

Estimated CO₂e emission reductions for purchasing Shepherd's Grain Flour

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Outline

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Abbreviations: CO₂e = Carbon dioxide equivalence, SG = Shepherd's Grain, NT = No-till, CT = Conventional till

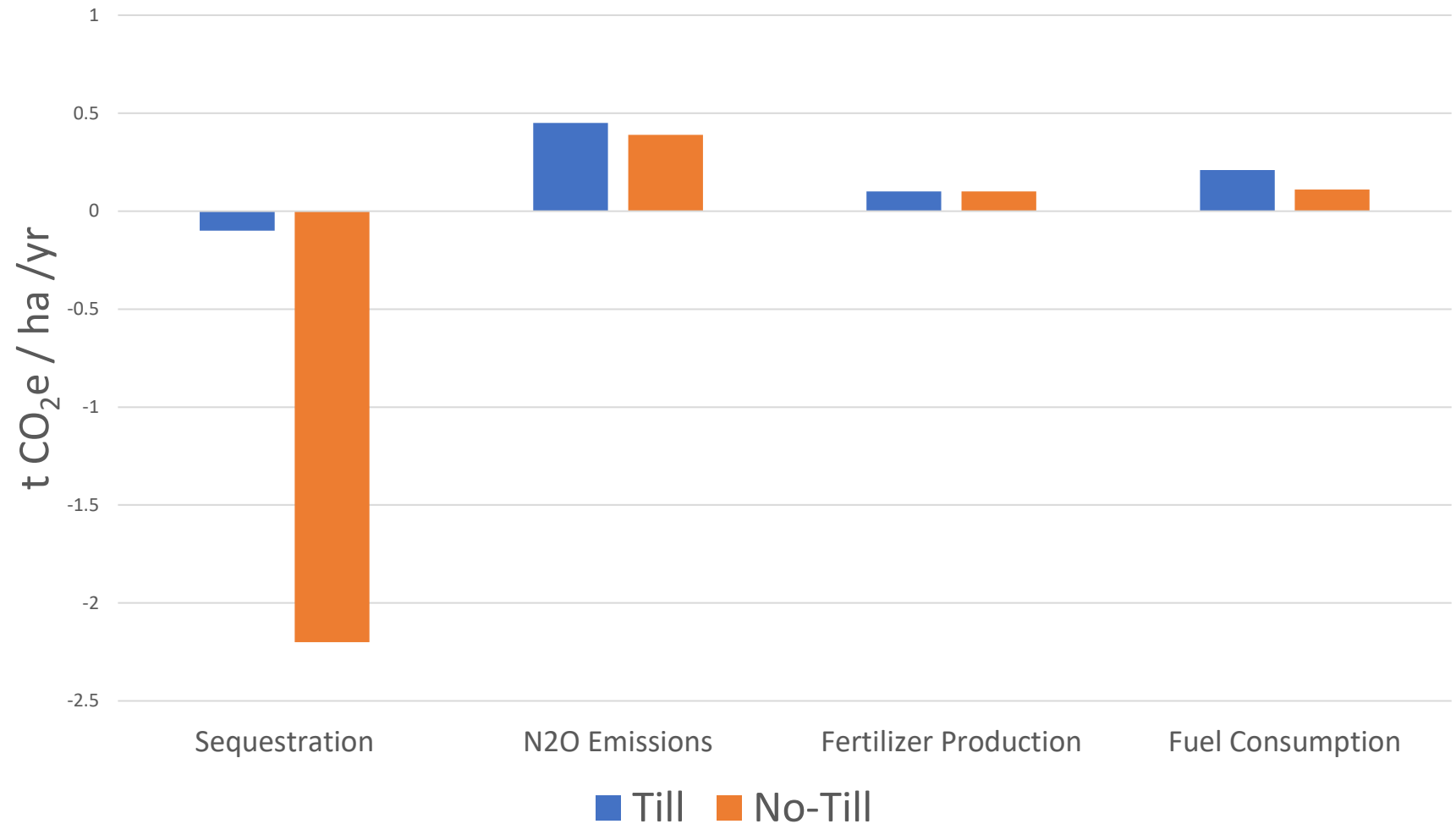
Summary

NT practices used by SG growers reduce CO₂e by reducing on farm diesel burning and increasing the C storage of the soil. **We estimate a 0.0111 t/bu wheat (0.0259 t/100# flour) reduction CO₂e when compared with the CT systems.** Sequestration of soil carbon, which is one of the largest contributors to increases in an NT system over a CT system are difficult to estimate precisely, and may introduce error into the estimation. A more conservative estimate assuming CO₂e net 0 for NT would be a reduction of 0.0025 t/bu (0.0058 t/100# flour) when compared with CT. In both cases the reductions in CO₂e are substantial.

Sources and Sinks of CO₂e in Agriculture

- Removal from the atmosphere
 - Sequestration in soils
- Emissions
 - Nitrous oxide emissions
 - Off farm fertilizer production
 - On farm fuel consumption

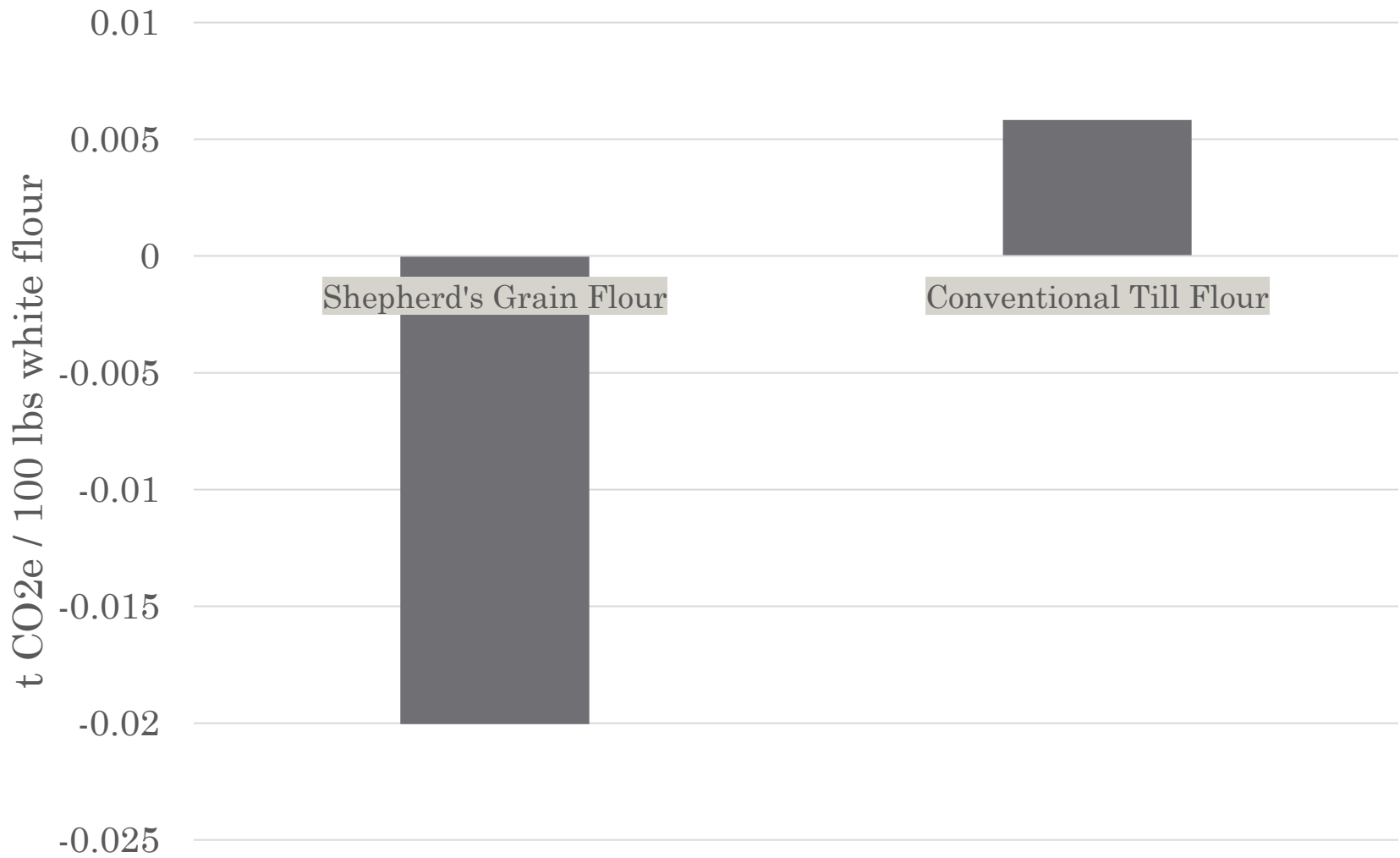
t CO₂e emissions from conventional till and no till farms



CO₂e t/ha/yr reductions

	Till	No-Till
Sequestration	-0.1	-2.2
N ₂ O Emissions	0.45	0.39
Fertilizer Production	0.1	0.1
Fuel Consumption	0.21	0.11

Estimated CO₂e sequestration and emissions from conventionally tilled and Shepherd's Grain flour



Approach and Primary Sources

Using relevant and modeling and measurement studies conducted in the Pacific Northwest, we estimated differences in the CO₂e between CT and NT production systems.

- Studies using modeling (Stockle et al. 2012, Zaher et al. 2013)
- Measurements of soil C sequestration on SG farms (Apfelbaum et al. 2022)
- Measurements of N₂O emissions (Kostyanovsky et al. 2019)

Conclusions and Considerations

- The available scientific literature and data support the conclusion that SG wheat which is grown using NT methods substantially reduces the CO₂e on a per bushel basis.
- Measuring CO₂e emissions is difficult to measure precisely and the estimations presented here use assumptions and estimations which may not be 100% accurate, but nevertheless the best available science in the form of regional modeling and actual validated measurements offer a valuable estimate for the reductions in CO₂e which can be achieved by purchasing NT SG flour.

Works Cited

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Kostyanovsky, K. I., Huggins, D. R., Stockle, C. O., Morrow, J. G., & Madsen, I. J. (2019). Emissions of N₂O and CO₂ following short-term water and n fertilization events in wheat-based cropping systems. *Frontiers in Ecology and Evolution*, 7(APR). <https://doi.org/10.3389/fevo.2019.00063>

Stöckle, C., Higgins, S., Kemanian, A., Nelson, R., Huggins, D., Marcos, J., & Collins, H. (2012). Carbon storage and nitrous oxide emissions of cropping systems in eastern Washington: A simulation study. *Journal of Soil and Water Conservation*, 67(5), 365–377. <https://doi.org/10.2489/jswc.67.5.365>

Zaher, U., Stöckle, C., Painter, K., & Higgins, S. (2013). Life cycle assessment of the potential carbon credit from no- and reduced-tillage winter wheat-based cropping systems in Eastern Washington State. *Agricultural Systems*, 122, 73–78. <https://doi.org/10.1016/j.agry.2013.08.004>

Additional notes and assumptions

- Zaher's model estimated approximately 0.6, 0.35, and 0.25 t CO₂e/ha/yr sequestered in NT systems in the high, medium, and low rainfall zones. However, actual measurements conducted over a 7 year period on SG farms resulted in 2.2 t CO₂e/ha/yr average across all rainfall zones.
- Using some general assumptions about yield across the region we estimated CT emissions to be 0.058 t CO₂e/100# flour compared to a net reduction of 0.0200 t CO₂e/100# flour for SG producers. This results in an overall reduction of 0.0258 t CO₂e/100# flour.
- The yield assumptions we made were an average yield of 100, 70, 40 bu/a for the high, medium, and low rainfall zones. Additionally we assumed that the average wheat yield of SG farmers was 75 bu/a. With more time and data these numbers could be refined to develop a more robust estimation of the CO₂e savings per 100# flour.

Modeled Estimates of CO₂e

