Deep Reinforcement Learning based Renewable Energy Error Compensable Forecasting

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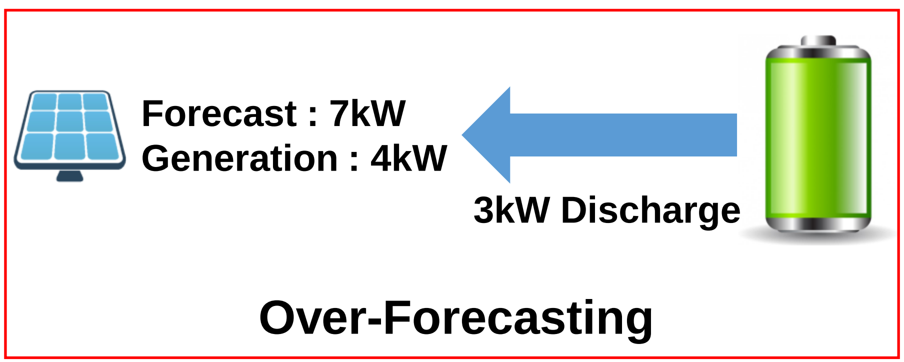
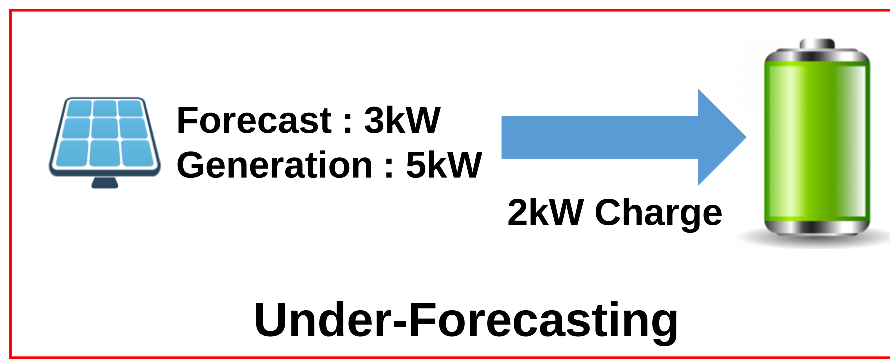
Introduction

- Renewable energy is rapidly integrated into the power grid to prevent climate change.

- Accurate forecasting of renewable generation becomes critical for reliable power system operation.

- However, forecasting always induces errors, and large-scale batteries can be used to compensate forecasting errors.





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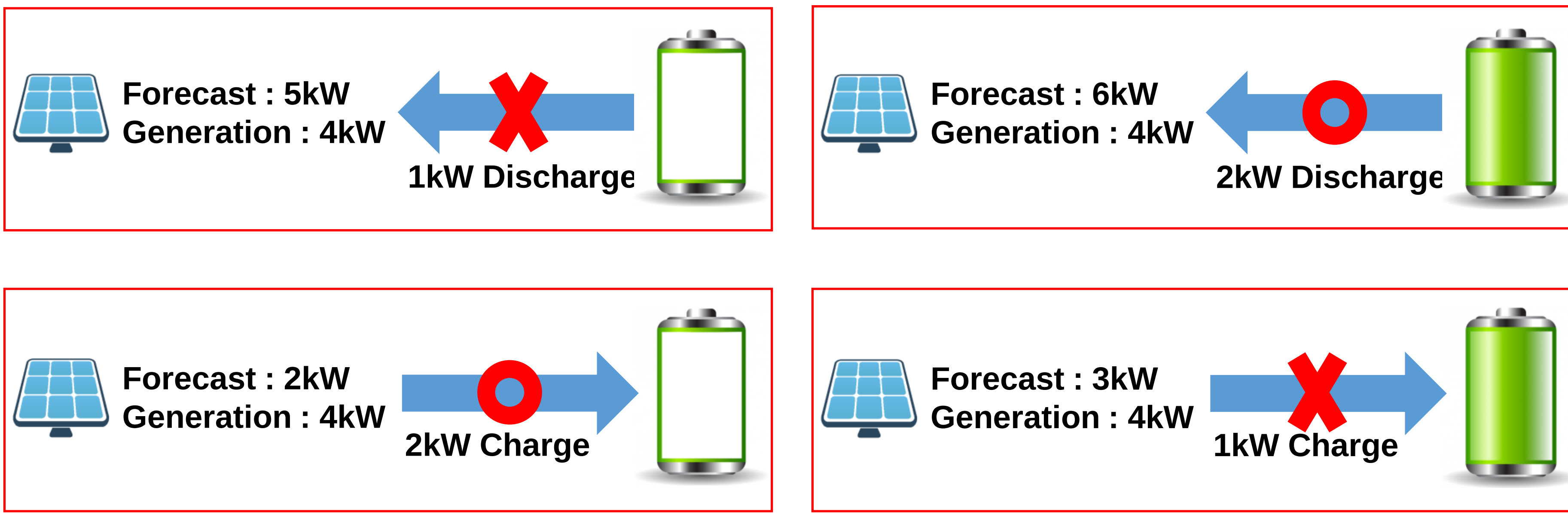
Introduction

- Traditional deep learning based forecasting methods commonly aim to minimize the forecasting errors.
- However, reducing errors does not necessarily imply compensable errors.



Error Compensable Forecasting (ECF)

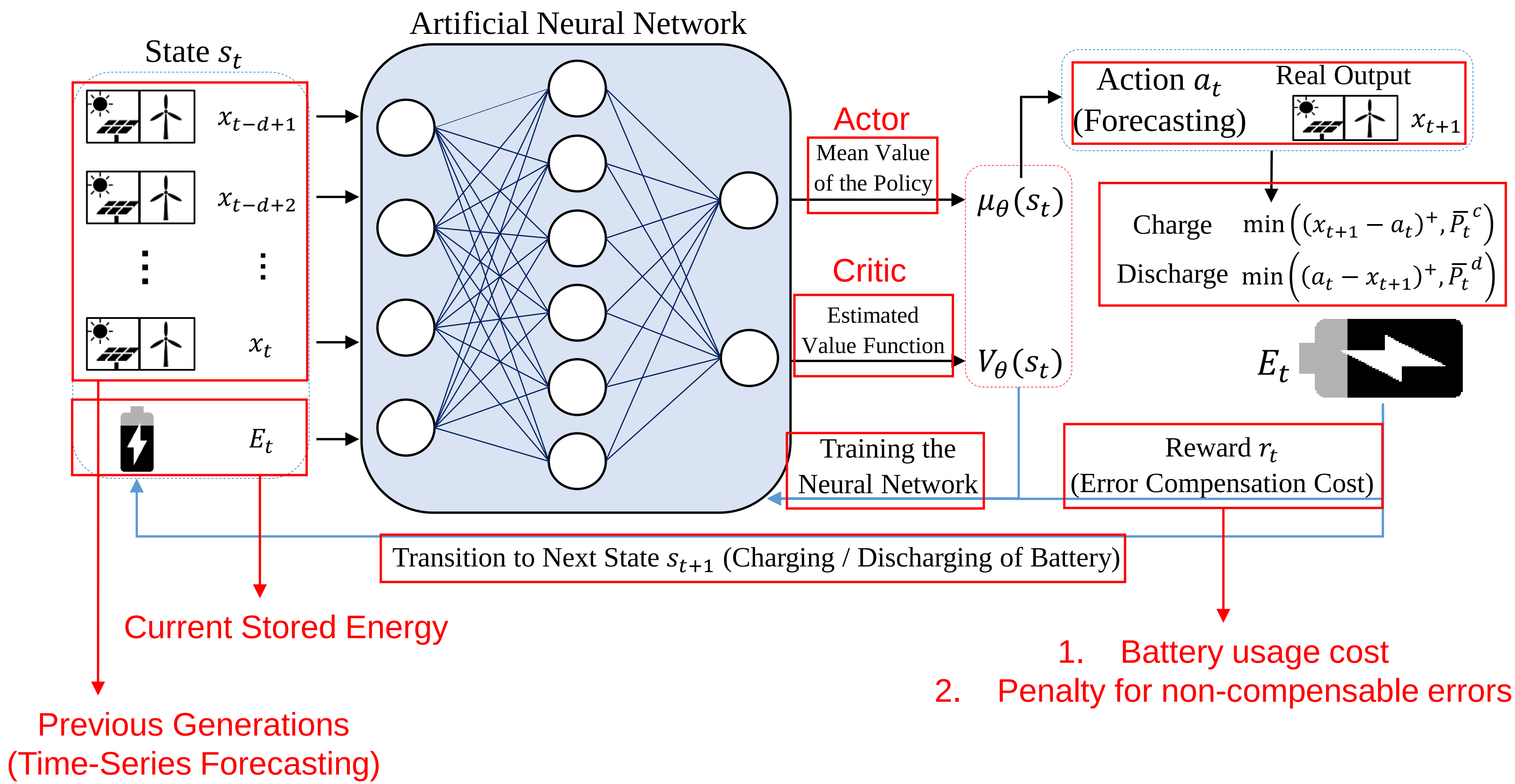
☐ Key Idea

- We switch the objective of forecasting from reducing errors to making compensable errors.
- The stored energy is affected by the previous forecasting result.
  - » We tackle this problem by leveraging reinforcement learning.

☐ Deep Reinforcement Learning

- Continuous Action Space
  - » An action is a continuous forecasted value
- Proximal Policy Optimization
  - » Simple to implement with outstanding performance

A framework of ECF



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Experiment Results

Solar Power

Maximum Generation = 1 p.u.

	Battery Size = 0.25 p.u.		Battery Size = 0.5 p.u.	
	BF	ECF	BF	ECF
MAPE	18.74%	10.08%	17.70%	0.13%

Wind Power

Maximum Generation = 1 p.u.

	Battery Size = 0.25 p.u.		Battery Size = 0.5 p.u.	
	BF	ECF	BF	ECF
MAPE	6.16%	1.21%	4.85%	0.20%

- **Baseline Forecasting (BF): conventional deep learning-based forecasting**
- **MAPE** $= \frac{100}{N} \sum \frac{\text{Compensated Real Output} - \text{Forecated value}}{\text{Compensated Real Output}} [\%]$
- **The proposed ECF far improves all the performances compared to the BF**
- **When the battery size is 0.5 p.u., the MAPE becomes near zero**

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