H_2 Global Warming Potential

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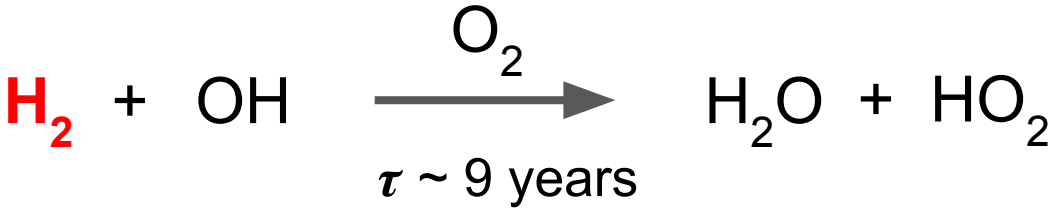
H_2 is not a greenhouse gas but its oxidation perturbs the Earth's radiative budget



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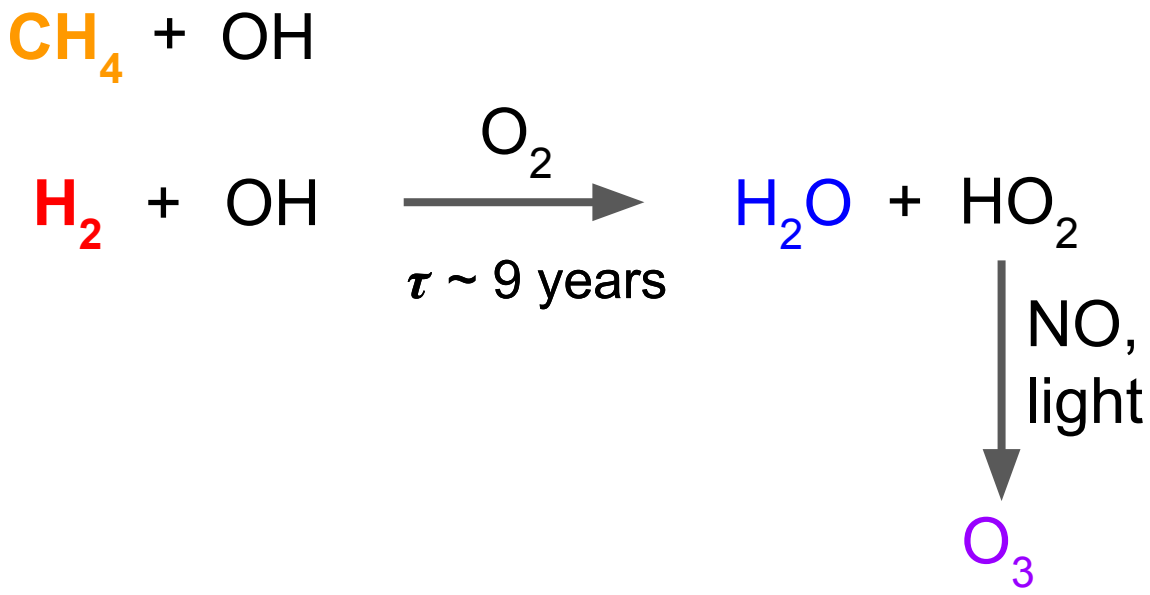
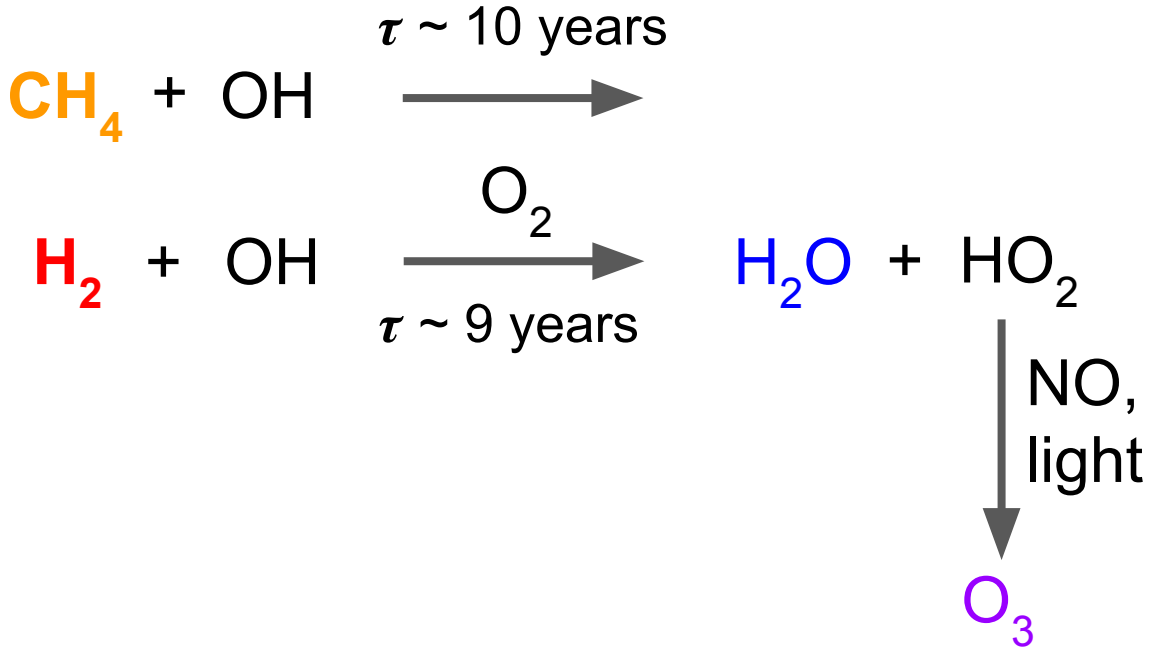


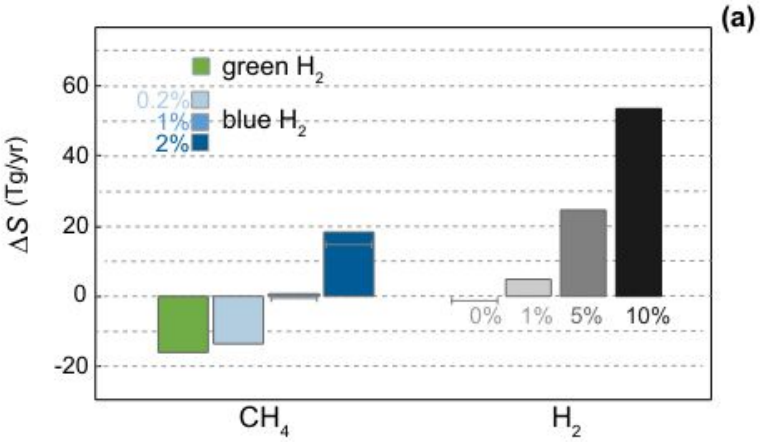
- H_2 oxidation increases CH_4 lifetime and produces **stratospheric H_2O** and O_3
- Chemistry is well understood (Derwent 2001)

H_2 is a lot like CH_4 from a chemical standpoint

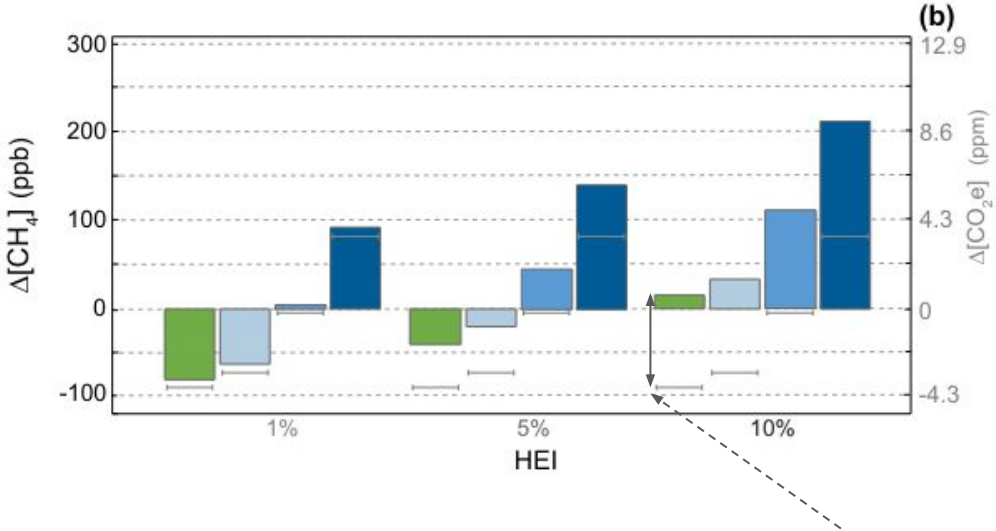


- H_2/CH_4 oxidation increases CH_4 lifetime and produces **stratospheric H_2O** and O_3
- **O_3 and stratospheric H_2O increase CH_4 forcing by 45% (AR6)**
- **Climate impact of H_2/CH_4** depends on **chemical conditions**

H_2-CH_4 feedback in action



15% of present-day energy consumption replaced by H_2 (500 Tg/yr)



"Chemical" penalty due to H_2 oxidation by OH

Bertagni (2022)

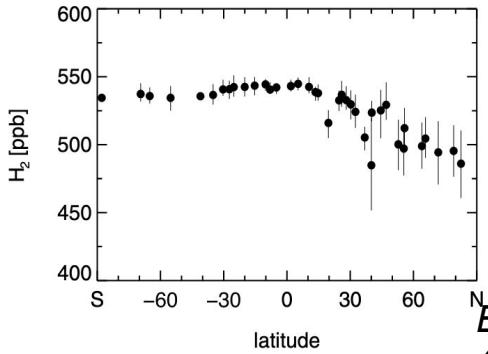
Unlike CH_4, H_2 has a large non-atmospheric sink

CH_4 + OH → (τ ~ 10 years)

H_2 + OH → (O_2, τ ~ 9 years) H_2O + HO_2

H_2 → (τ ~ 3 years) soil

HO_2 → (NO, light) O_3



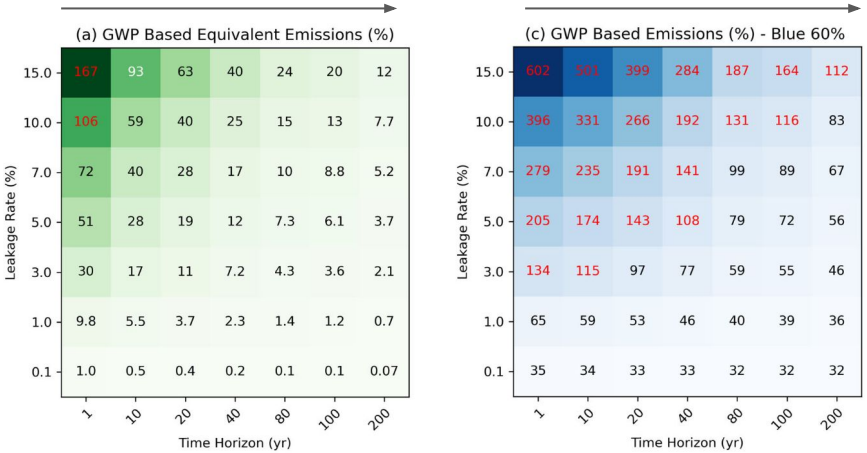
Ehhalt (2009)

- H_2/CH_4 oxidation increases CH_4 lifetime and produces **stratospheric H_2O** and O_3
- **Climate impact of H_2/CH_4** depends on **chemical conditions**
- **Soil sink moderates the radiative impact of H_2**

Estimate of H_2 GWP100

Derwent (2001, 2020, 2022)	3.3 - 5.6 (no including stratospheric water) 8 +/- 2
Hauglustaine (2022), Paulot (2021)	12.8
Warwick (2022)	10.9
CICERO (multi-model, preliminary)	12.4

H_2 impact decreases with time



Hauglustaine (2022)

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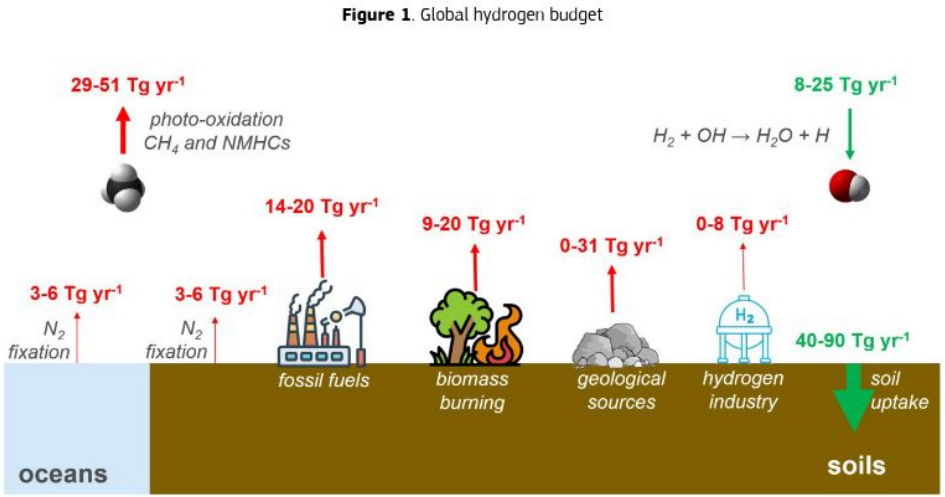
Differences between estimates can be ascribed to:

a) Experimental setup (location of H_2 perturbation, chemical environment)
b) Model representation (CH_4 feedback, radiative transfer)
c) Representation of H_2 biogeochemical cycle

H_2 present-day sources/sinks are not well constrained



Arrigoni (2022)

Very few soil uptake measurements

⇒ **Soil sink is used as a tuning knob to match atmospheric** observations based on prescribed source inventory

⇒ Representation of H_2 in global models is largely **based upon circa 2000s** knowledge

Faster soil sink

⇒ a lower fraction of H_2 is oxidized by OH

⇒ **lower climate impact for increasing H_2 emissions**