Loch Kemp Storage - EIA Report

Appendix 3.6: Carbon Balance

November 2023

ash

ash design + assessment
Suite 2/3, Queens House
19 St Vincent Place
Glasgow, G1 2DT

Tel: 0141 227 3388
Fax: 0141 227 3399

Email: info@ashglasgow.com
Web:
www.ashdesignassessment.com

Technical Appendix 3.6: Outline Carbon Balance

Loch Kemp Pump Storage Scheme

Loch Kemp Storage

Prepared by:

SLR Consulting Limited

No. 50 Stirling Business Centre, Wellgreen, Stirling,
FK8 2DZ

SLR Project No.: 428.04707.00032

10 November 2023

Revision: 01

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
00	8 November 2023	A. Huntridge	R. Watson.	G. Robb
01	10 November 2023	A. Huntridge	R. Watson.	G. Robb
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This document has been prepared by SLR Consulting Limited (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Loch Kemp Storage (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

Table of Contents

1.0 Introduction

This document provides an outline assessment of the projected net Greenhouse Gas (GHG) carbon benefits for the Loch Kemp Pumped Storage Hydro Scheme (the "Proposed Development").

1.1 Proposed Development

The Proposed Development is located within the Dell Estate, approximately 13 kilometres to the northeast of Fort Augustus, Highlands, Scotland.

It comprises a new 600MW hydro pumped storage hydro (PSH) scheme with a generation energy storage capacity of up to 9 Gigawatt Hours (GWh), utilising the existing Loch Kemp as the upper storage reservoir and Loch Ness as the lower reservoir. To allow drawdown for storage, Loch Kemp would be raised by approximately 28 m. Four new saddle dams and four minor cut off dams would be constructed around Loch Kemp to form the upper reservoir.

The Proposed Development comprises two main elements:

- the upper reservoir works comprising the upper reservoir (Loch Kemp), eight dams and an inlet/outlet structure; and
- the lower reservoir works comprising the lower reservoir (Loch Ness), a powerhouse building, a quayside above the inlet/outlet structure with a small pier into Loch Ness, and an access tunnel adit on the shore of Loch Ness.

The upper and lower reservoir works would be linked by a series of underground tunnels.

Details of all elements of the Proposed Development are given in **Chapter 3: Description of Development**.

1.2 Background and Benefit of PSH

PSH works on a very simple principle, exploiting gravitational potential energy. Two reservoirs in close proximity to each other but at different heights are required. At times of peak electricity demand, water stored in the upper reservoir is released to the lower reservoir, flowing through a turbine. This converts the gravitational potential energy of the water into useable electrical energy. At times of low electricity demand, the excess energy on the grid can be used to pump water back to the upper reservoir and stored again until times of high demand.

Benefits of PSH in relation to reduced carbon emissions include:

- reduction of electrical grid carbon emissions by displacing fossil fuel generation; and
- increasing efficiency of the electrical grid by reducing wind power curtailment during times of low demand.

1.3 Methodology Adopted

The assessment of the net benefit associated with the Kemp PSH scheme is based on calculation of the GHG emissions (tCO_2e) during the construction phase, then comparing this with the net carbon benefits of the energy outputs during the operational phase in terms of avoided GHG emissions associated with electricity generation from the PSH using 100% surplus energy generated from renewable sources (i.e wind power).

This is a similar approach to that adopted and accepted by regulators when assessing GHG emissions associated with wind farm developments.

2.0 Outline Carbon Balance Assessment

The assessment for generating potential Carbon Losses (tCO_2e) and Carbon Savings (tCO_2e) is detailed below in Sections 2.1 and 2.2 with the calculations detailed in Table 1.

2.1 Proposed Development Carbon Losses

The GHG (tCO_2e) losses associated with the Proposed Development have been estimated using data relevant to the Proposed Development from the industry standard Carbon Calculator Tool[1].

The Carbon Calculator Tool[1] was designed for high level assessment of carbon payback times for wind farm developments. However, this tool has been considered suitable for this assessment to calculate the main carbon losses as the Proposed Development is similar in terms of ancillary development infrastructure (access tracks, borrow pits, cable trenching and construction compounds) and construction materials (concrete). The Carbon Calculator Tool uses the following key inputs to determine the carbon losses associated with the construction of the Proposed Development;

- Volume of concrete utilised within the Proposed Development
- Length of track
- Length of cable routes
- Extents of development
- Operational duration of the development

The Carbon Calculator reference is provided in Table 1 with the calculated GHG losses associated with the Proposed Development are of the order of 1,282,300 tCO_2e.

2.2 Proposed Development Carbon Savings

The annual power generation from the Proposed Development when operational is 1,000 GWh.

This assessment assumes that to facilitate the annual power generation surplus energy generated from renewable sources (i.e wind power) is used to pump water from Loch Ness to Loch Kemp and to 'prime' the PSH scheme.

The carbon emissions savings are calculated using the current emission factor of 0.432 t CO2 MWh from the Carbon Calculator Tool[1] for the counter factual case for power generation which has been assumed to be the UK Grid Mix.

The net emission of GHG (tCO_2e) which would be saved by utilising the PSH for power generation instead of the UK Grid mix is of the order of 432,000 tCO_2 per year.

Table 1 Carbon Balance Assessment

Item	Description	Value	Units	Source
Greenhouse Gas (GHG - Carbon) Potential Losses Associated with Development				
1	GHG Emissions from construction and development.	1,282,314	tCO2e	SEPA Carbon Calculator Tool. Reference - O9PC-BXX5-JFBW

[1] Scottish Government (2016). *Calculating potential carbon losses and savings from wind farms on Scottish peatlands. Technical Note* – Version 2.1.0.0

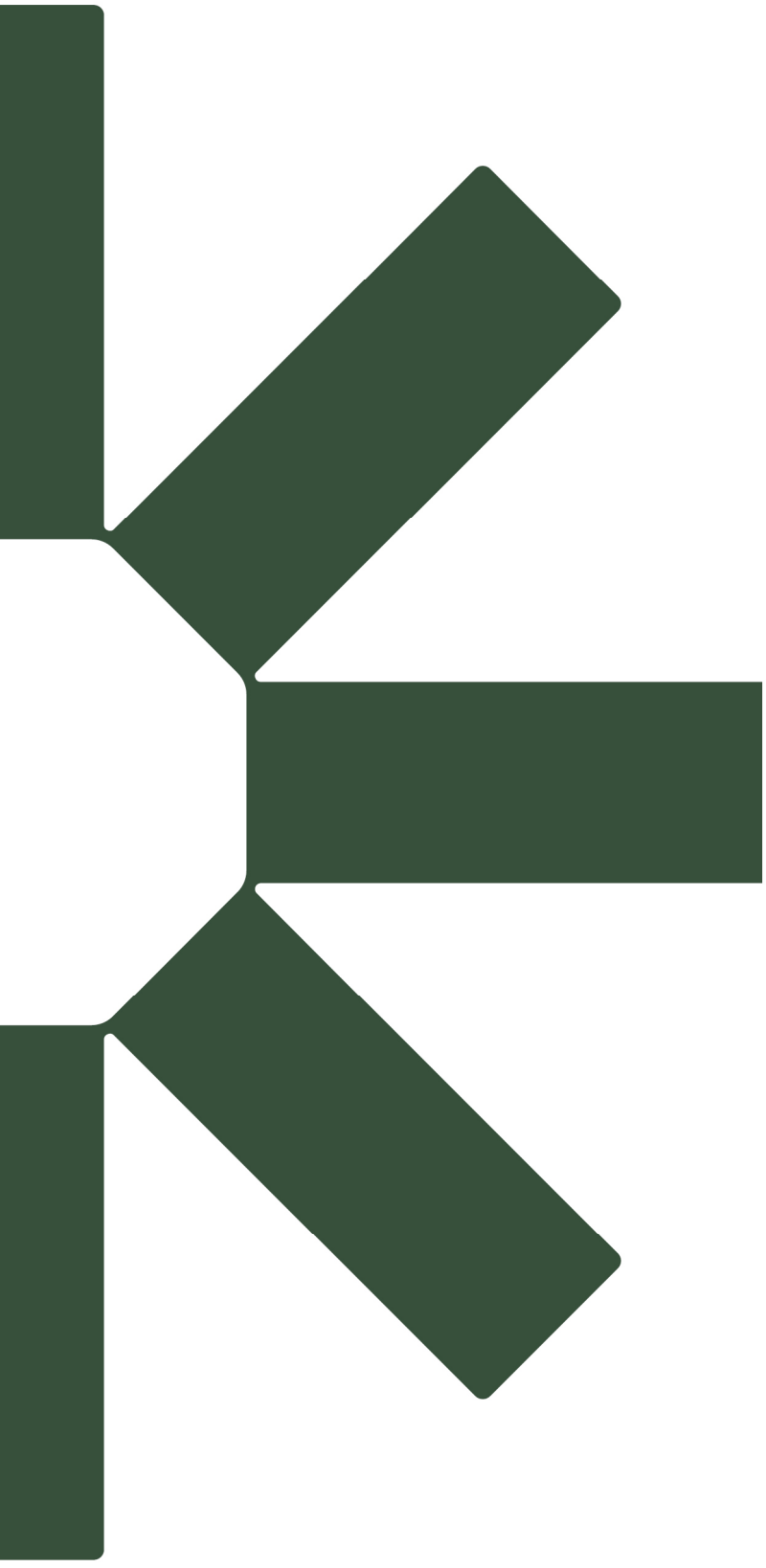
Item	Description	Value	Units	Source
Greenhouse Gas (GHG - Carbon) Potential Savings Associated with Development				
2	UK Fossil fuel-mix emission factor	0.432	(t CO2 MWh-1)	SEPA Carbon Calculator Tool
3	Annual generation from the Loch Kemp PHS. Assumes all operations are carried out using power generated by renewable sources i.e Wind Power.	1,000	GWh	Statera
4	Annual generation from the Loch Kemp PHS.	1,000,000	MWh	Converted from No.3 above.
5	GHG Emissions avoided.	432,000	tCO2e/ year	Annual Loch Kemp output of 1,000,000 MWh x Fossil Fuel Mix Emission Factor.

2.3 Carbon Balance and Payback Time

The carbon losses and carbon savings have been summarised in Table 2 below. It is shown that the carbon payback time calculated as approximately 3 years.

Table 2 Carbon Balance Payback

GHG Impact (tCO_{2e}) of Development	GHG Benefit (tCO_{2e}) per year (avoided CO2)	Approx Payback Time (Years)
1,282,300	432,000	3



Making Sustainability Happen