CHAPTER VI

CONCLUSION

This thesis has proposed the OMES-WSPHS integration under various conditions. The first study focuses on minimizing TOC using two pricing mechanisms: TOU scheme and RTP scheme. In the TOU cases, different case studies are analyzed to assess TOC reduction when multi-energy sources are coordinated effectively. Additionally, the PSO-LP algorithm is proposed to optimize the scheduling problem. A comparative analysis between conventional PSO and PSO-LP reveals that PSO-LP achieves a near-global optimal TOC more effectively than conventional PSO. However, PSO performs better in terms of computational runtime, making both methods suitable for daily scheduling applications. The results highlight the benefits of multi-energy coordination and the integration of high penetration RE in achieving an optimal TOC.

For multi-objective optimization, the FMOO method is employed for OMES-WSPHS integration. The objective functions include TOC, TCE, and EP minimization. FMOO addresses this multi-objective problem by constructing FSMF using PSO-LP to obtain optimal single-objective solutions. Subsequently, PSO is utilized to maximize FSMF, ensuring a balanced trade-off among the conflicting objectives. The results demonstrate a compromise solution among TOC, TCE, and EP, leading to an effective balance between economic cost, environmental impact, and grid electricity demand reduction. For comparison, WSMO is also considered, providing an alternative compromise solution based on assigned weightings of the objectives. However, the FMOO approach enables a more flexible and informed decision-making process by considering the satisfaction levels of all objective functions simultaneously, leading to a compromise solution that avoids favoring any single objective too heavily.

The stochastic analysis of OMES-WSPHS integration examines probabilistic scheduling under uncertain conditions for TOC minimization. MCS is employed to evaluate the fluctuations in RE generation and energy loads, requiring multiple iterations to generate probabilistic results. The stochastic model considers four uncertain input variables, leading to four uncertain decision variables and one uncertain objective function. The results indicate an increase in TOC compared to the deterministic case, emphasizing the impact of uncertainty on the objective function. Among the probability distributions tested, the normal distribution is found to be the best fit for TOC in this study, as evidenced by a small negative log-likelihood value compared to Weibull distribution.

Overall, this study provides a comprehensive approach to optimize scheduling with MES-WSPHS integration model. The findings confirm that can improve cost-effectiveness while reducing environmental impact and peak electricity demand. The proposed PSO-LP algorithm successfully enhances scheduling efficiency, and the FMOO approach effectively balances conflicting objectives. Furthermore, stochastic analysis highlights the influence of uncertainty on TOC, reinforcing the need for probabilistic methods in energy system modeling. Future work may explore more advanced optimization techniques, expand uncertainty modeling, or extend the proposed framework to larger-scale multi-energy systems.