

Carbon lane – Executive summary

Carbon Lane (CarLa) was an EIT Climate-KIC funded project in 2019. The project partners included two research institutions (Aalto University and University of Helsinki) and the City of Helsinki as a demand side actor with interests in both carbon sequestration and in improved quality and maintenance of urban green areas. The project initiated a network of market actors, facilitated the co-design of carbon drawdown solutions for urban green areas and planned a demonstration area in Helsinki. The project also developed general principles of urban demonstration sites for carbon sequestration and methods for disseminating related knowledge among citizens. Through these activities, it contributed to related market practices including public procurement.

The work process consisted of four workshops in which concepts were developed and of an ongoing dialogue with market actors to refine them and realise selected designs at the Jätkäsaari site. Altogether 32 to different organizations participated in the workshops including many from green building and gardening sectors.



Ideas and concept designs for urban carbon drawdown

Carbon drawdown refers to those materials, techniques and arrangements that contribute to the sequestration of atmospheric carbon. Concept designs and ideas¹ resulting from the project workshops and benchmarking of existing demonstration areas numbered 35 and included ideas in three broad categories:

- How to sequester carbon: The concepts related to the carbon contained in seedbeds, carbon accumulated through organic growth of vegetation, the carbon contained in organic waste and carbon contained in or absorbed by building materials other than soil.
- How to visualize processes related to carbon sequestration: The concepts can be roughly separated into on-site demonstration whereby particularly organic growth is a key feature and digital platforms which include mass balance data on carbon sequestration as well as monitoring data of physio-chemical processes related to carbon circulation. A range of media and soil related data can be used considered relevant for urban demonstration areas.²
- How to engage residents in the activities related to carbon sequestration: Ideas for engagement included resident activities at the park relating to e.g. gardening and management of the park, organized activities relating to climate change mitigation and adaptation as well as public art to communicate issues of carbon sequestration.

The outputs of the ideation workshop were screened against the following criteria

- Resource requirements: How costly and demanding is the implementation
- Implementation considerations: How well the ideas fit the site and the existing park design and how can they be included in the ongoing construction process.
- Potential benefits: What are the benefits for carbon sequestration? What other benefits do solutions provide?
- Future research: What uncertainties and risks are involved? What valuable knowledge can be gained from realizing and monitoring the solutions?

All these criteria will have different implications for different urban green area projects. Prices of different materials will vary according to market development; Implementation will depend on the phase of the project and thus degrees of freedom, but also whether a solution is highly integrated or a stand-alone solution. Potential benefits will depend on the needs of, for example, storm water management and on

¹ Report on concept designs for carbon drawdown. Carbon Lane -project: deliverable 1. Available at: <https://www.aalto.fi/en/carla>

² Report on principles of urban demonstration areas for carbon sequestration. Carbon Lane -project: deliverable 2. Available at: <https://www.aalto.fi/en/carla>

the recreation use and existing biodiversity of the area. Finally, research needs should only be a guiding factor if implementation and monitoring of solution can draw on related scientific expertise.

In order to gain more knowledge and better understand and demonstrate carbon sequestration, experiments with novel materials and practices, need to be designed and monitored according to scientific principles. This was a key concern also for the commercial actors in the project. Key principles for scientifically sound demonstrations³ include: careful documentation of all practices, randomization and replication of experimental units; control treatments with standard practice and reliable and cost-effective verification of carbon sequestration.

A plan for a demonstration site at Jätkäsaari

The City of Helsinki appointed a physical site in Jätkäsaari to provide the context of planning. As the construction of the park was ongoing, all concept solutions needed to fit both the existing park plan, the schedules of the city as well as the budget constraints. Hence, and due to the fact that the CarLa initiative entered the park planning at a relatively late phase, practical implementation and match with ongoing activities gained a central role.



Image: demonstration site at the Jätkäsaari, Hyväntoivonpuisto

Solutions to be used at Jätkäsaari⁴ include:

- 1) Seedbeds for carbon sequestration: a trial with 79 deciduous trees and 9 different treatments with seven different media suppliers, five of which use biochar to increase the carbon content of the soil.
- 2) New management practices: the project suggests for the city of Helsinki to consider less frequent management of lawns and the deposition of organic matter
- 3) Citizen engagement: the plan includes light and sound art. These are forms of design that can easily be fitted to the existing park design and yet enable evocative dynamic displays.
- 4) For further citizen engagement, the project proposes activities such as workshops to promote balcony gardening and onsite biochar production demonstration

The plan for the Jätkäsaari site⁵ details the monitoring plan for points 1-2.

^{3 4 5} Report on principles of urban demonstration areas for carbon sequestration. Carbon Lane -project: deliverable 2. Available at: <https://www.aalto.fi/en/carla>

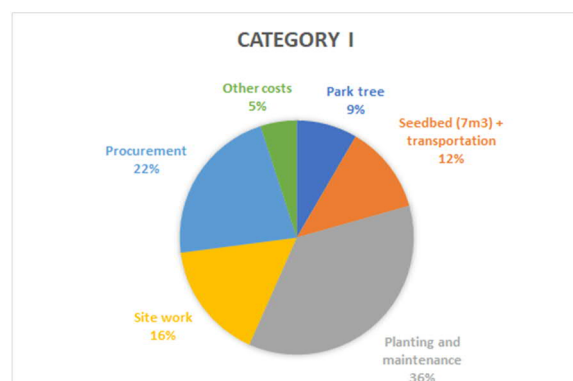
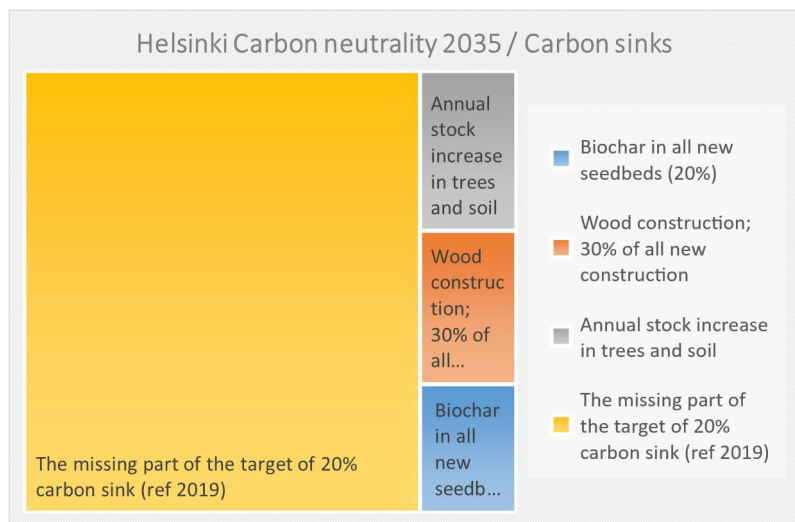
Evaluation of the significance of carbon drawdown

The significance of the proposed solutions in sequestering carbon can be viewed from the point of view of the overall scope and need for negative emissions and from a city administration point of view. Both *new soil management practices* and the *addition of biochar in soils* are listed as a cost effective, low risk, negative emissions technologies. Estimation of potential contribution of new soil management practices are pending and subject to increasing research. In agriculture, biochar use could range 2.5-20 tons biochar per hectare contributing to 7,5 to 60 tons of tn CO₂eq per hectare. In Finland, and discounting agricultural peatlands, this equals the total national emissions of 3 to over 20 years.

Helsinki is committed to achieving carbon neutrality by 2035. The vision includes an annual carbon sink equivalent to 20% of the current emissions. In Helsinki 20 000 - 30 000 m³ of biochar could be annually added in new planting soils. The annual

potential of carbon removal would be 18 000 - 28 000 tn co₂eq, which equals to 0,7 to 1 % of the annual emissions and 3,5-5% of the targets of negative emissions of Helsinki. There is no exact data of reused soils, but they also offer a similar potential to use biochar as amendment. The potential of biochar pairs with a major transition in wood construction; amendment in new seedbeds corresponds to using wood in 20-35% of all new construction activity in Helsinki. Yet, scenarios for increasing wood construction point at difficulties in a manifold increase of the current market share of 6% in multi-story buildings. To set these figures in further perspective, the existing carbon stock of urban trees and parks in Helsinki has been growing at a rate of 35000 tn co₂eq, but due to land use changes, this stock is threatened, and a net increase in the standing tree stock in Helsinki is not perceived as a potential major contribution to achieving the targets of negative emissions.

The current price of biochar for the soil amendment on Finnish market is around 225-250€ per cubic meter (300kg). The relative cost increase of biochar will depend on applications. The soil products for the demonstration areas were more expensive in comparison to standard seedbeds. However, for urban trees, the cost of seedbed is relatively small and novel seedbeds would increase total costs by 4-7%. Novel seedbeds and new management practices for increased carbon sequestration could also provide immediate cost savings for the city. This is due to improved plant health but also possibly less frequent cutting of lawns and removal of leaves. In sum, urban green areas, with their high construction and maintenance cost can serve as a niche for and contribute to the wider use of biochar as a soil amendment to achieve carbon drawdown in urban environments.



The biochar market is at its introductory phase and the commercial availability is limited to small-scale production. However, the production of biochar is expected to rapidly increase during the incoming years. Technological advancement and scale-up activities can significantly increase the feasibility of biochar, making it more competitive carbon removal solution in the future. Biochar can be cost-efficiently included in ongoing processes such as production phase of plating soils. Currently in Finland, municipalities, companies, universities and institutes are having an increasing number of projects and research related to applications biochar in various fields, such as animal agriculture, cultivation, soil and gardening, and urban areas. Due to increasing demand in carbon drawdown as well as R&D, innovations in and increasing scale of production, biochar is likely to achieve a strong position in the gardening and green building sectors, in particular in composting, green roofs, seedbeds, filtering and managing stormwater and urban runoff. Before applying biochar, it is important to ensure that it complies with the existing national and international safety standards. In Europe, biochar producers can also certify their biochar production according to the voluntary based European Biochar Certificate - programme, which also monitors the quality of biochar. Verification of carbon sequestration and relevant quality standards for biochar are further presented in the “Report on principles of urban demonstration areas for carbon sequestration”

One of the key objectives of the Carbon Lane project is to explore how similar projects could, in the future, engage citizens and other stakeholders of the potential of urban carbon capture. The means of communication are divided into those, that are implemented inside the park and those that are off-site, such as online materials or trainings organized outside the park. The focus is on communication within the park, as it is probably the most effective way to influence on people when they are already inside the park. However, many of the communications within the park also utilize online communication tools to widen the impact.

The predictions and wider application of the solutions proposed by the CarLa project hinge of several issues. Firstly the stability of biochar and the effects on vegetation needs to be studied. Secondly, the product needs further development. Thirdly, the market practices of offering solutions for carbon sequestration and including them in carbon action plans of cities needs to be further developed. Finally, the large-scale use of biochar amendment and alternative soil management practices would benefit from the dissemination of knowledge and demonstration of practices for local residents and citizens more broadly. The outcomes of the ideation workshops⁶ of the CarLa project relating to citizen engagement offer ideas for local action for carbon sequestration in urban areas.

Commercial actors involved (* contributions in kind): BiHii Oy*, Biolan Oy*, Carbofex Oy*, Hyvinkään Tieluiska Oy*, Kekkilä Oy*, Ramboll Finland Oy, Sitowise Oy, VSU maisema-arkkitehdit Oy*, WSP Finland Oy, Helsinki Regional Authorities (HSY)*.

⁶ Report on concept designs for carbon drawdown. Carbon Lane -project: deliverable 1. Available at: <https://www.aalto.fi/en/carla>