



Wir schaffen Wissen – heute für morgen

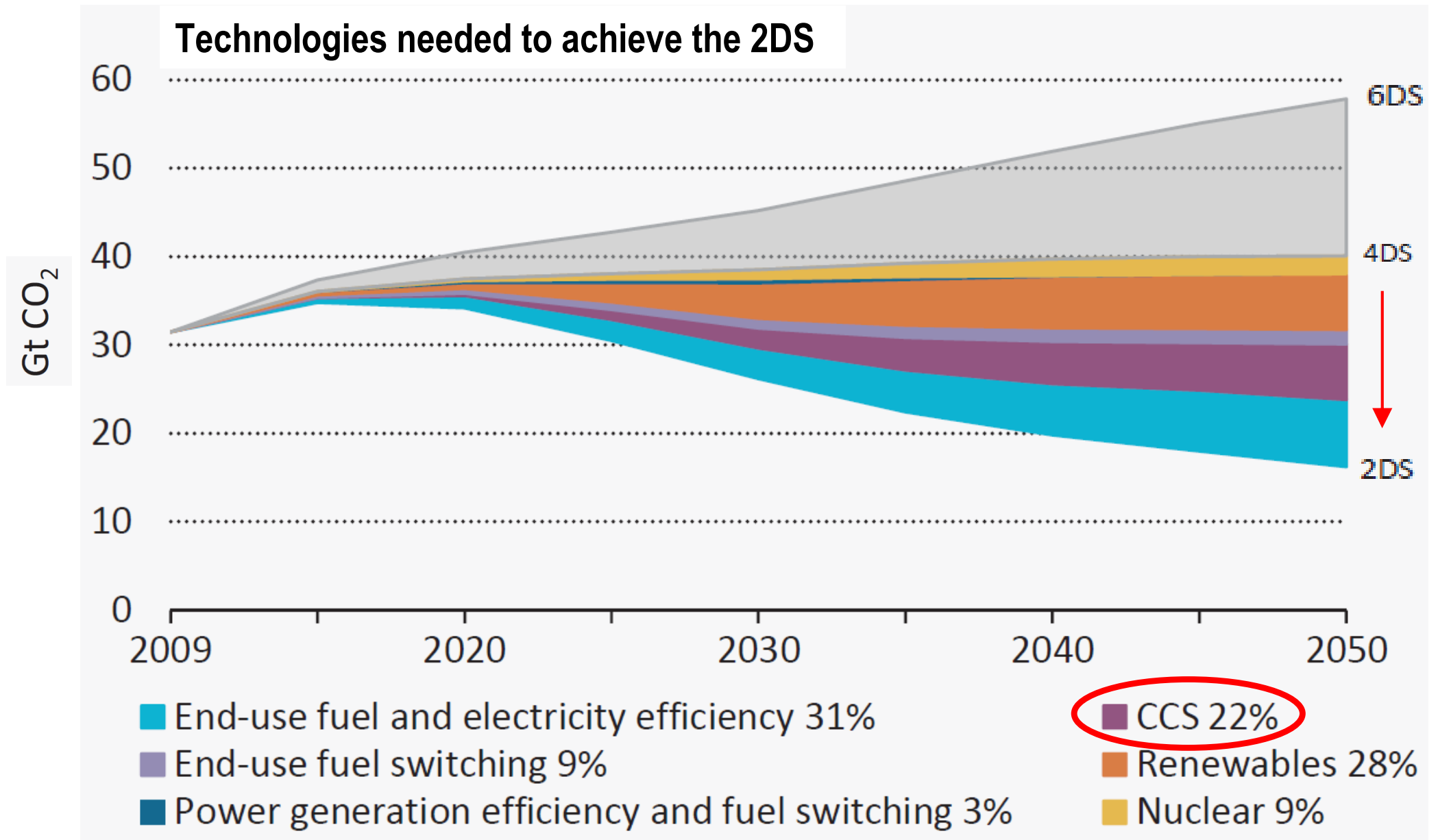
Paul Scherrer Institut

Kathrin Volkart

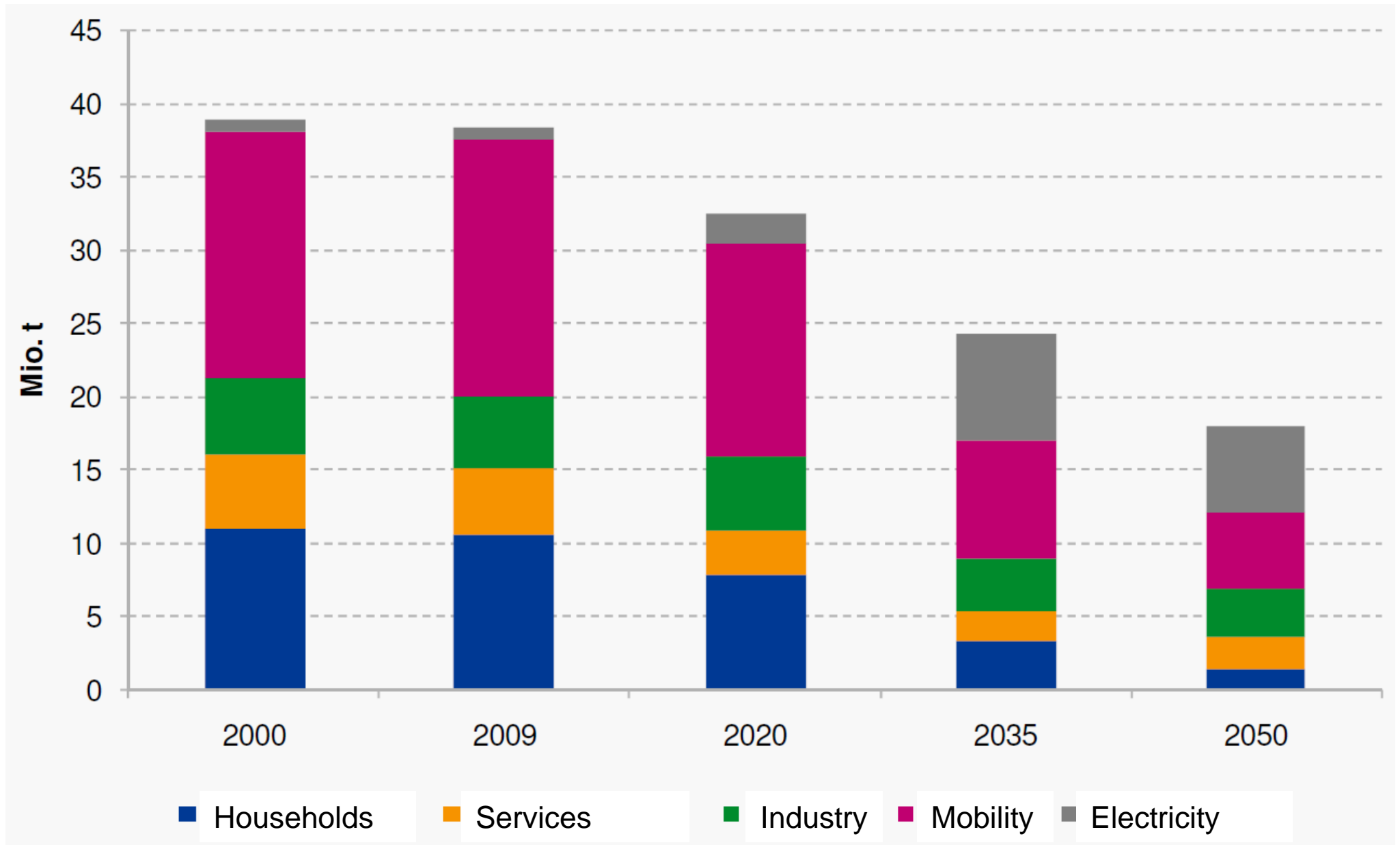
Carbon Capture and Storage –

A future option for Switzerland?

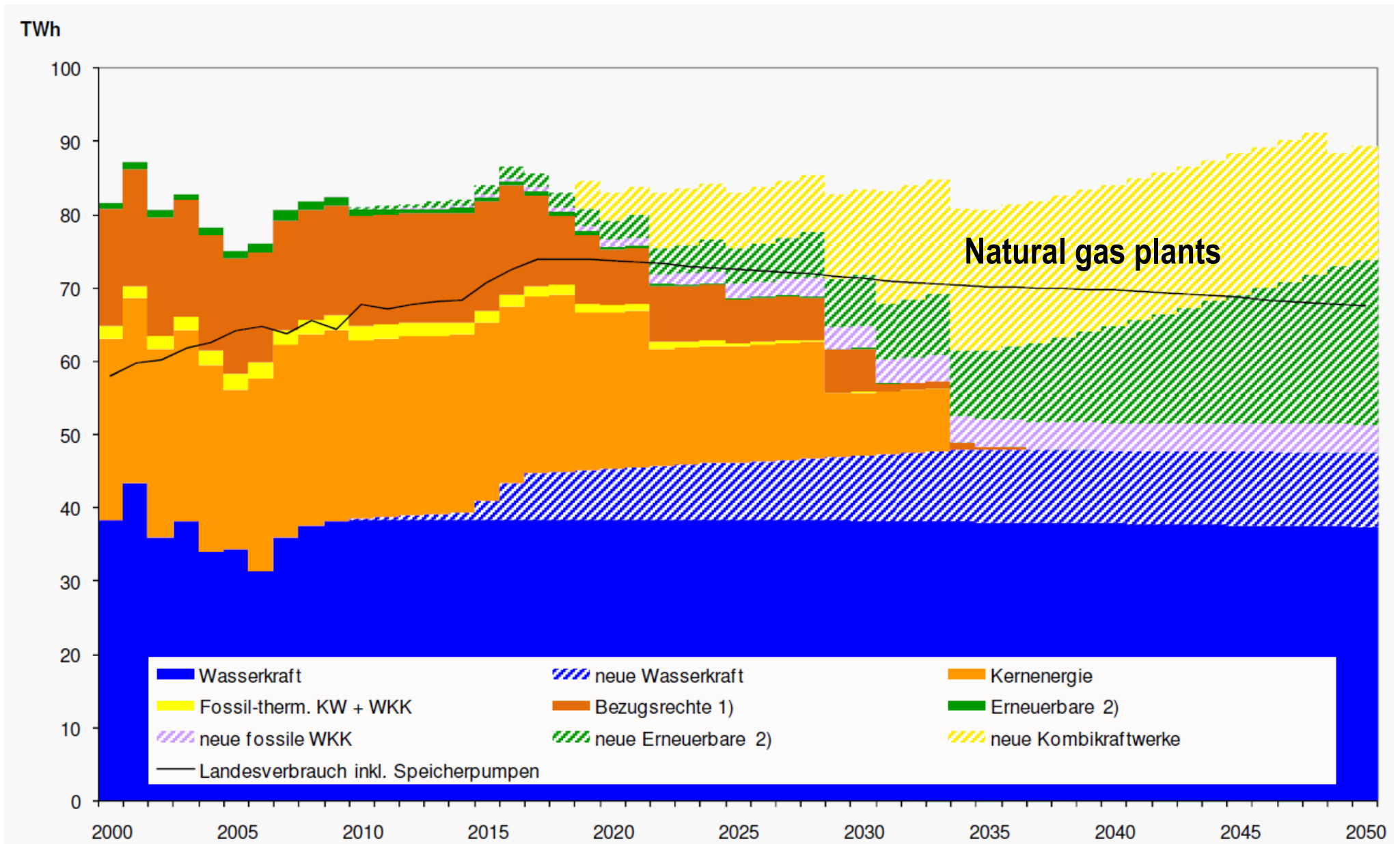
- Introduction
- CCS technology
- Life cycle assessment of CCS
- Conclusions
- Roadmap and CCS pilot project for Switzerland



Source: IEA Energy Technology Perspectives 2012



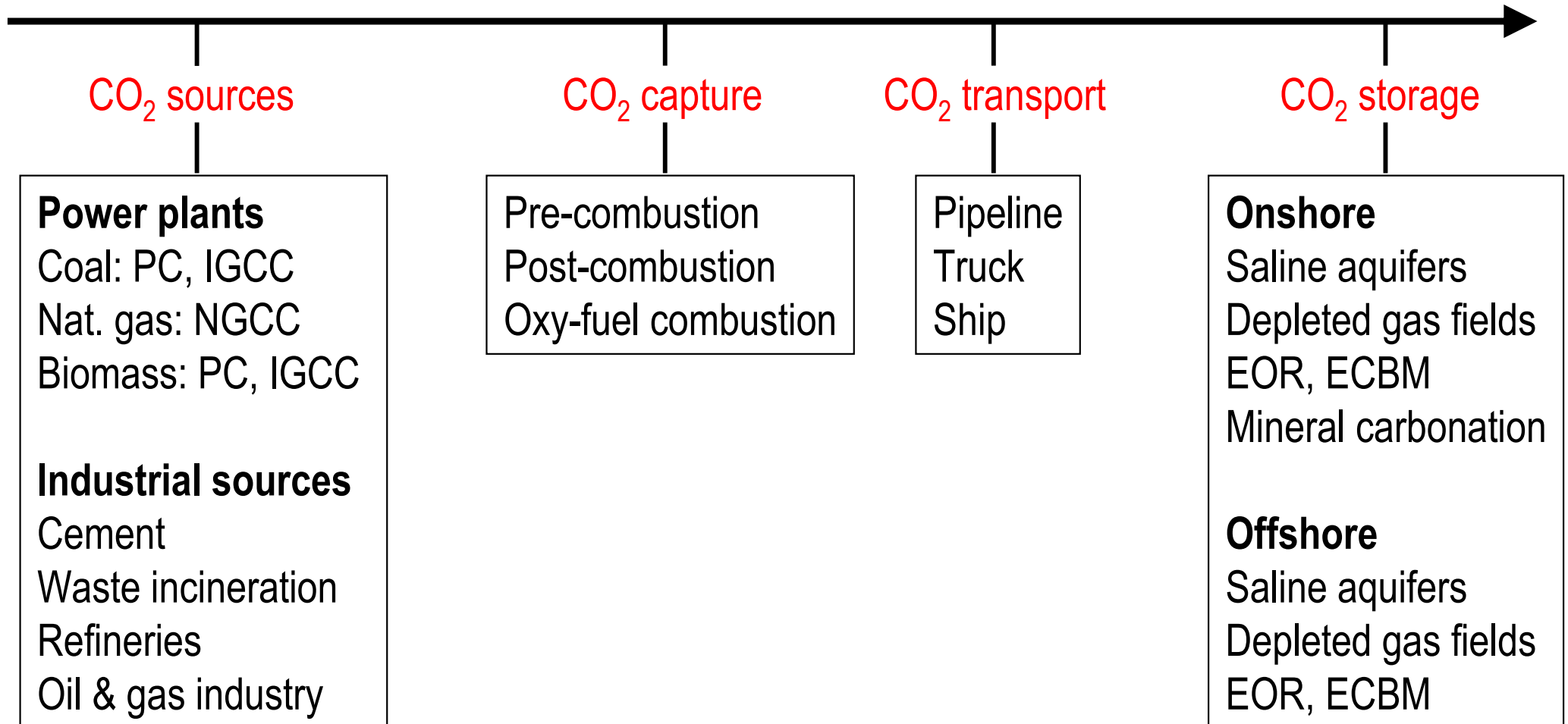
Source: Prognos 2011 (new energy policy, supply 2, option C&E)



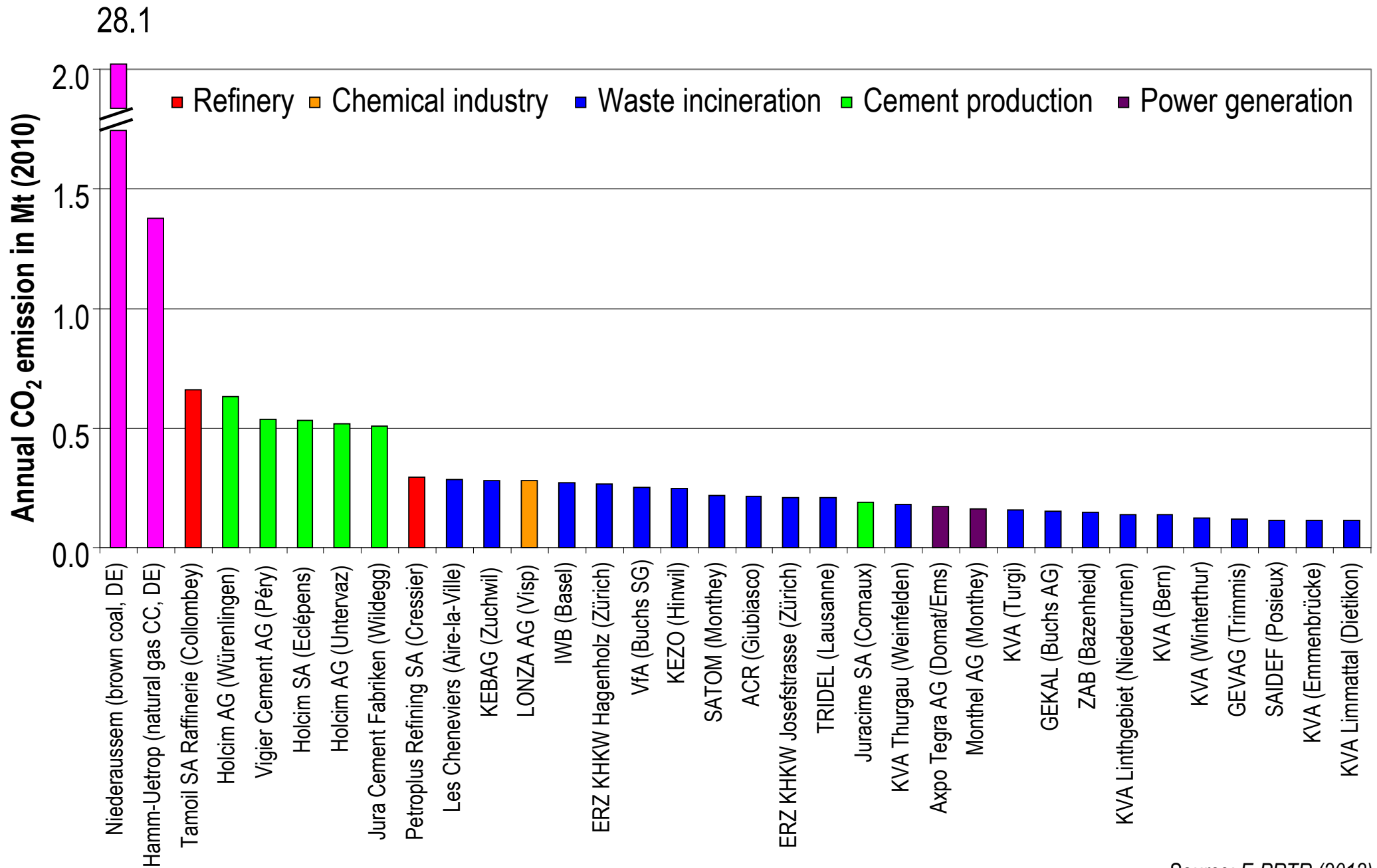
Source: Prognos 2011 (new energy policy, supply 2, option C&E)

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CCS chain






Large Swiss CO₂ point sources (2010)



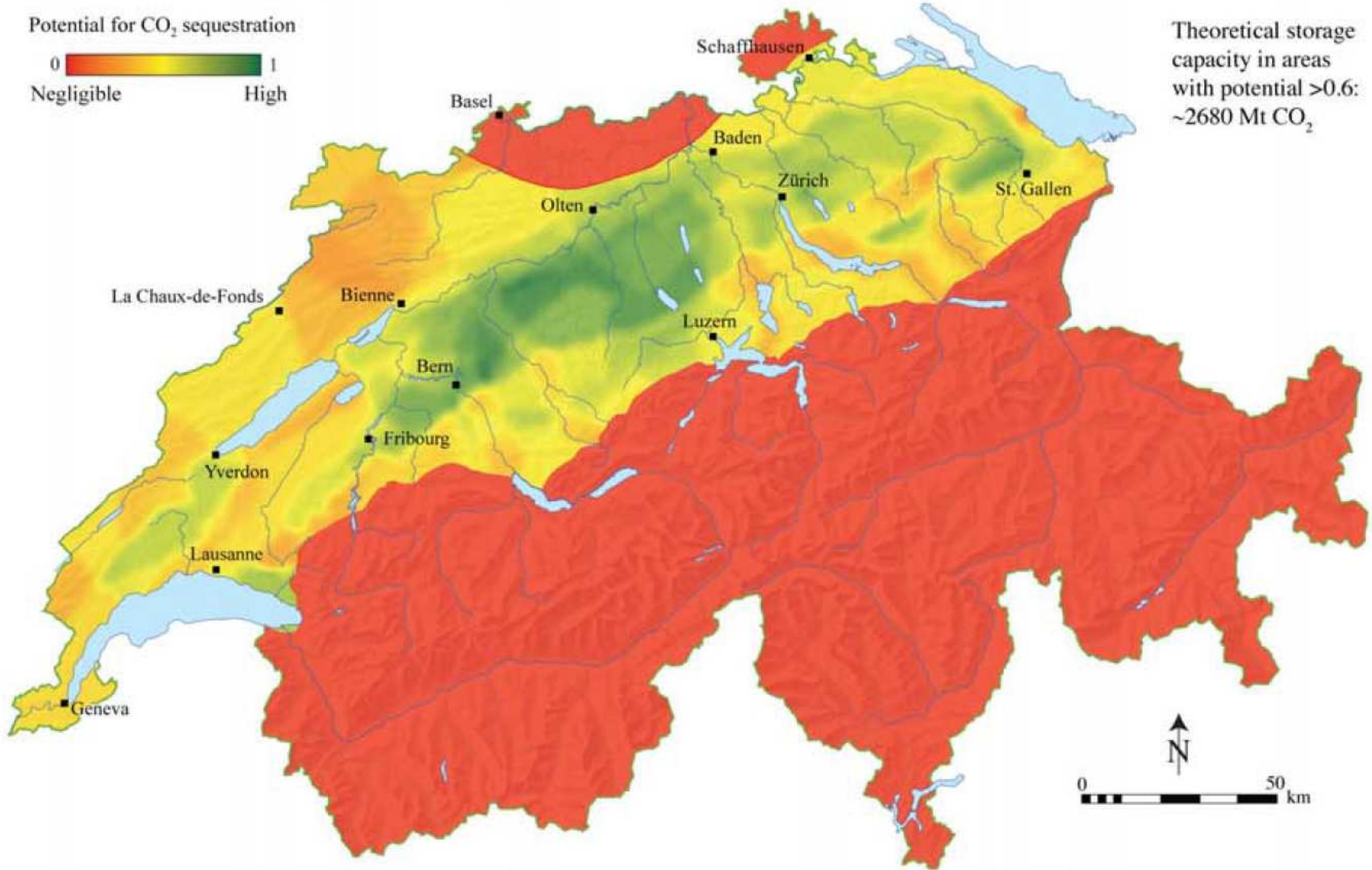
Source: E-PRTR (2012)

Large Swiss CO₂ point sources (2010)

-  Refinery
-  Cement production
-  Waste incineration
-  Chemical industry
-  Power generation

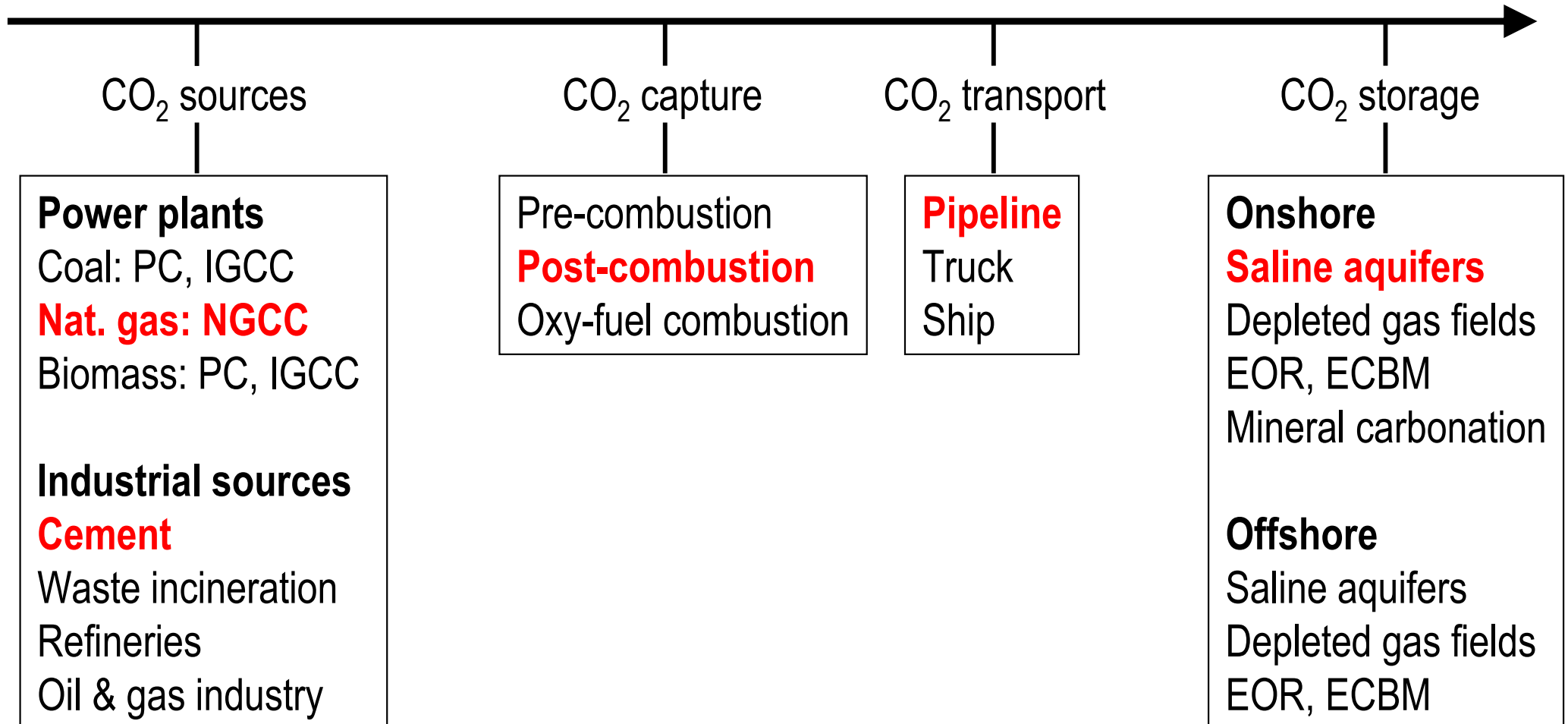


Potential for geological CO₂ storage in Switzerland



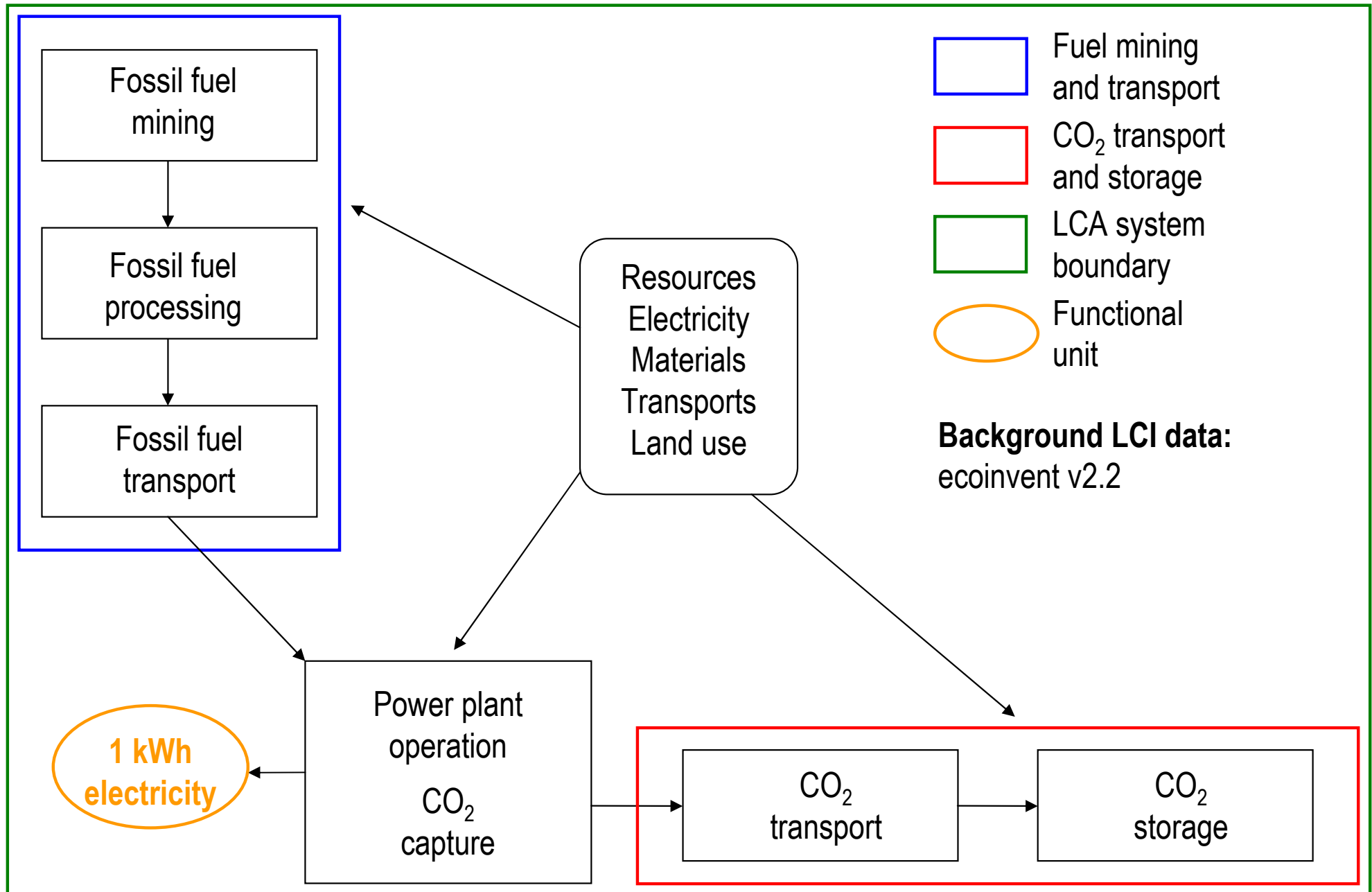
Source: Diamond, Leu et al. (2010)

CCS chain



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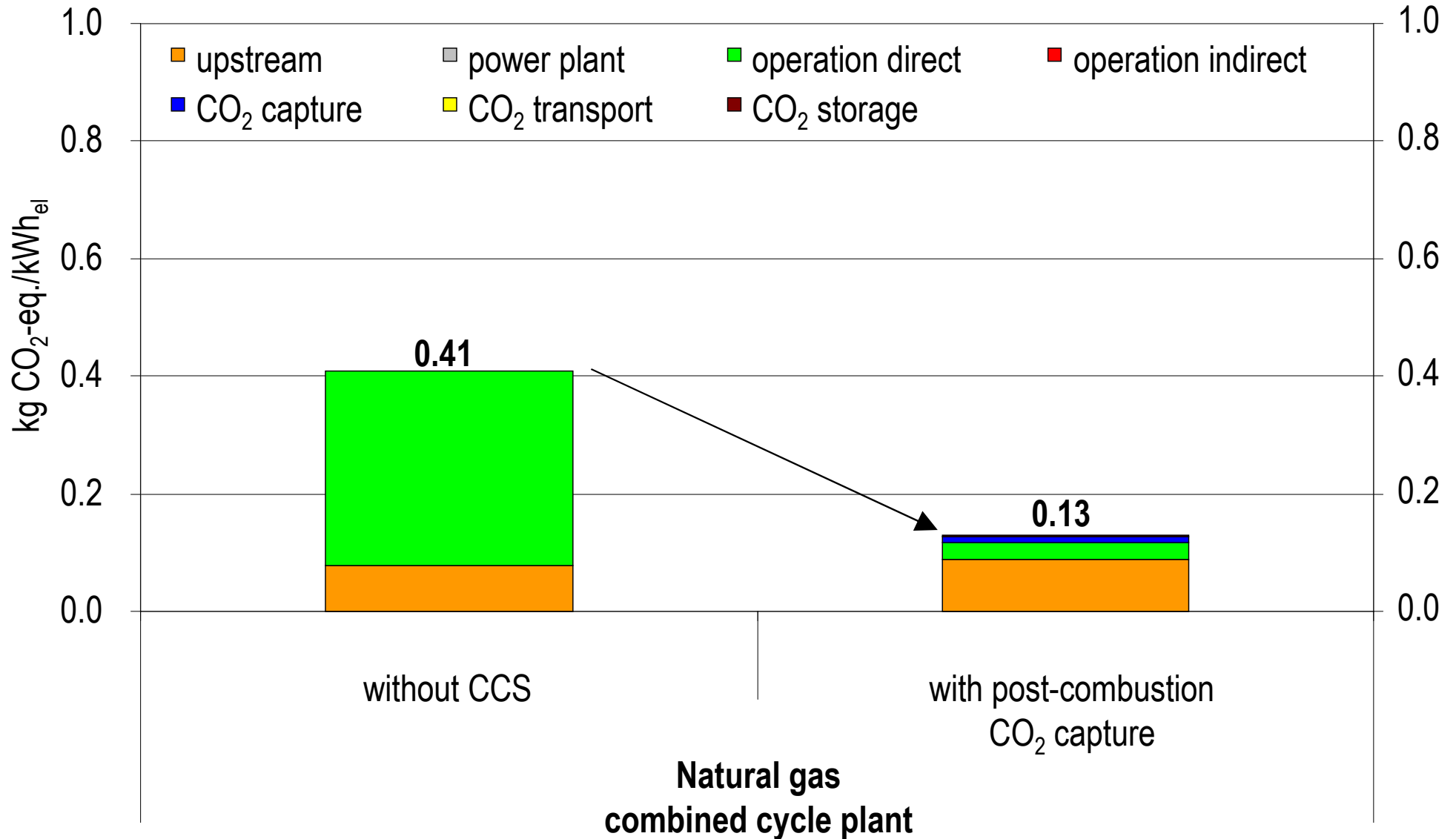
LCA of power generation with CCS: Goal and scope



Source: Volkart, Bauer et al. (2013)

Method: IPCC 2007

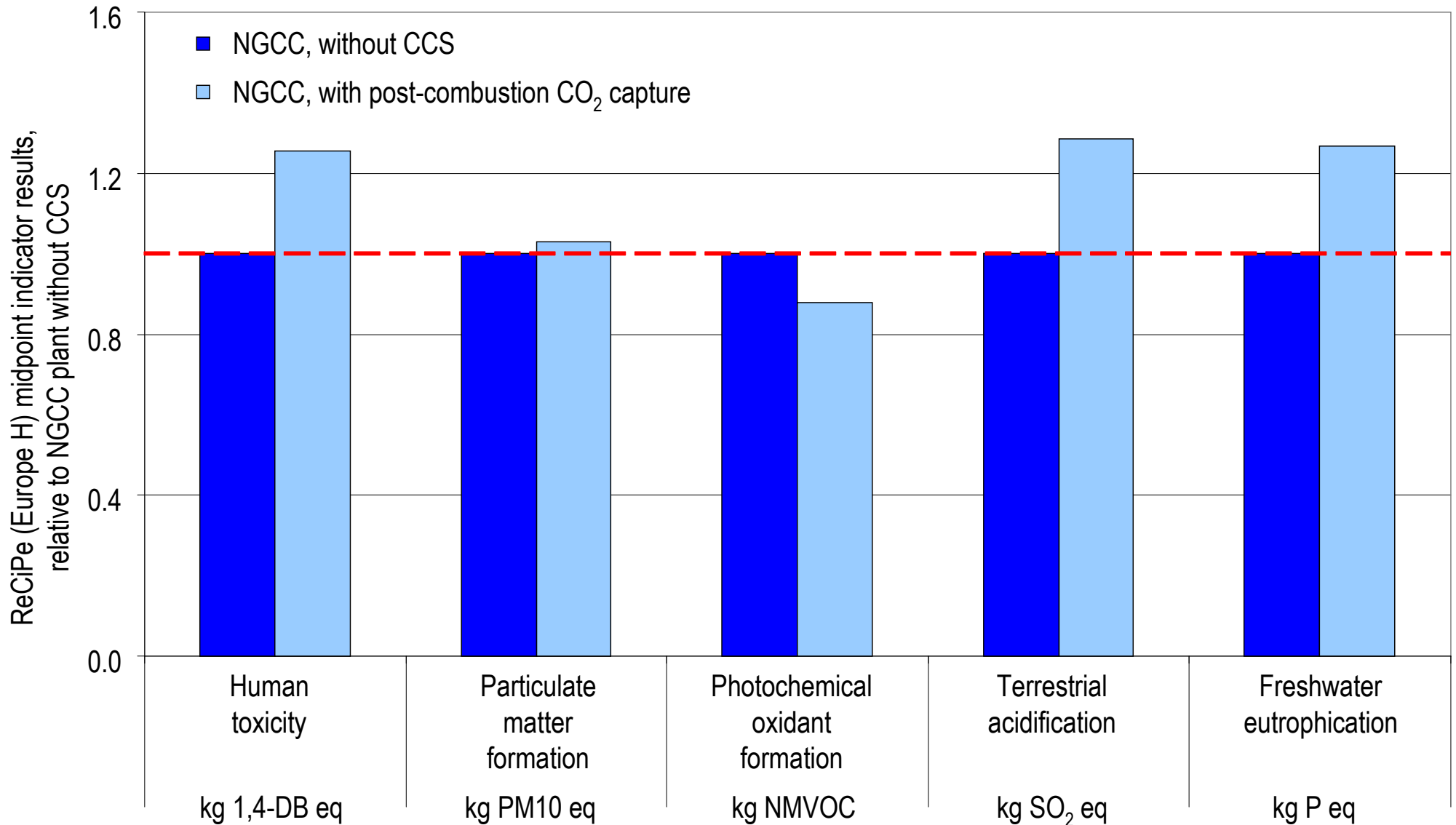
Assumption: 200km pipeline transport, 1000m storage depth



Source: Volkart, Bauer et al. (2013)

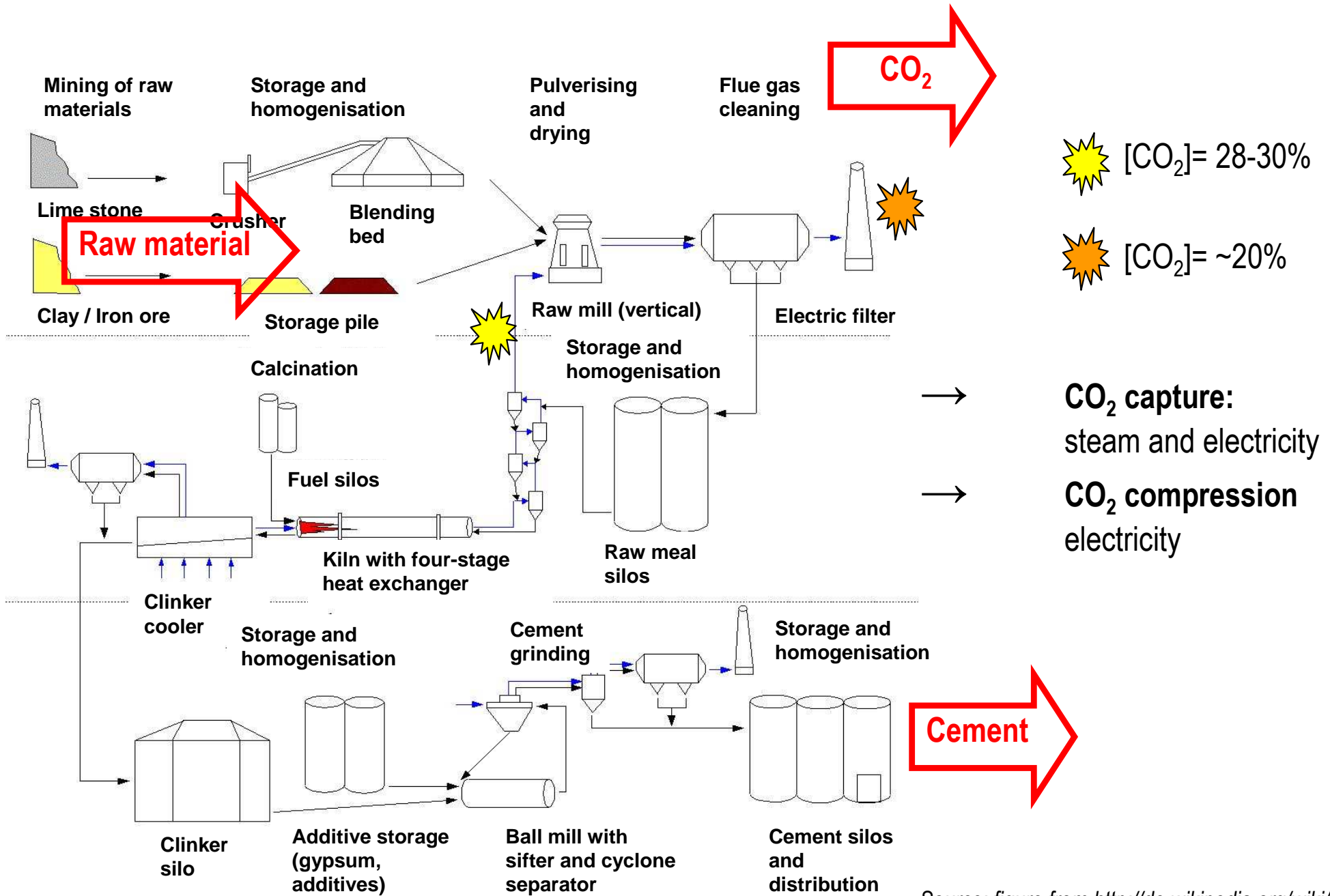
Method: ReCiPe (Europe H) midpoint

Assumption: 200km pipeline transport, 1000m storage depth



Source: Volkart, Bauer et al. (2013)

LCA of cement production with CCS: Goal and scope



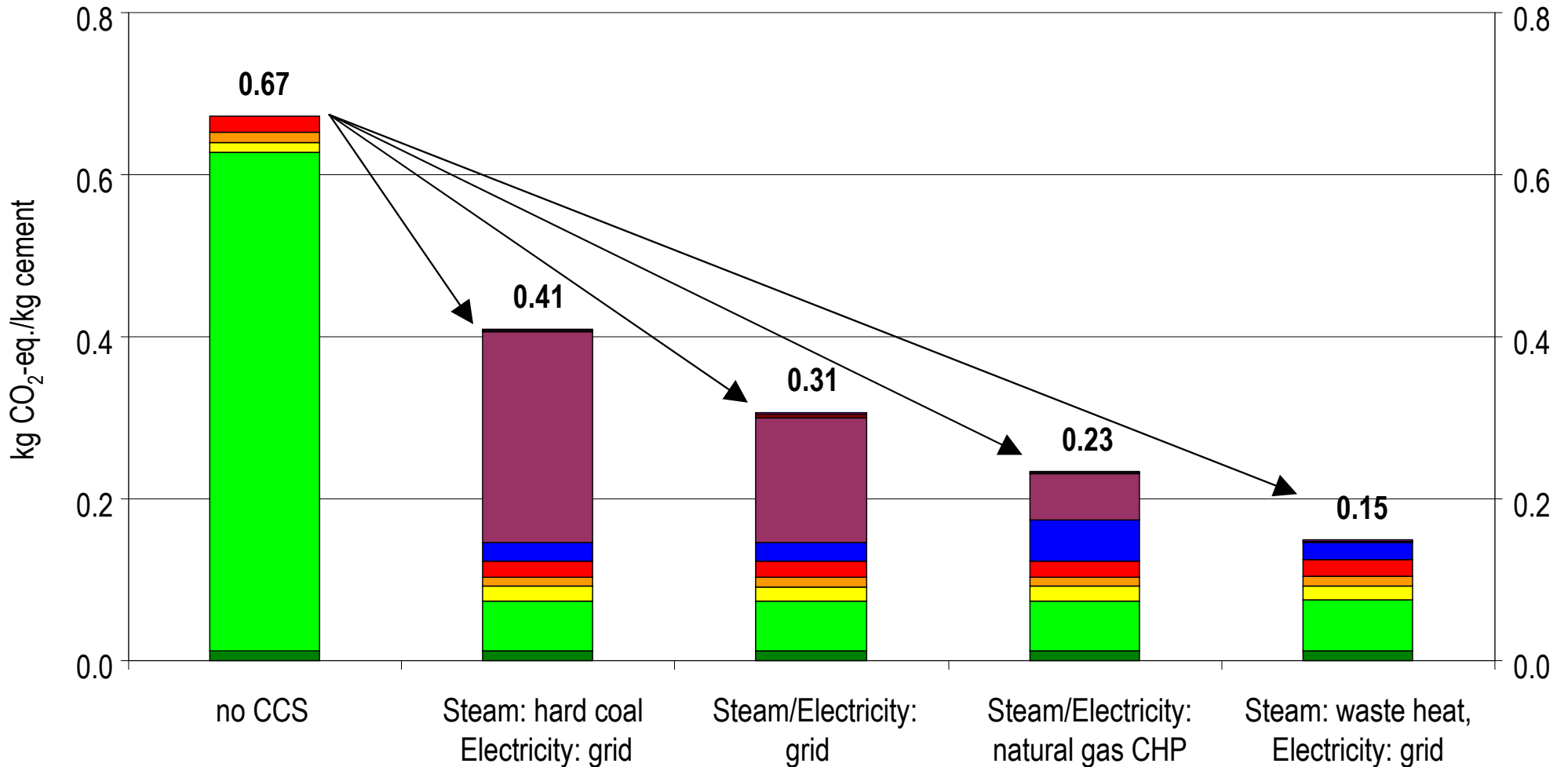
Source: figure from <http://de.wikipedia.org/wiki/Zement>

LCA of cement plants (2025)

Method: IPCC 2007

Assumption: 200km pipeline transport, 1000m storage depth

- Cement production
- Clinker: primary fuels
- CO₂ capture: indirect
- Clinker: direct
- CO₂ capture: electricity
- CO₂ transport
- Clinker: indirect
- CO₂ capture: heat
- Clinker: primary raw material
- CO₂ capture: heat
- CO₂ storage

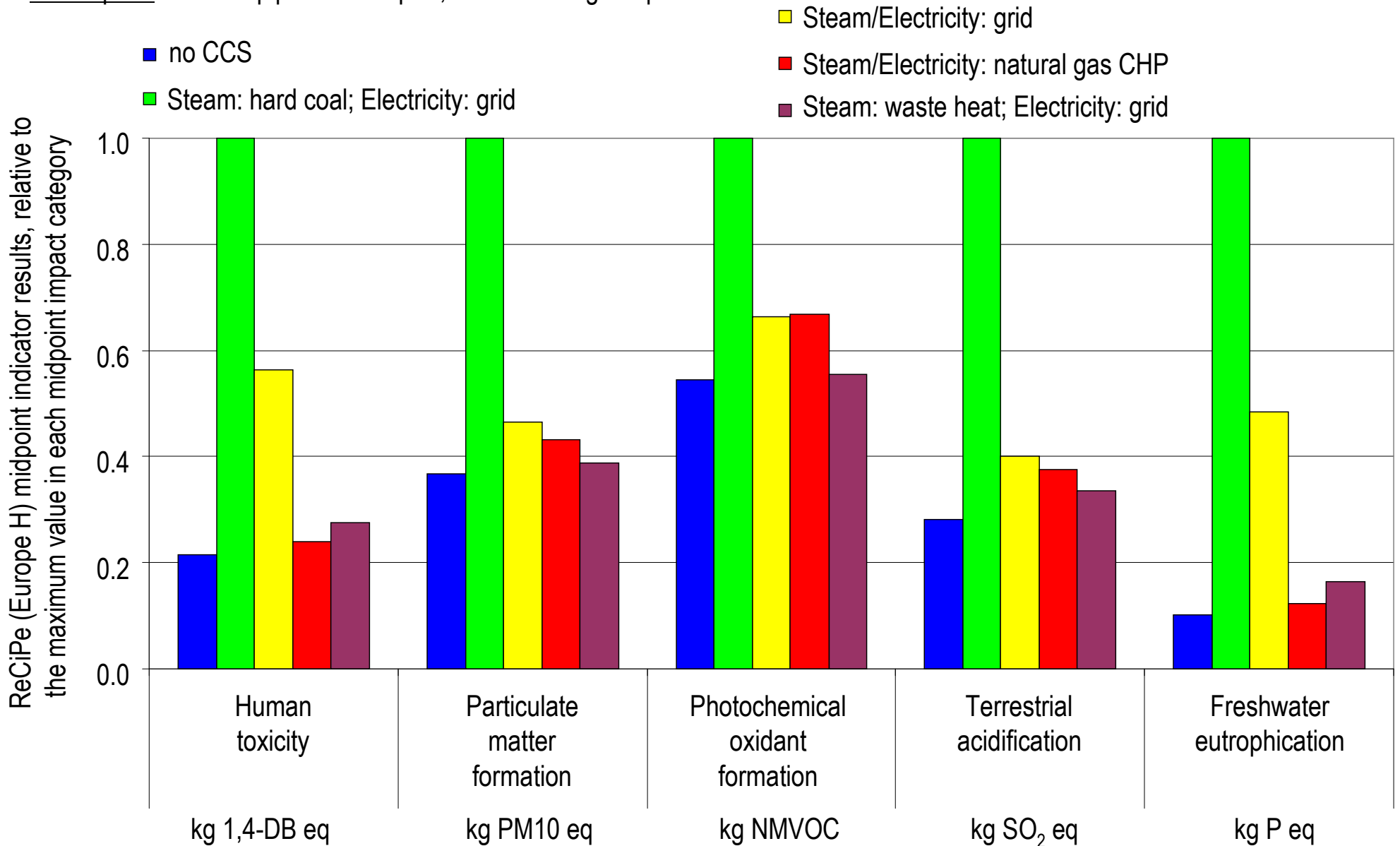


Source: Volkart, Bauer et al. (2013)

LCA of cement plants (2025)

Method: ReCiPe (Europe H) midpoint

Assumption: 200km pipeline transport, 1000m storage depth



Source: Volkart, Bauer et al. (2013)

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- **Conclusions on the life cycle assessment results**
 - CCS has the potential to strongly reduce **life cycle GHG-emissions** from natural gas electricity generation (by ~70%) and cement production (by ~40-80%).
 - CCS can thus significantly contribute to both, **low carbon electricity and low carbon cement** production.
 - **Trade-offs** related to other environmental aspects have to be kept in mind.
- **Conclusions on CCS in Switzerland**
 - **Future developments** may lead to the need for CCS in Switzerland.
 - The legal situation (**CO₂ Gesetz**) is – among other criteria – decisive.
 - CO₂ capture and transport are proven technologies. CO₂ storage instead is subject to considerable **uncertainties**.
 - To prove the feasibility of CCS in Switzerland a **full cycle pilot project** including an injection site is required.

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- **Key issues for a CCS pilot project**

CO₂ storage site, legal aspects (mining, waste, water protection, ...), costs and acceptance

- **Objectives of the CCS roadmap**

- Adequacy of the target formations for CO₂ storage, demonstration of the safety of the CO₂ injection and storage, testing of predictive modelling results

- Assessment of the economics

- Knowledge transfer to the public, policy makers and licensing authorities

- Provision of specific knowledge for a later planning & construction of a full CCS chain

- **Tentative timeline**

- Risk dialogue with authorities and public 2013/14
- Seismic exploration 2014/15
- Site acquisition & Drilling Permit 2015-17
- Drilling & Installation Operations 2017-19
- CO₂ Injection Operations 2019-22
- Monitoring 2022-min. 2032

I would like to thank

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Questions?

