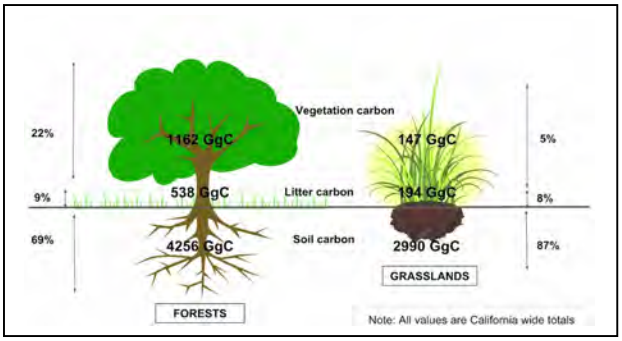
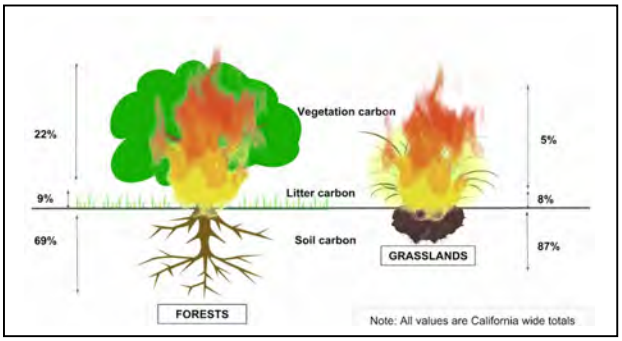
Climate Change: Potential for grasslands in addressing CO_2 emissions.

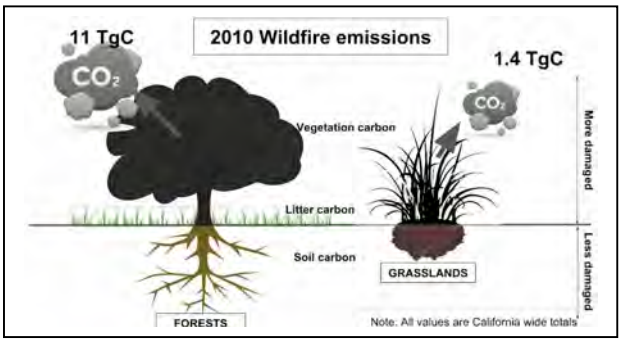
Under the current rate of climate change, some parts of New Zealand could find (like California), trees could become a greater source of carbon emission than carbon capture. This is evidenced by a recent study by UC Davis: "…. the U.S. Forest Service reports. Eight of the state's 20 most destructive fires have occurred in the past four years, with the five largest fire seasons all occurring since 2006. (Not including this last season)" (Source: https://climatechange.ucdavis.edu/news/grasslands-more-reliable-carbon-sink-than-trees/). Released June 2018

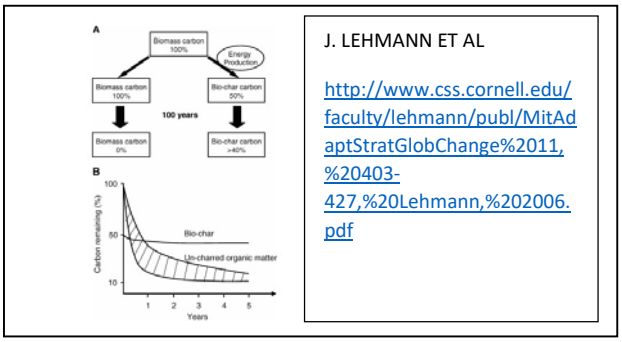
Vegetation images from video by Lead author, Pawlok Das;

https://cdn.iopscience.com/content/1748-9326/13/7/074027/Mmedia/abstract-video-62931908f806cb9af6355f7c8f6b8a40.converted.mp4









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http://www.css.cornell.edu/faculty/lehmann/publ/MitAdaptStratGlobChange%2011,%20403-427,%20Lehmann,%202006.pdf

- **It makes no difference whether the pine tree makes it into manufactured product or not, the outcome is the same. No long term reduction in atmospheric CO_2, most returning within 50 years, right when we most need the reduction.**
- Lehmann's graphic shows that unutilised biomass will result in >80% becoming CO_2 within 5 years. When pyrolysed, >40% will be carbon stable for 100s of years.
- Carbonisation of the biomass will mobilise the volatiles yielding some excess energy and turn the resdual into fixed elemental carbon biochar which will be carbon stable with a half life of a 1,000 years.
- The graphic on P.2 shows the profound effect that increasing biochar application has on soil GHG emission, to absorb and release plant available water and nutrient (via the burnt toast effect).
- P.3 shows biochar as the carbon cycle game changer.
- The image on P.4 illustrates how the water and nutrient exchange capacity of biochar translates into increased plant vigour / increased green leaf area to facilitate increased carbon accumulation.
- A carbon market would put a value on capturing carbon accumulation.
- A carbon market would drive an industry stabilizing biomass to elemental carbon.
- A carbon market would make a meaningful difference to addressing CO2 emissions.

Carbon cycle discussion. Current position as at 1st April 2019
http://www.southernxpress.co.nz/

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Carbonised biomass has no nutrient value. What it does have is a significant Cation Exchange Capacity (CEC). This is a capacity to absorb and release plant available water and nutrient.

https://www.researchgate.net/publication/48856368_Hydrothermal_carbonization_of_biomass_residuals_A_comparative_review_of_the_chemistry_processes_and_applications_of_wet_and_dry_pyrolysis

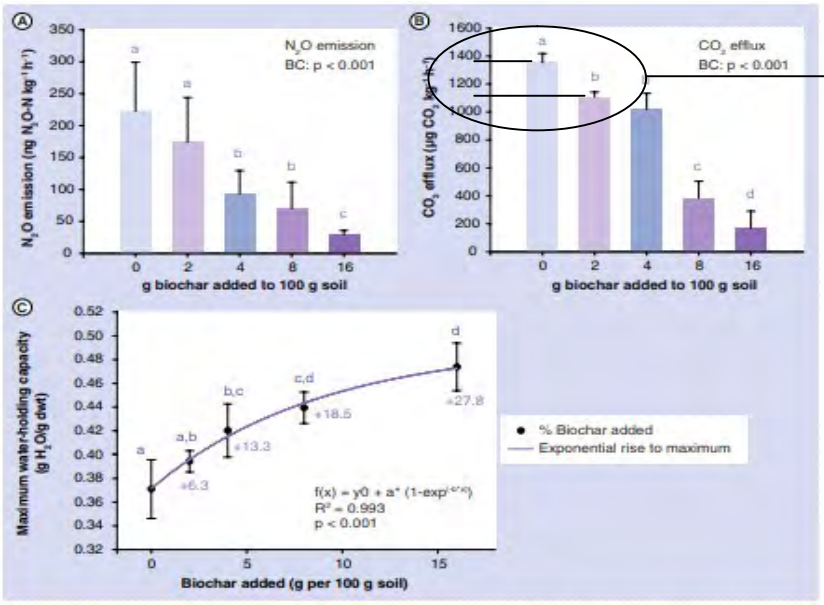

Figure 5. Reduction of (A) N_2O emissions and (B) CO_2 efflux (mean ± standard deviation, n = 4) from a sandy loam brown earth mixed with increasing amounts of biochar (peanut hull from Eprida, USA) and set to 65% of the maximum water-holding capacity of the respective mixture. Since the water-holding capacity increased significantly with increasing amounts of biochar (**C**; in purple: percentage increase compared with the control), the absolute amount of water added to the biochar mixtures was increasingly higher than that added to the control. Letters indicate significant differences between treatments (**A**, **B** and **C**: one-way analysis of variance and Student-Newman–Keuls all pairwise test procedure; statistics and curve fitting: SigmaPlot 11.0). The flux measurement was performed 4 weeks after mixing soil and biochar and incubating it at 22 ± 1°C in the laboratory, and 1 day after addition of 50 µg N g^{-1} soil of a $NH_4^+NO_3^-$ solution to stimulate denitrification. Jar incubations and GC analyses of the gas samples for N_2O and CO_2 were carried out as described in [194].

1380 – 1100 = ~ 20% reduction?

Widespread grassland application of bio char, amounts to a huge capacity of our grasslands to contain elemental and Soil Organic Carbon (SOC). Concievably, increasing reactive SOC Saturation Limitation as found in ancient Amazon Terra Preta soil.

https://biochar.co.nz/about-biochar

C. shows a significant increase in plant available water, a further climate change mitigation by increasing grassland plant capacity to maintain green leaf area for atmospheric CO_2 accumulation for longer into periods of moisture stress.

- Why is there no ETS recognition of biochar production?
- **The above graphic and the charging pic below show the compounding, long-term environmental win-win from applying carbonised biomass to soil;**
  1. **To boost ongoing soil organic carbon status through reduced emissions.**
  2. **Increased plant performance for increased carbon accumulation.**
- This is more than a minor advantage over planting pine trees.
- However, commercial reality asks, why would you make biochar for no commercial advantage, when you could take the energy value of >$50/MT and make all the char into CO_2?
- In the absence of a carbon market for biochar, commercial viability is unlikely.
- The Biochar potential was well documented through a period 8-12 years ago, but appears to be largely unrecognised outside that community of research workers.

The next two graphics below shows that trees on there own will at best, get to be carbon neutral, a biomass process could be genuinely carbon negative. This is not just a brief respite, this is long term with a half life of a thousand years.

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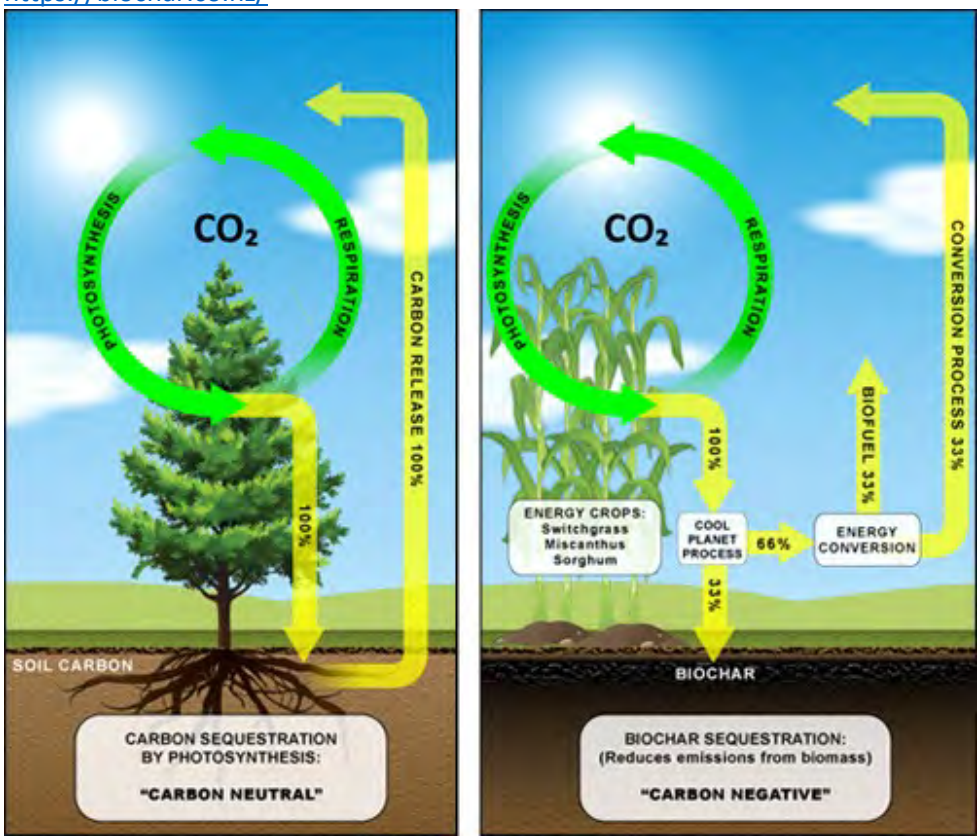
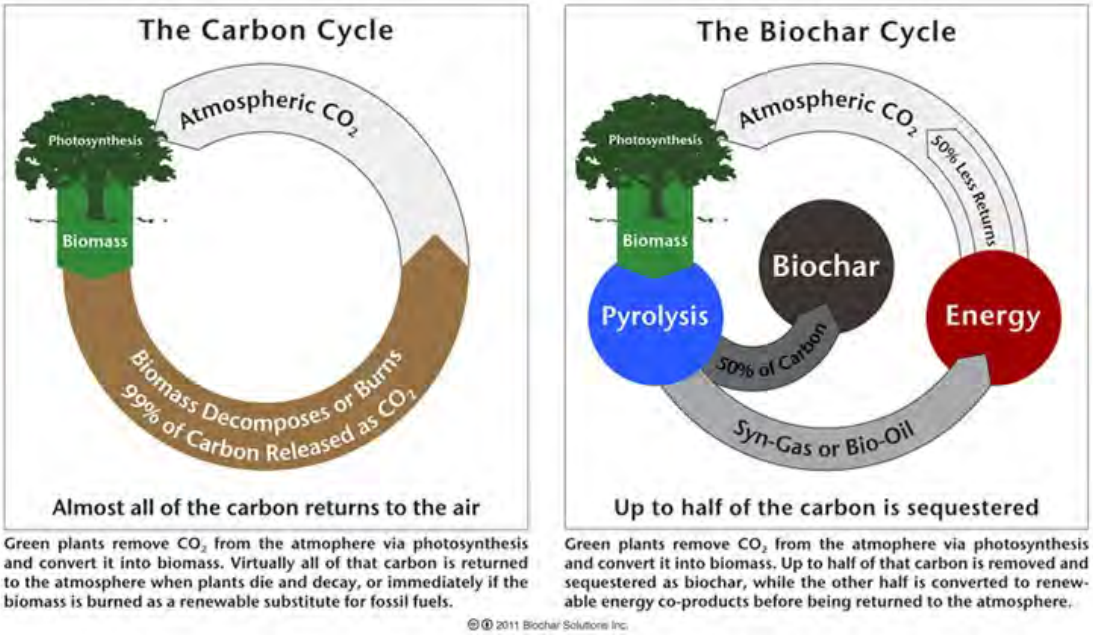
https://biochar.co.nz/



https://2050kids.org/biochar-a-game-changer-for-the-climate/



The experiment below demonstrates the capacity for biochar to deprive seedlings of nutrient and its capacity to release and enhance green leaf area for carbon accumulation, often in the order of 200 – 300% in degraded environments.

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http://www.ithaka-journal.net/wege-zu-terra-preta-aktivierung-von-biokohle?lang=en

Principles of biochar charging

If biochar is incorporated pure and without activation into the soil, its high adsorption capacity and increasing CEC will result in the absorption and fixing of available nutrients and water in the soil. This may lead to inhibition of plant growth, at least in the beginning (several months to a year), depending on the soil's nutrient content. To prevent this, it is recommended that prior to biochar's application, biochar should be:

1. Loaded with nutrients and water
2. Colonized with microorganisms to ensure the fixed nutrients are more easily available to plants
3. Aged by oxidation to bring CEC close to its maximum.

The experiment by Andreas Thomsen clearly shows the importance of charging biochar. In the picture, the upper portion shows a series of experiments wherein pure biochar particles were added in increasing dosage. In the lower series of the picture, the biochar was composted first for 4 months and then cleaned of compost to make sure that only the charged biochar in the experiment was used. While pure biochar resulted in growth inhibition of mustard plants, charged biochar showed a significant increase in growth (thanks to Andreas Thomsen).

Note: Biochar responses are not consistent across all soil types.
https://www.nature.com/articles/srep01732#t1

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