Second ECRA/CEMCAP workshop
Düsseldorf Nov 6-7, 2017

Commercial use of captured CO_2 and CCU options for the cement industry

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Reference cement plant (CEMCAP D3.2)

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CO_2 avoidance target for 2050

CO2

1,05 Gt/year
IEA target for 2050

90% capture in 1373 reference plants

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Literature review

Market size
2017 and forecasts

Process issues
Energy demand

TRL

1. $CaCO_3$
2. Aggregates
3. Carbonated cement
4. Methanol
5. DME
6. Hydrocarbons (liquids)
7. Methane
8. Ethanol
9. Isopropanol
10. Biodiesel
11. Poly(Propylene Carbonate)
12. Polyols
13. Cyclic carbonates
14. Formic acid
15. CO_2 (utilization and storage)

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Case 1: Polymers

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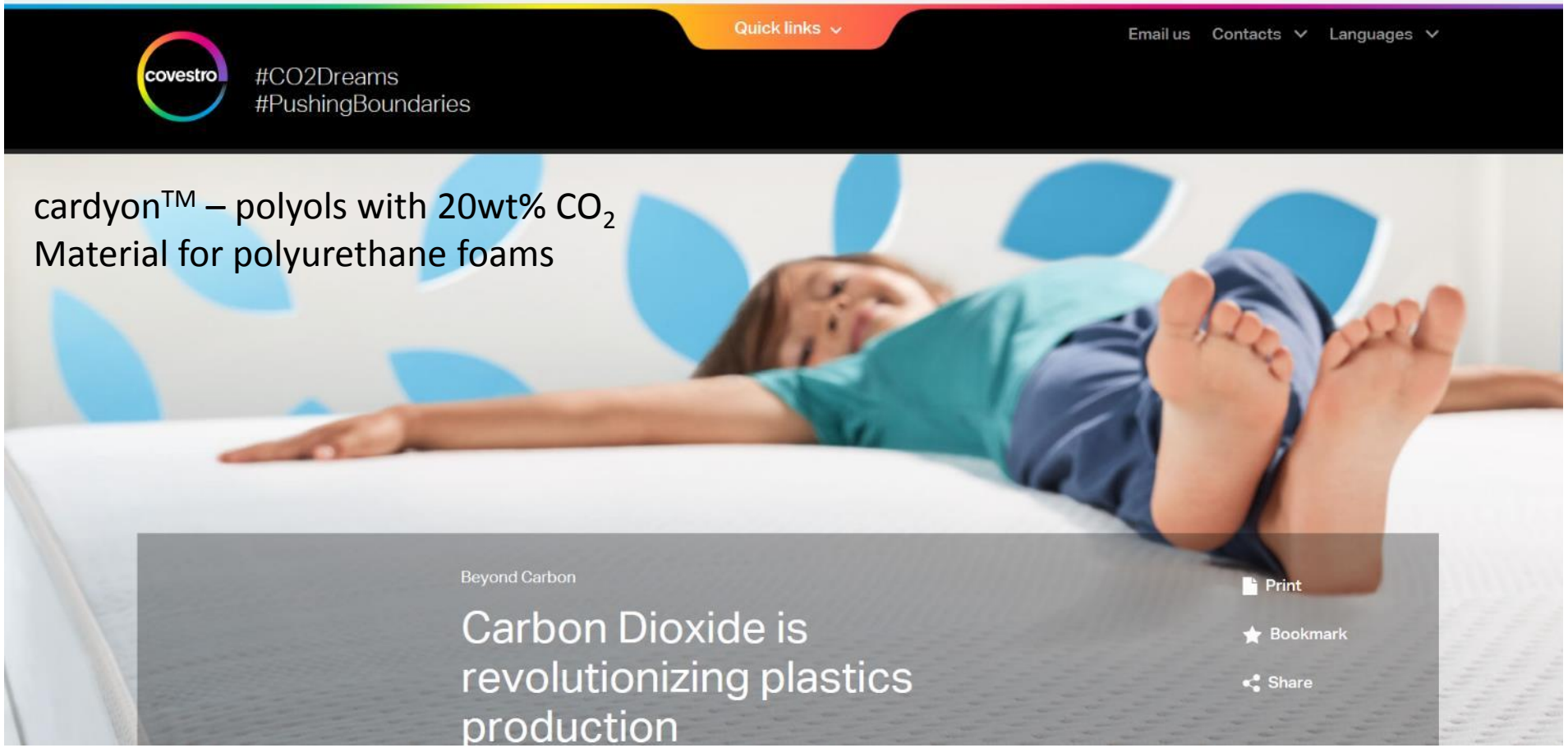
For sustainable dreams



cardyon™ – polyols with 20wt% CO_2
Material for polyurethane foams

https://www.co2-dreams.covestro.com/

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Polyols

Polyols market = 10 Mt/year (2015)

CO_2 uptake potential = 2 Mt/year

2,35 reference plants

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Reference cement plant + polyols plant

7,1%

CO_2

Chemical plant
250 kton/year

polyols

*typical scale 100 kton/year

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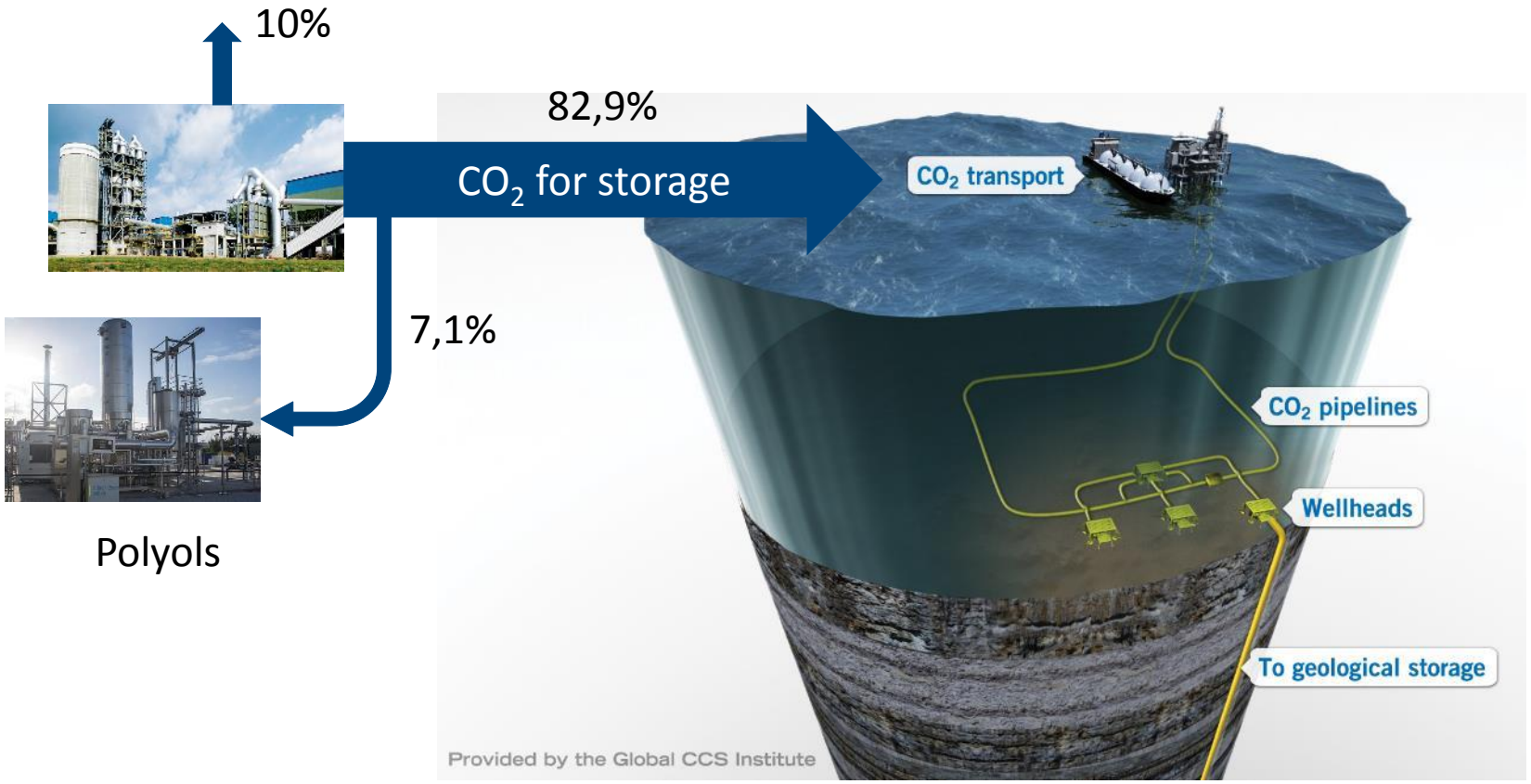
90% Capture → Polyols (7,1%) + Storage (82,9%)



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Reference cement plant + polyols plant

Chemicals
290 M€/y

5 M€/y

CO_2

Chemical plant
20 M€

polyols

0,28 M€/y
Utilities

C. Fernández-Dacosta et al., "Prospective techno-economic and environmental assessment of carbon capture at a refinery and CO2 utilisation in polyol synthesis," J. CO2 Util., vol. 21, no. Supplement C, pp. 405–422, 2017

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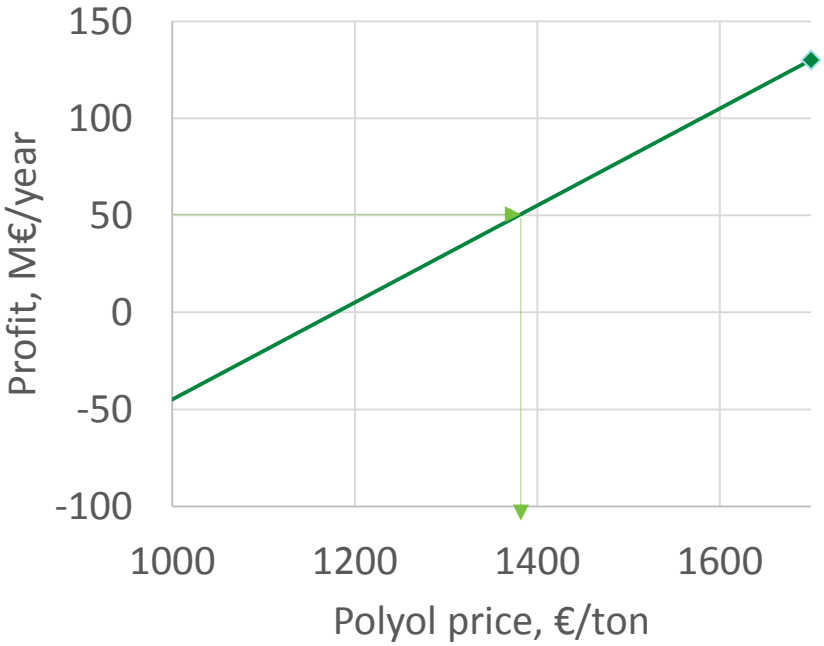
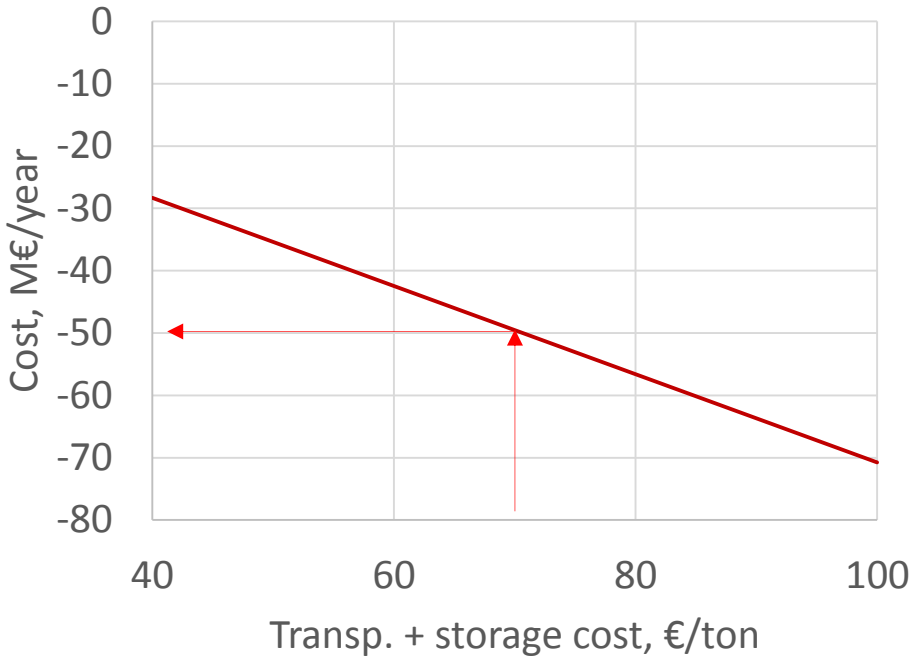
Reference cement plant + polyols + storage





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Conclusions (1)

- High-valued product CCU → limited by market
- Storage → cost dependent on storage site
- CCUS → combined result, may be profitable

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CCUS?

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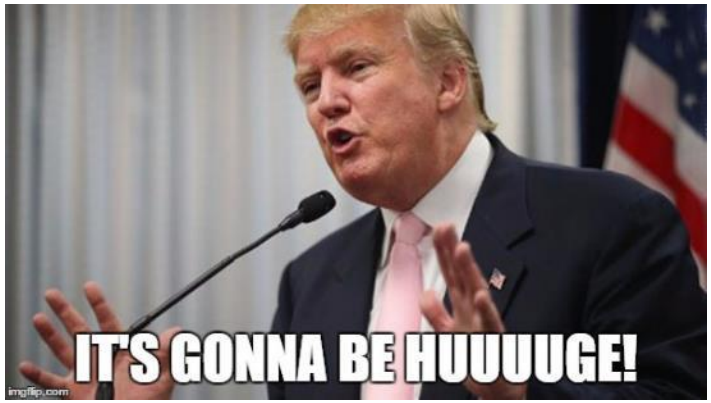
Methane market

CO2

1,05 Gt/year
IEA target for 2050

25%-35% of the global methane production



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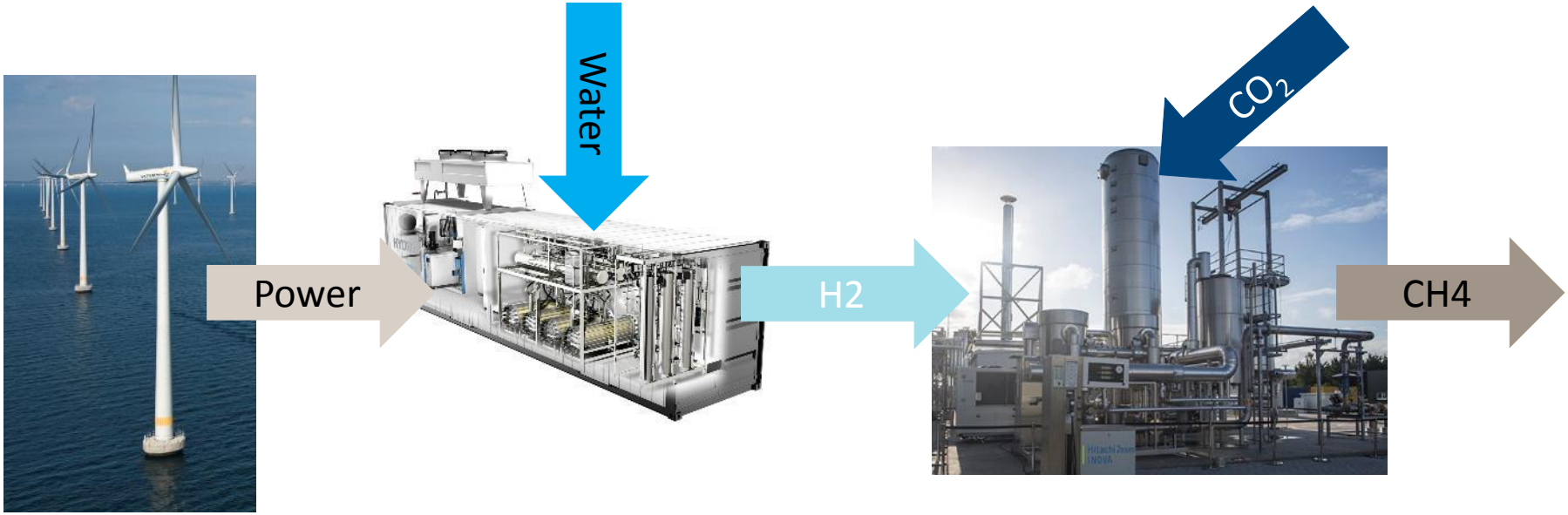
Power to Gas (PtG) concept



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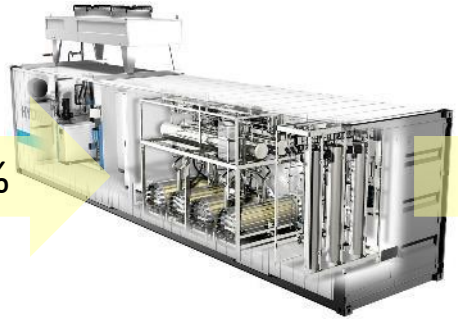
Plant: ETOGAS/Audi e-gas (TRL8)

4 x 3,6 MW = 14,4 MW

ε = 41%



2 x 3 MW = 6 MW

ε = 58%

1000 ton/y (SNG)

CH4

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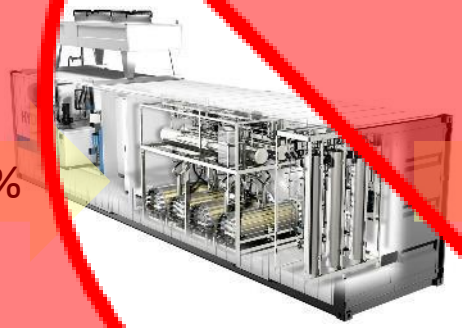
PtG for a cement plant (90% capture)

London Array: largest offshore wind farm
175 turbines = 0,63 GW

91 turbines x 9,5 MW
865 MW

ε = 100%



9 x 100 MW
865 MW

ε = 100%

250 kton/y (SNG)

CO_2

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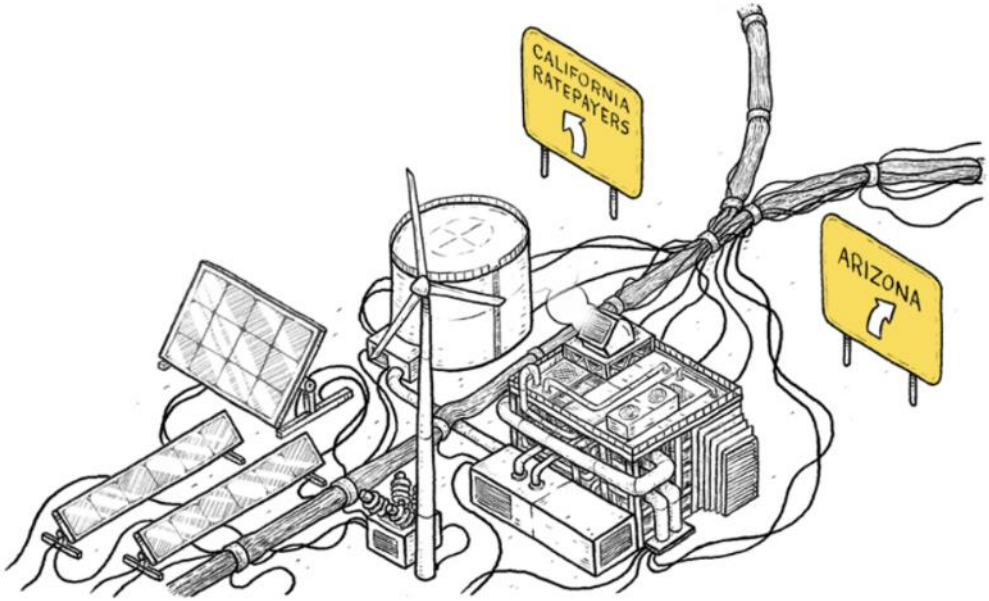
Excess electricity price (zero, negative?)

Los Angeles Times

California invested heavily in solar power. Now there's so much that other states are sometimes paid to take it

By IVAN PENN
JUNE 22, 2017



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90% Capture + PtG + Storage

Wind farm e.g. 1 GW

14,4 MW
Excess electricity

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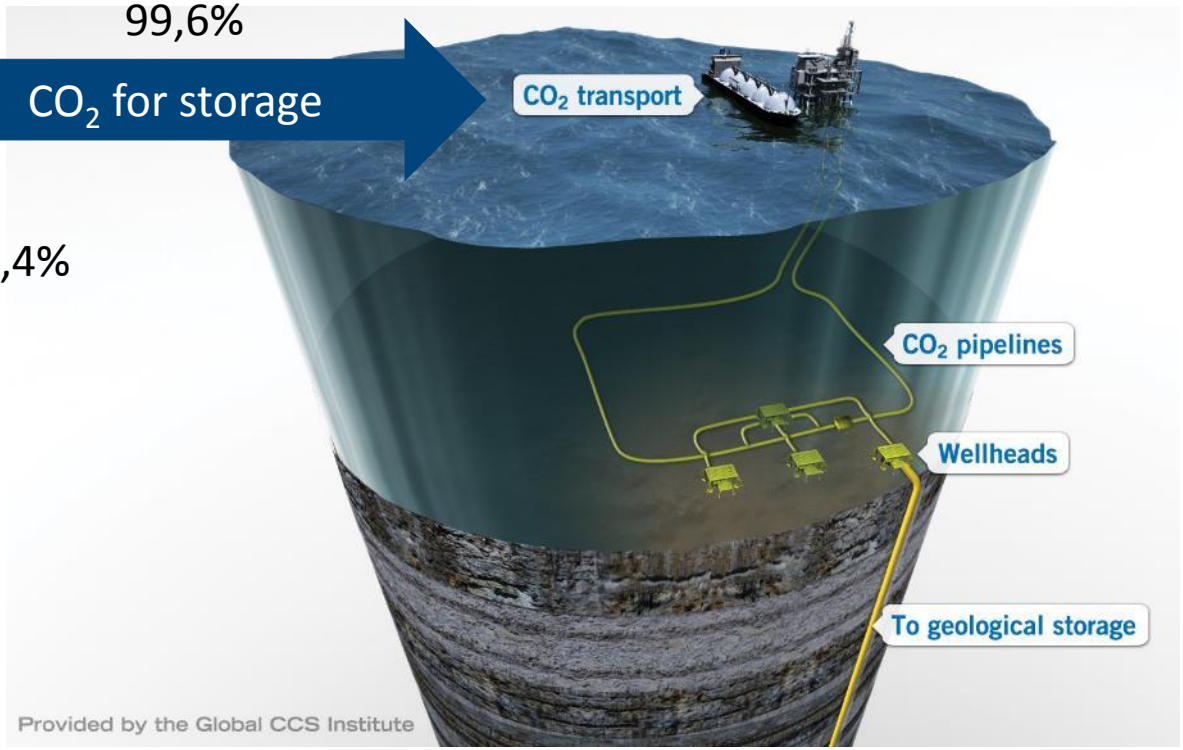
90% Capture + PtG + Storage

99,6%

CO_2 for storage

0,4%

CCU



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Conclusions (2)

Multiple possibilities for combining CCU+S:

A. CCU → profit, cover storage costs
   - High-valued products, small market
   - Energy storage options (fuels)

B. Storage → costs
   - correct for market
   - correct for hydrogen availability

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