Why Drawing CO2 Into Soil is Essential

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Demand for “Carbon Removal” Services

- To hold global warming at 2° C., global GHG releases must be cut by at least **8 GtCO2e year by 2025 and ~20 GtCO2e/year between now and 2030**.
- Assuming all nations comply with their Paris Agreement commitments to cut GHG releases, **we will still fall short of the needed GHG cuts, by ~15 billion TCO2e/year**.

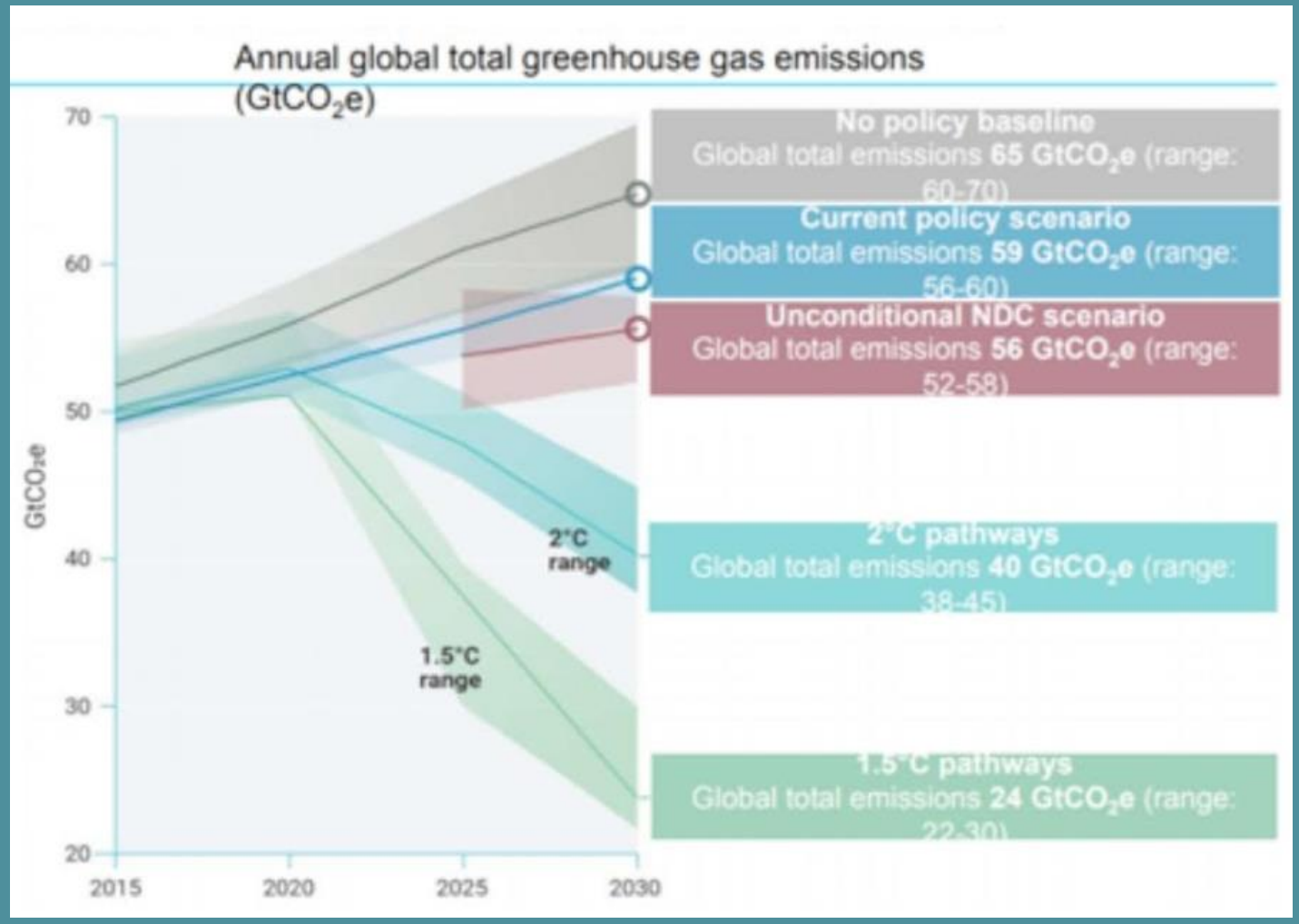


image source: **UNFCCC**, 2019

It Isn't Going to Happen

- 244 corporations and the customers they supply account for >80% (~31 Gt/year) of all energy production, energy use and industrial process GHGs (~37 Gt/year).
- In fact, **only 50 companies (and their customers) accounted for 55%-60% of global energy production and end-use and industrial GHGs released in 2015**.
- …of which 36 are directly or indirectly government owned or controlled
- If governments are continuing to produce and sell oil, why should the private sector stop?

Find this report at:
https://www.cdp.net/en/articles/media/new-report-shows-just-100-companies-are-source-of-over-70-of-emissions

Is There An Absolute GHG Discharge Limit?

According to the World Resources Institute:

"To have a medium chance of limiting warming to 1.5°C, the world can emit 770 gigatonnes of carbon dioxide (GtCO2). To have a likely chance (67 percent), the remaining budget drops to 570 GtCO2."

- If the world's "Top 50" corporate GHG emitters extract, process and sell only the fossil fuels reported as "proved reserves" (at their 2019 fiscal year end) —and write off the unproved reserves—that will result in the discharge of 810 to 940 gigatonnes of CO2.
- But in both 2018 and 2019, the "Top 50" committed, in aggregate, ~50% of their capital spending to *more* fossil fuel exploration and development, which is expected to expand proved fossil fuel reserves.

Who Are We Talking About?

- 28 state-owned and controlled entities account for ~44% of the GHGs discharged by the "Top 244" and their customers.
- If these state-owned entities were to exploit only their reported proved and developed oil, gas and coal reserves—and write off reported proved but undeveloped reserves—they and their customers will release an additional ~110 – 140 GtCO2e to the atmosphere by or before 2050.

	Scope 1		Scope 3		Scope 1+3	
	MtCO2e/year, as reported to the CDP project in 2017					
GHGs for Top 244 corporations in 2015	**2,965**	*9.7%*	**27,610**	*90.3%*	**30,575**	*100.0%*
of which…						
28 State-Owned Enterprises	**1,436**	*4.7%*	**12,039**	*39.4%*	**13,475**	*44.1%*
Saudi Aramco	215	*0.7%*	1,735	*5.7%*	1,950	*6.4%*
National Iranian Oil Co.	155	*0.5%*	870	*2.8%*	1,025	*3.4%*
Coal India	54	*0.2%*	971	*3.2%*	1,025	*3.4%*
Shenhua Group Corp Ltd	79	*0.3%*	922	*3.0%*	1,001	*3.3%*
China National Petroleum Corp	81	*0.3%*	544	*1.8%*	625	*2.0%*
Abu Dhabi National Oil Co.	91	*0.3%*	523	*1.7%*	614	*2.0%*
Petroleos Mexicanos	53	*0.2%*	477	*1.6%*	530	*1.7%*
Sonatrach	89	*0.3%*	404	*1.3%*	493	*1.6%*
Kuwait Petroleum Corp	43	*0.1%*	435	*1.4%*	478	*1.6%*
Qatar Petroleum Corp	73	*0.2%*	341	*1.1%*	414	*1.4%*
Petroleos de Venezuela	42	*0.1%*	366	*1.2%*	408	*1.3%*
Iraq National Oil Co	31	*0.1%*	360	*1.2%*	391	*1.3%*
Petroleo Brasileiro SA	27	*0.1%*	365	*1.2%*	392	*1.3%*
Datong Coal Mine Group	32	*0.1%*	333	*1.1%*	365	*1.2%*
China National Coal Group Co Ltd	30	*0.1%*	320	*1.0%*	350	*1.1%*
Petrolam Nasional Berhad	59	*0.2%*	281	*0.9%*	340	*1.1%*
Nigerian National Petroleum Corp	42	*0.1%*	287	*0.9%*	329	*1.1%*
Shanxi Coking Coal Group Co. Ltd	19	*0.1%*	298	*1.0%*	317	*1.0%*
Shandong Energy Group Co Ltd	24	*0.1%*	290	*0.9%*	314	*1.0%*
Shaanxi Coal Chemical Industry Group Co Ltd	23	*0.1%*	273	*0.9%*	296	*1.0%*
Poland Coal	25	*0.1%*	266	*0.9%*	291	*1.0%*
Yankuang Group CO Ltd	20	*0.1%*	236	*0.8%*	256	*0.8%*
Statoil ASA (now Equinor)	12	*0.0%*	219	*0.7%*	231	*0.8%*
TurkimenGaz	53	*0.2%*	177	*0.6%*	230	*0.8%*
Kazakhstan Coal	20	*0.1%*	203	*0.7%*	223	*0.7%*
Shanxi Jincheng Anthacite Coal Mining Group Ltd	13	*0.0%*	191	*0.6%*	204	*0.7%*
China Petrochemical Corp	23	*0.1%*	174	*0.6%*	197	*0.6%*
China National Offshore Oil Corp Ltd	8	*0.0%*	178	*0.6%*	186	*0.6%*

Who Are We Talking About?

- 22 publicly traded or privately held entities* account for 26% of the GHGs discharged by the “Top 244” and their customers.
- If these entities were to exploit only their reported proved and developed oil, gas and coal reserves—and write off their proved but undeveloped reserves—they and their customers will release an additional ~700 – 800 GtCO2e to the atmosphere by or before 2050.

** 8 of which are still largely under state control.*

	Scope 1		Scope 3		Scope 1+3	
	MtCO2e/year, as reported to the CDP project in 2017					
22 Publicly Traded or Privately Held	**638**	*2.1%*	**7,259**	*23.7%*	**7,897**	*25.8%*
Gazprom	108	*0.4%*	1,090	*3.6%*	1,198	*3.9%*
Rosneft OAO	83	*0.3%*	694	*2.3%*	777	*2.5%*
ExxonMobile Corp	54	*0.2%*	523	*1.7%*	577	*1.9%*
Royal Dutch Shell	48	*0.2%*	460	*1.5%*	508	*1.7%*
BP PLC	28	*0.1%*	420	*1.4%*	448	*1.5%*
Peabody Energy Corp	10	*0.0%*	387	*1.3%*	397	*1.3%*
Chevron Corp	36	*0.1%*	341	*1.1%*	377	*1.2%*
Glencore PLC	36	*0.1%*	287	*0.9%*	323	*1.1%*
Lukoil	3	*0.0%*	325	*1.1%*	328	*1.1%*
BHP Billiton Ltd	27	*0.1%*	290	*0.9%*	317	*1.0%*
Total SA	20	*0.1%*	293	*1.0%*	313	*1.0%*
Arch Coal Inc.	7	*0.0%*	225	*0.7%*	232	*0.8%*
Eni SPA	23	*0.1%*	208	*0.7%*	231	*0.8%*
ConocoPhilips	24	*0.1%*	199	*0.7%*	223	*0.7%*
SUEK Ltd	18	*0.1%*	200	*0.7%*	218	*0.7%*
Henan Coal Chemical Industry Group Co Ltd.	18	*0.1%*	197	*0.6%*	215	*0.7%*
Anglo American	5	*0.0%*	210	*0.7%*	215	*0.7%*
Jizhong Energy Group Co Ltd	19	*0.1%*	194	*0.6%*	213	*0.7%*
Surgutneftegas OAO	20	*0.1%*	193	*0.6%*	213	*0.7%*
Bumi Resources	18	*0.1%*	182	*0.6%*	200	*0.7%*
Kailuan Group Co Ltd	17	*0.1%*	175	*0.6%*	192	*0.6%*
Shanxi Lu'an Mining Group Ltd	16	*0.1%*	166	*0.5%*	182	*0.6%*

What Does an Aggressive "Top 50" Climate Change Action Plan Look Like — e.g. Equinor (Statoil)?

We expect around
15-20%
of our annual investments to be directed towards new energy solutions in 2030, assuming we can access and mature profitable projects.

From 2014 to 2018:

- Direct operating facility GHGs shrank by ~1MMTCO2e/yr, while
- GHGs discharged by consumers using their products grew by 26MM TCO2e/yr.

Indicators	Boundary	Unit	2018	2017	2016	2015	2014
Oil and gas production	OC	mmboe	1077	1099	1030	1073	997
Oil and gas production	Equity basis	mmboe	770	759	723	719	703
Renewable energy production	Equity basis	GWh	1251	830	423	475	536
Scope 1 GHG emissions	OC	million tonnes CO_2e	14.9	15.4	15.4	16.3	16.3
CO_2 emissions (Scope 1)	OC	million tonnes	14.4	14.9	14.8	15.4	15.3
CO_2 emissions (Scope 1)	Equity basis	million tonnes	11.6	12.0	12.7	12.3	12.4
Scope 3 GHG emissions	Equity basis	million tonnes CO_2e	314	310	296	295	288

In 2018 around
4%
of the USD 9.9 billion in organic investments was related to investments in new energy solutions.

- >50% of capital spending is still being allocated to the exploration and development of more fossil fuel supply
- <20% of capital spending is allocated to "new energy solutions" through 2030
- 100% of investments in "new energy solutions" appear to depend on continuing revenues from fossil fuel sales, which translates into growing "Scope 3" GHG emissions

1.5° to 2° of Warming by 2100 is Almost Inevitable

- Therefore, accelerating investment in activities and technologies that can remove heat-trapping gases from the atmosphere and retain the recovered carbon (C) in terrestrial reserves (e.g. soils, root systems, sustainable above-ground biomass stocks, mineral deposits, the built environment) is essential.
- ***Accelerated investment in the adoption of food production practices that <u>coincidentally</u> draw down and store recovered C while improving soil health & resilience, and our capacity to produce food in the event of warming, should be top priority.***

Where Can We Store More C in Ag Soils?

- Scientists estimate that soil organic carbon (SOC) stocks in croplands and grasslands are half of what they once were 300 years ago, and can be recovered to historic levels at rates typically ranging from 0.4 to 2.5 TCO2e/acre/year.
- That translates into **global potential to draw a net ~10 to 25B* TCO2e/year out of the atmosphere for 100 years**.

** This net CO2 drawdown range is conservative and relies on many significant assumptions, including but not limited to natural C respiration rates, GHG discharges from equipment used in crop production, etc.*

Note that when 1 TCO2e is drawn out of the atmosphere, 0.272 tonnes of C might be added to terrestrial SOC stocks.

Why is a Discrete Carbon Removal Market Essential?

- There are only 3 ways to reduce existing and projected atmospheric concentrations of heat-trapping gases:
  - **Remove** GHGs and store recovered C in natural and man-made reservoirs.
  - **Retain** fossil fuels in terrestrial reservoirs that otherwise ben removed/released.
  - **Recycle and reuse** C that is recoverable
- Existing “emissions” markets reward reduced use of fossil-based products and services at discrete geographic points, & credits are issued even when there is no C retention.
- So true carbon retention credits are not price competitive with less valuable point of end-use emission reduction or avoided emission credits.

Key Challenge: How Should We Address “Permanence”?

- No carbon removal service provider can truly promise “permanent” carbon retention in organic or mineral form, especially when that commitment is in exchange for a single up-front payment, or a series of payments received over only the first 10 years of a mandated 100+ year permanence term
- This approach is how we ended up with “abandoned mines” and “orphaned wells”.
- **Carbon Removal and Retention is a service**. Operators of natural carbon “warehouses” require recurring storage rent payments to fund the cost of truly preserving carbon stocks.

Key Challenge: “Permanence”

- No carbon removal service provider can truly promise “permanent” carbon retention in organic or mineral form, especially when that commitment is in exchange for a single up-front payment, or a series of payments received over only the first 10 years of a mandated 100+ year permanence term.

- Operators of natural carbon “warehouses” require recurring storage rent payments to fund the continuing costs of truly monitoring and preserving carbon stocks.

“Permanence” – two more complications

- The “abandoned mine” and “orphaned well” phenonoma.
- State property laws, for example:

- Maximum term for a lease (under North Dakota law):
  - 10 years for agricultural land; 99 years for all other leases
  - *See* N.D.C.C. §47-16-02 "No lease or grant of agricultural land reserving any rent or service of any kind for a longer period than ten years shall be valid. No lease or grant of any city lot reserving any rent or service of any kind for a longer period than ninety-nine years shall be valid."

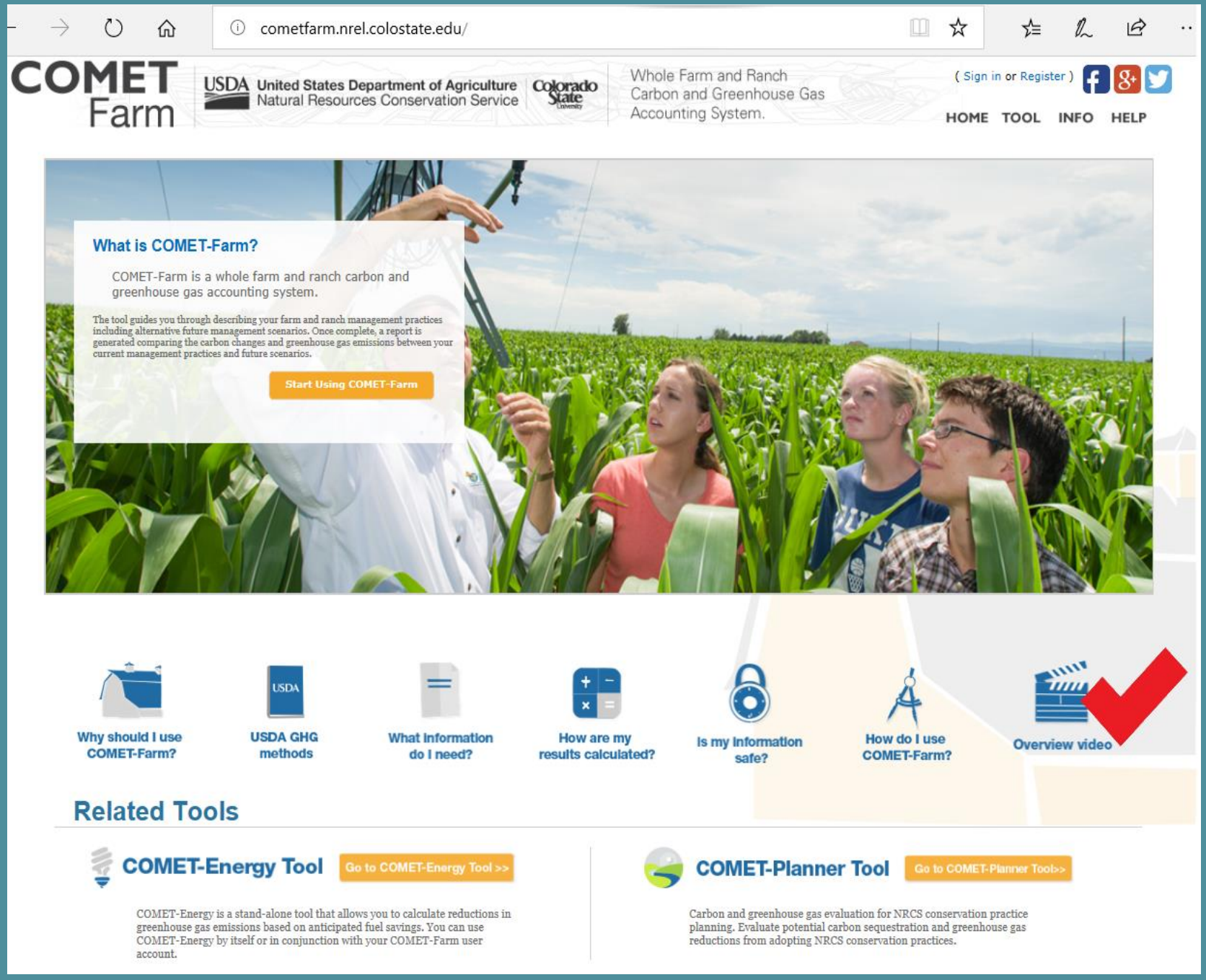
Nori's Solution to the Permanence Dilemma

- Land owners are issued NRTs (the Nori carbon removal credits) when it is verified that they have drawn 1 incremental TCO2e from the atmosphere, through the adoption of regenerative practices. They contractually commit to make best efforts to retain the recovered C for at least 10 years.
- By re-enrolling their Project in the Nori market, the land owner can potentially earn a carbon removal and retention payment that recurs once every 10 years.
- An NRT buyer that wishes to establish the equivalent to "permanence" can acquire 10 NRTs in one purchase.

Only 2 tests for Additionality—when and how did soil treatment and cropping practices change?

- Nori's only test for "additionality" is embedded in the project's "baseline" soil organic carbon stock trend definition.
- "Switch Year" reflects a season in which a verifiable change in land management was initiated with a reasonable expectation of improving soil health.
- "Baseline" is the counterfactual SOCSC trend that would occur if the pattern of land management practices that was established before the Switch Year continued, with baseline SOCSC trend estimates reflecting actual weather and climate impact.

NRT Quantification: Working With Leading Scientists to Establish Dynamic Project Baselines



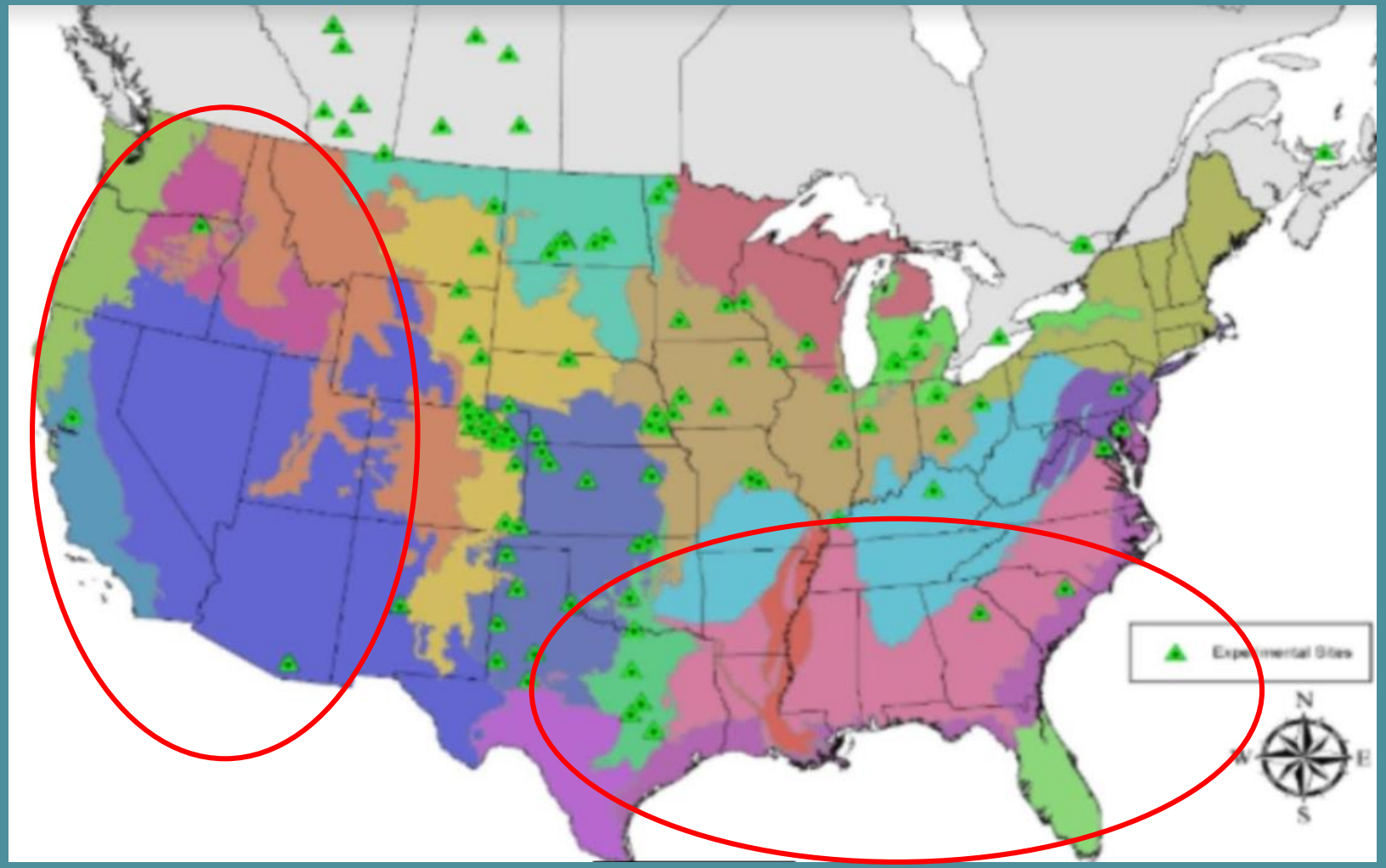
When it comes to Tier 3 SOCSC estimates, what do we most need?

- Estimates of incremental soil organic carbon **stock change**, after controlling for weather impacts on SOC stocks. (Not just a series of point-in-time SOC stock estimates.)
- Reporting of **uncertainty intervals** along with all underlying SOC and SOCSC trend estimates, along with documentation disclosing how uncertainty is calculated.
- Nori's credit quantification method results in reduced SOCSC trend uncertainty over time
- Note that **most soil sample test results are not "measurements".** They are estimates. Ask soil testing labs what the land manager and the lab must do differently to generate SOC stock estimates with their uncertainties.

The Nori “Carbon Quantification Tools” must generate Tier 3 SOC stock and flux estimates

-- the models informing COMET-Farm reflect robust soil sampling and testing (but not enough, yet)

-- “ground truthing” costs: $15/credit vs. $0.69/credit?



Working With COMET-Farm (CSU) to Establish Dynamic Project Baselines