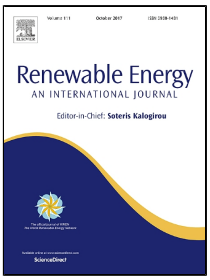
Accepted Manuscript



Stakeholder Requirements for Commercially Successful Wave Energy Converter Farms

Aurélien Babarit, Diana Bull, Katherine Dykes, Robert Malins, Kim Nielsen, Ronan Costello, Jesse Roberts, Claudio Bittencourt Ferreira, Ben Kennedy, Jochem Weber

PII:	S0960-1481(17)30545-1
DOI:	10.1016/j.renene.2017.06.040
Reference:	RENE 8905
To appear in:	*Renewable Energy*
Received Date:	28 November 2016
Revised Date:	06 June 2017
Accepted Date:	09 June 2017

Please cite this article as: Aurélien Babarit, Diana Bull, Katherine Dykes, Robert Malins, Kim Nielsen, Ronan Costello, Jesse Roberts, Claudio Bittencourt Ferreira, Ben Kennedy, Jochem Weber, Stakeholder Requirements for Commercially Successful Wave Energy Converter Farms, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.06.040

Stakeholder Requirements for Commercially Successful Wave Energy Converter Farms

Aurélien Babarit[*1], Diana Bull[#], Katherine Dykes[o], Robert Malins[#], Kim Nielsen[&], Ronan Costello[%], Jesse Roberts[#], Claudio Bittencourt Ferreira[^], Ben Kennedy[%], Jochem Weber[o]

[*]Ecole Centrale de Nantes – CNRS, 1 rue de la Noë, 44300 Nantes, France
[#]Sandia National Laboratories, Albuquerque, New Mexico, USA
[o]National Renewable Energy Laboratory, Golden, Colorado, USA
[&]Ramboll, Denmark
[%]Wave-Venture, United Kingdom
[^]DNV GL, United Kingdom

ABSTRACT

In this study, systems engineering techniques are applied to wave energy to identify and specify stakeholders' requirements for a commercially successful wave energy farm. The focus is on the continental scale utility market. Lifecycle stages and stakeholders are identified. Stakeholders' needs across the whole lifecycle of the wave energy farm are analyzed. A list of 33 stakeholder requirements are identified and specified. This list of requirements should serve as components of a technology performance level metric that could be used by investors and funding agencies to make informed decisions when allocating resources. It is hoped that the technology performance level metric will accelerate wave energy conversion technology convergence.

KEYWORDS: Wave energy converter, wave energy farm, systems engineering, requirements, technology performance level, technology convergence

1. INTRODUCTION

Wave energy converter (WEC) technology development as a whole has not yet delivered the desired commercial maturity or, more importantly, the techno-economic performance needed to penetrate the electric utility marketplace. Both commercial readiness and market viability are required for successful entry into and survival in the energy market.

The ways in which WEC technologies have been developed have been analyzed in [1] and [2]. Technology development progress, technology value, and technology funding have largely been measured, associated with, and driven by technology readiness, measured in technology readiness levels (TRLs). Originating primarily from the space and defense industries, TRLs focus on procedural implementation of technology developments of large and complex engineering projects, where cost is neither mission critical nor a key design driver. The key deficiency with the TRL approach in the context of wave energy conversion is that WEC technology development has been too focused on commercial readiness and not enough on the economic viability required for market entry.

To compensate for this deficiency, technology performance levels (TPLs) have been introduced in [1], and further detailed in [2], as a techno-economic performance assessment metric for WEC technologies. The techno-economic performance assessment metric in [2] provides a means to measure the market viability of different WEC technologies and thus may be used by funding agencies or investors to make informed decisions when allocating resources. The metric was recently used as one of the performance measures in the *Wave Energy Prize* competition organized by the U.S. Department of Energy [4]. The initial form of the TPL assessment and its corresponding metric were developed based on experience in the wave energy sector, and knowledge of the key performance attributes needed for wave energy converters to be commercially successful [3].

An alternative approach used to identify the components and content of a techno-economic performance metric consists of applying systems engineering techniques. Systems engineering is an

[1] Corresponding author: aurelien.babarit@ec-nantes.fr