Biohiilen mahdollisuudet hiilimarkkinoilla

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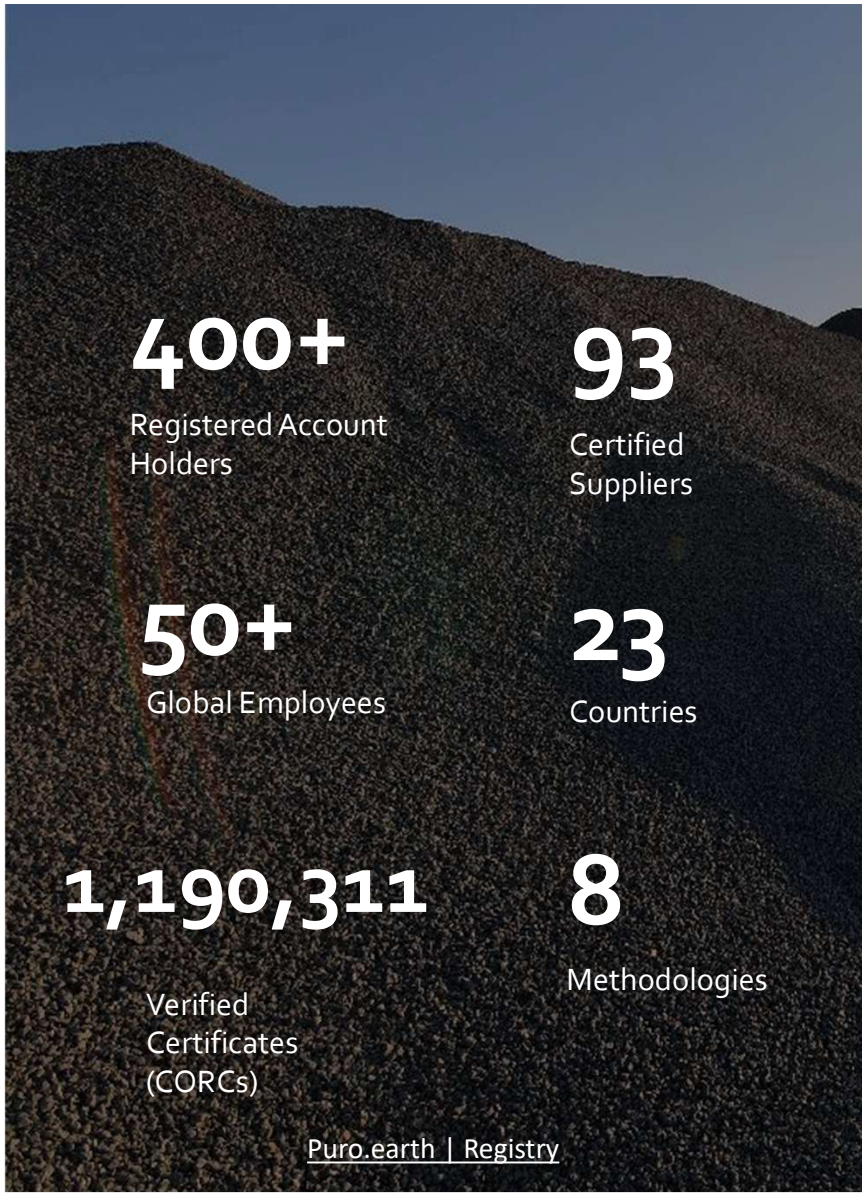
Puro.earth – globaali hiilenpoistorekisteri ja sertifikaatti

- Keskittynyt ainoastaan pysyviin hiilivarastoihin
- Perustettu 2019, kotipaikka Helsinki, nykyiset omistajat Nasdaq, Fortum ja henkilöstö
- Puro Standard määrittelee säännöt hiilenpoistotavoille (methodology)
  - kelpoisuudelle (eligibility)
  - netto-ilmastovaikutuksen laskemiselle (quantification)
  - turvallisuudelle (environmental and social impacts)

- Hiilenpoistohankkeet ja niistä syntyvät CORC-yksiköt
  - auditoidaan Kelpoisuus, turvallisuus ja netto-hiilensidonta
  - rekisteröidään julkiseen rekisteriin Puro Registry



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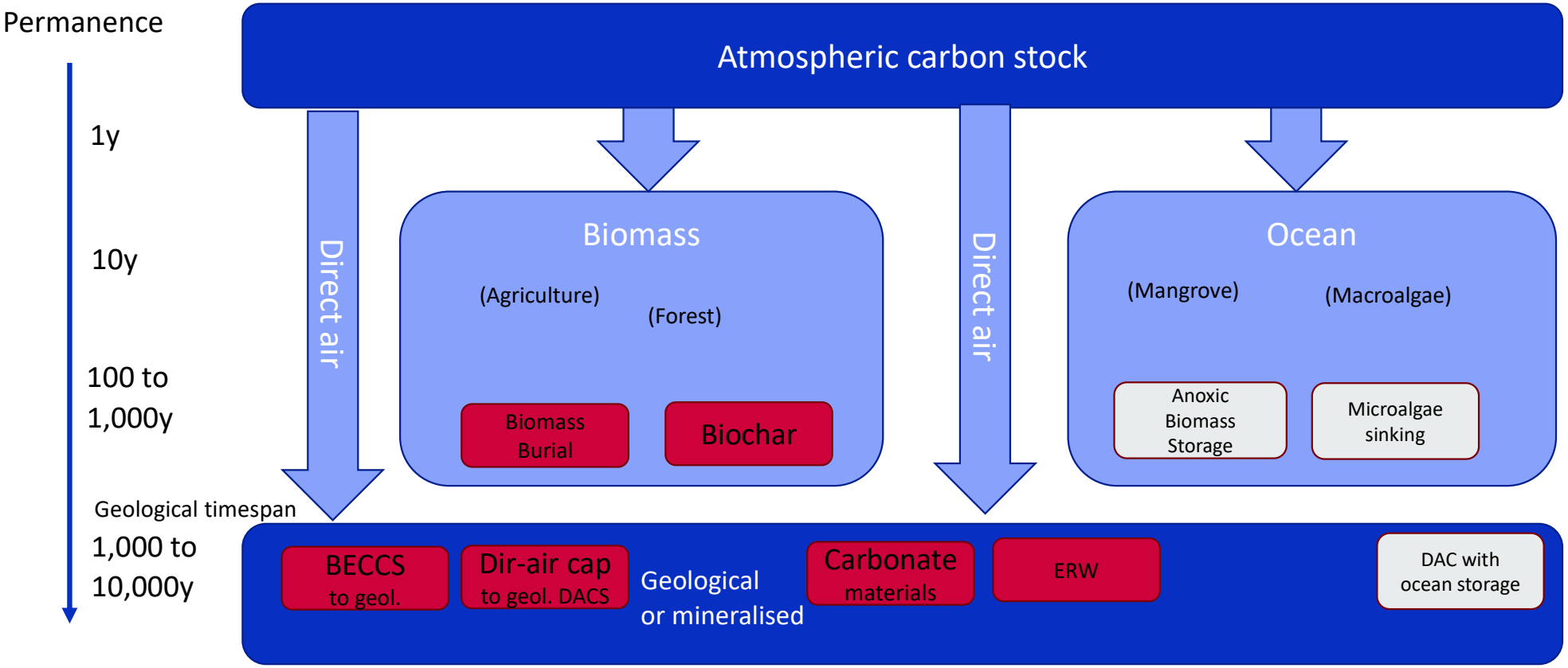
Biohiilen hiilensidonta ominaisuudet verrattuna muihin CDR*-methodologioihin



*CDR – Carbon Dioxide Removal, hiilenpoisto pysyvään varastoon

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Biohiilen hiilivaraston pysyvyyslaskennan evoluutio

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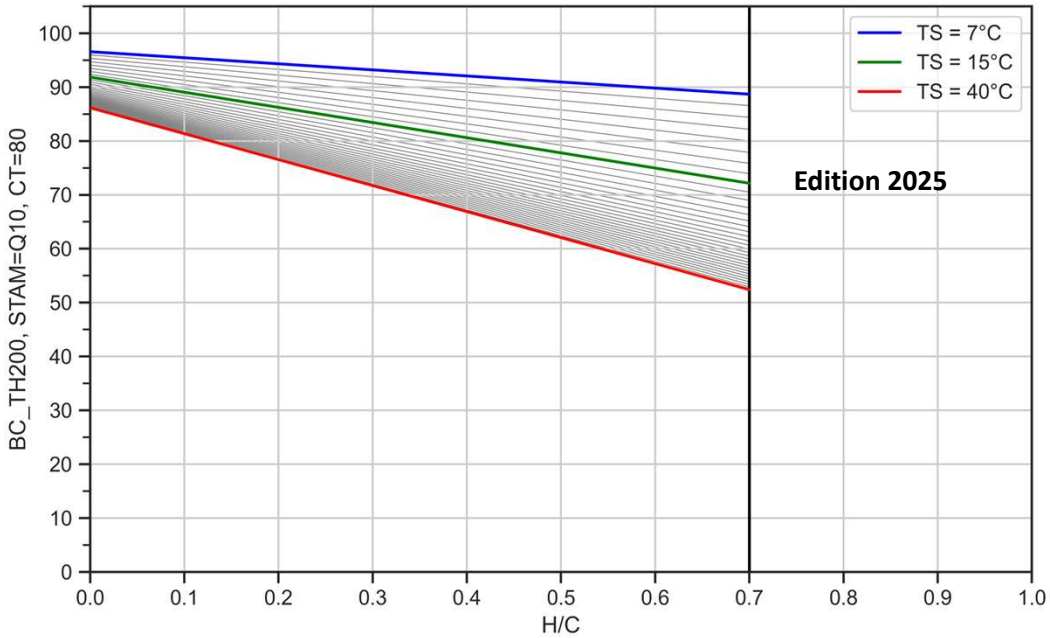
Edition	Persistence approach evolving with scientific publications
2019	Based on Spokas 2010. Removal guaranteed unspecified, issued as **CORC**. Variables: O/C_{org}. Persistence set to 100% if $O/C_{org} < 0.2$ or 95% if $0.2 < O/C_{org} < 0.4$, with deductions estimated from a half-times suggested by Spokas 2010 and linear decay rates.
2022	Based on Woolf et al 2021. Removal for 100+ years, issued as CORC100+. Variable: H/C_{org} (<0.7) and T_s (mean annual soil temperature). Method summary: linear regression between BC_{100} and H/C_{org} at a given T_s, over the domain [0 – 1.5], with biochar Q_{10} soil temperature adjustment method, dataset selection as in Woolf et al 2021, exponential decay extrapolation to 100 years, and 50% confidence interval (default regression).
2025	**Revised decay-based equations, with possibility to report inertinite** • Based on Woolf et al. 2021, Azzi et al. 2024, Li et al. 2024, and others. Developed by Puro.earth and published open-source on GitHub. • Removal guaranteed for: **several centuries, CORC 200+ years** • Variables: **H/C_{org}** (<0.7) and **T_s** (mean annual soil temperature, dataset provided by Puro, average by subnational regions, rounded 1°C upward, with minimum conservative value of 7 °C). • Method summary: linear regression, between BC_{200} and H/C_{org} at a given T_s, over the domain [0 – 0.7], with biochar Q_{10} soil temperature adjustment method, dataset selection as in Azzi et al. 2024, power decay extrapolation to 200 years, and 80% confidence interval included in the linear regression. • Random reflectance (inertinite) measurements can be reported and validated, though not yet used in quantification (see section 6.2). Early verification allows potential retroactive adjustments. Puro's aim is to advance understanding of this approach.



Next scientific steps…

a. Continue to monitor advances in biochar decay experiments, lab, field, and reviews

b. Confirm the scientific validity of random reflectance measurements to infer persistence, integrating where possible with decay research

c. Better understand the correlation between random reflectance distributions, H/C_{org}, pyrolysis temperature, HyPy, and other properties

d. Refine suggested equations of persistence based on random reflectance values (e.g. from Biochar Europe)

Biohiilen osuus 35% ensimmäisestä megatonnista 2019-2025

1st Puro Biochar Methodology

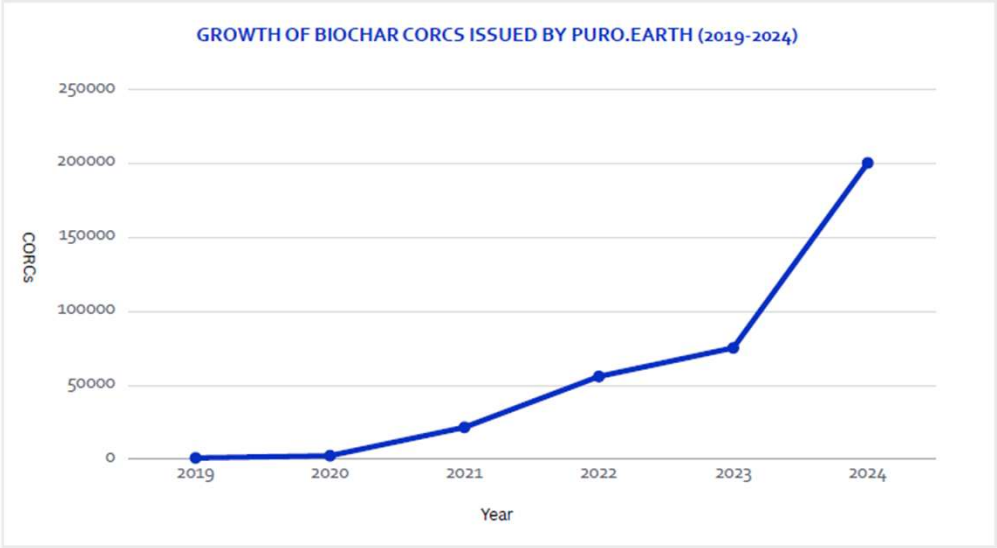
399,483 CORCs
≈35%

2nd Puro Geologically Stored Carbon

379,809 CORCs
≈ 34%

3rd Puro Carbonated Materials

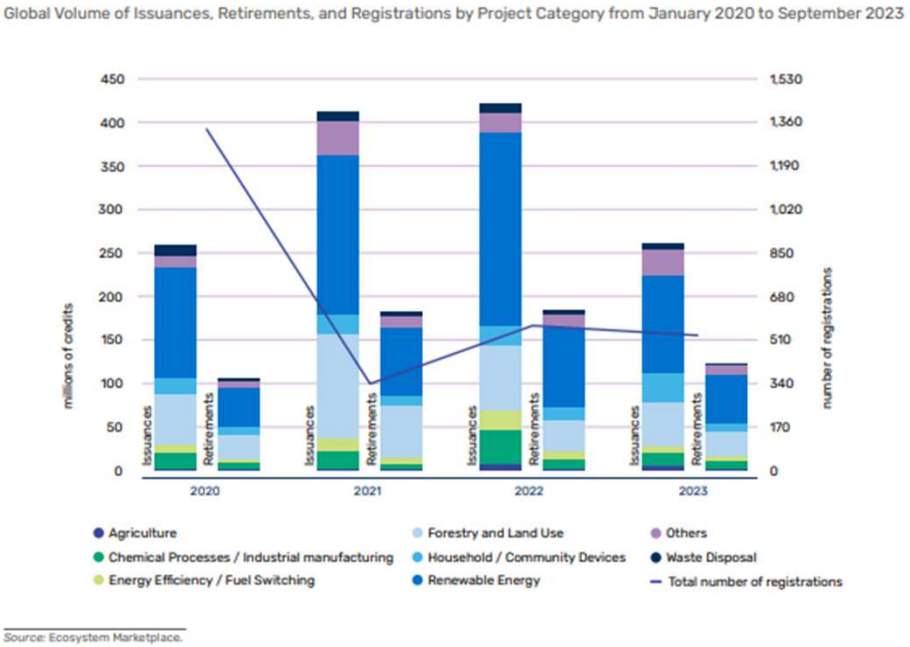
64,539 CORCs
≈ 6%



*CORC – CO_2 Removal Certificate, Puro.earth tavaramerkki

Hiilimarkkinat

- Päästökauppa kattaa 23% maailman päästöistä (World Bank)
  - Yksikkö: päästöoikeus-tonni josta maksettu "jätemaksu" valtiolle
- Vapaaehtoinen hiilimarkkina (VCM)
  - Yksikkö: päästövähennys-tonni (Emission reduction)
  - Yksikkö: hiilensidonta-tonni (Carbon Removal)
    - Temporary upto 40 years
    - Permanent (hundreds of years)
- Pysyvät hiilensidontayksiköt ovat vielä pieni (<1%) mutta kasvava osa markkinaa



VCM – Voluntary Carbon Markets

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Biohiilen markkinatietoja

- 93% of issued biochar CORCs have completed a primary transaction, and 80% have already been retired—meaning a buyer has taken full ownership. In 2025, the average time from issuance to primary transfer is just 22 days, and time to retirement is 65 days. This makes biochar one of the most liquid and buyer-ready carbon removal assets in the market today. **Link to Puro Report** Biochar's Market Momentum: Leading the Carbon Removal Revolution
- Pricing is hard to forecast, but recent data suggests stability rather than volatility. The Nasdaq CORC Price Index that tracks the price of biochar shows credits trading consistently between €120–145 per CORC throughout 2025. CORC Carbon Removal Price Indexes
- Biohiili johtaa tilastoa toimitetuista hiilensidonta-yksiköistä (tonnes delivered) CDR.fyi

Name	Tonnes Delivered	Tonnes Sold	Method
Exomad Green	196 274	1 679 189	Biochar Carbon Removal (BCR)
Varaha	99 512	214 845	Biochar Carbon Removal (BCR)
Aperam BioEnergia	89 548	121 433	Biochar Carbon Removal (BCR)
Wakefield Biochar	57 936	57 944	Biochar Carbon Removal (BCR)
Carboneers	54 730	140 780	Biochar Carbon Removal (BCR)
Pacific Biochar	49 125	52 625	Biochar Carbon Removal (BCR)
Freres Biochar	26 119	26 119	Biochar Carbon Removal (BCR)
Planboo	23 488	34 507	Biochar Carbon Removal (BCR)

Name	Tonnes Delivered	Tonnes Sold	Method
AtmosClear	0	6 750 000	Bioenergy with Carbon Capture and Sequestration (BECCS)
Stockholm Exergi	0	5 259 998	Bioenergy with Carbon Capture and Sequestration (BECCS)
Vaulted Deep	20 427	5 141 194	Biomass Geological Sequestration
CO280	0	4 359 446	Bioenergy with Carbon Capture and Sequestration (BECCS)
Ørsted	0	4 001 500	Bioenergy with Carbon Capture and Sequestration (BECCS)
Gaia ProjectCo	0	2 950 000	Bioenergy with Carbon Capture and Sequestration (BECCS)
Exomad Green	196 274	1 679 189	Biochar Carbon Removal (BCR)

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Biohiilen edut hiilimarkkinoilla

- **Monipuolisuus**
  Biohiili tuottaa pitkäkestoista hiilenpoistoa (carbon removal), mutta myös muita hyötyjä luonnolle ja ympäröiville yhteisöille
- **Muunneltavuus**
  Biohiilituotanto on erittäin muuneltavaa, pystyy hyödyntämään paikallista biomassaa laajasti ja on toteutettavissa kaikissa maissa
- **Varmuus**
  Biohiili on kypsin ja toimintavarmin tarjolla olevista hiilenpoistomenetelmistä

- For buyers looking to secure long-term supply, a competitive market with high liquidity is strategic way to lock in volume and pricing in multi-year offtake agreements.
- Investing in carbon removal now is a positive action. In climate urgency, we need to use the means that we have now and not stop and wait for technology evolution.
- Puro.earth released the world's first biochar carbon removal methodology in 2019, and it has since undergone multiple updates to reflect evolving science, stakeholder input, and field experience. This track record makes it one of the most robust and trusted methodologies in the market today.
- You can trust Puro Standard to certify only biochar projects that meet the stringent requirements on environmental safety and rigorous quantification.


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