

EUROPEAN COMMISSION

HORIZON 2020 PROGRAMME - TOPIC H2020-LC-BAT-2019
Affordable High-Performance Green Redox Flow Batteries

GRANT AGREEMENT No. 875613



HIGREEW – Deliverable Report

D3.2 – CFD and shunt current models for cell and stacks



The research leading to these results has received funding from the European Union under Grant Agreement no. 875613

Deliverable No.	HIGREEW D3.2	
Related WP	3	
Deliverable Title	CFD and shunt current models for cell and stacks	
Deliverable Date	2022-02-28	
Deliverable Type	<u>REPORT</u>	
Dissemination level	Confidential – member only (CO)	
Written and checked By	Jiří Charvát, Miloš Svoboda (UWB)	21/02/2022
Reviewed by	John Collins (CTECH)	24/02/2022
Approved by	Eduardo Sánchez (CICe)	24/02/2022
Status	Final	25/02/2022

Disclaimer/ Acknowledgment



Copyright ©, all rights reserved. This document or any part thereof may not be made public or disclosed, copied or otherwise reproduced or used in any form or by any means, without prior permission in writing from the HIGREEW Consortium. Neither the HIGREEW Consortium nor any of its members, their officers, employees or agents shall be liable or responsible, in negligence or otherwise, for any loss, damage or expense whatever sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error therein contained.

All Intellectual Property Rights, know-how and information provided by and/or arising from this document, such as designs, documentation, as well as preparatory material in that regard, is and shall remain the exclusive property of the HIGREEW Consortium and any of its members or its licensors. Nothing contained in this document shall give, or shall be construed as giving, any right, title, ownership, interest, license or any other right in or to any IP, know-how and information.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875613. The information and views set out in this publication does not necessarily reflect the official opinion of the European Commission. Neither the European Union institutions and bodies nor any person acting on their behalf, may be held responsible for the use which may be made of the information contained therein.

Publishable summary

The goal of the HIGREEW project is to design, build, and demonstrate a prototype of a new high-energy density generation of aqueous organic redox flow battery based on a water-soluble low-cost organic electrolyte featuring low-cost components and long service life. To achieve this goal, every aspect of the battery from material selection to battery management system must be optimized.

In WP2, a single cell composed of chosen materials was successfully tested. The next step is to scale up this single cell to the battery stack in industrial size. However, the experimental development of the battery stack design would be very costly and time consuming, as a lot of different designs would need to be manufactured. Therefore, in this report, the development of two mathematical models, the CFD model of pressure losses and flow distribution, and the analytical model of shunt current and pressure losses, is described. These models enable cell design optimization to be done much more efficiently and allow easy prediction of larger system behaviour. The mathematical approach allow also to react on partial changes in chemical composition of electrolyte. With the use of the analytical model, the basic parameters of optimal cell geometry (length, width, and depth of the guide channels) might be estimated with respect to pressure and shunt current losses, and these obtained parameters might be further used as input parameters to the CFD model, and with the use of the CFD model the optimal shape of main guide channels might be found. These two models are introduced and described in this report and validated with experimental data.

The results of these models show that the pressure losses in the felt electrode are more significant than the pressure losses in the guide channels. This result shows that a significant part of the pressure losses cannot be lowered by optimizing the guide channels. However, relatively high pressure drops in the felt electrode help to homogeneous flow distribution in the cell.

6 Acknowledgement

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

#	Partner	Partner Full Name
1	CICe	CENTRO DE INVESTIGACION COOPERATIVA DE ENERGIAS ALTERNATIVAS FUNDACION, CIC ENERGIGUNE FUNDAZIOA
2	GAMESA	GAMESA ELECTRIC SOCIEDAD ANONIMA
3	UAM	UNIVERSIDAD AUTONOMA DE MADRID
4	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS
5	C-TECH	C-TECH INNOVATION LIMITED
6	HEIGHTS	HEIGHTS (UK) Limited (Termination report ongoing)
7	UWB	ZAPADOCESKA UNIVERZITA V PLZNI
8	PFES	PINFLOW ENERGY STORAGE, S.R.O.
9	UNR	UNIRESEARCH BV
10	SGRE	SIEMENS GAMESA RENEWABLE ENERGY
11	FRAUNHOFER	FRAUNHOFER ICT



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 875613