SUPPLEMENTARY MATERIAL

Table S1 | Material carbon emission factors using in the LCA method

Item	Value	Unit	Data source
Cement	735	$kgCO_2e/t$	GB/T 51366-2019
Medium sand	2.51	$kgCO_2e/t$	
Crushed stone	2.18	$kgCO_2e/t$	
C25 concrete	216	$kgCO_2e/m^3$	
C20 concrete	193	$kgCO_2e/m^3$	
Φ14 Anchor Bar	2600	$kgCO_2e/t$	Chen *et al*. (2016)
14#Galvanized wire mesh	1230	$kgCO_2e/t$	Shi *et al*. (2020)
PVC pipe	2430	$kgCO_2e/t$	
Sand gravel	4.27	$kgCO_2e/t$	Li *et al*. (2024)
Organic fertilizer	72.7	$kgCO_2e/t$	Guo *et al*. (2023)
Grass fiber	83	$kgCO_2e/t$	CPCD (2025)
Water retainer	3.062	$kgCO_2e/t$	
Compound fertilizer	2.47	$kgCO_2e/t$	
Long-lasting fertilizer	7.76	$kgCO_2e/t$	
Non-Woven fabric	3.82	$kgCO_2e/t$	

Table S2 | Carbon emission factors for common modes of transportation

Type	Value	Unit	Data source
Truck, Petrol, Light (2 tons load)	0.334	$kgCO_2e/t \cdot km$	GB/T 51366-2019
Truck, Petrol, Medium (8 tons load)	0.115		
Truck, Petrol, Heavy (10 tons load)	0.104		
Truck, Petrol, Heavy (18 tons load)	0.104		
Truck, Diesel, Light (2 tons load)	0.286		
Truck, Diesel, Medium (8 tons load)	0.179		
Truck, Diesel, Heavy (10 tons load)	0.162		
Truck, Diesel, Heavy (18 tons load)	0.129		
Truck, Diesel, Heavy (30 tons load)	0.078		
Truck, Diesel, Heavy (46 tons load)	0.057		
Electric Locomotive	0.010		

Automobile	0.011
Railroads (China market average)	0.010
Liquid Carrier (2000 tons load)	0.019
Dry Bulk Carrier (2500 tons load)	0.015
Container Ship (200 TEU load)	0.012

Table S3 | Energy carbon emission factors using in the LCA method

Energy type		Value	Unit	Data source
Electricity (By region)	Northern China	0.6776	$kgCO_2e/kWh$	CO_2 emission factors for electricity in 2022
	Northeastern China	0.5564		
	Eastern China	0.5617		
	Central China	0.5395		
	Northwest China	0.5857		
	Southern China	0.3869		
	Southwest China	0.2268		
Diesel		3.72	$kgCO_2e/kg$	Song *et al.* (2025)

Table S4 | The carbon emission factor of maintenance resource input in LCA method

Type	Value	Unit	Data source
Compound fertilizer	2.73	$kgCO_2e/kg$	
Insecticide	7.73	$kgCO_2e/kg$	Xue *et al*. (2022)
Piped water	0.3	$kgCO_2/t$	
Labor	1.123	$kgCO_2e/day$	IPCC (2006) CEIC （2022）
Gasoline	3.56	$kgCO_2e/kg$	IPCC (2006)

The carbon dioxide (CO_2) emission factor for gasoline is referenced from the calculation method in the "2006 IPCC Guidelines for National Greenhouse Gas Inventories." It is calculated by multiplying the CO_2 emission factor for different fossil energy sources, provided by the national greenhouse gas emission factor database, by the lower heating value of the corresponding fossil energy as specified in the "General Rules for Comprehensive Energy

Consumption Calculation," and then adding the unit production process carbon emissions for the corresponding energy category.

Table S5 | Carbon assimilation capacity of plants commonly used for slope protection

	Plant type	Assimilations (per unit per year)	Data source
Tree	*Magnolia Grandiflora Linn*	151.39 $kgCO_2$	Long et al. (2022)
Tree	*Cinnamomum camphora*	52.92 $kgCO_2$	
Shrub	*Nerium oleander*	23.64 $kgCO_2$	
Shrub	*Camellia japonica*	16.45 $kgCO_2$	
Shrub	*Ligustrum quihoui Carr*	10.25 $kgCO_2$	
Herb	*Zoysia japonica*	1.19 $kgCO_2$	《Guidelines for Carbon Sink Design of Urban Green Spaces in Tianjin.》
Herb	*Poa annua*	1.2 $kgCO_2$	
Herb	*Local wildflower combination*	0.733 $kgCO_2$	

References

GB/T 51366-2019 Standard for Building Carbon Emission Calculation. Ministry of Housing and Urban-Rural Development of the People's Republic of China (Chinese).

Chen, J.; Wang, X.; Wang, X.; Ma, X.; Chen, Y. Calculation of carbon dioxide emissions in the life cycle of high-speed railway. *J. China Railw. Soc*. **2016**, 38(12), 47–55.

Shi, M.Y.; Wang, Z.J.; Yang, G.Q.; Li, D. Calculation and evaluation of carbon emission from different types of retaining structures. *Railw. Investig. Surv.* **2020**, 46(4), 41-48.

Li, J.G. Study on low-carbon optimization of regional highway roadbed [D]. Xi'an: Xi'an Technological University, **2024**.

Guo, T.T.; Huang, Y.P.; Qian, H.; et al. Carbon budget of typical artificial plant communities in the parks around the West Lake in Hangzhou. *J. Zhejiang For. Sci. Technol.* **2023**, 43(6), 82-92.

CPCD 2025 China Product Carbon Footprint Factor Database. Available at: http://lca.cityghg.com/ (accessed 2 April 2025).

Song, X.C.; Du, S.; Deng, C.N.; et al. Comparative study on carbon footprint of sludge ceramsite and fly ash ceramsite. *China Environ. Sci.* **2025**, 45(1), 583-592.

Xue, S.Y.; Zhu, J.J.; Hu, C.X. Study on carbon emission calculation and carbon reduction strategy in landscape planting and maintenance stage of residential community: Taking a district in Jiangning District of Nanjing City as an example. *Constr. Sci. Technol.* **2022**, (10), 66–69.

IPCC 2006 Guidebook: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Institute for Global Environmental Strategies, Kanagawa, Japan.

CEIC 2022 Energy Consumption per Capita in China. Available from: https://www.ceicdata.com.cn/zh-hans/china/energy-consumption-percapita (accessed 2 April 2025).

Long, S.Y.; Shen, J.C.; Zhao, H.; Dong, H.H. Study on carbon sequestration of vegetation in expressway area. Heilongjiang *J. Transp. Sci. Technol*. **2022**, (3), 149

Tianjin Municipal Commission of Housing and Urban-Rural Development. Tianjin Urban Green Space Carbon Sink Design Guidelines (Trial Implementation) [S]. *Tianjin Constr. Sci. Technol*. **2022**, 32(5), 22.