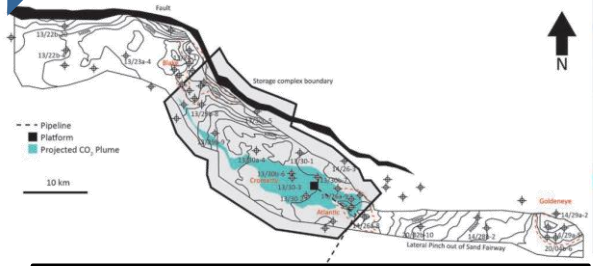
⇒ Don't spend too much on plant design until your rate constraints and locations are well *enough* known

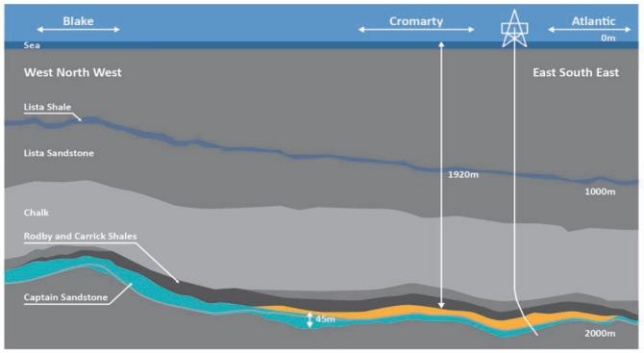
Reference: Alf Garnett (UQ) @IEA CTS infrastructure workshop (May 2017, Paris)

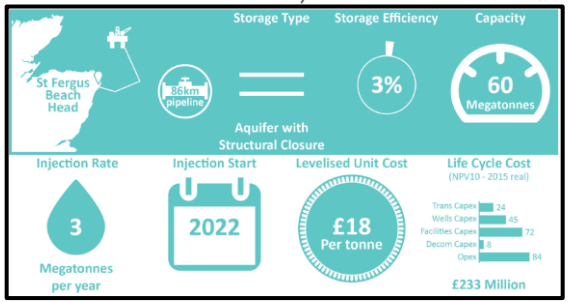
UK Appraisal Project (ETI/PBD) – example of CTS feasibility study

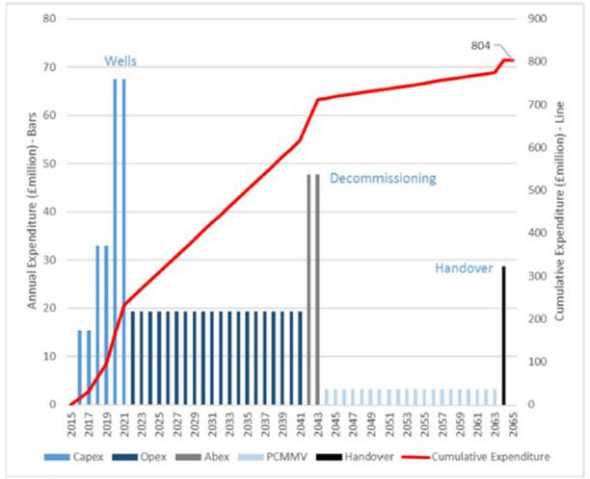
CO2Stored | Many to Twenty | Twenty to Five | Mature Five Sites | Disseminate Outputs











- One of the most comprehensive screening and selection process for strategic CO_2 storage resource
- 12 month project; > £ 2.5m; 15,000 man hours
- Screening from 265 sites (8.6 Gt) to 20 to 5 sites (1.6 Gt)
- 5 fully costed and risk assessed Field Development Plans with associated appraisal programs

CO_2 storage – challenges (1)

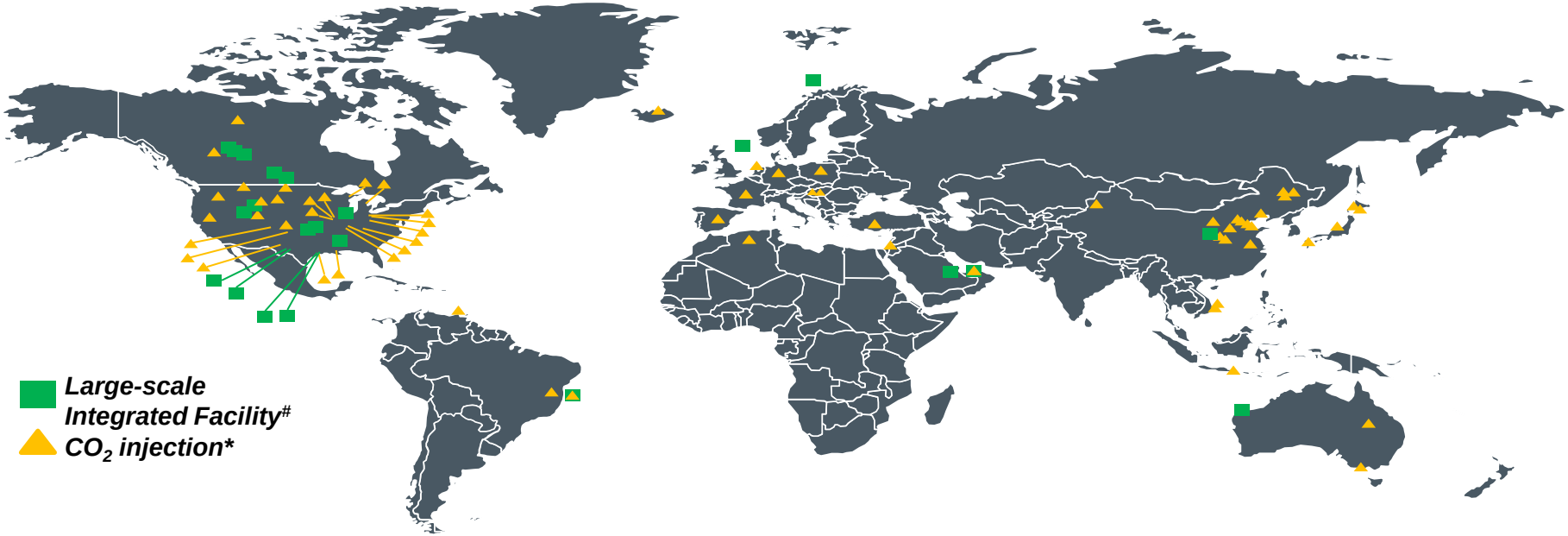
- CCS related risks: CCS values; Political/policy uncertainty; public support
- Lack of government leadership focusing on CO_2 storage assessment and development
- No coordinated strategies and plans for developing CO_2 transport and storage common-user infrastructure
- Difficult CO_2 T&S business models
- No CO_2 storage service/delivery company to plan, build and operate CO_2 transport & storage facilities (structure, competencies, government versus industry involvement)
- CO_2 storage legislations and regulations (lack of or over prescriptive)
- Lack of access to pore space (permitting conditions and requirements)
- Unacceptable (from industry) risk allocation during operations and post-operations
  - Counterpart/Cross-chain risks
  - Decommissioning cost sufficiency and financial securities
  - CO_2 leakage/Long term liability
- Insurance market limitations for CO_2 T&S operations
- Legal: Overlapping tenure risks; subsurface competitive interests; cross- border issues

CO_2 storage – challenges (2)

- Storage confidence (sub-surface CO_2 storage performance risks impacting on storage rates and capacity)
- Data access to/availability (quantity & quality)
- Offshore storage likely (public perception) - costly
- Lack of CO_2 storage resource classification and assessment methodology
- Misconceptions about CO_2 storage (capacity, storage cost, E&A requirement, ST vs LT CTS development)
- Lack of CO_2 storage assessment & characterization effort
  - So far only focus on integrated CCS (power)projects
  - Lack of dedicated incentives/funding to cover upfront cost of CO_2 storage resource assessment
  - No portfolio E&A management (all eggs in the same basket – common risks)
  - Exploration & Appraisal failure risks (regret costs)

Injection, storage and monitoring has decades of experience

CO_2 injection projects



 # Operational or under construction; Global CCS Institute Project Database, May 2017.
** Number of projects not exhaustive; under construction, operational, or completed.*

After: Hosa et al. 2014; Cook et al. 2014; Global CCS Institute 2017

CO_2 storage - opportunities

- Regions/countries with political and public support for CCS
- Regions/areas
  - With good quality and accessible data (O&G provinces)
  - Familiar with sub-surface activities
- Well – characterised storage sites (depleted O&G fields)
- Large capacity and permeable (with baffles) CO_2 storage resources
- Proximity to CO_2 sources (onshore rather than offshore)
- Possible CO_2 revenue through EOR (and CCU)
- Existing infrastructure deemed fit to be re-used or re-purposed for CO_2 transport (surface facilities, pipelines) and storage (platforms, wells)
- Government incentives, funding
- Existing CO_2 storage permitting and regulatory framework
- Storage hubs/clusters with multiple sources = economy of scale

CO_2 storage – key points

- No CCS without the "S": CO_2 storage must come first
- CCS deployment will require an up-front development of storage resources
  - ⇒CO_2 storage assessment needs to start as early as possible and over a wide portfolio of potential stores
  - ⇒CO_2 Exploration & Appraisal (especially dynamic testing) is crucial to reduce uncertainties
- Multi-users CTS infrastructure development is essential for large-scale CCS deployment, but at this stage,
  - ⇒There is no specific support mechanisms tailored for CCS early deployment and CO_2 storage development
  - ⇒There is no coordinated strategic plans for the development of transport and storage systems
- New step by step approach involving public and private partnership is required urgently to prioritise and progress CO_2 storage resource assessment and development
  - Servicing a wide range of CO_2 sources
  - To accelerate early CTS infrastructure development enabling the long term CCS deployment

Explore the data behind *ETP*

www.iea.org/etp

www.iea.org

IEA

Available on the App Store

GET IT ON Google play

Download from Windows Phone Store

www.iea.org/statistics