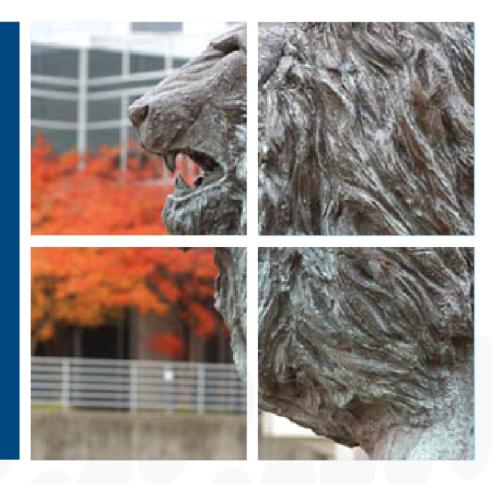
OLD DOMINION UNIVERSITY

I D E A FUSION



CIGRE GOTF

Cleveland OH October 23, 2017

A Simulation-Based Energy Management Game

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Outline

Gaming in power infrastructure planning

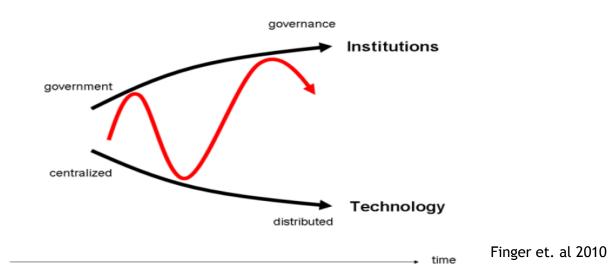
- Simulation Engine
- Play Mechanism
- User Interface



Research Interest

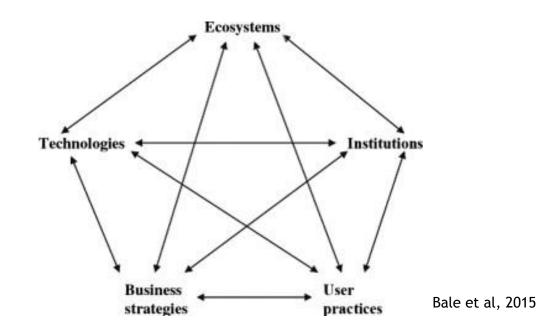


- 1. Understand how infrastructure systems co-evolve with Society (populations, policy, institutions, economy, etc.) and Nature (resources, ecosystems).
- 2. Understand how to best influence this coevolution



Research Interest

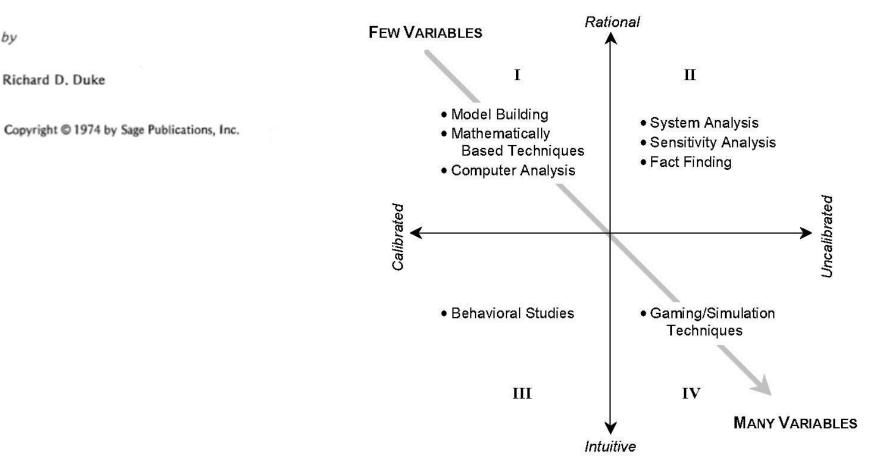
Today's power sector is an <u>extreme example</u> of a co-evolving complex dynamic system in transition, characterized by path dependency, learning and adaptation, institutional changes, technological innovation, consumption pattern changes, etc.



Gaming in power infrastructure planning

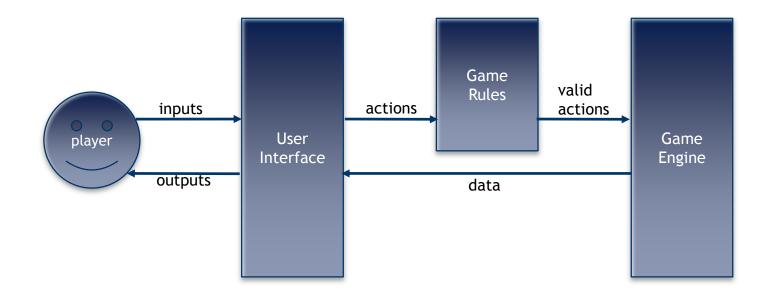
GAMING: THE FUTURE'S LANGUAGE

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Structure of a game





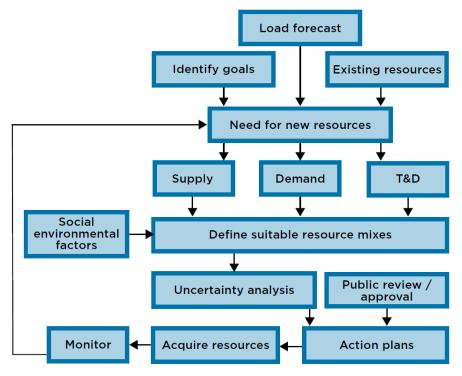




- Player: Student, Policy Maker, Utility Manager
- Goal: Incrementally build a long term grid expansion plan under uncertain regulatory, fuel and technology forecast regimes with cost, reliability and sustainability constraints
- Actions: build, expand, retire generator/storage/transmission

Spark! Game Mechanics

The game mechanics simulate a yearly IRP process



Source: Wilson and Biewald, 2013

Spark! Simulation Engine

A dynamic, stochastic discrete event production cost model

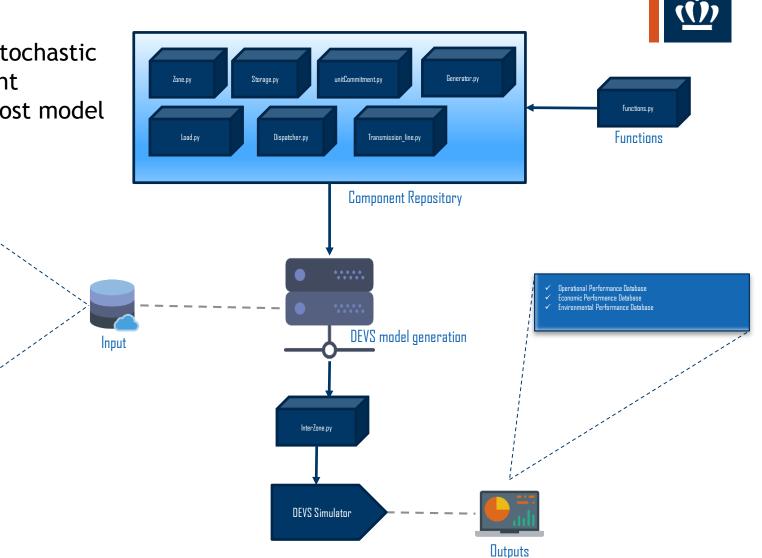
Load Forecast Database Generator Technology Cost Database Generator Technology Database Fuel Forecast Database

Solar and Wind Potential Database

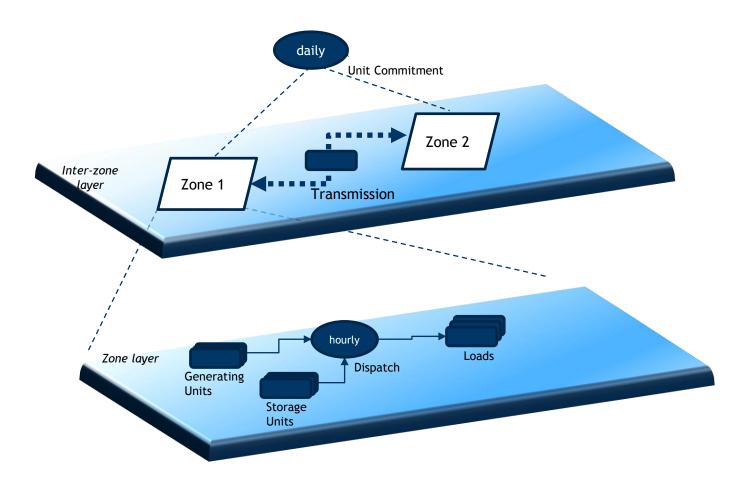
Transmission Lines Database Hydro flow Database

Generator Database

✓ Storage Database
 ✓ Storage Technology Database
 ✓ Storage Technology Cost Database

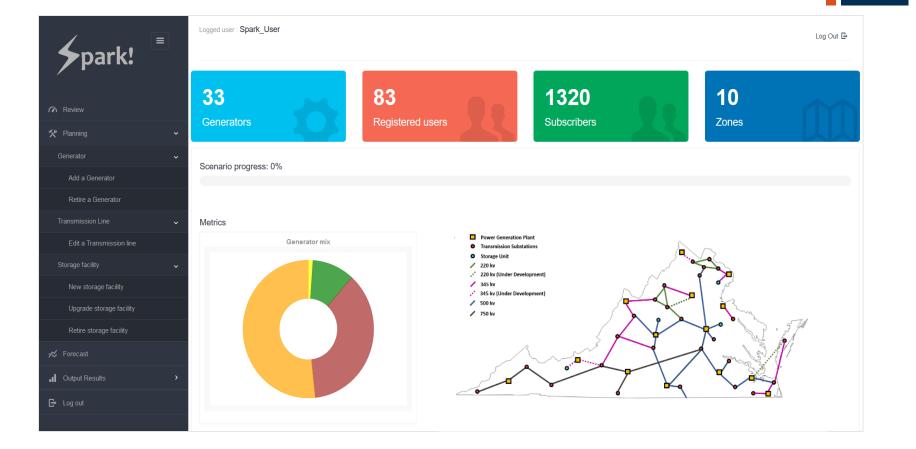


Spark! Simulation Engine



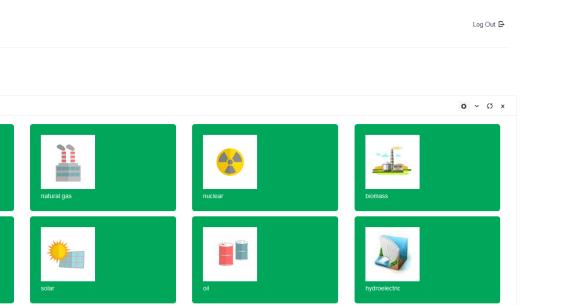
Spark! Simulation Input

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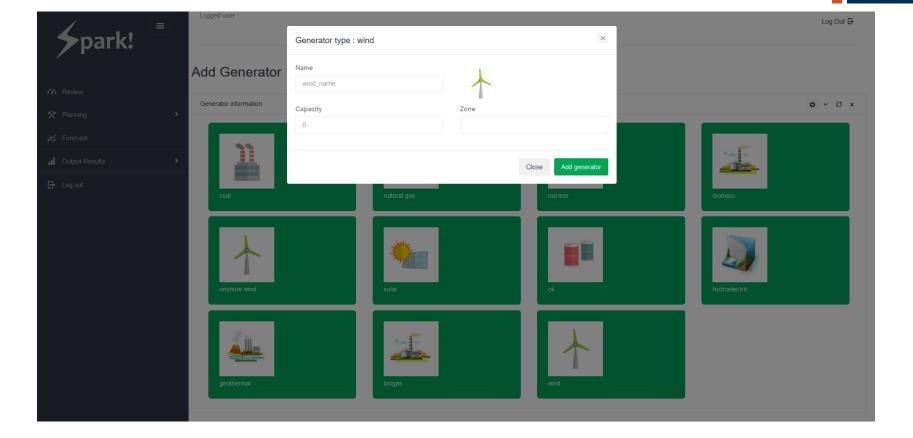


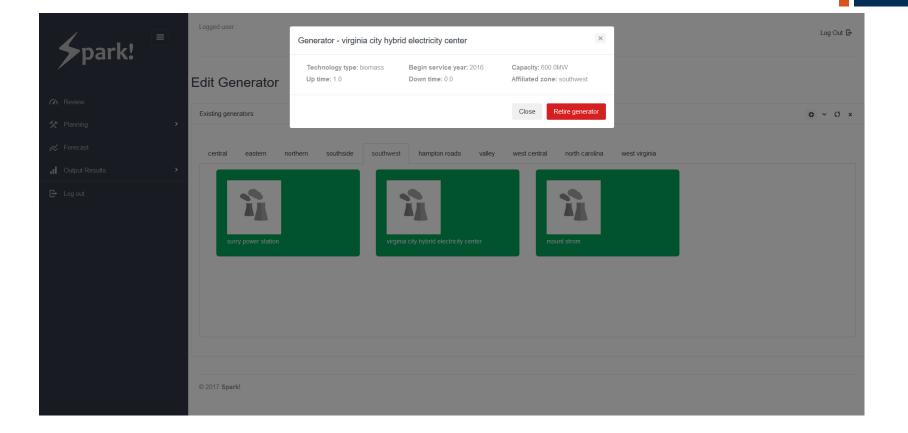
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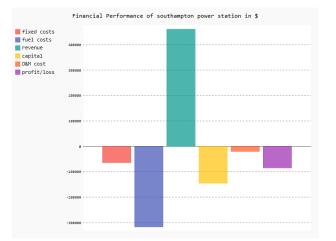




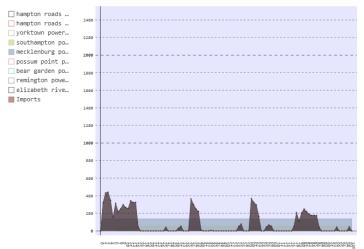
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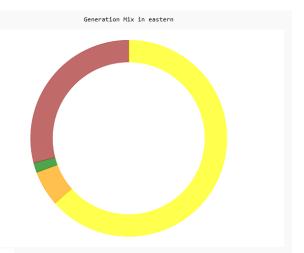
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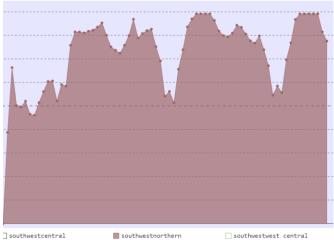
Typical outputs



Power Generation hampton roads







Summary



- We have developed a gaming application for power sector infrastructure planning.
- The game has potential application in training, policy analysis, public relations.
- Future steps involves launching an online game challenge for the 2050 US Grid
- Thanks to the Dominion Educational Fund for the initial funding of this effort !
- We welcome requests for collaboration, use, sponsorship to develop this game further