



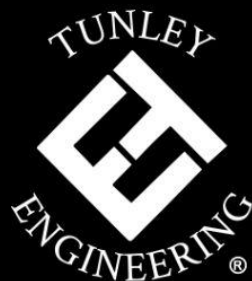
# CARBON ASSESSMENT REPORT

**Tunley Engineering**

*"Engineering A  
Decarbonised Future"*

LAGOON POOLS

CONTEMPORARY RELIABLE EXPERTS





# **CARBON ASSESSMENT REPORT**

**for**

**LAGOON POOLS LTD**

**LAGOON POOLS**  
CONTEMPORARY RELIABLE EXPERTS

September 2022

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## Nomenclature

AR6 is the sixth assessment report of the IPCC, published in August 2021.

Carbon Equivalent is the effect on global warming of a greenhouse gas (GHG) relative to that of CO<sub>2</sub>.

Carbon Offsetting is the action of compensating for unavoidable necessary residual greenhouse gas emissions by participating in a programme designed to make equivalent atmospheric carbon dioxide reductions.

Embodied Carbon is the total GHG emissions generated to produce a product; It includes those from extraction, manufacture, processing, transportation, and assembly in every component.

Global Warming Potential is the heat absorbed by a GHG as a multiple of the equivalent in carbon dioxide.

Greenhouse Gases are gases that trap heat in our atmosphere. GHG include Carbon dioxide, methane, nitrous oxides, and fluorinated gases.

The Greenhouse Gas Protocol is the GHG Protocol Corporate Accounting and Reporting Standard which provides requirements and guidance to prepare a corporate-level GHG emissions inventory.

ICE is The Inventory of Carbon and Energy.

IPCC is the Intergovernmental Panel on Climate Change. It provides regular scientific assessment on climate change to policy makers.

ISO 14001 is the international standard that specifies requirements for an effective environmental management system (EMS).

Net Zero Carbon (NZC) is the sum effect of combining actions to reduce GHG emissions with actions to offset them.

Scope 1: Direct GHG emissions are those that occur from sources that are owned or controlled by the company such as emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc., emissions from chemical production in owned or controlled process equipment.

Scope 2: Indirect GHG emissions account for GHG emissions from the generation of imported energy such as purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary

of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect GHG emissions. The GHG Protocol Corporate Accounting and Reporting Standard defines Scope 3 as an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services. BS EN ISO 14064 separates out Scope 3 emissions into categories 3 to 6 covering indirect emissions from transportation, products used, use of products from the business and other sources respectively.

kgCO<sub>2</sub>e is the notation for kilograms of carbon dioxide equivalent emissions.

tCO<sub>2</sub>e is the notation for tonnes of carbon dioxide equivalent emissions.

Zero Carbon is the absence of GHG emissions.

## Methodology and Quantification Standards

This assessment was completed to the international standard BS EN ISO 14064-1 and The GHG Protocol. Quantification of carbon dioxide equivalent emissions arising from transportation activities for freighting was completed in accordance with the emission factors of Greenhouse gas reporting: conversion factors published by DEFRA, the UK government Department for Business, Energy and Industrial Strategy for 2022.

Carbon equivalent data conversions were calculated in accordance with greenhouse gas reporting: 2019 published by the UK Government Department for Business, Energy and Industrial Strategy.

Emission factors were taken from Environmental Protection Declaration (EPD) documents of relevant materials or estimated using data from Defra 2021 and reasonable assumptions.

Global Warming Potentials are stated from IPCC Sixth Assessment Report, 2021 (AR6).

## Executive Summary

Climate change poses a significant challenge to the environment, necessitating mitigating measures at international, national, and local levels. It impacts businesses, natural systems, and communities. This is caused by global warming as a result of an increase in greenhouse gas (GHG) emissions, known as carbon emissions.

Lagoon Pools Ltd is a leading specialist in pool construction and they would like to demonstrate the environmental advantages of their products – insulated and uninsulated pools via conducting a series of carbon assessments. Quantification of embodied carbon emissions of the products puts Lagoon Pools Ltd in a position to demonstrate their sustainability and environmental responsibility to their customers and the wider public; it allows them to make a measurable change to climate change emissions. Lagoon Pools Ltd and Tunley Engineering have collaborated to identify emission sources and collect data.

This assessment covers embodied carbon emissions for the construction of insulated and uninsulated pools, and operational carbon emissions for the operating of the two types of pools. Material usage, transportation of materials and construction processes are considered.

Data were provided to Tunley Engineering by Lagoon Pools Ltd or by the company’s contractors/partners (via Lagoon Pools Ltd).

The embodied carbon emissions arising from the construction of the insulated and uninsulated pools are 29.0 and 27.5 tCO<sub>2</sub>e, respectively (Figure 1). To maintain water temperature at 29<sup>0</sup>C for the insulated and uninsulated pools, the annual carbon emissions are 3.4 and 7.2 tCO<sub>2</sub>e, respectively.

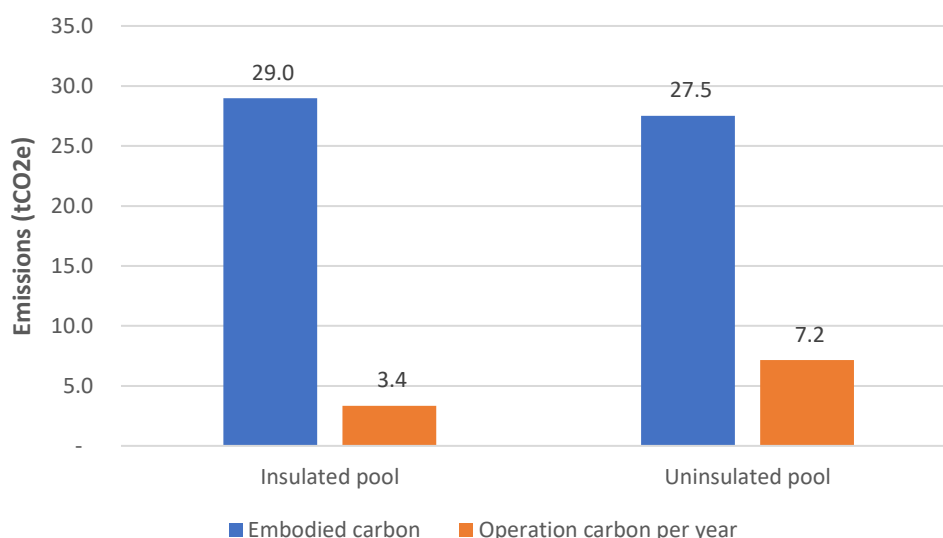


Figure 1: Comparison on embodied carbon emissions for two types of pools.

## Introduction

Tunley Engineering conducted this assessment using the standard protocols stated [above](#) and data provided by Lagoon Pools Ltd and their business partners. The assessment covers quantifications for

- i) Embodied carbon assessments for construction of an insulated pool, considering material usage, transportation of the materials and construction processes,
- ii) Embodied carbon assessments for construction of an uninsulated pool, considering material usage, transportation of the materials and construction processes,
- iii) Comparison between operation carbon emissions from insulated and uninsulated pools to highlight the environmental benefits of the former.

Appreciating the importance of determining major contributors to the emissions, Tunley Engineering provides detailed analysis and discussion on the contribution of different components to the total emissions from each technique; this will support Lagoon Pools Ltd with their decision-making processes to reduce their carbon emissions, for example in terms of material usage and transportation distances. Where information and data were limited, Tunley Engineering made reasonable assumptions based on our expertise and external sources of data; Tunley Engineering discussed the assumptions with Lagoon Pools Ltd to ensure data accuracy. This report was completed to internationally recognised [standards](#) stated previously.

## Assumptions, Limitations and Estimations

The transportation distance of materials to site was assumed as 3 miles; this reflects the endeavours to source materials locally.

Where accurate emissions for electrical equipment are not available, estimation was performed using average weight of the equipment and emission factor from Defra.

## Data

### Embodied Carbon Emissions

In this section, data on embodied carbon emissions for insulated and uninsulated pools are presented and discussed. Table 1 provides details on greenhouse gas emissions from material usage, transportation of the materials to site and construction processes of the two pool types. The main components of pools are similar for two products; the range of materials include wood, cement, concrete, glass, ceramic tiles and metal components. The pools have a “pool cover” system which is controlled electronically and operated using a motor. The difference between them is the deployment of insulation materials for the pipe system and the pool for the insulated pool. The emissions from transportation and handling processes of the insulation materials are insignificant; therefore, greenhouse gas emissions for transportation and processes are assumed as being identical for two pool types.

Table 1: Details on carbon emissions from material usage, transportation of the materials and construction processes.

Type of pools	Item	Emissions (tCO <sub>2</sub> e)		
		Materials	Transportation	Processes
Both	Plywood	0.21	0.0220	0.173
	A393 10mm steel reinforcement mesh	1.16	0.0431	
	Steel re-bar no.100	0.29	0.0107	
	P450 shotcrete concrete	7.17	1.8521	
	Medium density concrete block	0.22	0.0573	
	Cement bags	1.42	0.0506	
	Glass Mosaic	0.18	0.0029	
	Ardex tile adhesive	0.20	0.0058	
	Ardex tile grout	0.06	0.0029	
	Pool safety cover canvass	0.40	0.0045	
	Aluminium pockets	1.61	0.0028	
	Cover tracks - Aluminium	3.76	0.0066	
	Aluminium brackets	0.17	0.0003	
	Aluminium trays	0.58	0.0010	
	Aluminium roller	7.04	0.0123	
	Electric motor	0.10	0.0009	
	Pool filtration pump	0.05	0.0004	
	Air source heat pump	0.32	0.0029	
	Lacron pool filter	0.08	0.0007	
	Dryden Aqua AFM filtration media	0.005	0.0058	
Boxes, PVC pipes	0.19	0.0017		
Insulated pools	Pipe insulation	0.003	0.0004	
	Insulation for the pool	1.47	0.0113	

Table 2: Emissions sources of two pool types. Data are in tCO<sub>2</sub>e.

Item	Insulated pool	Uninsulated pool
Materials	26.71	25.24
Transportation	2.10	2.10
Manufacturing	0.17	0.17
Total	29.0	27.5

Table 2 shows data from three main emissions sources of the construction of two pool types; this table is a simplified version of Table 1. The majority of emissions arises from the use of materials, at 92% (Figure 2). Emissions from material usage of the insulated pool is 6% greater than that of the uninsulated pool due to the use of the insulation materials. Total embodied emissions of the insulated pool are 5% more significant than that of the alternative, by 1.5 tCO<sub>2</sub>e. This difference in embodied emissions is equivalent to driving 3,600 miles using an average fuel car.



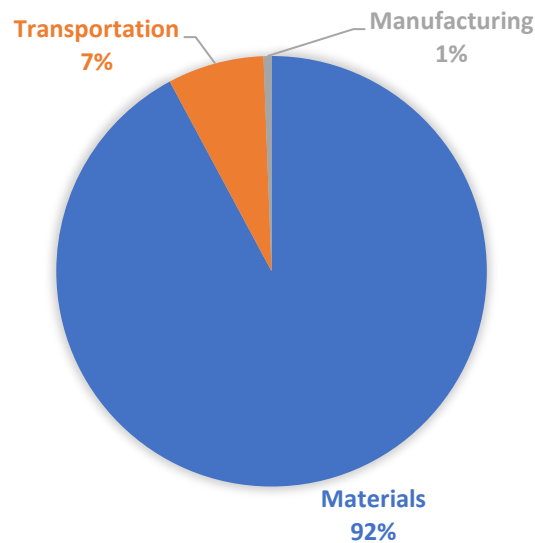


Figure 2: Percentage contributions of emission sources for the insulated pool.

Given the use of extra materials for the insulated pool, its embodied carbon emissions are greater. However, there is an environmental benefit in operating insulated pools compared to uninsulated pools and the quantification of this advantage in terms of greenhouse gas emissions will be provided in the next section.

### Operational Carbon Emissions

In this section, environmental and financial benefits from operating the uninsulated and insulated pool are quantified. The former refers to a conventional pool for which four sides and the bottom of the pool are not insulated, a surface cover of high thermal conductivity is used. The latter refers to fully insulated pools with insulation materials of 10 cm in place for four sides all the bottom, the surface of the pool is covered using a material of small thermal conductivity.

Pools were assumed to be used between May and November every year at 18 hours per day (Table 3). Two scenarios were considered for this analysis, assuming the pools are fully covered during operational hours. Data of heat loss and carbon savings were quantified using the data shown in Table 3. In addition, it is assumed that the cost of electricity is 20 p/kWh and the amount of electricity needed to maintain the temperature of 29°C for the water is equal to the amount of heat loss quantified. In this analysis, heat loss due to thermal transfer between the water and the pipe is assumed as being significant and thus is not considered; the main sources of thermal loss are through the sides and bottom of the pools and through the either conventional or insulated surface covers.

To quantify thermal loss in operating the two types of pools, the following data and assumptions were used

Table 3: Parameters deployed to calculate heat loss.

Item	Data	Unit	Uninsulated pool	Insulated pool
Length	10	m	✓	
Width	5	m	✓	
Depth	1.5	m	✓	
Number of months in operation	6	month	✓	
Number of hours in operation per day	18	hours	✓	
Desired water temperature	29	°C	✓	
Ground temperature	18	°C	✓	
Air temperature	15.7	°C	✓	
Thermal conductivity of tile/concrete	1.15	W/m.C	✓	
Thermal conductivity of side insulation	0.035	W/m.C		✓
Thermal conductivity of normal cover	5.717	W/m <sup>2</sup> .C	✓	
Thermal conductivity of insulated cover	3.9	W/m <sup>2</sup> .C		✓

Table 4: Carbon and financial benefits

Item	Uninsulated pool	Insulated pool
Heat loss through the sides and bottom (kWh)	4.01	0.34
Heat loss through the cover (kWh)	7.22	4.93
Total heat loss per hour (kWh)	11.2	5.26
Total heat loss per year (kWh/year)	36,989	17,336
Percentage	100%	47%
Carbon emissions (tCO <sub>2</sub> e)	7.15	3.35
Carbon saving (tCO <sub>2</sub> e)	0	3.80
Cost to supply electricity	£7,398	£3,467
Cost saving	0	£3,931

Although the embodied carbon emissions of constructing an insulated pool is greater than that of a conventional pool by 1.5 tCO<sub>2</sub>e, the carbon benefit from operating the insulated pool is 3.8 tCO<sub>2</sub>e annually. In addition, users could save nearly £4,000 a year on electricity bills by using insulated pools (Table 4).

## Conclusion

Total embodied carbon emissions for constructing the insulated and uninsulated pools are 29.0 and 27.5 tCO<sub>2</sub>e, respectively. The carbon emissions from electricity for the two types of pools for maintaining the water temperature at 29°C are 7.15 and 3.35 tCO<sub>2</sub>e. The carbon saving of 3.8 tCO<sub>2</sub>e is equal to the emissions from driving 8,557 miles of an average fuel car. In addition, users can save nearly £4,000 on electricity cost per year.

Tunley Engineering has provided Lagoon Pools Ltd with detailed analysis showing carbon emissions for two types of pools. There are clear environmental benefits of building and



operating the insulated pools. By providing this information on their products, Lagoon Pools Ltd highlights the environmental benefits of their products and enhance their reputation to their customers in the outdoor pool construction industry.

## Tunley Engineering's Report Emission Statement

Tunley Engineering's GHG emissions from completing this assessment were 0.01 kgCO<sub>2</sub>e.

## Approval (Internal use only)

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B					
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