Deep Reinforcement Learning to Minimize Long-Term Carbon Emissions and Cost

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Abstract

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1 Introduction

A transition from a high carbon electricity supply to a low-carbon system is central to avoiding catastrophic climate change [1]. Much of the work in decarbonisation relies on a low-carbon electricity supply, such as cooling, heating and automotive, amongst others. Such a transition must be made in a gradual approach to avoid frequent collapse of the electricity supply.

Renewable energy costs, such as solar and wind sources, have dropped in price making them cost competitive with fossil fuels. This is projected to continue into the future [2]. The future cost of generation, demand and fuel prices, however, remain uncertain over the long-term future. These uncertainties are risks which investors must analyse while making long-term investment decisions.

In this paper, we use the deep deterministic policy gradient reinforcement learning algorithm to simulate the behaviour of investors over a 40-year horizon [3]. The environment used was a modified version of the global FTT:Power model [4].

- Requirement to reduce carbon emissions globally.
- This must be achieved cost effectively.
- Requirement for a global solution to find optimal mix of electricity mix with imperfect information about the future (eg. costs and demand).
- Use of reinforcement learning to take into account all uncertainties to achieve goal of a cost effective and low-carbon solution
- Use of FTT:Power model to simulate investment in the UK and Ireland over a 50 year horizon
- Examples of existing literature

2 Model and methodology

- Use of simplified FTT:Power model (Ireland + UK)
- Explain DDPG algorithm
- Detail how we adopted the algorithm to minimize both cost and carbon emissions

3 Results

- Display electricity mix over time-horizon

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- Investment in solar, offshore, onshore and wave
- Visualise carbon emissions and electricity price over time
- Discuss these results and detail

References

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