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CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

Life Terra

"Comparative Life Cycle Assessment of tree planting and seedling production in the LIFE Terra Project"

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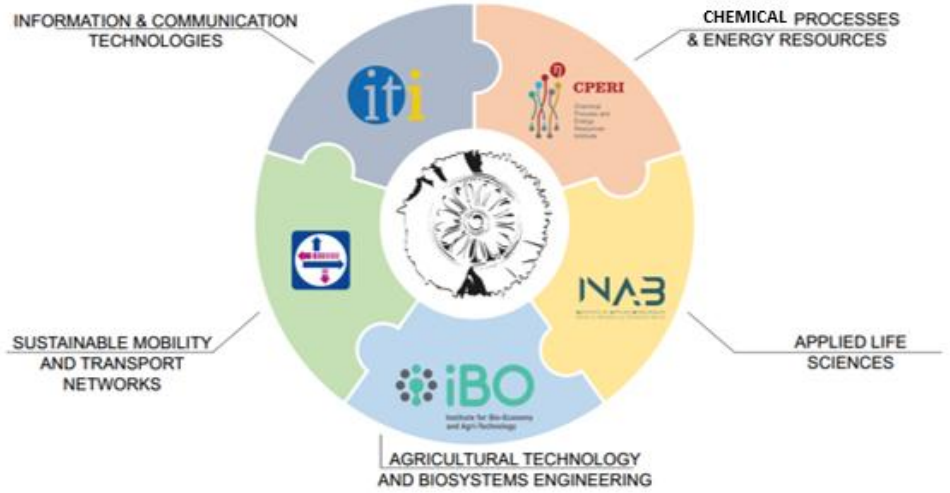
CERTH at a glance

- Foundation: 2000
- Legal form: Legal entity governed by private law under the auspices of the General Secretariat for Research & Innovation of the Ministry of Development & Investment
- Personnel: > 1500
- Annual Revenues: > 50 M€ (3-year average)
  - *77% from competitive research projects through open call for proposals*
  - *13% from bilateral industrial research contracts*
  - *10% from government institutional funding*
- Numerous distinctions & awards (Descartes Prize, ERC Advanced Grant, Trading Agent Competition Award, etc.)

Five institutes



Our mission:

- Promotion of the threefold framework: Research-Development Innovation;
- High Quality Scientific Research;
- Development of Innovative Products and Services;
- Strong partnerships with the National and International Industry;
- Strong collaboration with Research Centers and Universities in Greece & Abroad

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LIFE Terra in brief

Europe's single biggest citizen-driven initiative to plant and monitor 500 million trees to mitigate climate change

LIFE Terra's objectives

1. **Engage** a record number of citizens and stakeholders to take climate action by facilitating tree planting
2. **Connect** participants through an innovative web platform and app to streamline the planting process
3. **Innovate** with monitoring and satellite technologies to provide citizens and specialists with precise and transparent data on trees planted
4. **Inspire** the next generation of EU citizens to thrive in the face of climate change challenges, through a unique STEM based sustainability education program

What makes LIFE Terra unique

- Plant the right tree in the right place, knowledge and expertise
- Educate future generations, sustainability and climate change
- Monitor each tree planted, unique tracking system
- Build communities, planting trees impacts society at large

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Comparative Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) in the LIFE Terra Project

Scope of the Study:

- Evaluate **environmental (LCA)** and **economic (LCC)** performance of innovative vs. traditional approaches in two key afforestation processes:
  - **Tree Planting** – Manual vs. Automated
  - **Seedling Production** – Peat-based vs. Biochar-enhanced substrate

Methodology:

- Based on **ISO 14040/14044** for LCA and **five-year cost** for LCC
- Functional Unit:
  - 1 planted tree (for planting)
  - 1 produced seedling (for nurseries)

Goal:

- Identify **sustainable, scalable** and **cost-effective** practices for large-scale reforestation in Europe
- Support evidence-based decision-making aligned with **climate neutrality** and **circular economy** targets

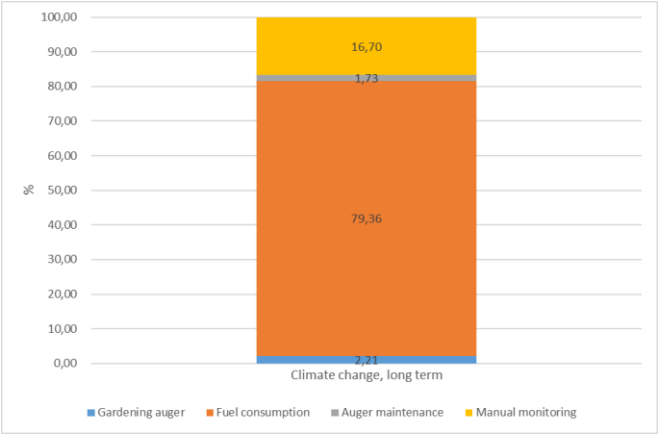
Environmental Impact of Tree Planting Methods – LIFE Terra vs. Traditional

System Boundaries:

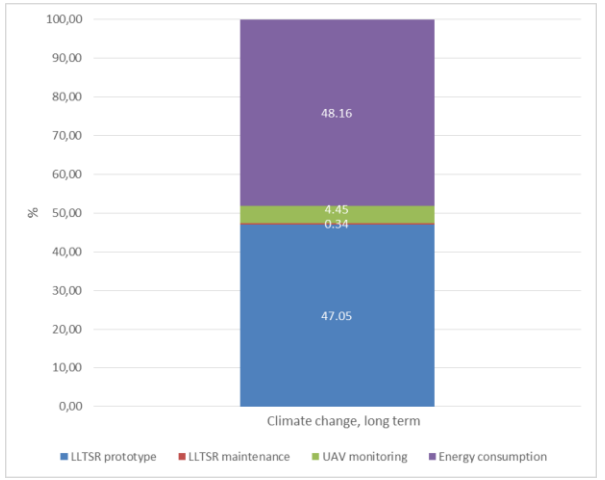
- **Traditional case:** Use of gasoline-powered auger and manual monitoring, includes tool production, diesel consumption, transport of equipment and staff
- **LIFE Terra case:** Use of LandLife Tree Seeding Robot (LLTSR) and UAV monitoring, includes robot and drone manufacturing, electricity use, and staff transport

Main Results:

- **GHG Emissions per tree:**
  - Traditional: **0.029 kg CO_{2eq}/tree**
  - LIFE Terra: **0.021 kg CO_{2eq}/tree**
- **Reduction: ~27%** GHG savings with the LIFE Terra method



Percentage share of traditional case in planting a tree in overall climate change emissions



Percentage share of LIFE Terra case in planting a tree in overall climate change emissions

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Life Terra

Environmental Performance of Seedling Substrates – Peat vs. Peat-Biochar

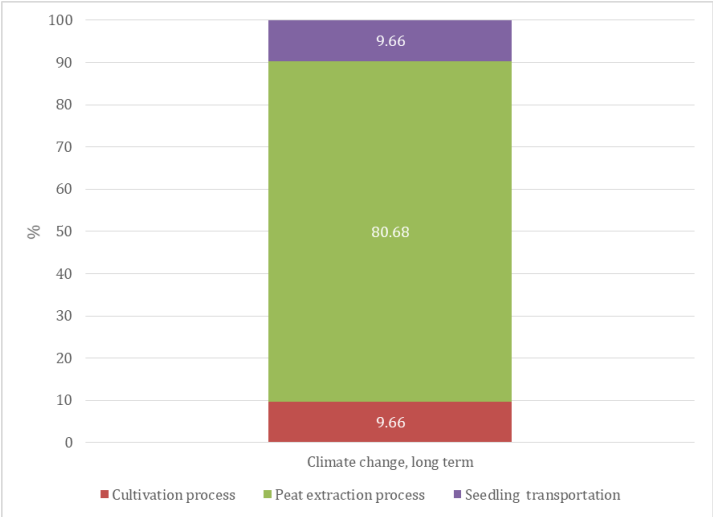
System Boundaries:

- **Traditional case:** Peat extraction, nursery cultivation (water, fertilizer, pesticide), seedling transport
- **LIFE Terra case:** Same as traditional, but with biochar mixed into substrate, includes biochar production

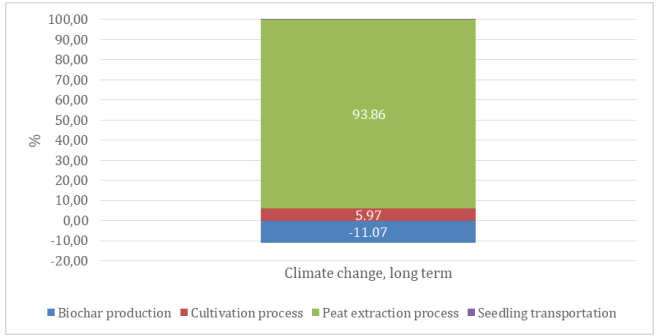
Main Results:

- GHG Emissions per seedling:
  - Peat only: **0.0616 kg CO_{2eq}/tree**
  - Peat + biochar: **0.0529 kg CO_{2eq}/tree**

Reduction: ~16% lower emissions with the biochar mix



Percentage share of seedling production using traditional substrate in overall climate change emissions



Percentage share of seedling production using new formula substrate in overall climate change emissions

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Economic analysis of tree planting methods

Costs (€/tree):

- Traditional planting (manual): 2.50–3.50 €
- LIFE Terra (LLTSR + UAV):
  - Base case: 1.68 €
  - Optimized case (400 pits/day): 0.90 €

Conclusion:

- The LIFE Terra approach is **more cost-efficient** and **scalable**, with lower environmental and operational costs

Economic analysis of seedling substrate options

Costs (€/seedling):

- Peat-based substrate: 0.276 €
- Peat + biochar mix: 0.294 €

Conclusion:

- The biochar mix has a marginal cost increase (+0.018 €), but offers significant climate and soil health benefits, supporting circular economy goals

Key Conclusions from the LCA and LCC analyses

- The **LIFE Terra planting method** (LLTSR + UAV) showed a **27% GHG reduction** and up to **60% cost savings** compared to traditional planting
- The **biochar-enhanced substrate** in nurseries led to a **16% lower carbon footprint**, with only a **0.018 €/seedling** cost increase
- Both innovative practices proved to be:
  - Environmentally beneficial
  - Economically viable
  - Aligned with EU Green Deal goals

Adoption of these practices supports **scalable, low-carbon reforestation** with measurable climate and economic benefits

Thank you!

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