Meeting the Climate Change Challenge

NEW HORIZONS FOR COMPOST

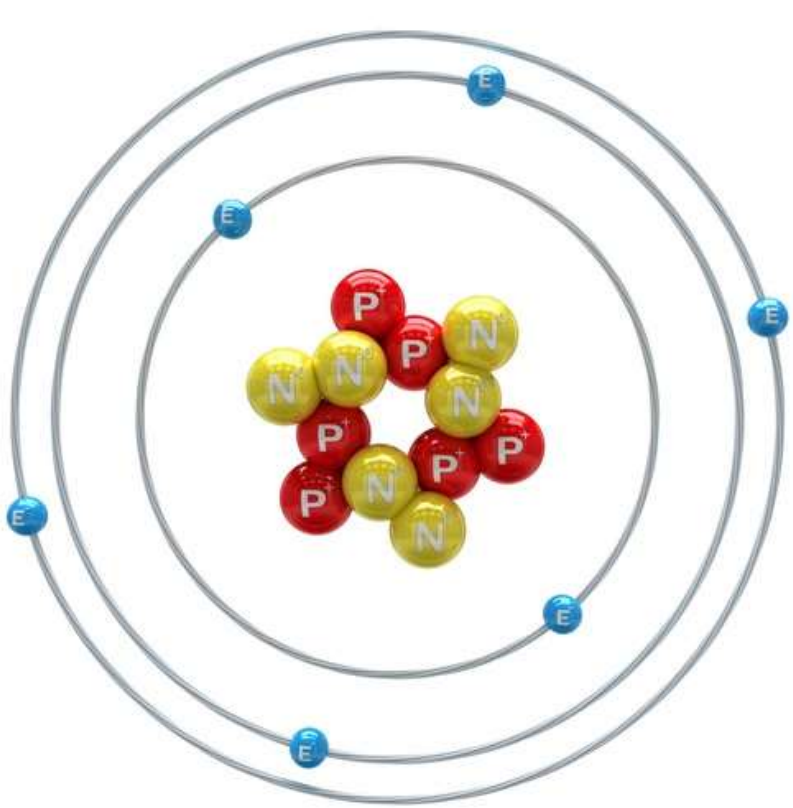
Three Key Points

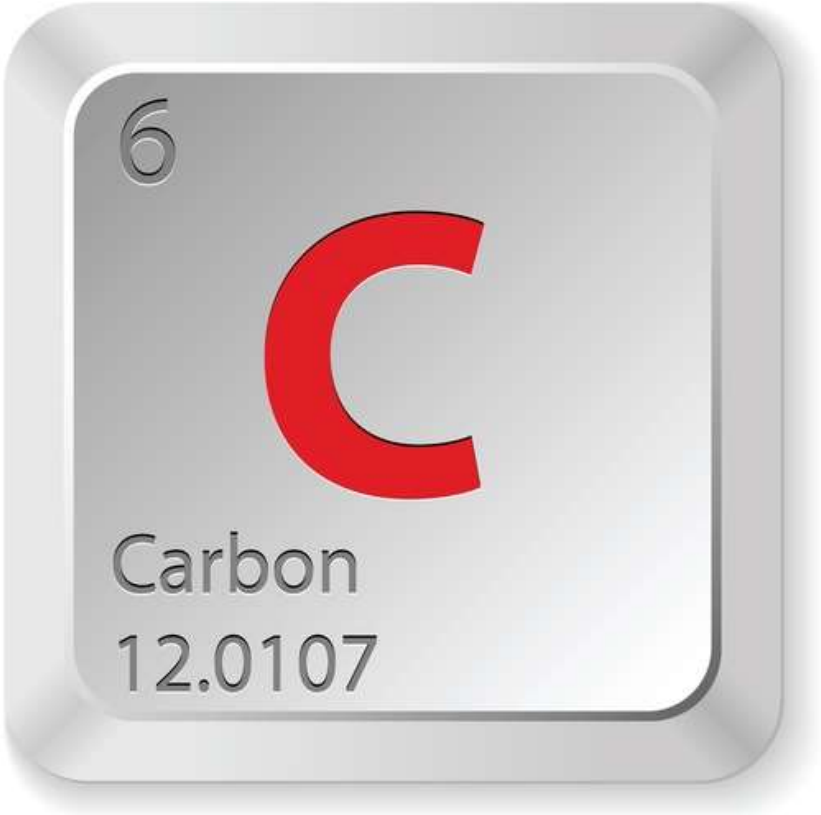
1. Climate change is all about carbon management

2. Soils can absorb enough carbon to significantly mitigate climate change

3. Compost is a catalyst for carbon sequestration by soils

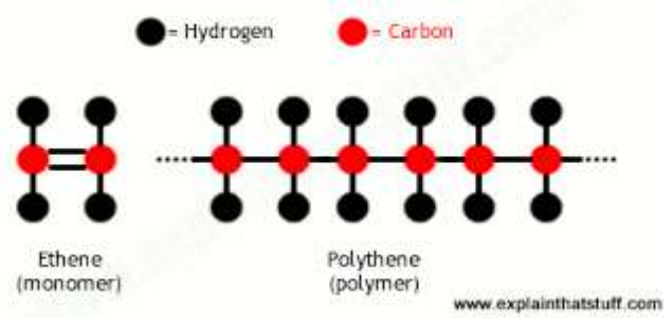
Carbon – the energy currency of life



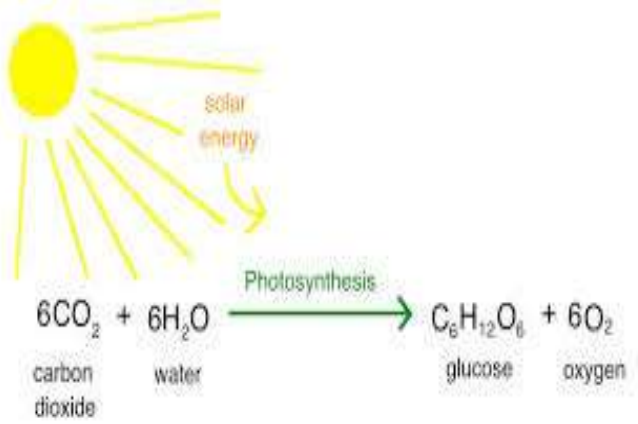


Carbon – Life's Backbone AND Energy Currency

C has ability to form polymers (long stable chains of carbon atoms -- with other atoms attached as "sidekicks" – at a normal range of temperatures.



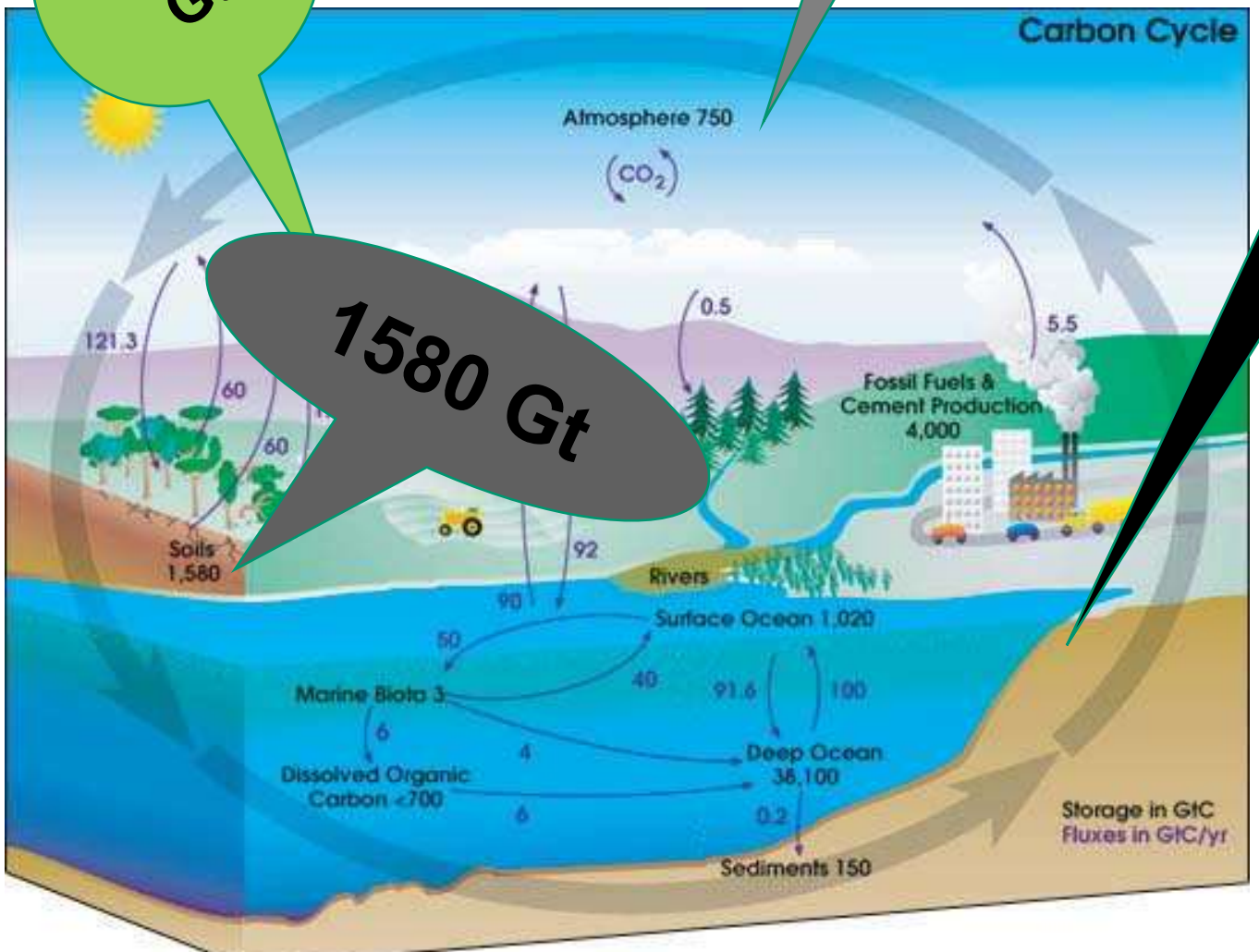
These long, stable carbon chains form the backbone of sugars, carbohydrates, proteins, and even DNA – all the "stuff" of life. The most basic of these carbon chains – simple glucose (sugar) -- is the initial product of *photosynthesis.*



Some Facts about Carbon

- 4th most abundant element in the universe
- Formed in the heart of stars (NOT in the Big Bang!)
- Extremely versatile (diamonds, charcoal, graphite, etc.)
- The basis for life on earth (organic chemistry)
- About 50% of all soil organic matter (SOM)

The Carbo cle



610 Gt

750 Gt

1580 Gt

2,795 GT of known fossil fuel reserves

Composition of the Earth's Atmosphere

Gas	Per cent of atmosphere
Nitrogen (N_2)	78
Oxygen (O_2)	21
Argon	.93
Carbon dioxide (CO_2)	.04

The Carbon Management Opportunity

Too much C in the atmosphere

- CO_2 levels have gone from 315 ppm in the 1950s to more than 400 ppm recently
- 350 is the level many scientists feel we should achieve & maintain

Too little C in our soils

- Organic matter in agricultural soils has dropped by an average of more than 50 per cent since the introduction of the plough
- This drop in organic matter represents an addition to atmospheric carbon as well as a loss in soil fertility

This is an opportunity!

Too little carbon in a living soil ecosystem?

Sounds like the right opportunity for people who manage carbon!

Like composters, for instance….

The Real Nature of Soil Humus

This soil sequesters carbon

This soil loses carbon

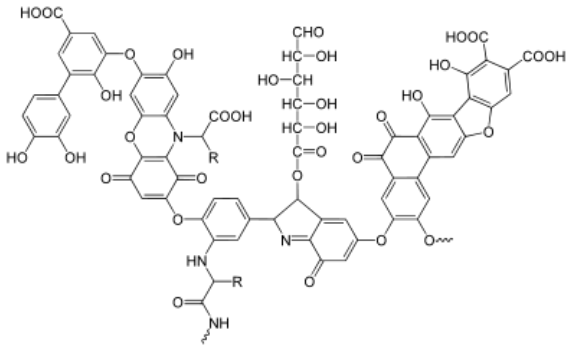
Why?

The Shifting Understanding of what Constitutes Soil Humus

What exactly IS soil humus?

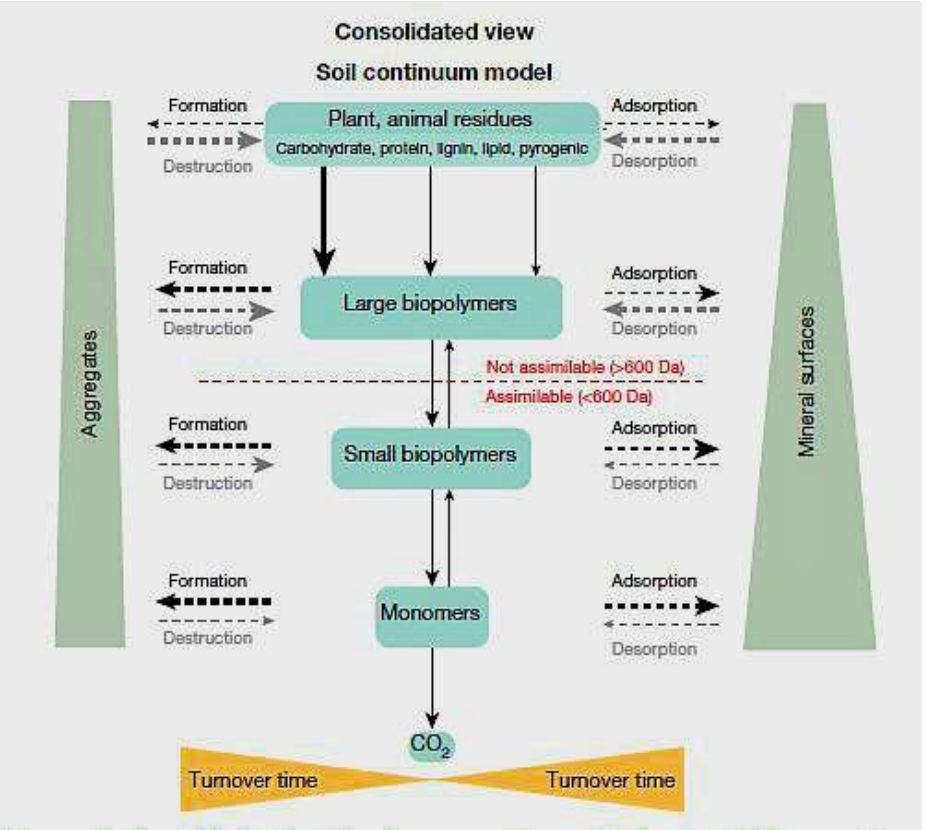
OM too tough for the bugs?

Huge organic molecules synthesized by either chemical or biological means?



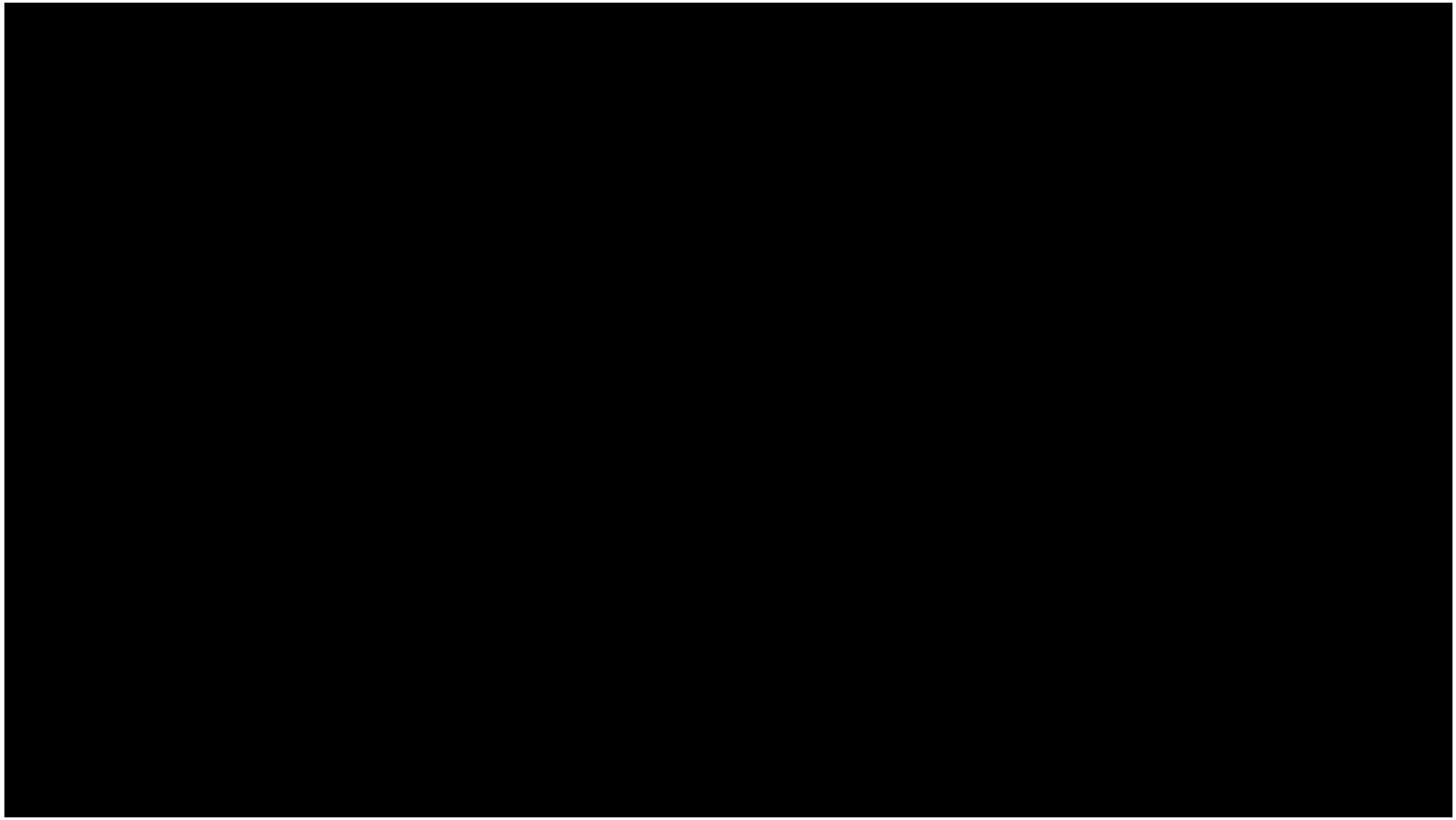
Soil Humus – A New Understanding

Humus is the accumulation of microbial by-products, at various levels of protection and/or recalcitrance



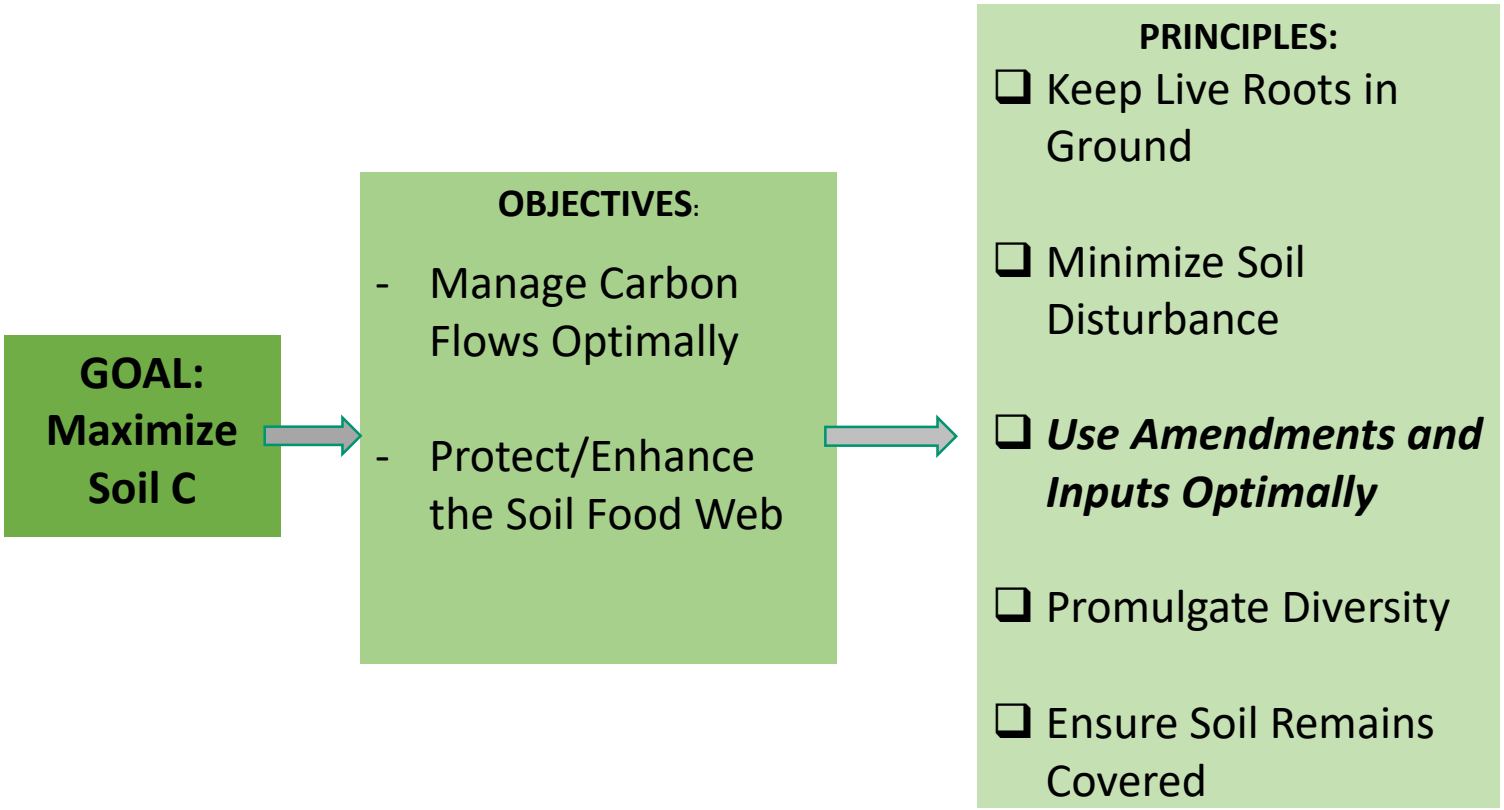
Soil Bacteria

Soil Fungi



Soil aggregates

The Basic Principles



Compost as Soil Sequestration Catalyst

Three main reasons:

- Carbon is sequestered by soil microbes
- Compost provides soil microbes with food, energy, and habitat
- Compost also expands the **microbial diversity** of soils

Carbon Sequestration by Lawns

On average, lawns sequester about 0.5 to 1.5 tonnes of carbon, per hectare per year, as opposed to an average no-till cropland rate of 0.3 tonnes of carbon per hectare per year.

Why?

- **grass is a perennial, one that "armors" the soil**
- **once planted and established, there's little to no soil disturbance**
- **the natural death and regeneration of its roots add biomass**
- **leaving the clippings on after mowing enables the soil biome to thrive and carbon to be stored**
- **Adding compost feeds the microbiome and replenishes its diversity**

Compost on Rangelands

Marin Carbon Project

NOTE: The bulk of the C sequestration came from the additional productivity, rather than the compost itself.

"…results show that a single application of compost to two grasslands resulted in soil C sequestration rates of **over 3 Mg C/ha over three years with concomitant increases in soil N.**"

- Ryals et al. *Impacts of organic matter amendments on carbon and nitrogen dynamics in grassland soils*. Soil Biology & Biochemistry 68 (2014) 52e61

https://www.marincarbonproject.org/

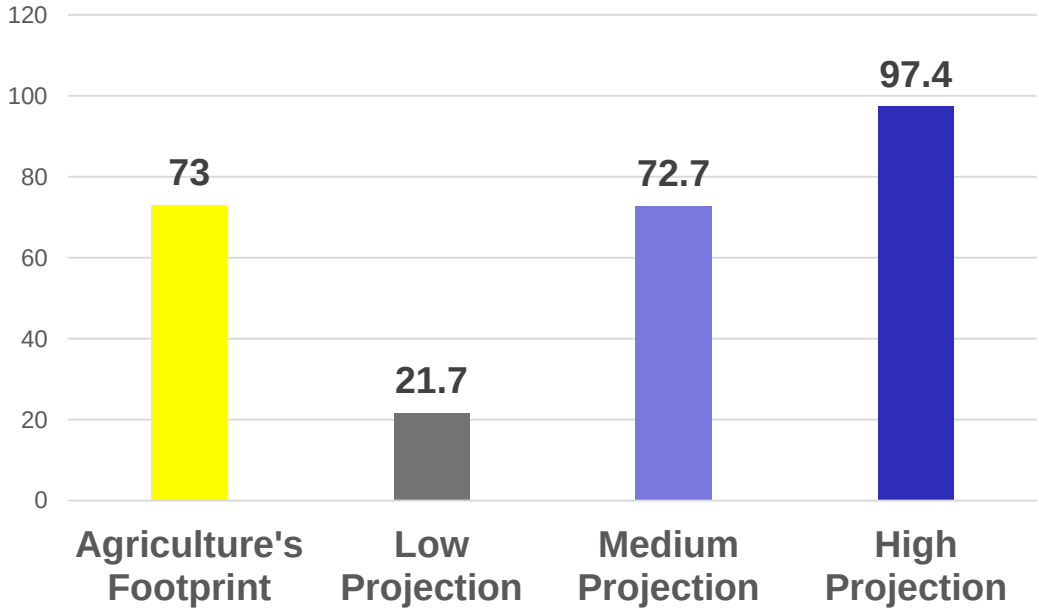
What does a reduction of one tonne of CO_{2e} look like?

One eighth of an average home

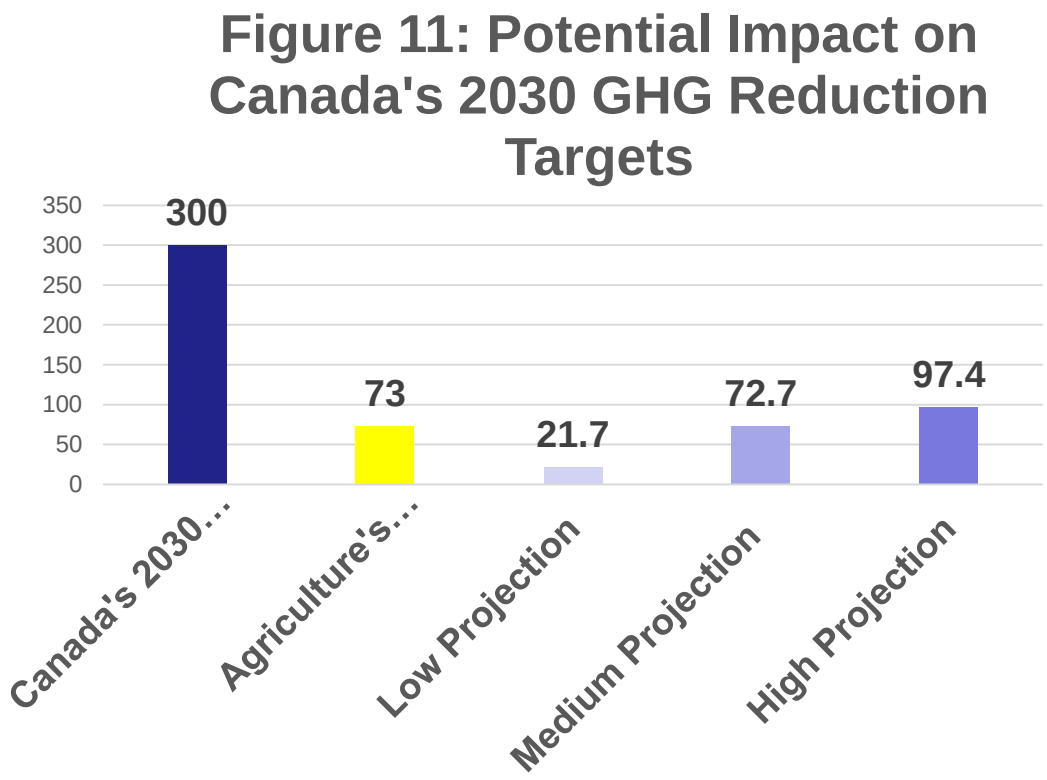
One fifth of a passenger vehicle

120,000 cell phone charges

Figure 10: Potential to Offset Agriculture's GHG Footprint



Potential Impact on Canada's GHG Targets

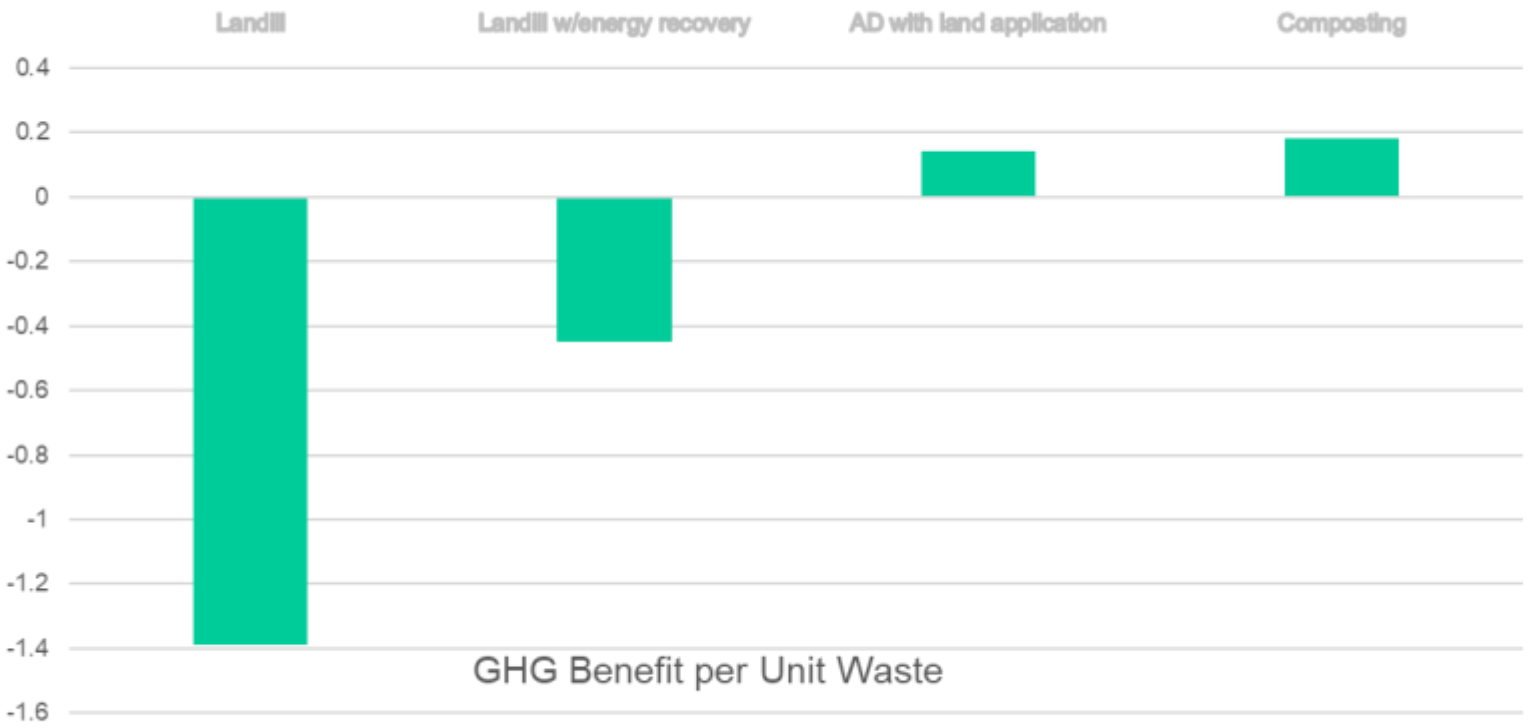


Compost's unique role in soil-carbon sequestration

- There are many BMPs that have been shown to build SOC and optimize soil health
- These include:
  - Zero and strip tillage
  - Cover crops
  - Diverse rotations
  - 4Rs

Compost makes all of these practices work better!

GHG Benefits of Composting



Conclusion

Climate change is an existential threat, not to the planet, but to our civilization. We need to act. One of the easiest and most effective things we can do is make sure that organic residuals get back into the soil, preferably as compost.

Questions or Comments Welcome!