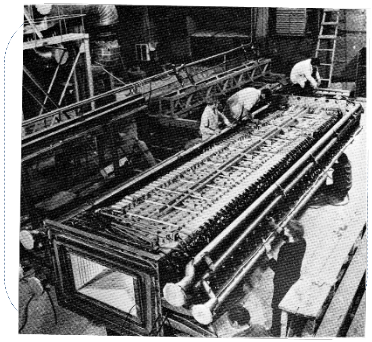
  

Magnetohydrodynamics Power Generation Workshop

October 1, 2014

Dr. Darren J. Mollot

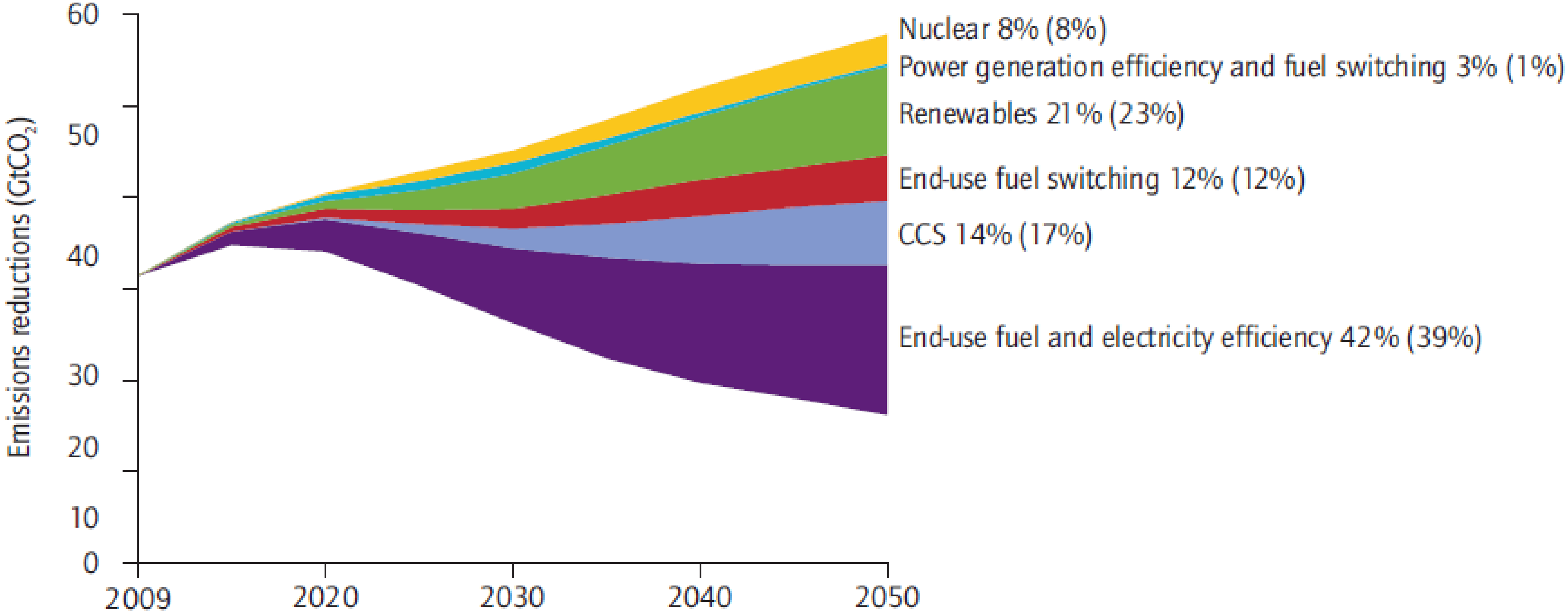
Director, Advanced Fossil Technology Systems

Office of Fossil Energy

U.S. Department of Energy

U.S. DEPARTMENT OF ENERGY | Fossil Energy

IEA CCS Roadmap 2013: Key Technologies for Reducing Global CO_2 Emissions



Lower Cost Carbon Capture is Required to Meet GHG Goal

U.S. DEPARTMENT OF ENERGY | Fossil Energy

Source: IEA Roadmap 2013.
Note: Numbers in brackets are shares in 2050. For example, 14% is the share of CCS in cumulative emission reductions through 2050, and 17% is the share of CCS in emission reductions in 2050, compared with the 6DS.

DOE Office of Fossil Energy Clean Coal Program

DOE/FE's Clean Coal and CCS Mission

Success of the demos

- Serial # 1 in operation 2013-2018
- A deep and rich set of public learning

R&D – Making CCS technology widely adopted

- Intrinsic Capture of CO2 e.g. Advanced combustion
- Dramatic reductions in size, reliability, and cost
- Ensure storage is safe and permanent

New mode: delivering solutions

Integrated Fossil Energy Solutions

Advanced Combustion

5 MWE Oxycombustion Pilot

- ❑ Pressurized
- ❑ O_2 membrane
- ❑ Chemical looping
- ❑ USC Materials

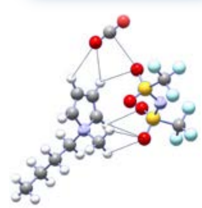
Advanced Energy Systems

- ❑ Gasification
- ❑ Turbines
- ❑ Supercritical CO_2
- ❑ Direct Power Extraction

Advanced Turbines

Efficiencies > 45%
↓ Capital Cost by 50%
\$10 - \$40/tonne CO_2 Captured
Near-zero GHGs
Near-zero criteria pollutants
Near-zero water usage

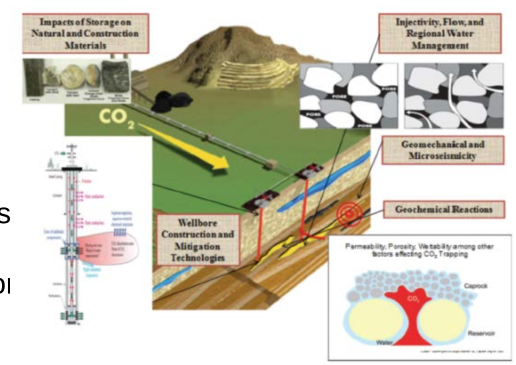
Advanced CO_2 Capture and Compression



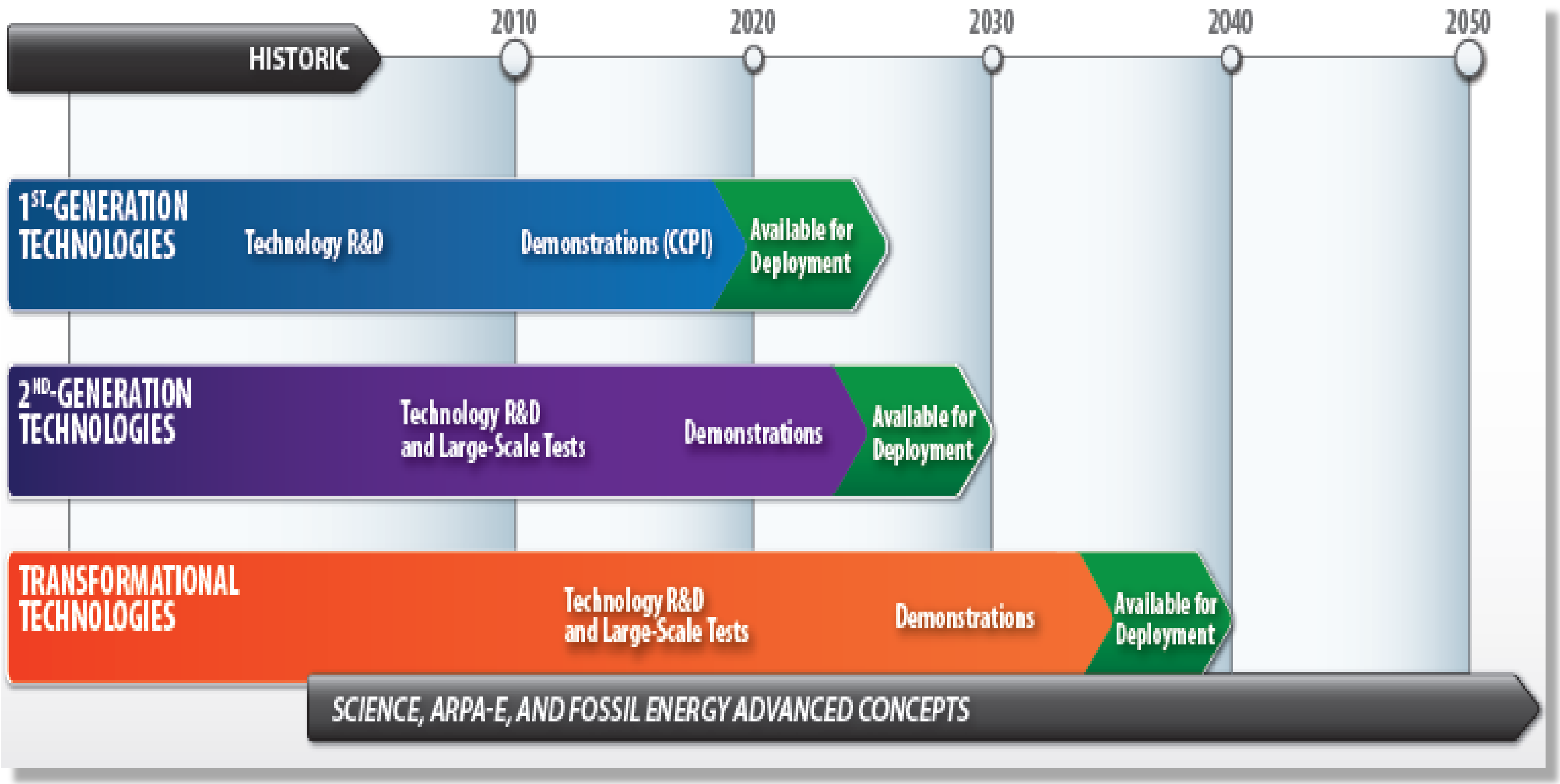
- ❑ Solvents
- ❑ Sorbents
- ❑ Membranes
- ❑ Hybrid
- ❑ Process Intensification
- ❑ Cryogenic Capture

CO_2 Storage

- ❑ Carbon Utilization (EOR)
- ❑ Infrastructure (RCSPs
- ❑ Geological Storage
- ❑ Monitoring, Verificatio and Accounting



A technology pipeline for affordable CCS



We need more 2nd generation pilots!

U.S. DEPARTMENT OF ENERGY | Fossil Energy

Why Take a Fresh Look at MHD?

What has changed in 25 years

Legacy MHD program	Today	Comments
No CO_2 capture	CO_2 Capture	Oxy-fuel combustion developed for capture enables MHD.
Large demos	Simulation & validation	Validated models for different generator concepts, not demos.
Pre-heated air	Efficient oxygen production	ASU power requirements have dropped 40% since 1990.
SOx and NOx control	Capture GPU	No emissions! Use oxy-fuel gas processing unit (GPU).
Magnets < 6 Tesla	Magnets > 6 Tesla	Advanced magnets exist today.
Analog electronics	Solid-state inverters/control	Electrode arcing could be controlled with digital devices.
Linear generator	Radial, Linear, others	Simulations can compare multiple geometries.
Conventional manufacturing	Advanced manufacturing	New channel construction approaches.
Seeded flows	New goal: injected plasma	Aspirational – use nanosecond pulse discharge to ionize gas ?

Why This Workshop is Important

- Get current status of technology
- Understand some over arching issues
- Identify synergies with current program e.g. O2 separation, simulation tools
- Fuel Collaboration – need to bring best minds together

Next Steps: Crawl/Walk/Run

- SOTA - Summarize what was learn at workshop
- Assess potential to meet efficiency and CCS goals
- Develop a program plan with path forward.