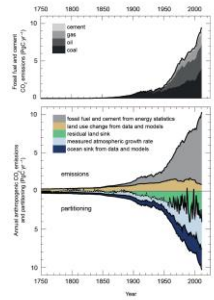
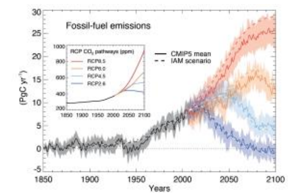
CURRENT SITUATION OF CARBONE CAPTURE AND STORAGE (CCS) TECHNOLOGIES IN POWER PLANTS

Klaudia BUZEA

International conference „Environmental safety issues in EU programme"
Miskolc-Lillafüred, 19/10/2015

WHY DO WE NEED TO REDUCE CO_2 EMISSION?



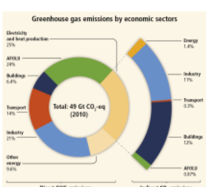


Limit of 2 °C?
Limit of 1.5 °C?

IPCC, 2014: Climate Change 2014: Synthesis Report

HOW CAN WE REDUCE CO_2 EMISSION?

Reducing the demand for energy | Changing the methods of energy production

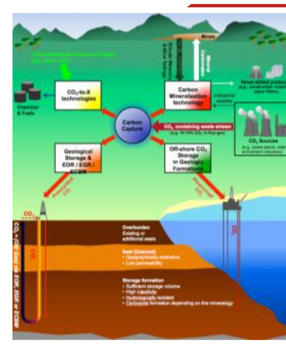


IPCC, 2014: Climate Change 2014: Synthesis Report

- Improving efficiency
  - Demand side
  - Supply side
  - Production side
- Fuel switching
  - Lower C/H ratio
  - Nuclear energy
  - Renewable energy
- CCUS
  - Usage
  - Storage

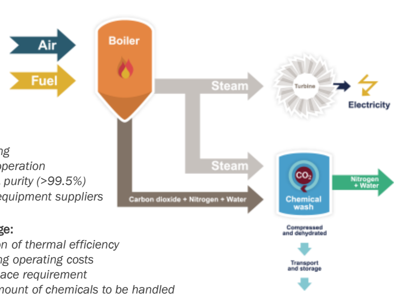
CCUS

- Carbon
- Capture
- Usage
- Storage



http://blogs.ei.columbia.edu

POST-COMBUSTION CCS



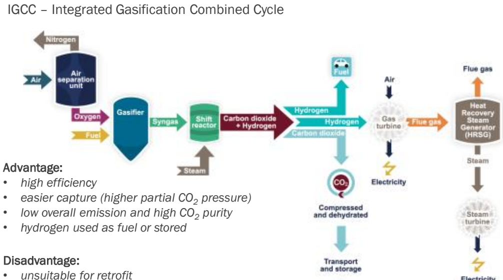
Advantage:
- *retrofitting*
- *flexible operation*
- *high CO_2 purity (>99.5%)*
- *several equipment suppliers*

Disadvantage:
- *Reduction of thermal efficiency*
- *Increasing operating costs*
- *Large space requirement*
- *Large amount of chemicals to be handled*

www.zeroemissionsplatform.eu

PRE-COMBUSTION CCS

IGCC – Integrated Gasification Combined Cycle

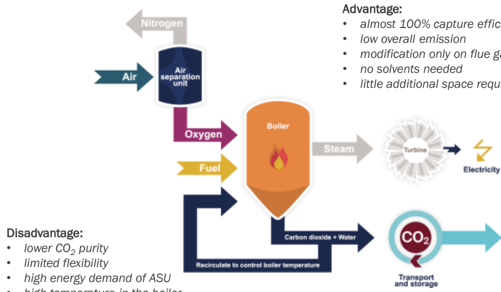


Advantage:
- *high efficiency*
- *easier capture (higher partial CO_2 pressure)*
- *low overall emission and high CO_2 purity*
- *hydrogen used as fuel or stored*

Disadvantage:
- *unsuitable for retrofit*
- *high energy demand of ASU and gasifier*
- *complex equipment, limited flexibility*
- *advanced hydrogen turbine*

www.zeroemissionsplatform.eu

OXYFUEL CCS



Advantage:

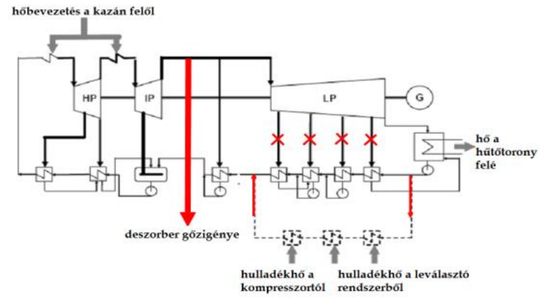
- almost 100% capture efficiency
- low overall emission
- modification only on flue gas side
- no solvents needed
- little additional space required

Disadvantage:

- lower CO_2 purity
- limited flexibility
- high energy demand of ASU
- high temperature in the boiler

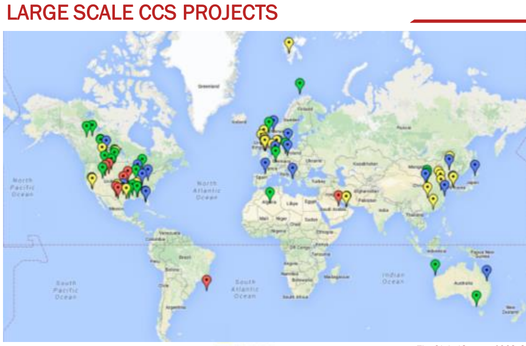
www.zeroemissionsplatform.eu

SEPARATION METHODS



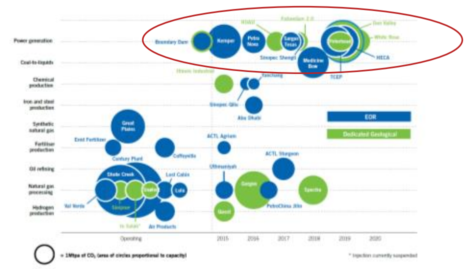
www.energy.siemens.com

LARGE SCALE CCS PROJECTS



The Global Status of CCS: 2014
www.globalccsinstitute.com

LARGE SCALE CCS PROJECTS



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LARGE SCALE CCS PROJECTS

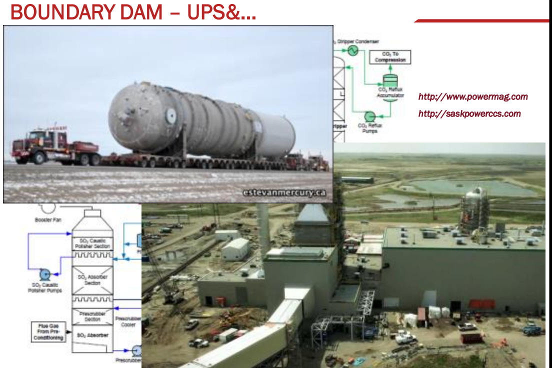
Project name	Location	Operation date	Capture type	Plant size MW	Capture capacity Mtpa	Storage type
Boundary Dam	Canada	2014	Post	110	1.0	EOR
Kemper	USA	2016	Pre	582	3.0	EOR
Petra Nova	USA	2016	Post	250	1.4	EOR
Sinopec Shengli	China	2018	Post	250	1.0	EOR
Haifeng	China	2019	Post	2000	1.0	Geological Storage
TCEP	USA	2019	Pre	400	2.4	EOR
Don Valley	UK	2020	Pre	650	1.5	Geological Storage
Huaneng GreenGen	China	2020	Pre	400	2.0	EOR
HECA	USA	2020	Pre	405	2.7	Under evaluation
Korea-CCS 1	South Korea	2020	Post	300	1.0	Geological Storage
Shanxi	China	2020	Oxyfuel	350	2.0	Not specified
Caledonia	UK	2022	Pre	570	3.8	Geological Storage
Korea-CCS 2	South Korea	2023	-	500	1.0	Geological Storage
Peterhead	UK	2019-20	Post	385	1.0	Geological Storage
ROAD	Netherlands	2019-20	Post	250	1.1	Geological Storage
White Rose	UK	2020-21	Oxyfuel	426	2.0	Geological Storage

http://www.globalccsinstitute.com/projects/large-scale-ccs-projects

PILOT PROJECTS

- Wilhelmshaven, Germany
  - Fluor Ecoamine FG Plus
  - MEA
  - 747 MW_e/3.5 MW_e , 70 tpd
  - Petra Nova
- Brindisi, Italy
  - Mitsubishi – KEPCO KM-CDR
  - KS-1
  - 60 tpd
- Plant Barry, USA
  - Mitsubishi – KEPCO KM-CDR
  - 770 MW_e/25 MW_e
- Le Havre, France
  - Alstom AAP, Ucarsol FGC 300
  - 600 MW_e/5 MW_e
- AEP Mountaineer , USA
  - Alstom CAP
  - 1300 MW_e 1.5%
  - We Energies Field, USA
  - E.On Karlshamm, Germany

BOUNDARY DAM – UPS&...



http://www.powermag.com

http://saskpowerccs.com

WHITE ROSE, VATTENFALL, FUTUREGEN - ...DOWNS

FutureGen, USA
Overunned costs, DoE cancelled funding
Revised as FutureGen 2.0

White Rose, UK
300 million EUR from NER300
Drax end further investment

Vattenfall, Germany
100 million EUR
Closed all CCS R&D

„it is always cheaper to emit CO_2 to the atmosphere than to capture and store it, markets will only evolve if climate policy is put in place that forces reduction of atmospheric CO_2 emissions" (Howard Herzog)

CROSSROADS...