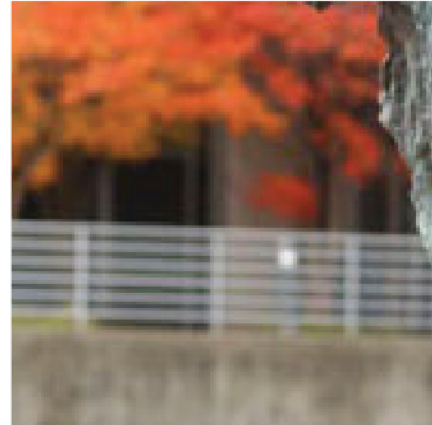
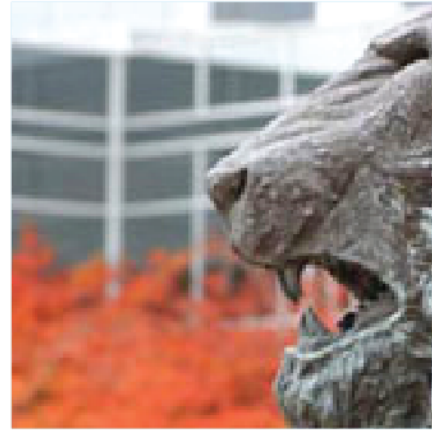




OLD DOMINION
UNIVERSITY

IDEA FUSION



CIGRE GOTF

Cleveland OH
October 23, 2017

A Simulation-Based Energy Management Game

Mamdou Seck, Ph.D., mseck@odu.edu

Ange-Lionel Toba*

Nathapon 'Max' Siangchokyoo*

Issakar Ngatang



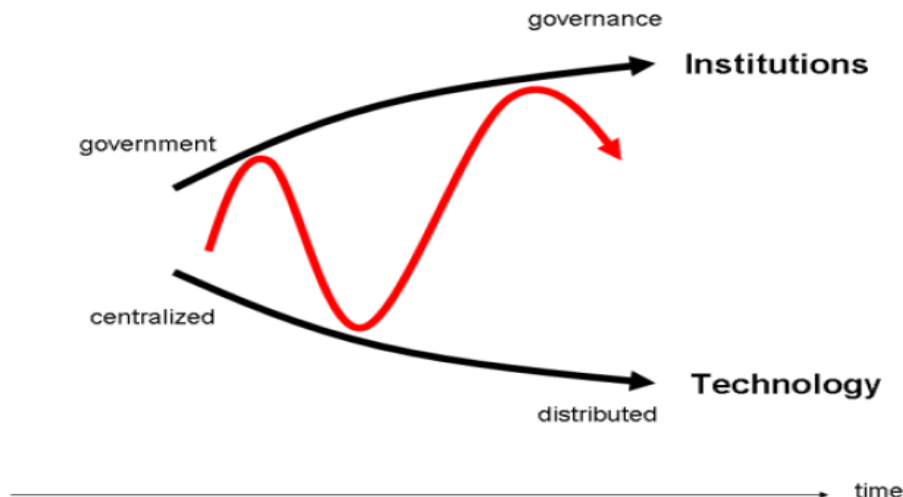
Outline

- Gaming in power infrastructure planning
- Simulation Engine
- Play Mechanism
- User Interface

Research Interest



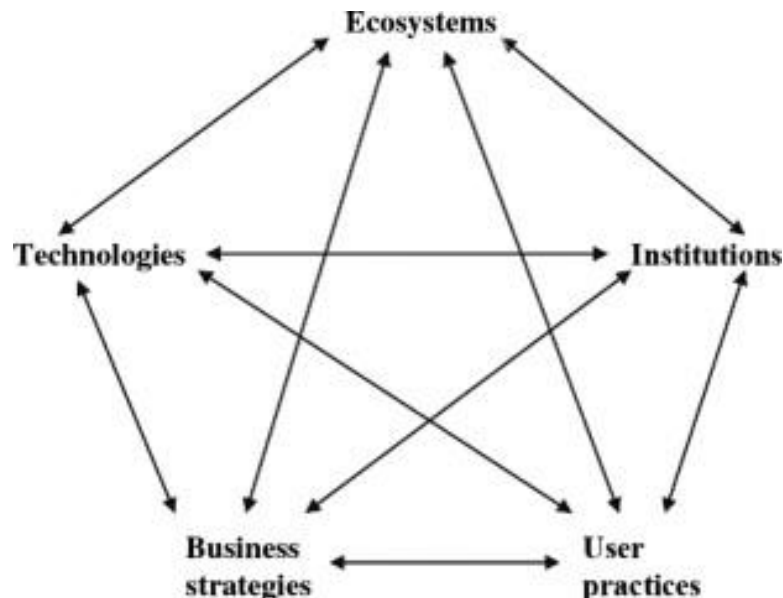
1. Understand how infrastructure systems co-evolve with Society (populations, policy, institutions, economy, etc.) and Nature (resources, ecosystems).
2. Understand how to best influence this co-evolution





Research Interest

- Today's power sector is an extreme example 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

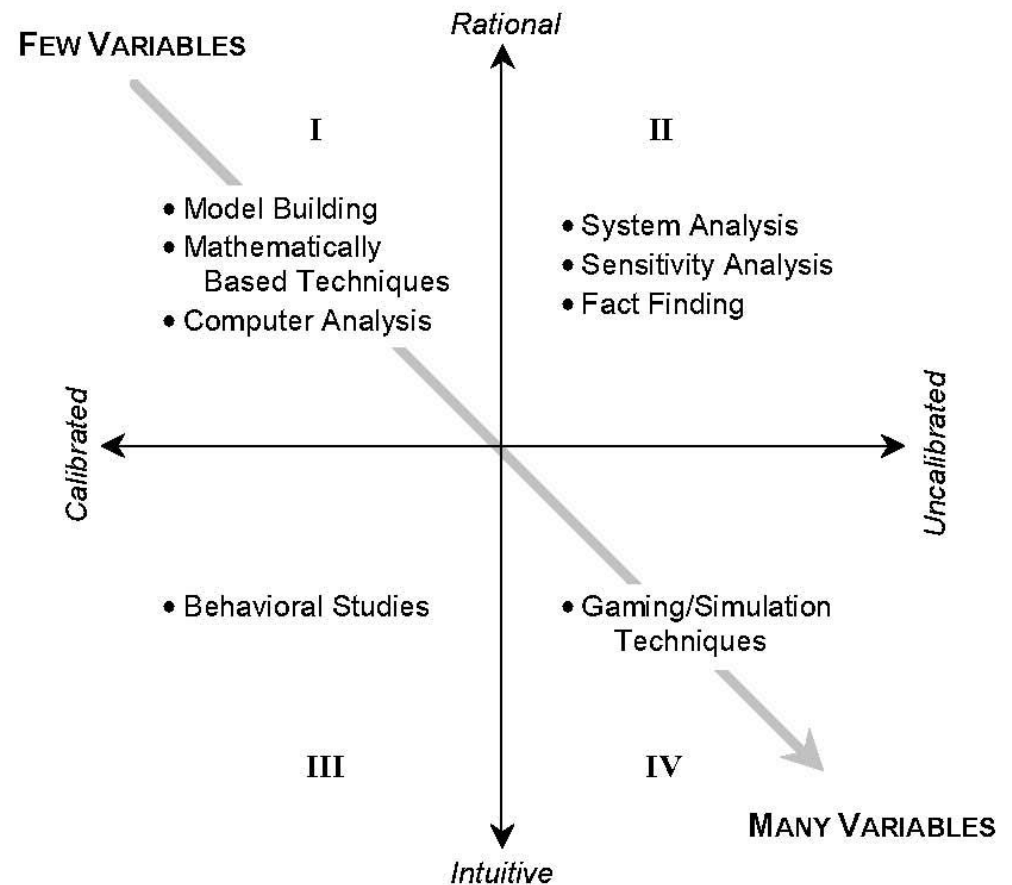


GAMING: THE FUTURE'S LANGUAGE

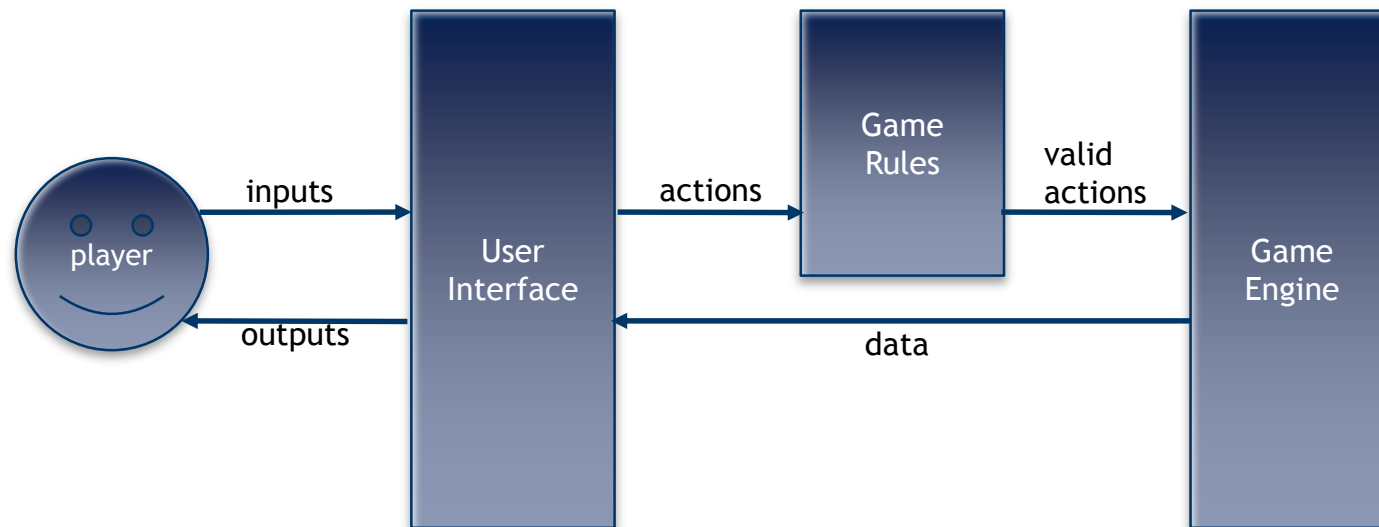
by

Richard D. Duke

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Structure of a game



Spark!

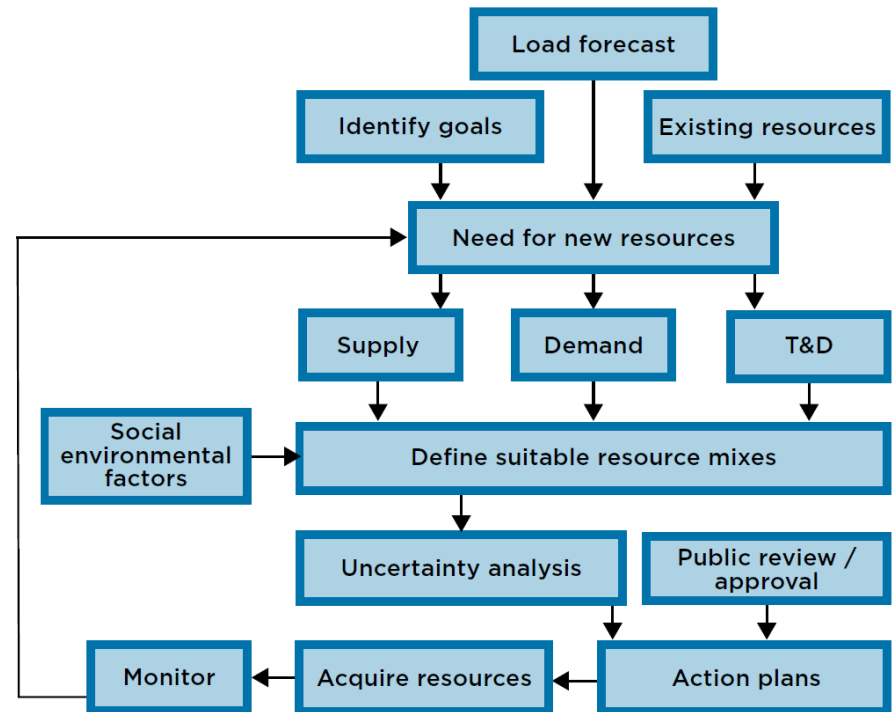


- Player: Student, Policy Maker, Utility Manager
- Goal: Incrementally build a long term grid expansion plan under uncertain regulatory, fuel and technology forecast regimes with cost, reliability and sustainability constraints
- Actions: build, expand, retire generator/storage/transmission

Spark! Game Mechanics



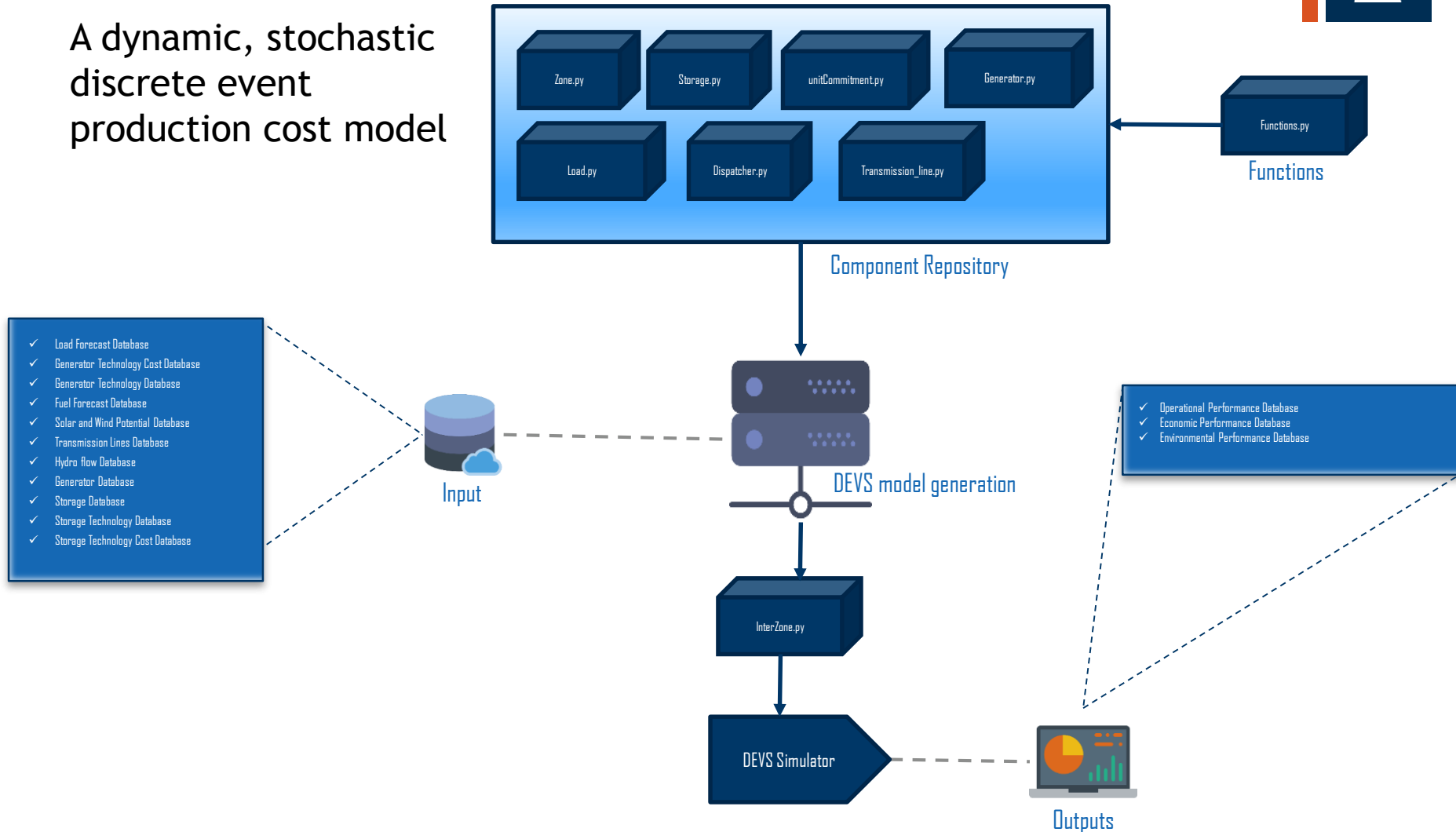
- The game mechanics simulate a yearly IRP process



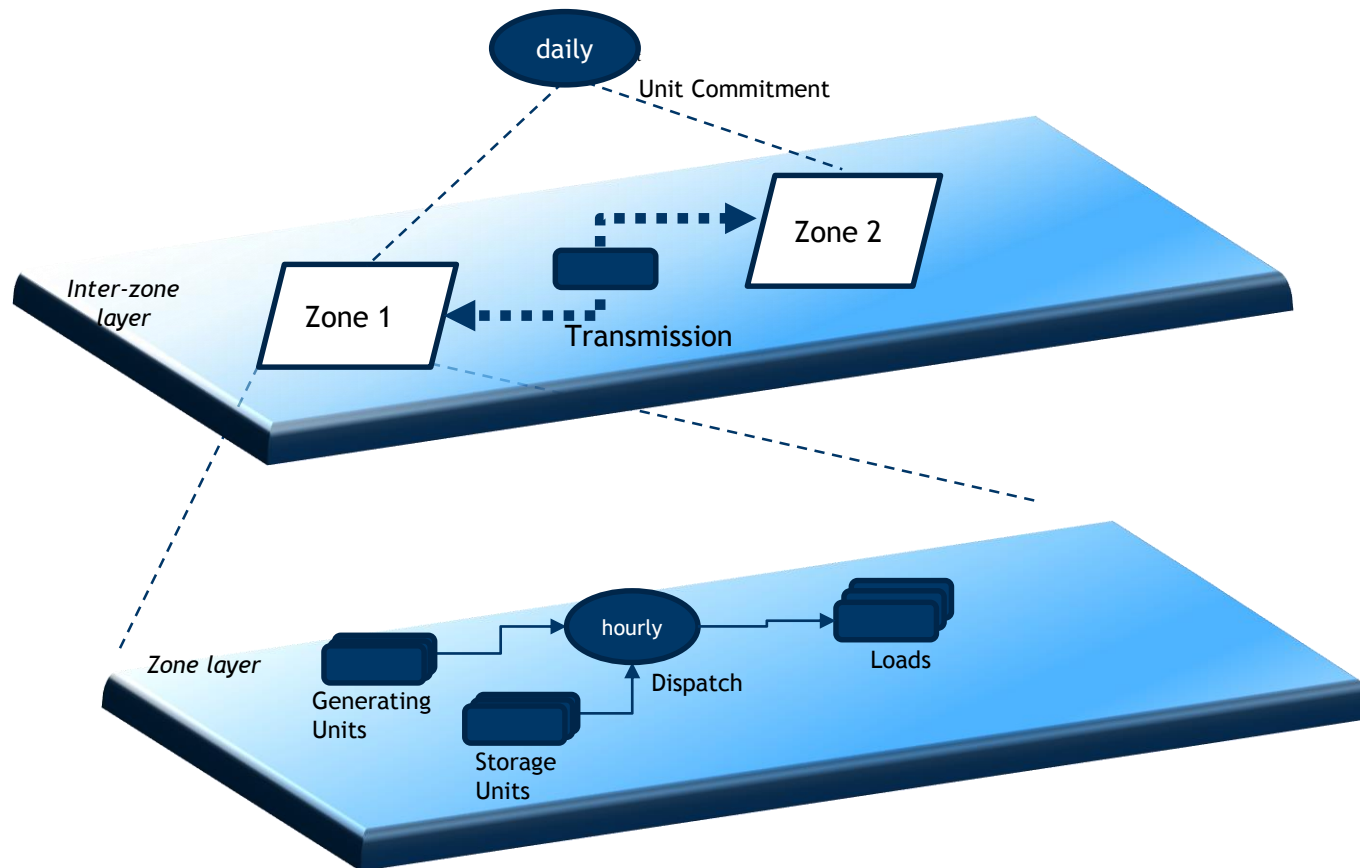
Source: Wilson and Biewald, 2013

Spark! Simulation Engine

A dynamic, stochastic
discrete event
production cost model



Spark! Simulation Engine





Spark! User Interface



Spark! User Interface





Review

Planning

Forecast

Output Results


Log out

Logged user :

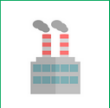
Log Out

Add Generator


Generator information




coal




natural gas




nuclear




biomass




onshore wind




solar




oil




hydroelectric



geothermal



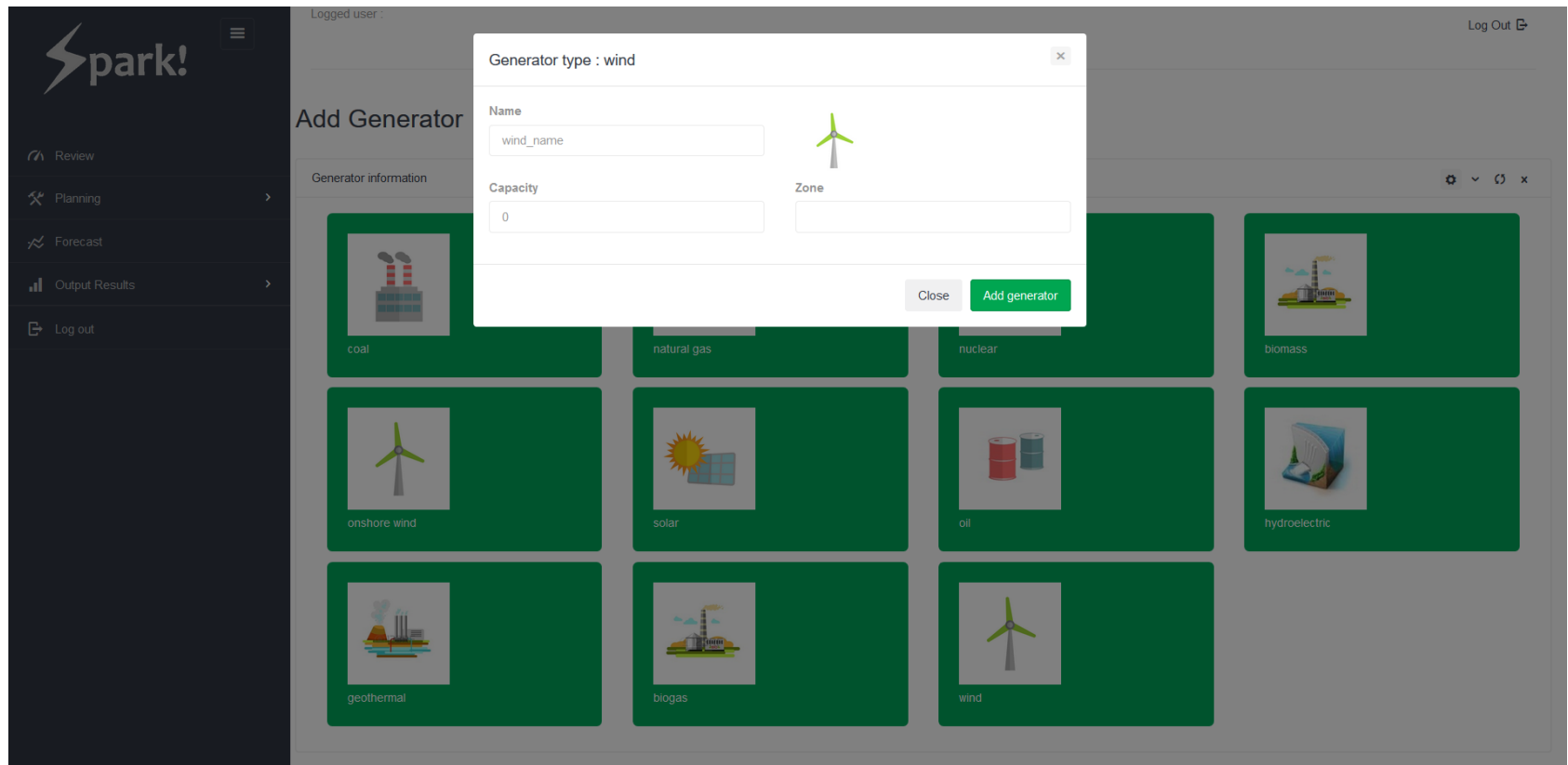
biogas



wind

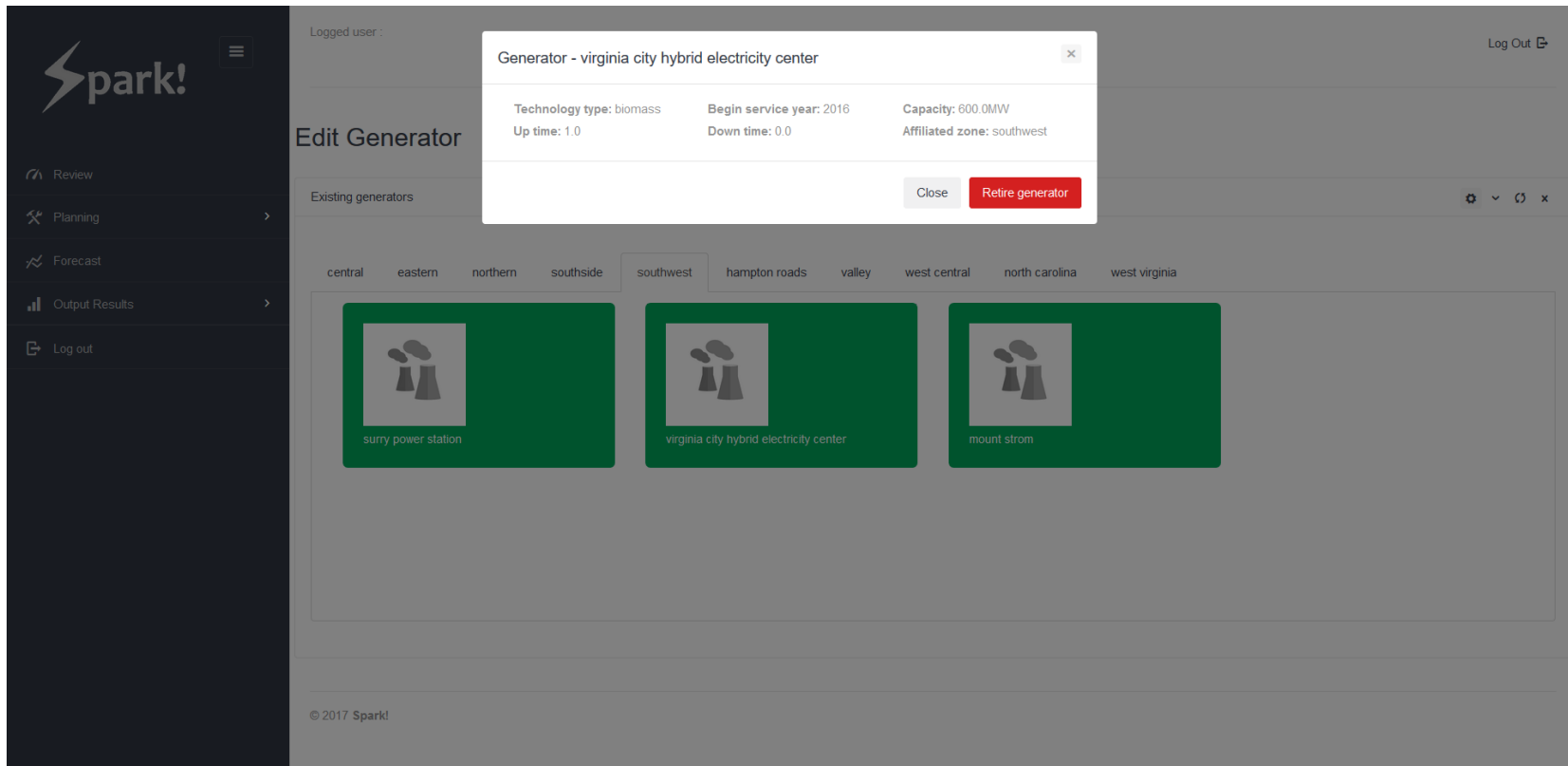


Spark! User Interface



Spark! User Interface

15



The screenshot displays the Spark! User Interface. On the left is a dark sidebar with the Spark! logo and a menu icon. The main area shows a modal window titled "Generator - virginia city hybrid electricity center" with the following details:

Generator - virginia city hybrid electricity center		
Technology type: biomass	Begin service year: 2016	Capacity: 600.0MW
Up time: 1.0	Down time: 0.0	Affiliated zone: southwest



Below the modal, the "Existing generators" section is visible, showing a grid of generator cards for different zones: central, eastern, northern, southside, southwest (selected), hampton roads, valley, west central, north carolina, and west virginia. The selected zone shows three cards: "surry power station", "virginia city hybrid electricity center", and "mount strom".


© 2017 Spark!


Spark! User Interface


16







 Review

 Planning >

 Forecast

 Output Results >

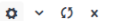
 Log out

Logged user :

Log Out 

Edit Generator

Existing generators



central eastern northern southside southwest hampton roads valley west central north carolina west virginia



surry power station

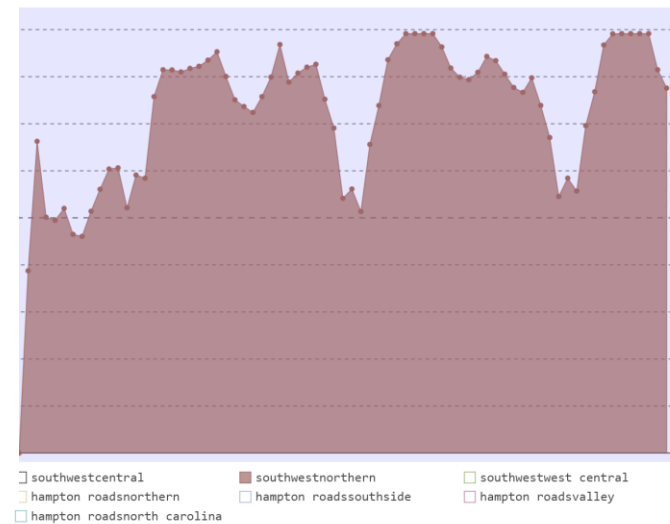
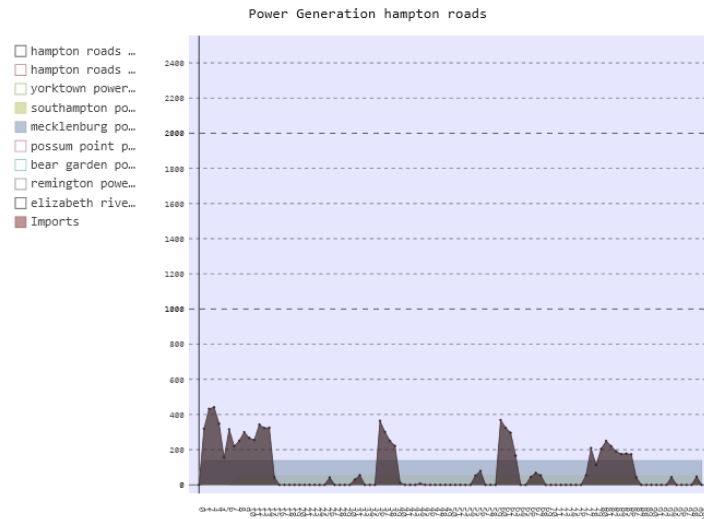
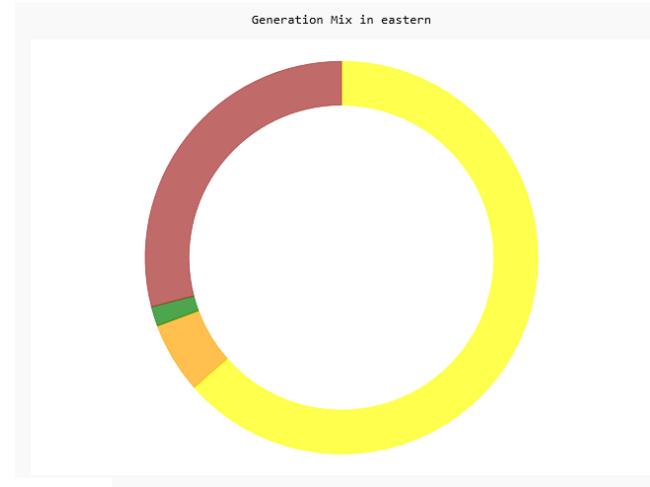
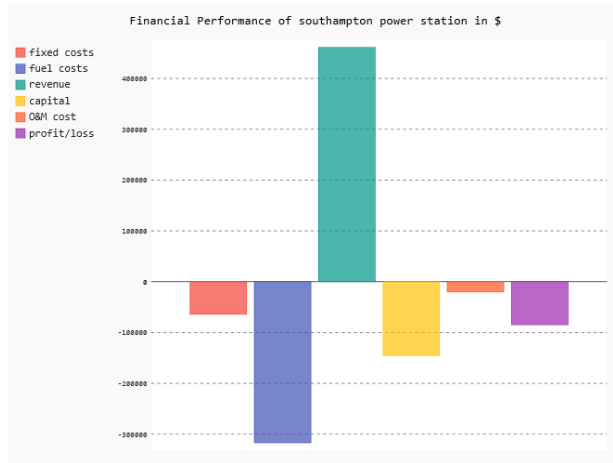


virginia city hybrid electricity center



mount strom

Typical outputs





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