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Energy Agency

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Status of industrial CCUS deployment & challenges for industry

Kira West

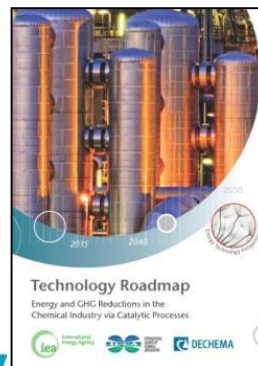
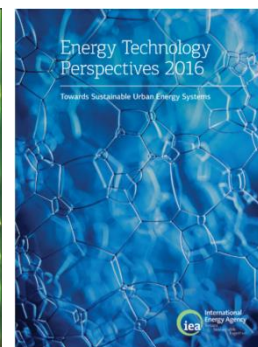
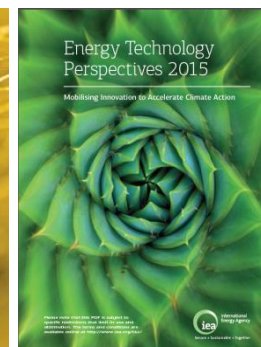
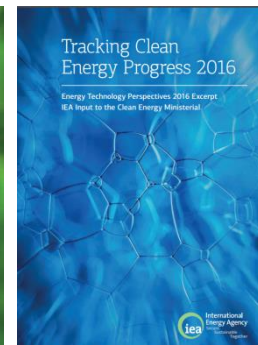
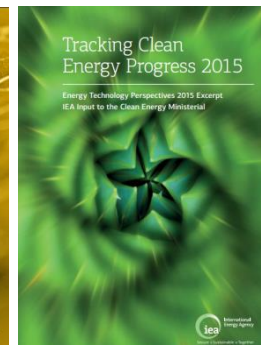
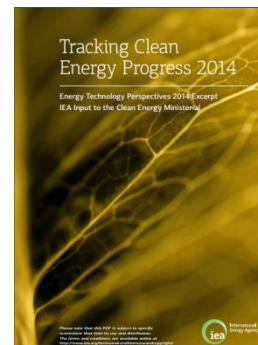
9 November 2016

ECRA Chair Scientific Event

Mons, Belgium

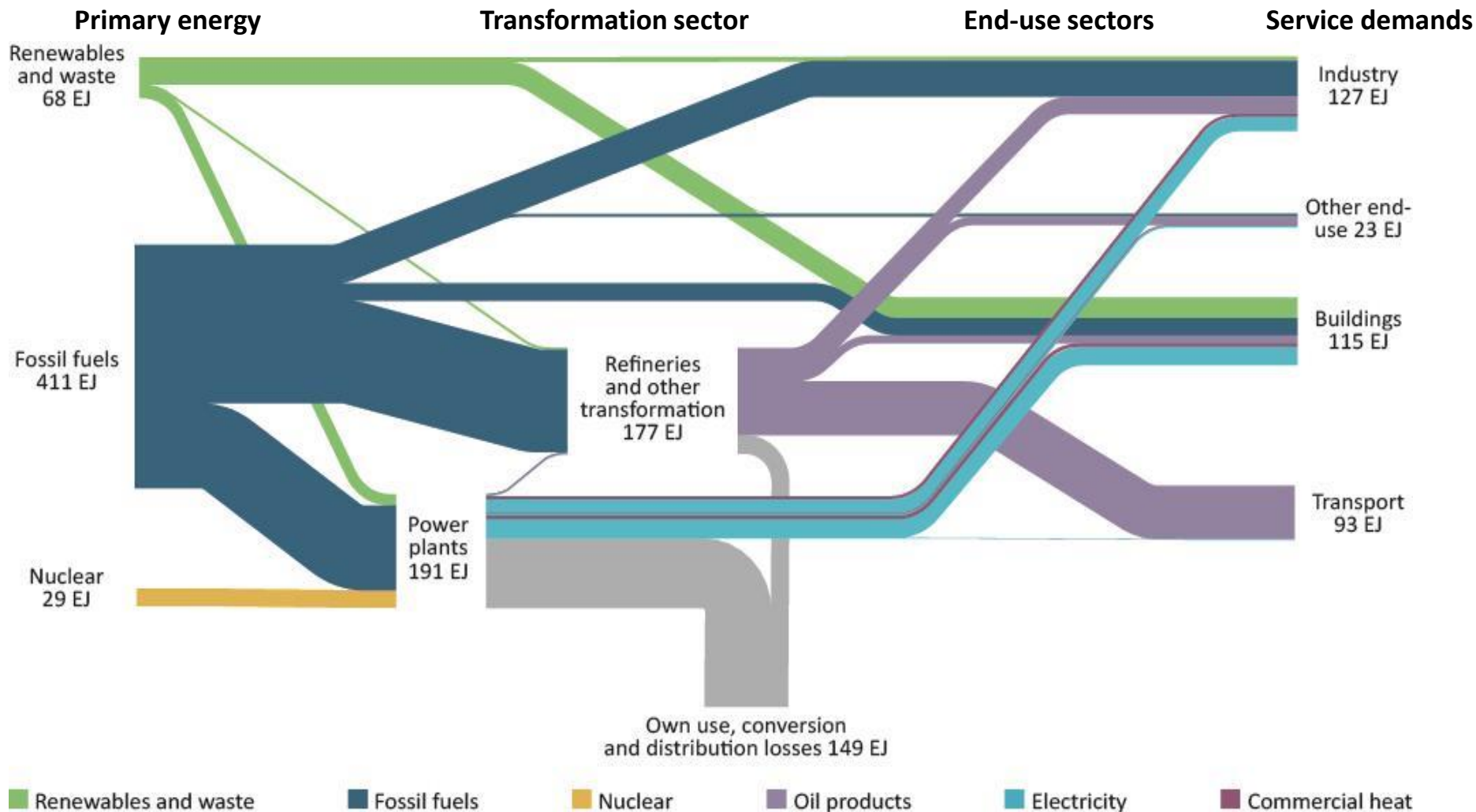
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- Where are we today?
- Where do we need to go?
- How do we get there?



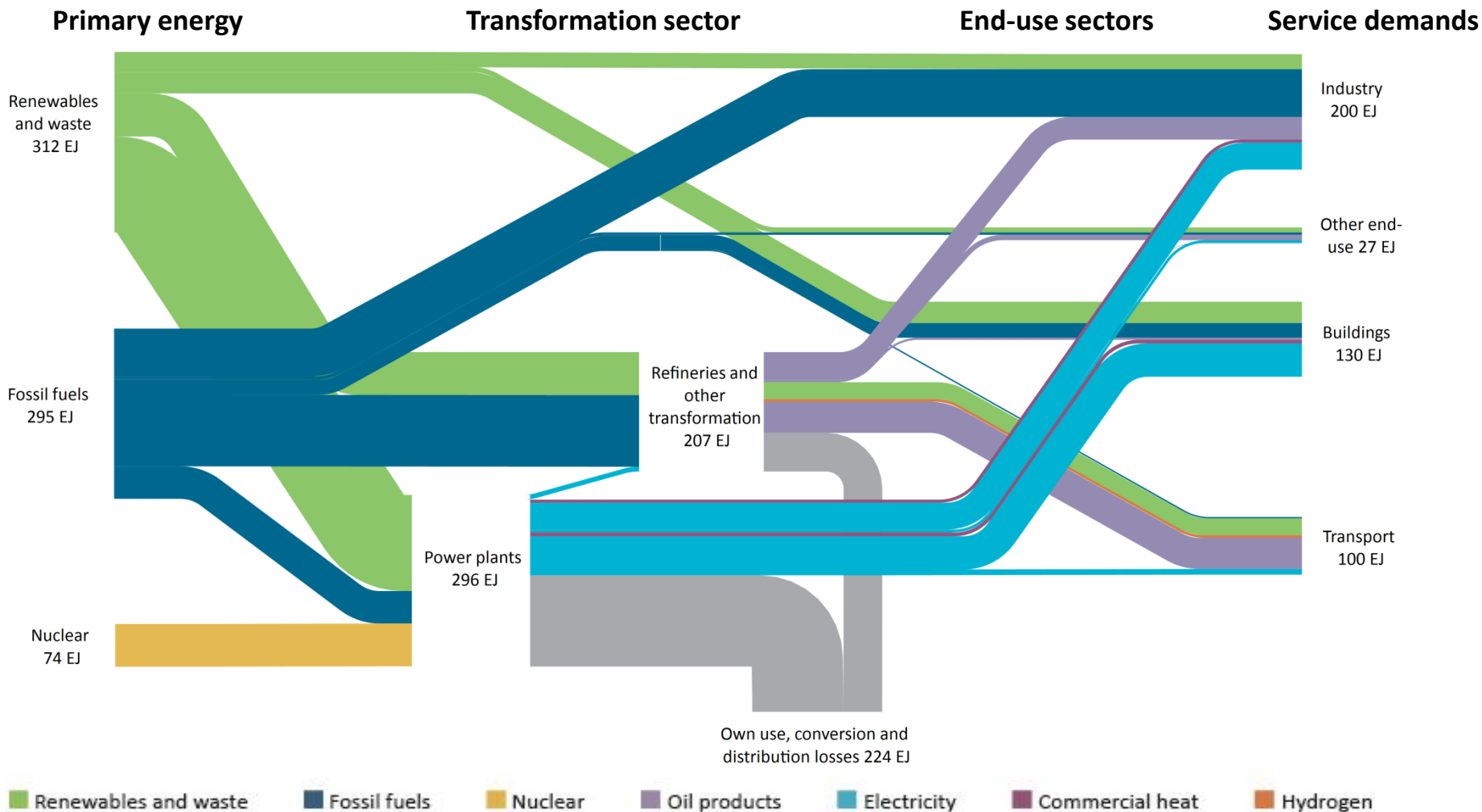
Detailed picture of today's energy system

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Global energy system today

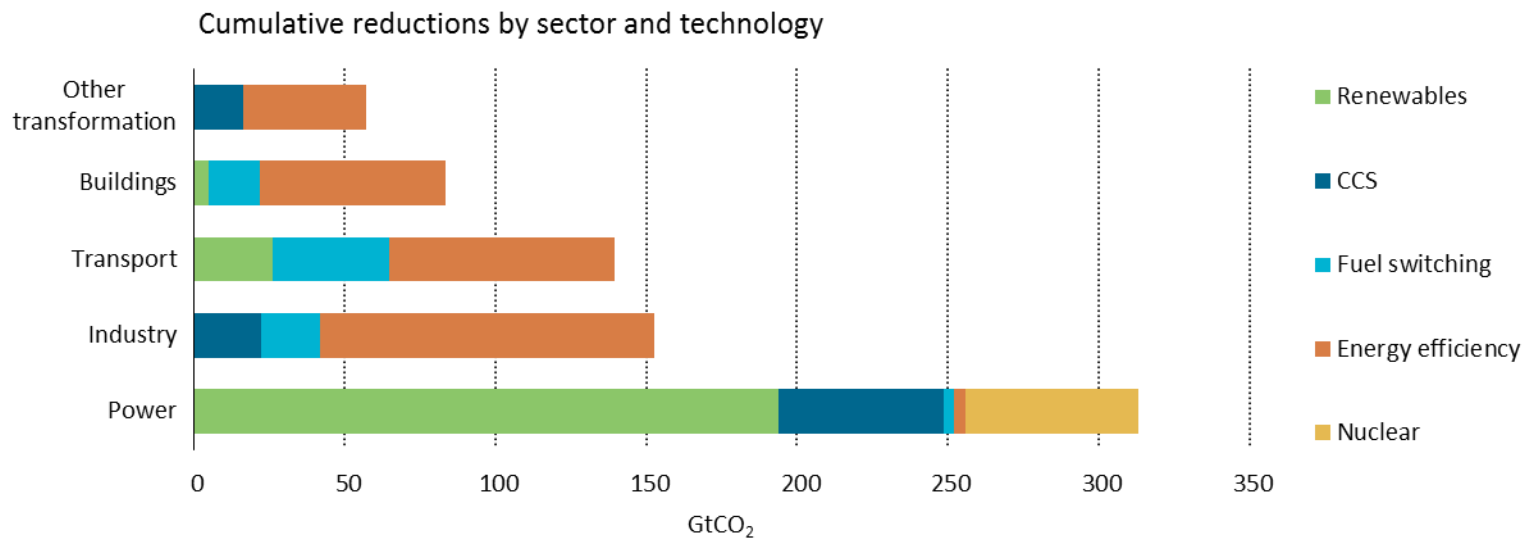
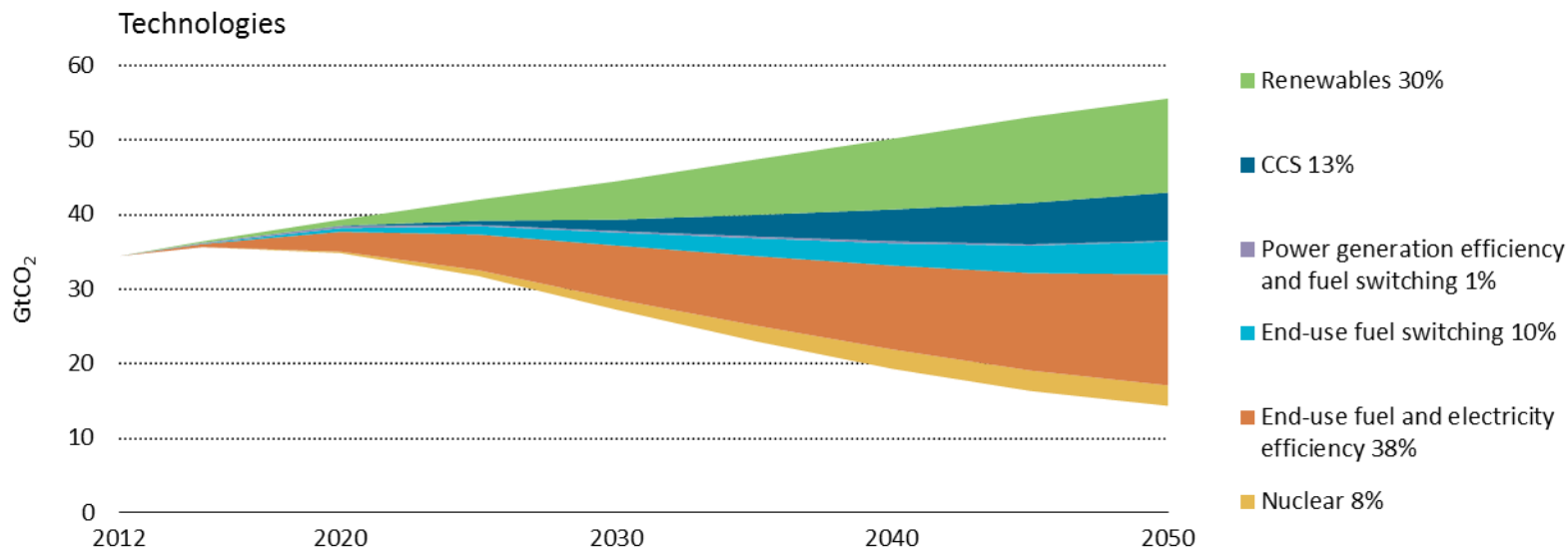
What would a 2DS world look like?



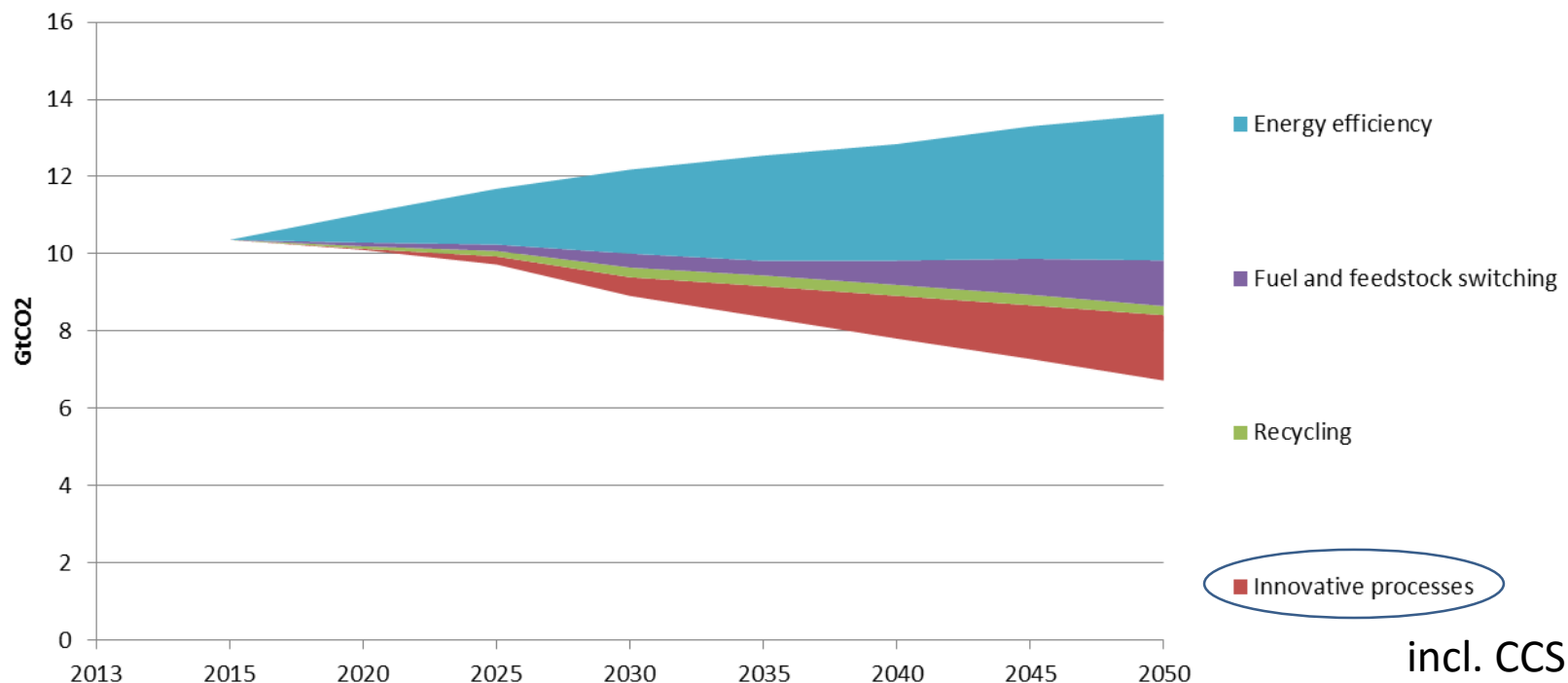
Global energy system in the 2DS 2050

How do we get there?

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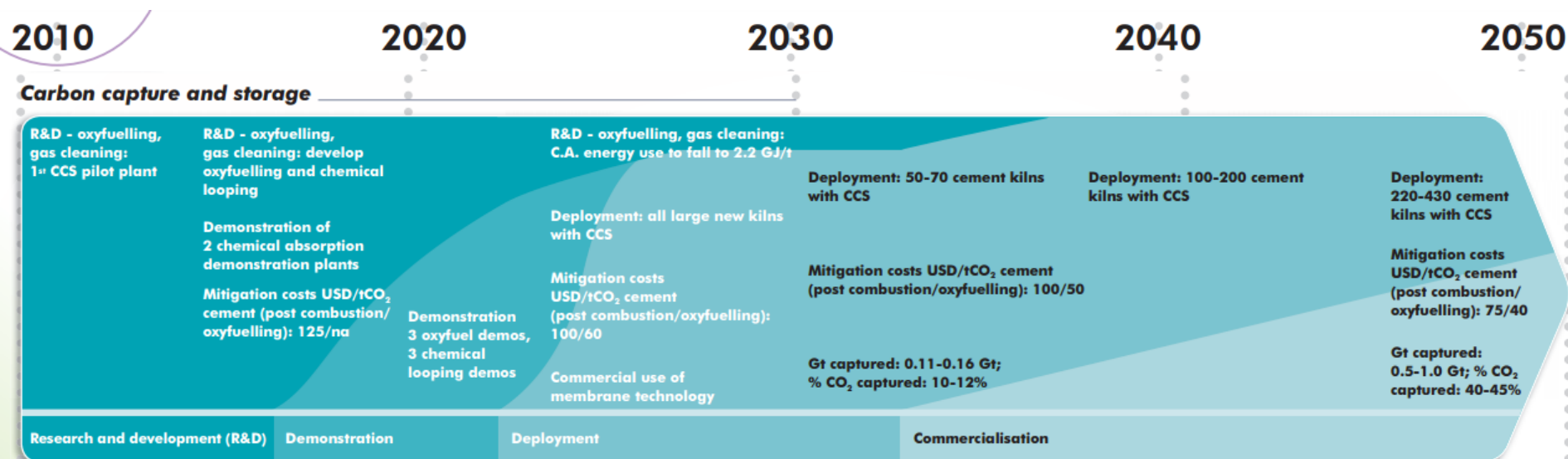
Direct CO₂ emissions reductions in industry, 6DS-2DS



- Innovative low-carbon processes in the industrial sector, including CCS, account for more than 200 MtCO₂ of CO₂ emissions reductions by 2020, and nearly 1.7 GtCO₂ by 2050**

Cement Technology Roadmap 2009

- Not on track to meet roadmap milestones for CCS
- 3 oxyfuel demos & 3 chemical looping demos by 2020
- Scaling up of CCS and significant cost reductions in oxyfuelling by 2030; widespread deployment by 2040
- Further improvements in cost and deployment through 2050



Global Action to Advance Carbon Capture and Storage

A Focus on Industrial Applications



Technology Roadmap

Carbon capture and storage



SUPPORTED BY



DEPLOYMENT OF CCS IN THE CEMENT INDUSTRY

Report: 2013/19
December 2013

INTERNATIONAL ENERGY AGENCY
WORKSHOP REPORT 2013

Methods to assess geologic CO₂ storage capacity: status and best practice

INTERNATIONAL ENERGY AGENCY
WORKSHOP REPORT 2015

Wolf Heidug

7th IEA International CCS Regulatory Network Meeting

Project permitting, enhanced oil recovery and the 'Road to Paris'



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Tristan Stanley

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- CCS plays a major role in the IEA's low-carbon scenario modelling – and industrial CCS is key
 - Individual technologies are well understood and in some cases technologically mature – but large-scale demonstration is needed
 - Incentive structures and regulatory frameworks must be put in place to ensure near-term action on CCS, as well as storage and transport infrastructure

Technology Roadmap
Carbon capture and storage

2013 edition

Global Action to Advance CCS: A Focus on Industrial Applications

www.iea.org

Global Action to Advance
Carbon Capture and Storage

A Focus on Industrial Applications



- **CCS is a critical decarbonisation option for many energy-intensive industries**
- **Public sector stakeholders should engage industry to tackle common CCS challenges and overcome competitiveness impacts of CCS**
- **Accelerate commercial-scale demonstration in key industrial sectors**
- **Consider global competitiveness of industrial sectors**

Annex to Tracking Clean Energy Progress 2015



Carbon Capture, Use and Storage (CCUS) Action Plan



Recent IEAGHG work on CCS in industry

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S U P P O R T E D B Y



- Iron & steel CCS study (Techno-economics integrated steel mill) – 2013
- Deployment of CCS in the Cement Industry – 2013
- CO₂ Capture in the Cement Industry: Technical Report – 2008
- Ongoing analysis on pulp & paper
- Updates to these types of analysis would be very useful

DEPLOYMENT OF
CCS IN THE CEMENT
INDUSTRY

Report: 2013/19

December 2013

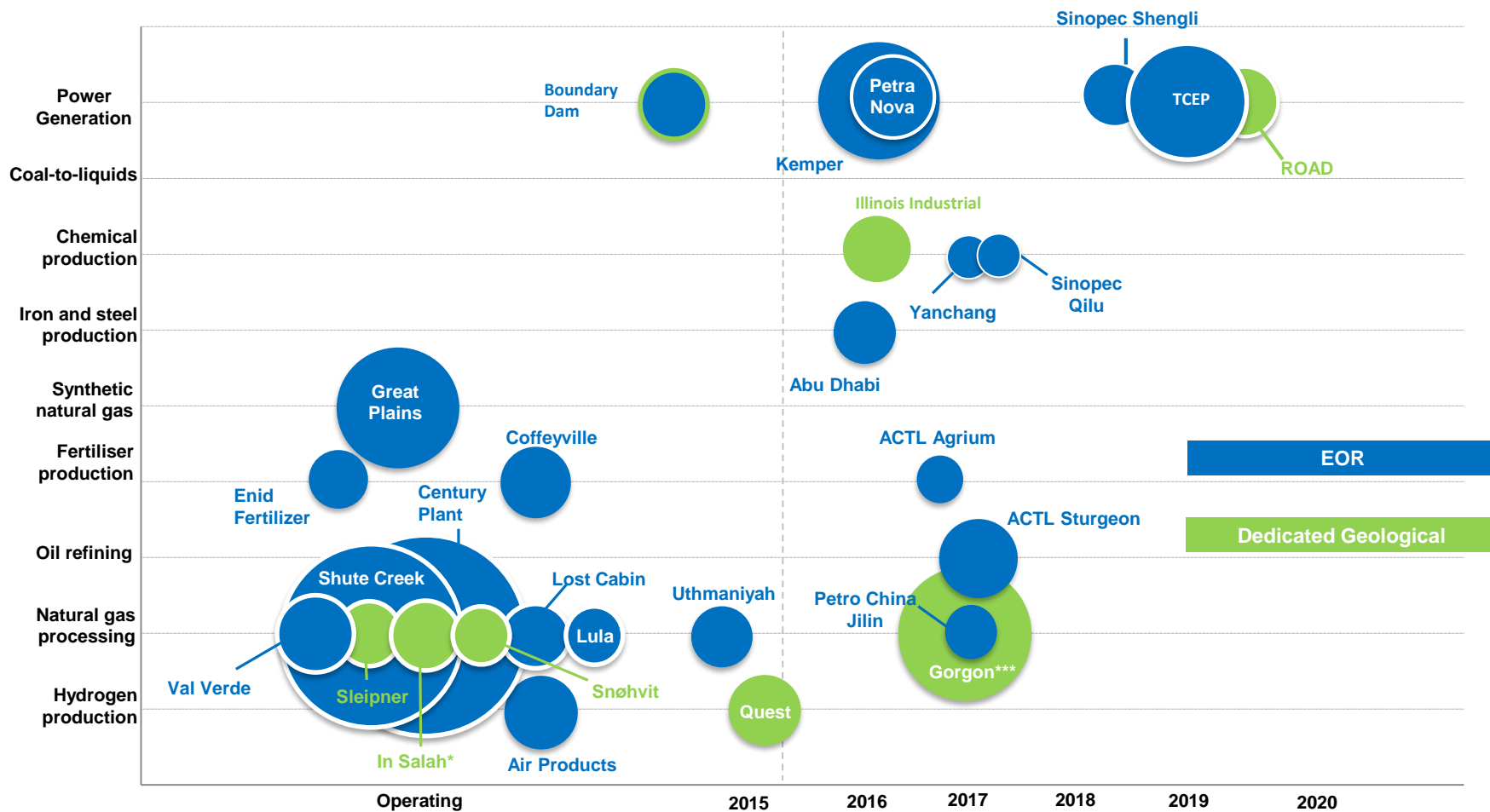
CCS project update: Norway – Sundvolden-erklæringen

- Gassnova has decided to progress with 3 CO₂ capture projects following feasibility studies, including detailed FEED studies
- Projects in cement (Brevik plant), ammonia, and waste-to-energy sectors
- Geological storage with ship transport
- Investment decisions to be made in 2019
- Full-scale CCS project to be realized in 2022
- Norwegian government responsible for transport & storage - cost of feasibility studies, FEED and concept design shared between public and private sector partners

- Corn-to-ethanol plant with 350 million gallon/yr capacity
- 1 MtCO₂/yr capture capacity with dedicated geological storage in an onshore saline aquifer
- Pipeline transport (1.6km)
- Operation to begin in 4Q16 or 1A17
- Expands capacity of existing small-scale test operation (Illinois Basin Decatur Project)
- Investment costs covered by ADM with grants from USDOE
 - 68% of estimated project cost of USD 208 million

Current status: CCS projects in operation, construction and advanced planning

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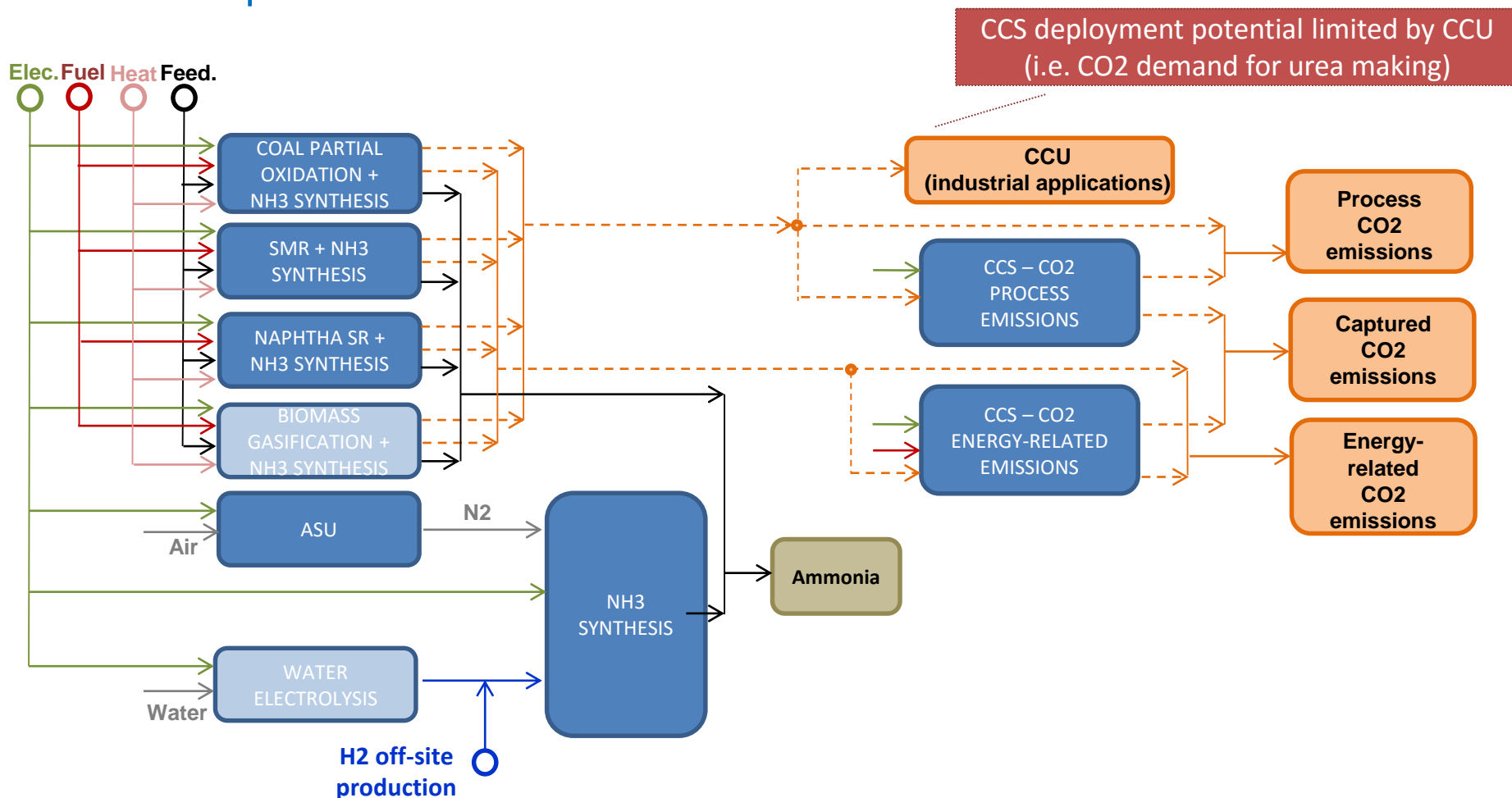
* Injection currently suspended ** Storage options under evaluation

*** Institute estimate

- CCU can provide a commercial incentive to develop CO₂ transport infrastructure where policy drive is absent – could ultimately be shared with CO₂ for permanent storage
- Many potential/existing CCU applications in the industrial sector
 - IEA technology scenario modelling explicitly includes carbon capture in ammonia production for urea and CO₂ use as feedstock for methanol production
 - Applications in food & beverage, agriculture, chemicals, etc.
 - Limited by market size/economic potential

CCU in industry: ammonia/urea production

- IEA technology scenario modelling estimates that in 2014 more than 50% of the CO₂ inherently separated in the production of ammonia was used for urea production



Key actions and recommendations

- **Introduce public-private financial de-risking mechanisms for demonstration and early deployment**
- **Accelerate large-scale demonstration of CCS in industrial applications**
- **Increase efforts to improve public understanding of CCS**
- **Encourage technology learning and cost reductions through continued R&D**
- **Encourage efficient development of transport infrastructure by anticipating locations of demand centres, storage locations and CO₂ emissions volumes**
- **Implement policies to encourage storage exploration and development**



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Thank you!

kira.west@iea.org

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