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Economic assessment of smart grid initiatives for island power systems

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Abstract— Islands are facing considerable challenges in meeting their energy needs in a sustainable, affordable and reliable way. The present paper develops an integrated approach to economically assess initiatives that can transform island power systems into smart ones. Single and multi-action initiatives fostering the deployment of renewable energy sources (RES), energy storage systems (ESS), demand-side management (DSM), and electric vehicle (EV) are considered. An hourly unit commitment on a weekly basis is proposed to assess the impact of the initiatives on the system operation costs of five prototype island power systems, which have been identified by applying clustering techniques to a set of sixty islands power systems. The different investment costs of the initiatives are accounted for determining their corresponding internal rate of return (IRR) through their lifetime. The economic assessment of single and multi-action initiatives for five prototype islands representing sixty island power systems quantifies which initiatives are most suitable for which type of island power system. The assessment shows that islands of different sizes and features require different initiatives. Larger islands tend to DSM initiatives, whereas smaller islands tend to RES initiatives. Multi-action initiatives achieve highest system operation cost reduction, whereas single action initiatives yield to highest IRR.

Index Terms— Smart island; Unit commitment; Energy storage; Renewable energy sources; Demand side management; Electric vehicles

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