Farm-level full GHG accounting with COMET-Farm

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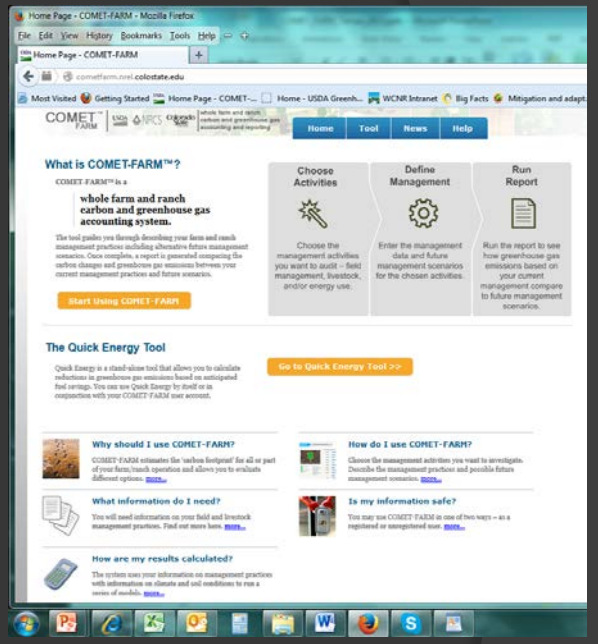
GHGs are becoming increasingly important for environmental BMPs – presenting a difficult challenge

- CA regs, voluntary offset markets, metrics for USDA programs, int'l efforts
- Like water quality & erosion, GHGs emissions/sinks are dispersed, non-point source & difficult to measure
- Direct measurement requires specialized equipment and training; too expensive for deployment in most mitigation projects.
- Model-based system provide the best alternative, but they need to incorporate local-scale variability in biophysical conditions and **field-specific practices**

Aim of COMET-Farm

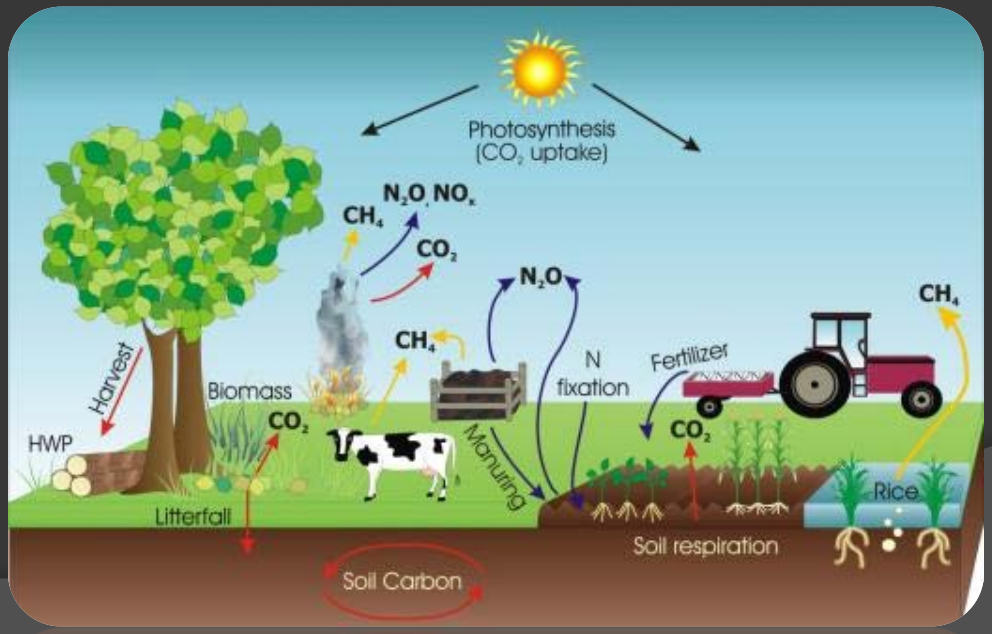
- Provide a means for non-GHG specialists (farmers, consultants, NRCS field staff, etc.) to easily estimate farm-scale GHG emissions and to explore alternative management and land use strategies.
- Employ state-of-the-art methods/models based on USDA Guidelines and consistent with US national GHG inventory
- Further development of previous COMET-VR and COMET2.0 tools.
- Free access on the internet



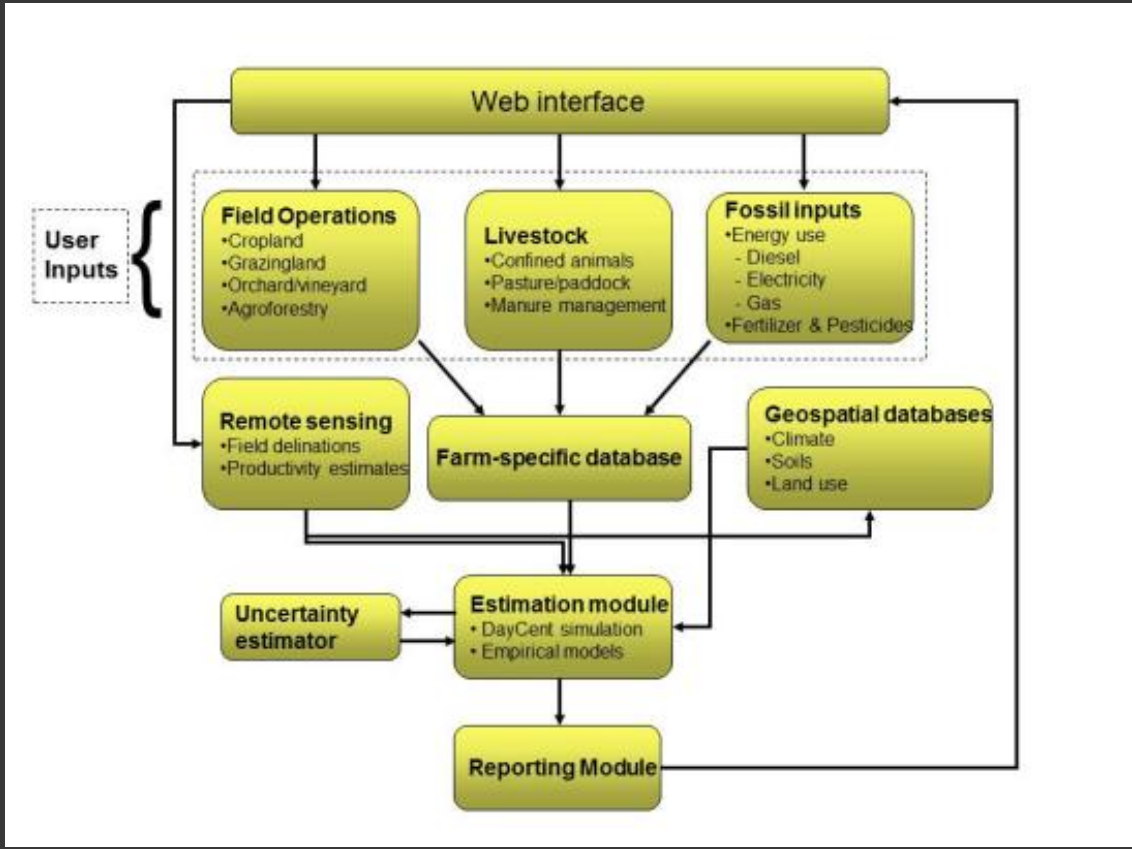
http://cometfarm.colostate.edu/

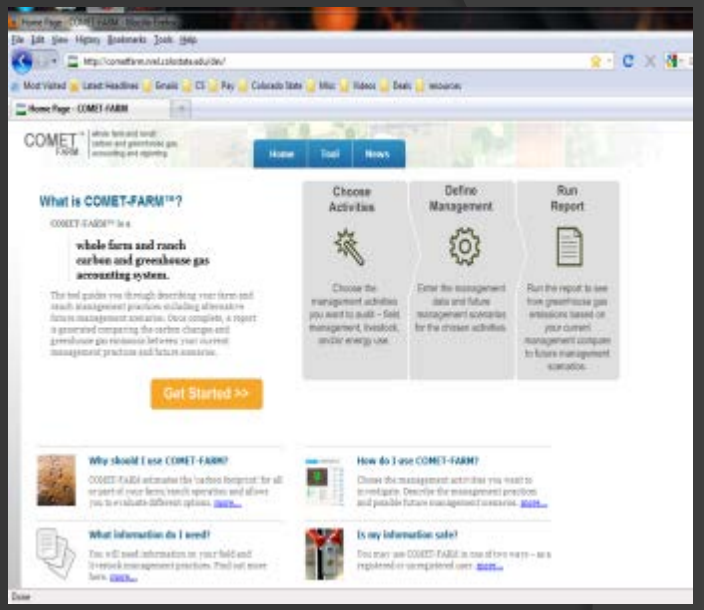
COMET-Farm
Scope and key features

- Full farm-level greenhouse gas accounting
  - Soil and biomass C stock changes
  - Soil N_2O and CH_4 emissions
  - Livestock – enteric CH_4 and manure CH_4 and N_2O
  - Energy – Fossil C emissions; on-farm renewables
  - Other emissions – burning, liming, …



COMET-Farm system for farm-level GHG accounting



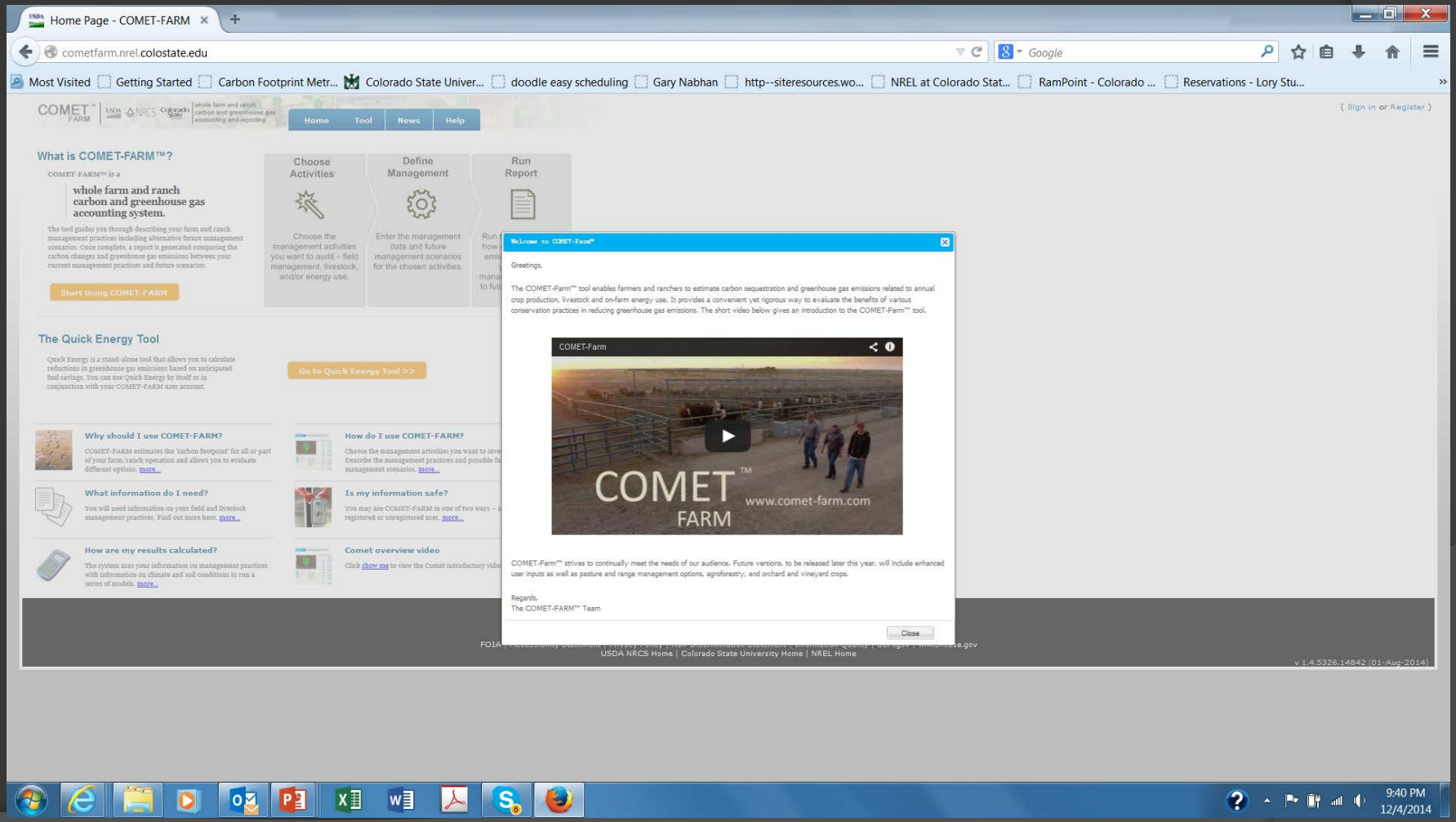


GHG estimation methods are based on the USDA 'Entity-scale' Inventory Guidelines released in July 2014

Current status of 'methods merge'

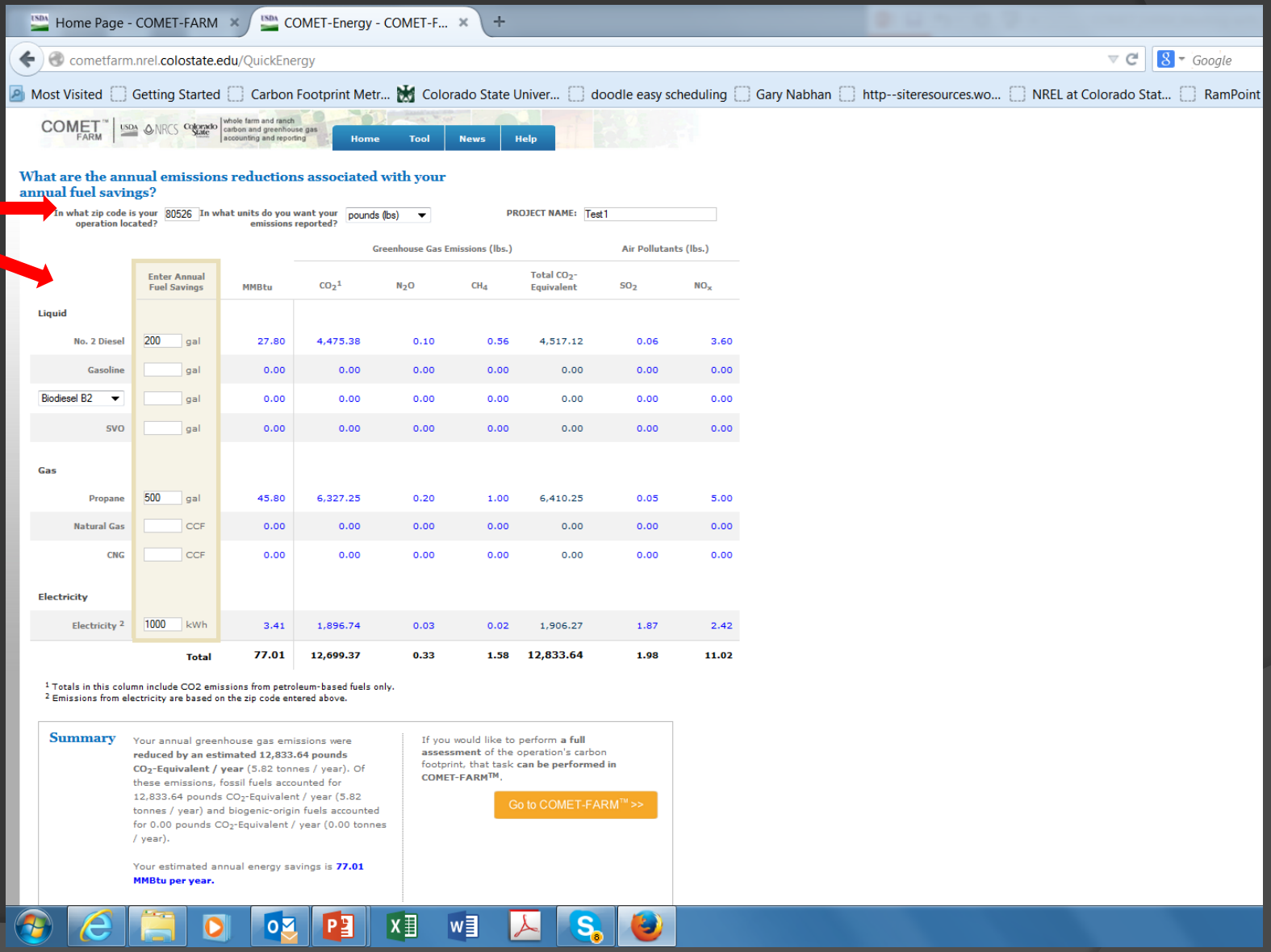
Completed	Underway	Planned	
☐	■	☐	Livestock Emissions
☐	■	☐	Cropland Soils
☐	■	☐	Agroforestry
☐	■	☐	Energy
☐	■	☐	Rice Methane
☐	☐	■	Grazing Land Soils
☐	☐	■	Biomass Burning
☐	■	☐	Liming

Quick Demo Film



COMET Quick Energy Tool

User inputs



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COMET FARM — whole farm and ranch carbon and greenhouse gas accounting and reporting

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What are the annual emissions reductions associated with your annual fuel savings?

In what zip code is your operation located? 80526 In what units do you want your emissions reported? pounds (lbs) PROJECT NAME: Test1

	Enter Annual Fuel Savings	MMBtu	Greenhouse Gas Emissions (lbs.) CO_2[1]	N_2O	CH_4	Total CO_2-Equivalent	Air Pollutants (lbs.) SO_2	NO_x
Liquid								
No. 2 Diesel	200 gal	27.80	4,475.38	0.10	0.56	4,517.12	0.06	3.60
Gasoline	gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biodiesel B2	gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVO	gal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas								
Propane	500 gal	45.80	6,327.25	0.20	1.00	6,410.25	0.05	5.00
Natural Gas	CCF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	CCF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electricity								
Electricity [2]	1000 kWh	3.41	1,896.74	0.03	0.02	1,906.27	1.87	2.42
	Total	**77.01**	**12,699.37**	**0.33**	**1.58**	**12,833.64**	**1.98**	**11.02**

[1] Totals in this column include CO2 emissions from petroleum-based fuels only.
[2] Emissions from electricity are based on the zip code entered above.

Summary

Your annual greenhouse gas emissions were **reduced by an estimated 12,833.64 pounds CO_2-Equivalent / year** (5.82 tonnes / year). Of these emissions, fossil fuels accounted for 12,833.64 pounds CO_2-Equivalent / year (5.82 tonnes / year) and biogenic-origin fuels accounted for 0.00 pounds CO_2-Equivalent / year (0.00 tonnes / year).

Your estimated annual energy savings is **77.01 MMBtu per year.**

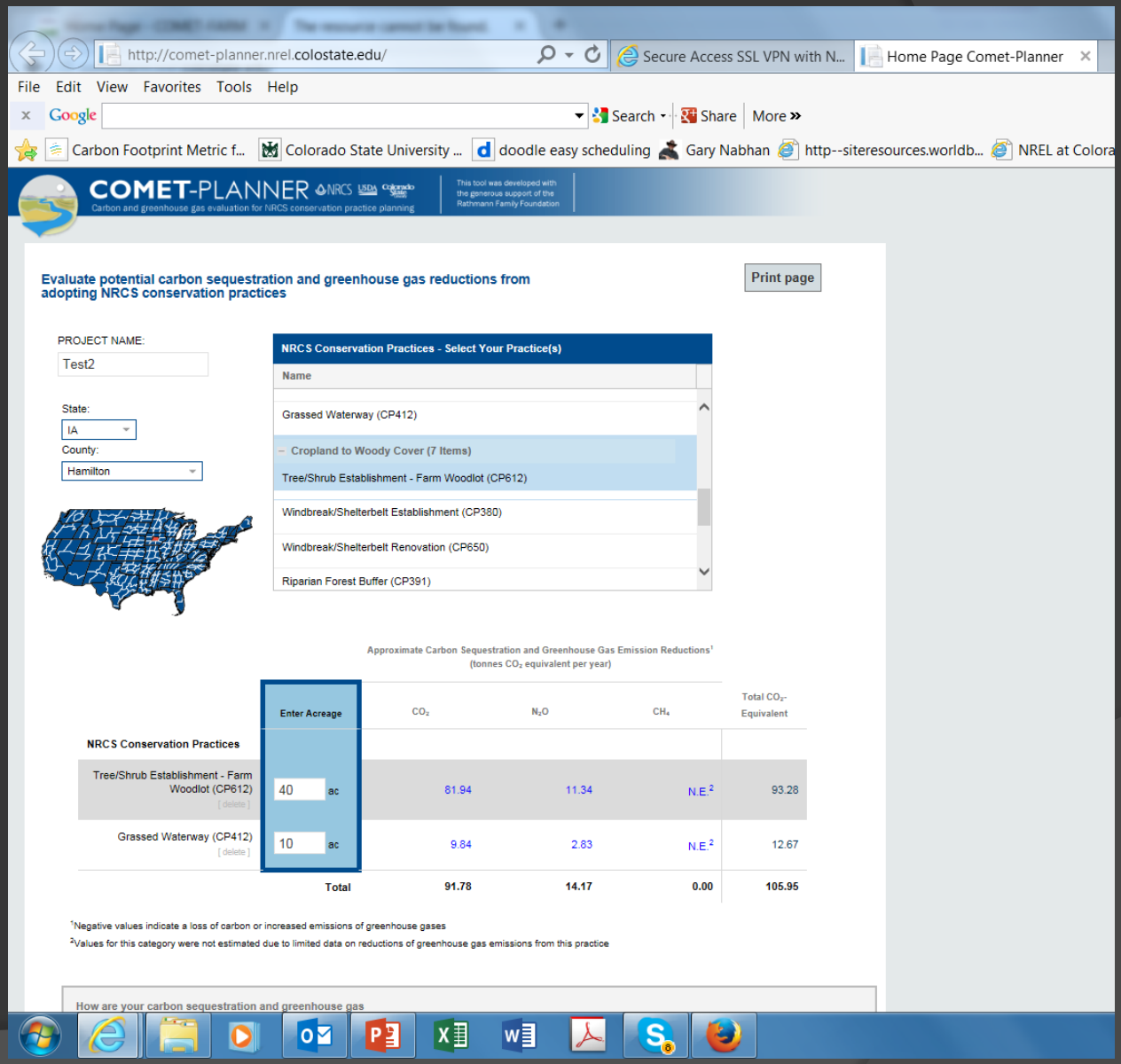
If you would like to perform **a full assessment** of the operation's carbon footprint, that task **can be performed in COMET-FARM™**.

Go to COMET-FARM™ >>

‘COMET-Planner’

Screening tool to provide a quick ‘Tier 1’ estimate of potential GHG reductions with implementation of NRCS Conservation Practices

- Provides empirical-based estimates for broad climate regions
- Intended as a complement to, and ‘easy entry’ to full COMET-Farm Tool



Carbon Sequestration and Greenhouse Gas Emission Reductions for NRCS Conservation Practices

Emission reduction coefficients were derived from recent meta-analyses and reviews. Coefficients were generalized at the national-scale and differentiated by dry and humid climate zones. Ranges for emission coefficients generally represent minimum and maximum values reported in meta-analyses and reviews. When ranges were not given, minimum and maximum values were calculated as -/+ 100% of the emission coefficient. Emission coefficients, ranges, a short explanation estimation methods, and primary sources are presented in the following tables.

CROPLAND MANAGEMENT

Practice	*Climate zone**	Carbon *Average (Range)*	Nitrous Oxide *Average (Range)*	Methane *Average (Range)*	Explanation and Notes	Primary Sources
		Mg CO_2 eq ha^{-1} y^{-1}				
Conventional Tillage to No Till	Dry/ semiarid	0.56 (0.04-1.34)	0.32 (0.14-0.50)	Not estimated	Carbon estimates represent averages of soil carbon change from recent reviews. The highest values for soil carbon were in corn systems with means of 1.03 and 1.48 Mg CO_2 eq ha^{-1} y^{-1} in dry and humid climates respectively. Estimates for nitrous oxide emissions represent the effects of changing tillage only and assume N fertilizer rates do not change (Swan et al.).	Eagle et al. 2012, ICF International 2013, Ogle et al. 2010, Swan et al. (in prep)
	Moist/ humid	1.03 (0.32-1.90)	-0.28 (-0.20- -0.39)	Not estimated		
Conventional Tillage to Reduced Till	Dry/ semiarid	0.25 (0.1-0.47)	0.18 (0.0 – 0.36)	Not estimated	Carbon es… soil carbon… Highest va… systems w… CO_2 eq ha… respective… changes w… Nitrous ox… value.	
	Moist/ humid	0.32 (0.05-0.54)	0.18 (0.0 – 0.36)	Not estimated		

Cropland to Herbaceous Cover

Practice	*Climate zone**	Carbon *Average (Range)*	Nitrous Oxide *Average (Range)*	Methane *Average (Range)*	Explanation and Notes	Primary Sources
		Mg CO_2 eq ha^{-1} y^{-1}				
Conservation Cover (Retiring Marginal Soils and Establishing Permanent Grass Cover)	Dry/ semiarid	2.59 (1.69 – 3.45)	0.20 (0.0 – 0.37)	Not estimated	Soil carbon estimates are based on studies of cropland converted to grassland in the U.S. (Ogle et al. 2010). Nitrous oxide estimates are based on weighted average fertilizer rates for major crops (USDA-ERS 2014) and emissions factors from Ogle et al. 2010 for direct and indirect emissions, and the assumption that herbaceous cover is unfertilized. Range for nitrous oxide is based on range of average fertilizer rates reported in ARMS (USDA-ERS 2014).	Ogle et al. 2010, USDA-ERS 2014
	Moist/ humid	2.43 (1.58 – 3.30)	0.70 (0.0 – 1.24)	Not estimated		
Forage and Biomass Plantings – Full Conversion	Dry/ semiarid	0.67 (-0.86 – 2.00)	0.24 (0.0 -0.48)	Not estimated	T-AGG (Eagle et al. 2012) analysis of impacts on soil organic carbon literature data for North America. Reduction in nitrous oxide is based on assumptions of lower N fertilizer and/or introduction of legume forages. Nitrous oxide ranges are +/- 100% of value reported.	Eagle et al. 2012
	Moist/ humid	0.67 (-0.86 – 2.00)	0.24 (0.0 -0.48)	Not estimated		
Forage and Biomass Plantings – Partial Conversion	Dry/ semiarid	0.52 (-0.01 – 1.20)	0.03 (0.0 – 0.06)	Not estimated	T-AGG (Eagle et al. 2012) analysis of impacts on soil organic carbon literature data for North America. Reduction in nitrous oxide is based on assumptions of lower N fertilizer and/or introduction of legume forages. Nitrous oxide ranges are +/- 100% of value reported.	Eagle et al. 2012
	Moist/ humid	0.52 (-0.01 – 1.20)	0.03 (0.0 – 0.06)	Not estimated		
Herbaceous Wind Barriers	Dry/ semiarid	2.59 (1.69 – 3.45)	0.20 (0.0 – 0.37)	Not estimated	Soil carbon estimates are based on studies of cropland converted to grassland in the U.S. (Ogle et al. 2010). Nitrous oxide estimates are based on weighted average fertilizer rates for major crops (USDA-ERS 2014) and emissions factors from Ogle et al. (2010) for direct and indirect emissions, and the assumption that herbaceous cover is unfertilized. Range for nitrous oxide is based on range of average fertilizer rates reported in ARMS (USDA-ERS 2014).	Ogle et al. 2010, USDA-ERS 2014
	Moist/ humid	2.43 (1.58 – 3.30)	0.70 (0.0 – 1.24)	Not estimated		

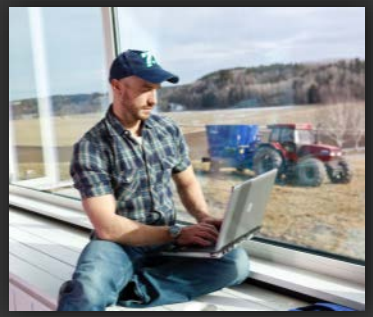
Other COMET-related developments

- Collaboration with CIG projects on GHG mitigation – included ‘off-ramp’ from COMET-Farm for users of DNDC-model based protocols
- Integration with NRCS LMOD database – option for user to select predefined management scenarios, by crop mgmt zones, as rapid entry point to full COMET-Farm system
- ‘COMET-Mondial’ - Collaboration with International scientists through a FACCE-JPI grant (joint funding from EU, Brazil and Australia, US sources) to extend COMET-Farm platform to other countries
- Discussions with Field-to-Market, Fertilizer Institute and International Plant Nutrition Institute on potential system integration for soil GHG emission estimation

Policy Assessments

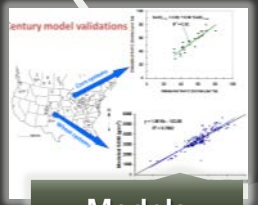
Inventories

Ecosystem Service Markets

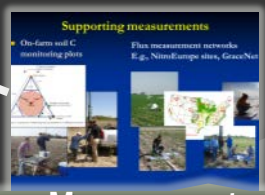


Geographic Databases

Remote Sensing Data



Models



Measurement Network

Visit COMET-Farm at:
http://cometfarm.nrel.colostate.edu

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