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Renewable energy project performance evaluation using a hybrid

multi-criteria decision-making approach: case study in Fujian, China

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- 9 **Abstract:** The evaluation of the best renewable energy project (REP) among many alternatives is a complicated multi-criteria decision-making (MCDM) problem, which 10 usually involves several criteria in economy, technicality, environment and society. To 11 12 solve this problem, a hybrid approach mixing 2-dimension uncertain linguistic variables (2DULVs), a cloud model and an extended TODIM (an acronym in Portuguese of 13 14 interactive and multicriteria decision making) together to evaluate REPs efficiently is proposed. Firstly, because of the extra reliability assessment, the 2DULVs are adopted by 15 decision-makers (DMs) to evaluate the performance of alternatives. Secondly, given that 16 17 the cloud model could vividly depict the fuzziness and randomness, a novel conversion 18 model is proposed to transform the 2DULVs into integrated clouds. Thirdly, the extended 19 TODIM approach is used to evaluate and rank REPs considering DMs' psychological 20 behaviors. Following this, the Fujian case study has been provided to demonstrate to verify the feasibility of the hybrid approach. The results show that the most important 21 22 criterion is the emission reduction of the greenhouse gases (GHG), and the wind power 23 project is selected as the best alternative, but the later sensitivity analysis shows that the optimal alternative is sensitive to the attenuation factor of losses. Finally, a comparative 24 25 analysis is conducted to demonstrate the correctness and superiority of the proposed 26 approach. The originality of this work is the first time to put forward the model of transforming 2DULVS into integrated cloud. 27
- 28 **Keywords:** renewable energy project; performance evaluation; 2-dimension uncertain linguistic variables; cloud model; extended TODIM.

30 Nomenclature

ŝ	A 2DULV		W	Weight vector of criteria
$[s_a, s_b]$	I class uncertain information of \hat{s}	linguistic	D	A finite set of DMs
$[h_c, h_d]$	<i>II</i> class uncertain information of \hat{s}	linguistic	λ	Weight vector of DMs
S_I	Predefined linguistic performance assessment	set for	$[\tilde{\hat{s}}_{ij}^{\ k}]_{m \times n}$	2DULVs decision matrix
H_{II}	Predefined linguistic reliability assessment	set for	$[{ ilde{\mathcal{Y}}_{ij}}^k]_{m imes n}$	Integrated clouds decision matrix

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