



**PUT IT BACK WHEN
YOU ARE DONE:
Storing Carbon Dioxide in the
Earth, not the Atmosphere**

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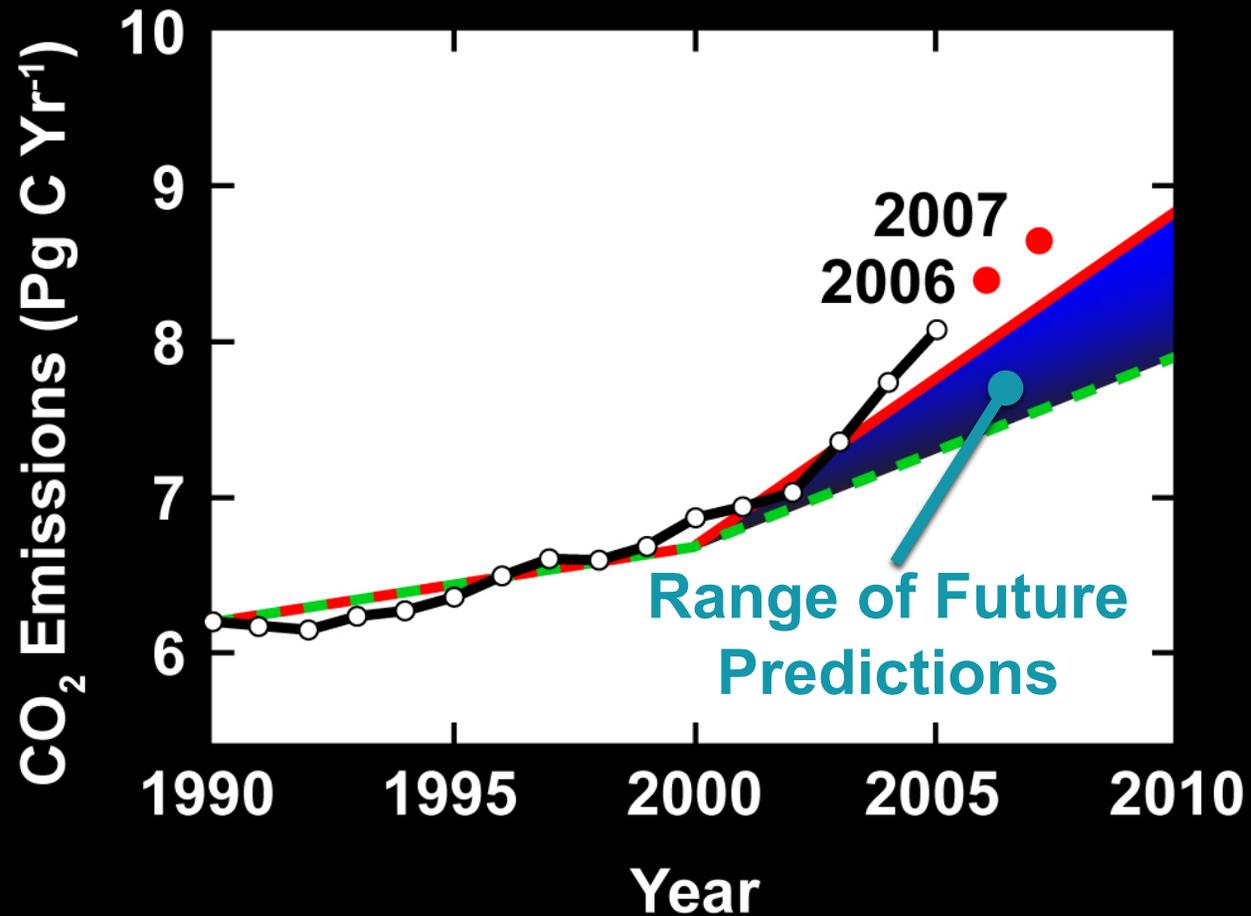
Balloon Demo

- **1 lb (about $\frac{1}{2}$ kg) of coal lights a 100W lightbulb for 10 hrs**
- **It burns to make about 3 lbs of carbon dioxide**
- **That carbon dioxide takes up 1 cubic meter of space as a pure gas**





The world is doing worse than any of the predictions in 2000



(Slide from Dr. Chris Field)









Post-combustion capture grabs the CO₂ from the smokestack before it is emitted

Pre-combustion separation converts carbon to CO₂ before burning

Coal, or biomass can be gasified at 800°C creating “syngas”



Adding water “shifts” the carbon monoxide to hydrogen



Hydrogen and CO₂ can be easily separated; the hydrogen can be burned, and CO₂ stored underground

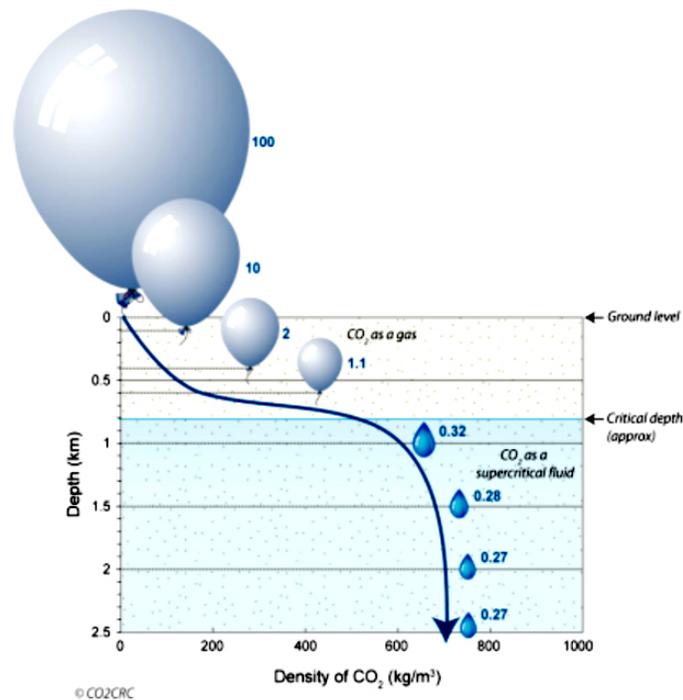
**Warning:
Chemistry!**





**The Beulah
gasification
plant in North
Dakota**

CO₂ takes up much less space when it is compressed – it is easy to put back underground



It has the density of oil, is less viscous, and has ~400x less volume than at surface

Storing CO₂ underground –
in big caves?

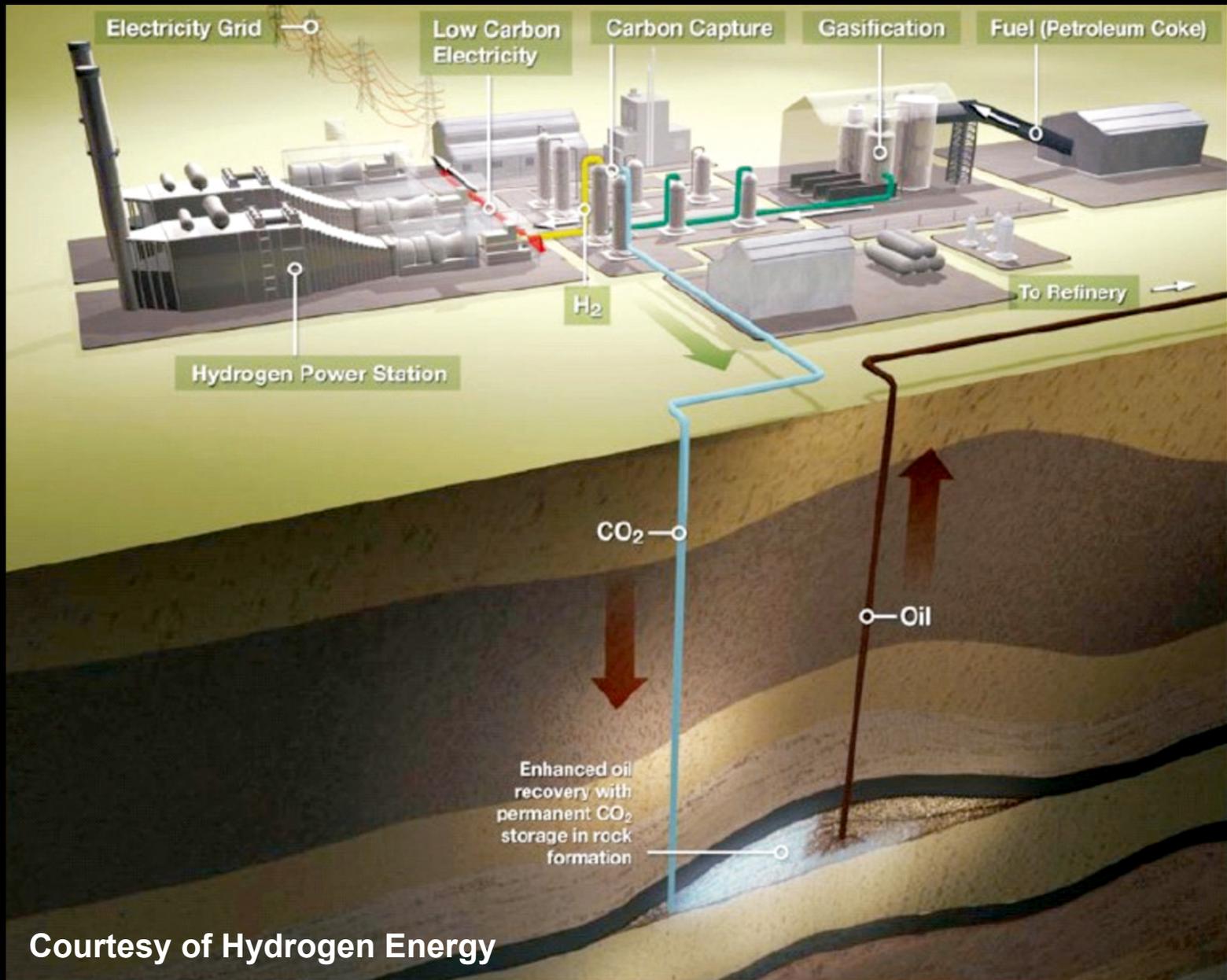
NO!



Ant Farm Demo

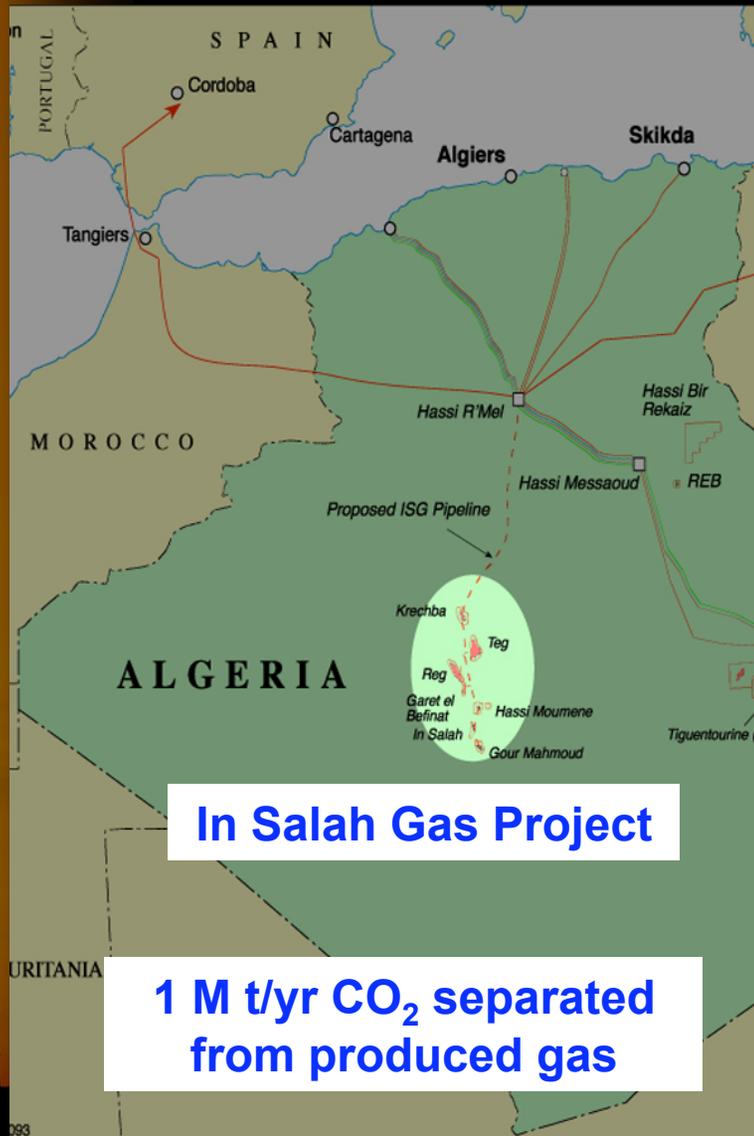
- Space between the sand grains
- CO₂ is a liquid 3000 feet underground





Courtesy of Hydrogen Energy

How do we know we can do this safely?



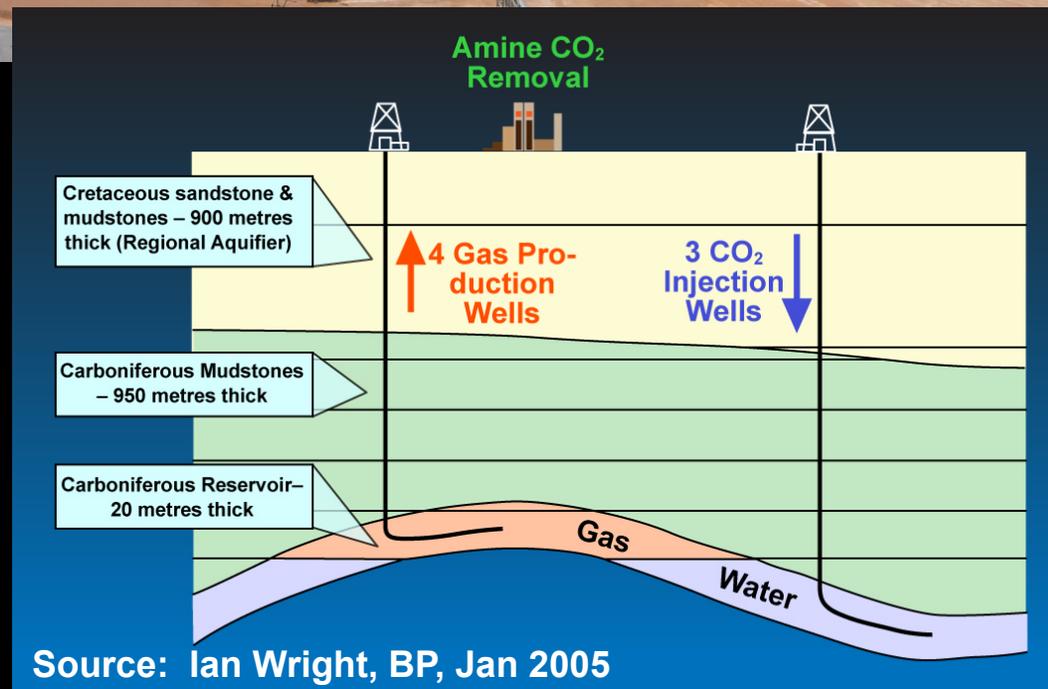
Natural gas (CH₄, methane) often has natural CO₂ in it

That CO₂ must be removed before sale – it won't burn!!

At In Salah, Algeria, BP is putting that CO₂ back underground

Source: Ian Wright, BP, Jan 2005

1 M t/yr CO₂ separated from produced gas is injected into aquifer below gas zones



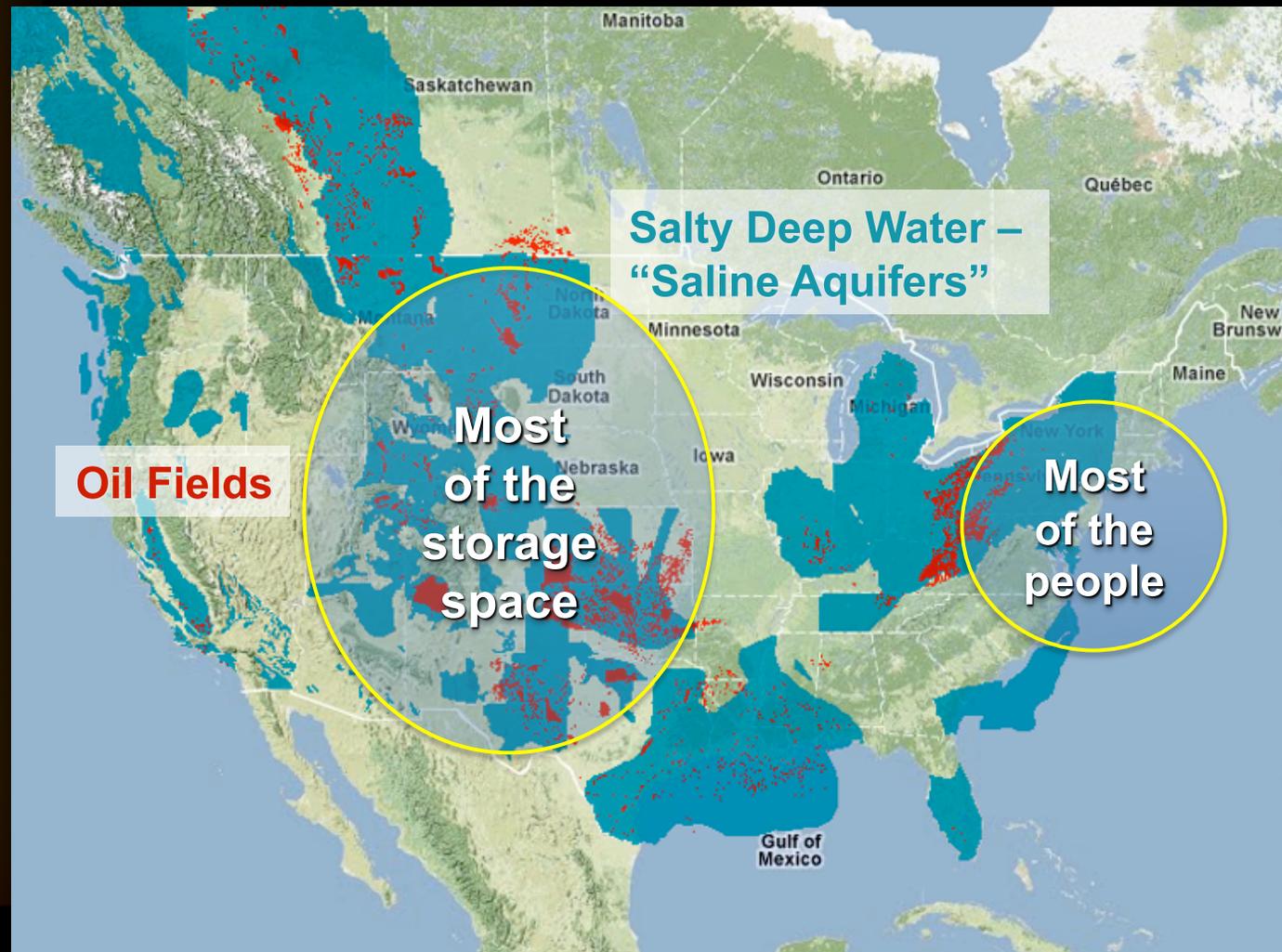
The Sleipner platform has been putting CO2 underground beneath the North Sea (Norway) for more than 10 years





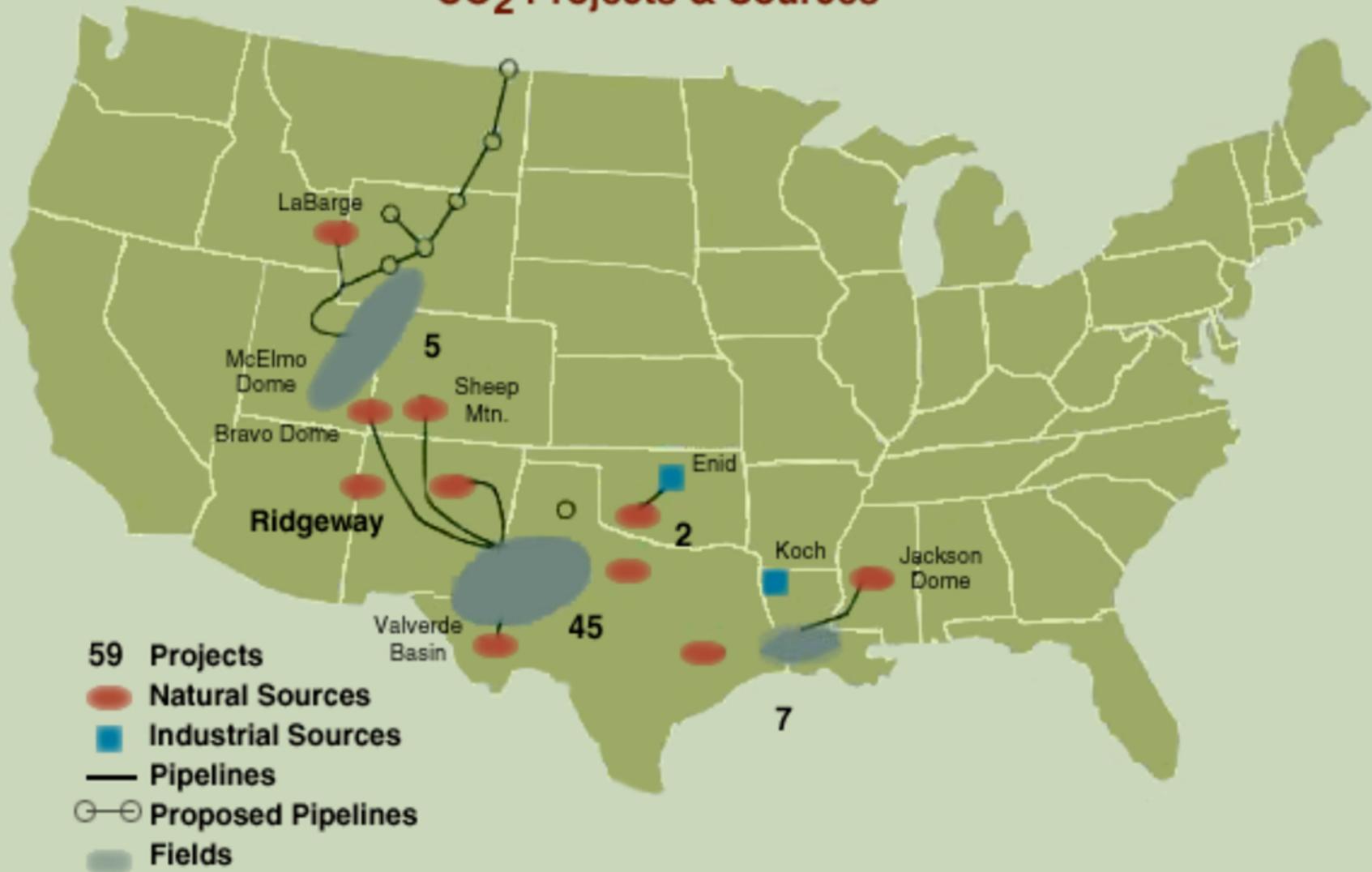


The US has more than enough underground space for CO₂



3000 miles of CO₂ pipelines today

CO₂ Projects & Sources



**What does LLNL do?
What can you do?**

