How to value an option to add a generator under uncertainties

**Background**

Building a small-scale power plant such as wind or solar farm for a community is a significant decision for generation and transmission planners. Such a decision has a significant consequence on labor and capital requirements, and it is faced with volatile demand.

**Research Question**

- **What is the option value of adding a generator considering the demand uncertainty?**
- **What is the optimal timing of the generator addition?**

Where,

- Adding a generator to a network alters power flow and locational marginal price
- Demand uncertainty is modelled as a geometric Brownian motion

**Model Formulation**

**Cases used for the study**

**Case 1:** Bus 1 has no generator  
**Case 2:** Bus 1 has a generator

**Option valuation framework**

- Mapping demand over the modelling horizon using a binomial lattice
- Calculating the cost paid by the community at the reference bus to fulfil their electricity demand based on the locational marginal price for case 1 and 2
- Computing the net benefit by subtracting the cost of case 2 from case 1
- Evaluating exercise values at all periods and hold value at the end period, then determining the option value as max(exercise value, hold value) for the last period
- Determining the option value at time 0 by repeatedly calculating the expected value and discounting it

**Derived from:** Demand evolution at bus 1 (Binomial lattice)

**Ongoing and Future Research**

- We evaluated the option value of adding a generator in a risk adverse condition considering the fact that all risks cannot be hedged
- We calculated the option value of adding a transmission line

For more information, visit Solar and Wind Energy using Engineering Economics Theory (SWEET) project website [https://www.imse.iastate.edu/sweet/](https://www.imse.iastate.edu/sweet/)