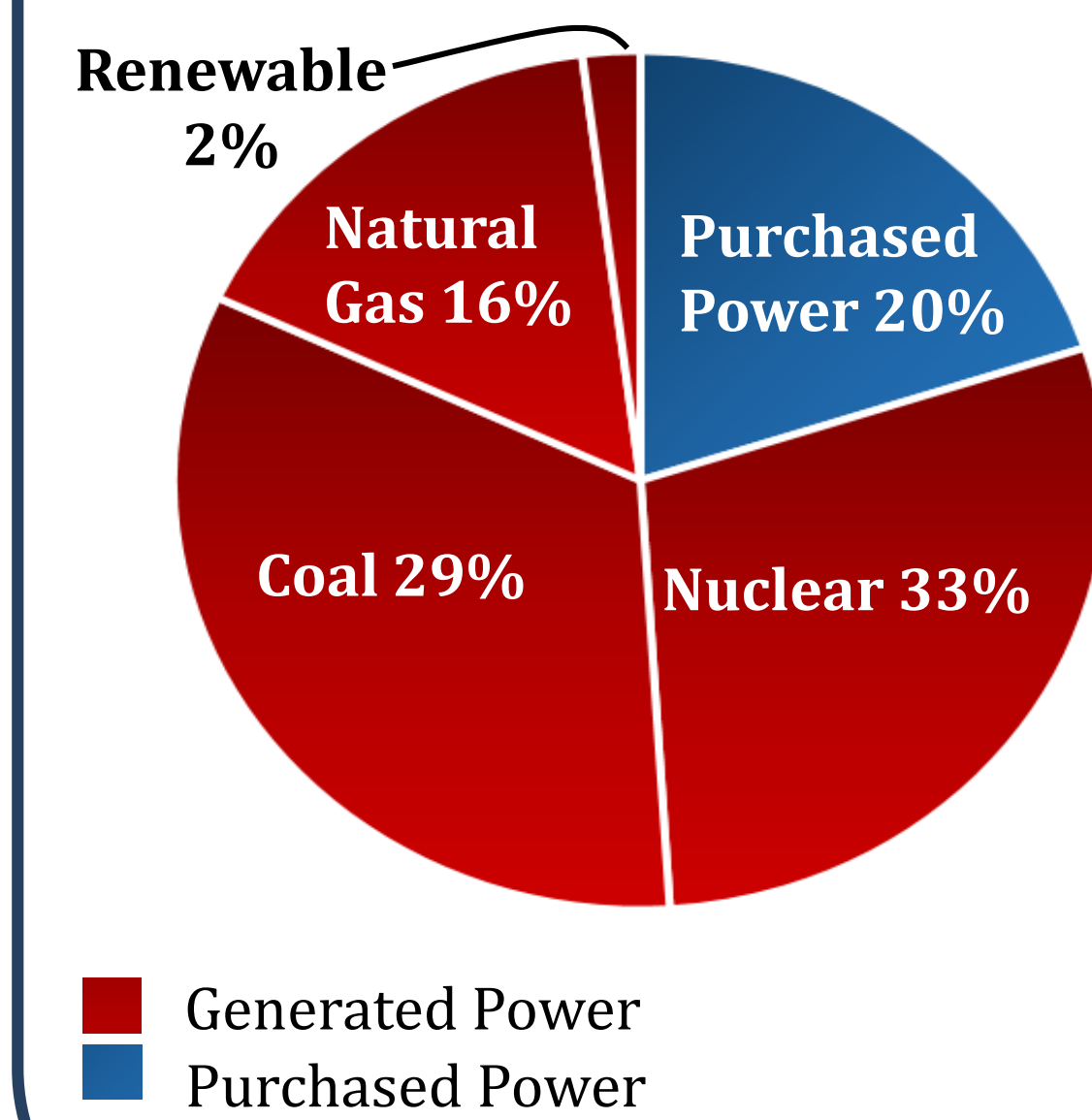


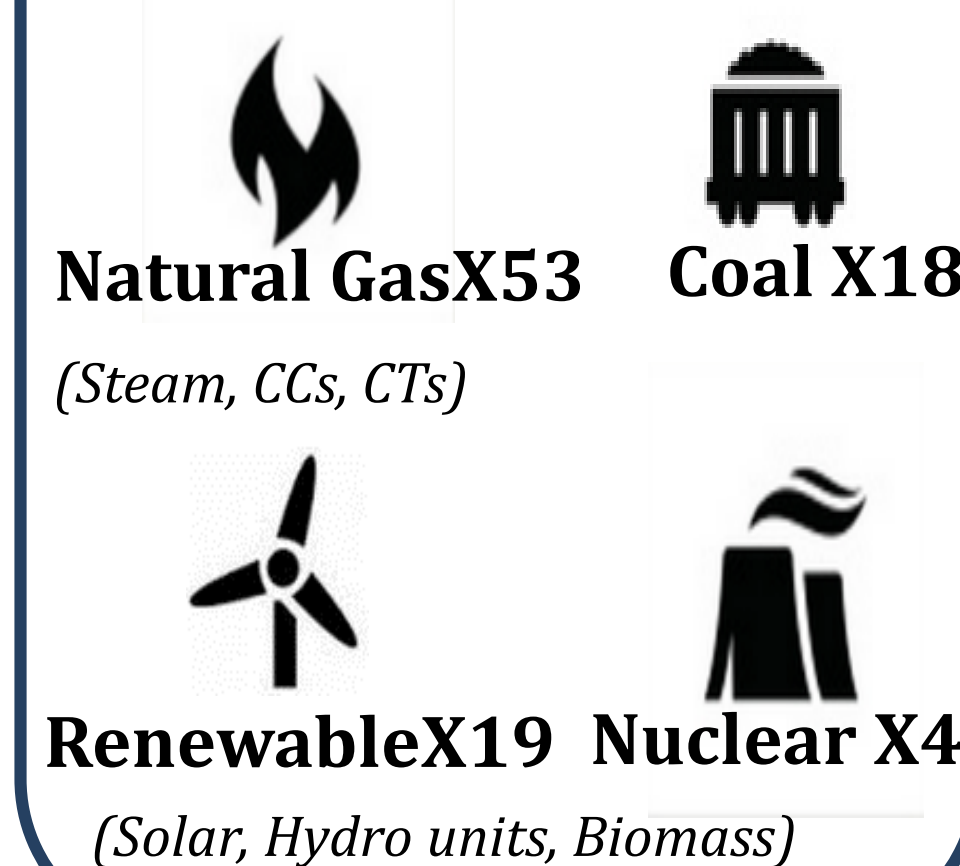
## Client Background

Dominion Virginia Power is a regulated electric monopoly that is facing a growing energy demand

### Dominion Virginia Power's Current Energy Mix



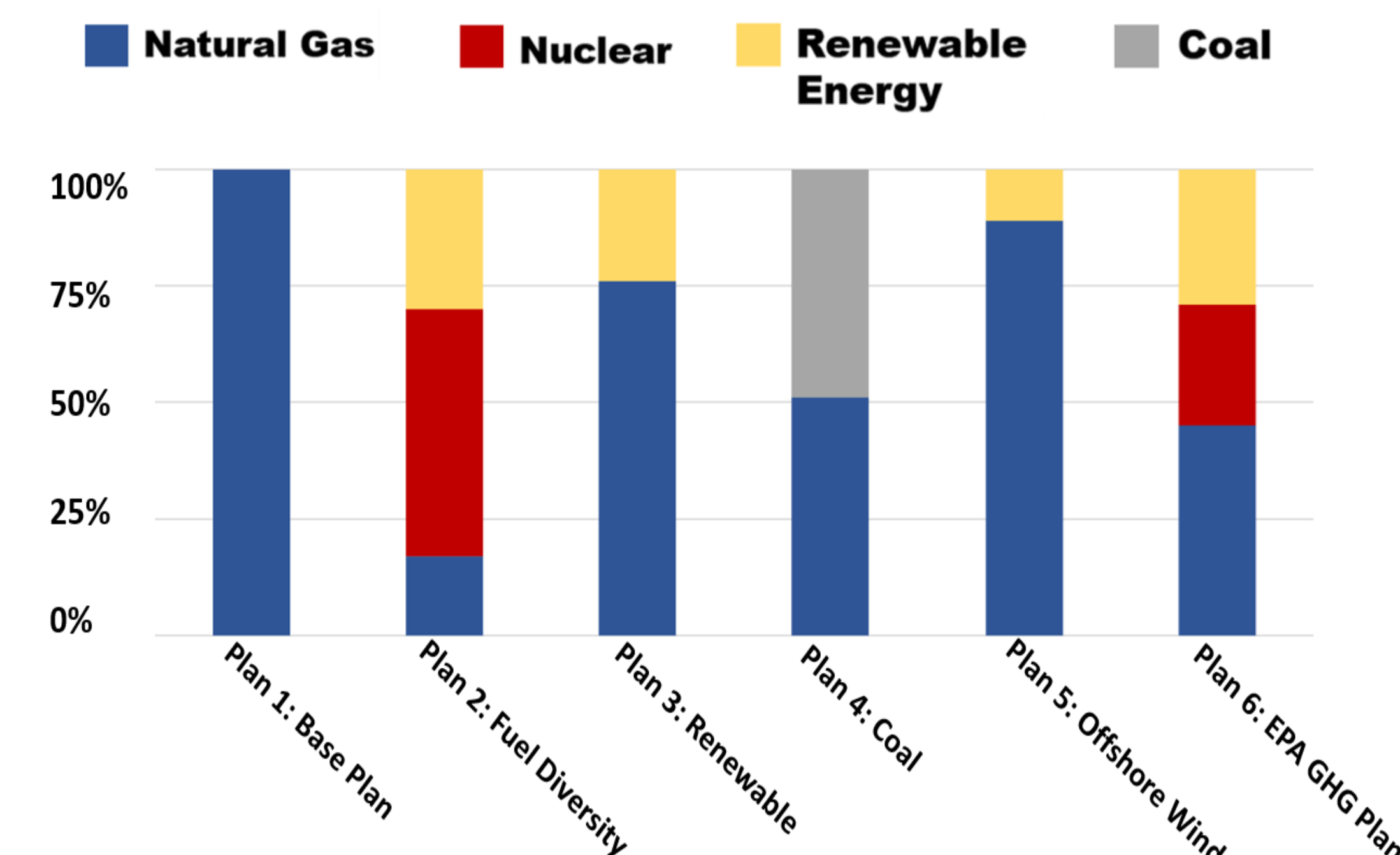
### Existing Generation Resources



### Peak Demand Projection

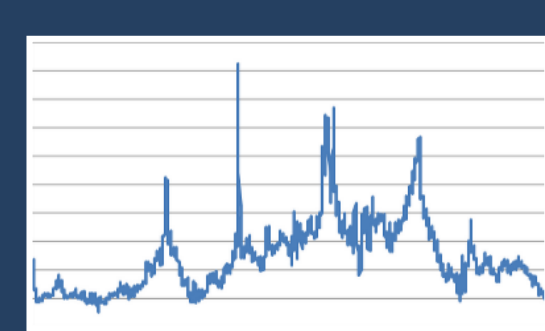


### DVP's Six Future Plans



## Problem Description

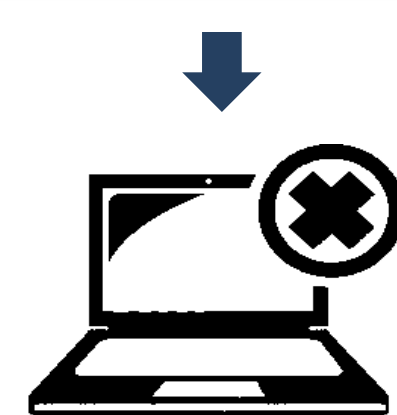
### Price Volatility



### Emission Taxes



What should be built to meet regulatory requirements?



Existing model can't measure risk quantitatively

### Project Goal



Variability of Cost

Value at Risk

Expected Shortfall

# Electric Utility Portfolio Optimization

## Dominion Virginia Power



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Nikhil Nandish | Aaron Seemungal

Yihang Yan | Kunal Shaparia

Estimated Cost Savings: **\$3.3 Billion**  
During Planning Horizon

## Methodology Overview

•DVP's Current System Analysis  
•Data Collection and Analysis

Phase 1: Planning & Organization  
Phase 2: Methodology

•Mean-Variance Portfolio Optimization  
•Expected Shortfall  
•Scenario Analysis

•Cost risk trade off  
•Cost Savings

Phase 4: Evaluation  
Phase 3: Deliverables

•Mixed Integer Optimization Model  
•Mean-Variance Efficient Frontier  
•Tail Risk Analysis  
•Gurobi Implementation

## Mixed-Integer Multi-Period Mean-Variance Portfolio Optimization Model

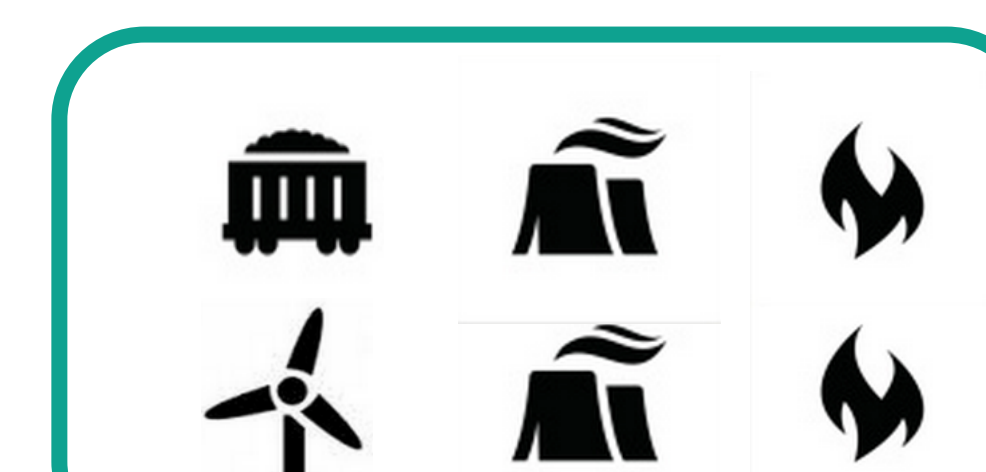
Current Infrastructure

Planning Horizon (Year 2015 - 2040)

Future Infrastructure



2015 2017 2018 2019 ..... 2039 2040



Objective Function

Minimize total cost of portfolios for every given level of risk

Important Constraints

Peak Power Demand Constraint

Energy Demand Constraint

Maximum Power Generation Constraint

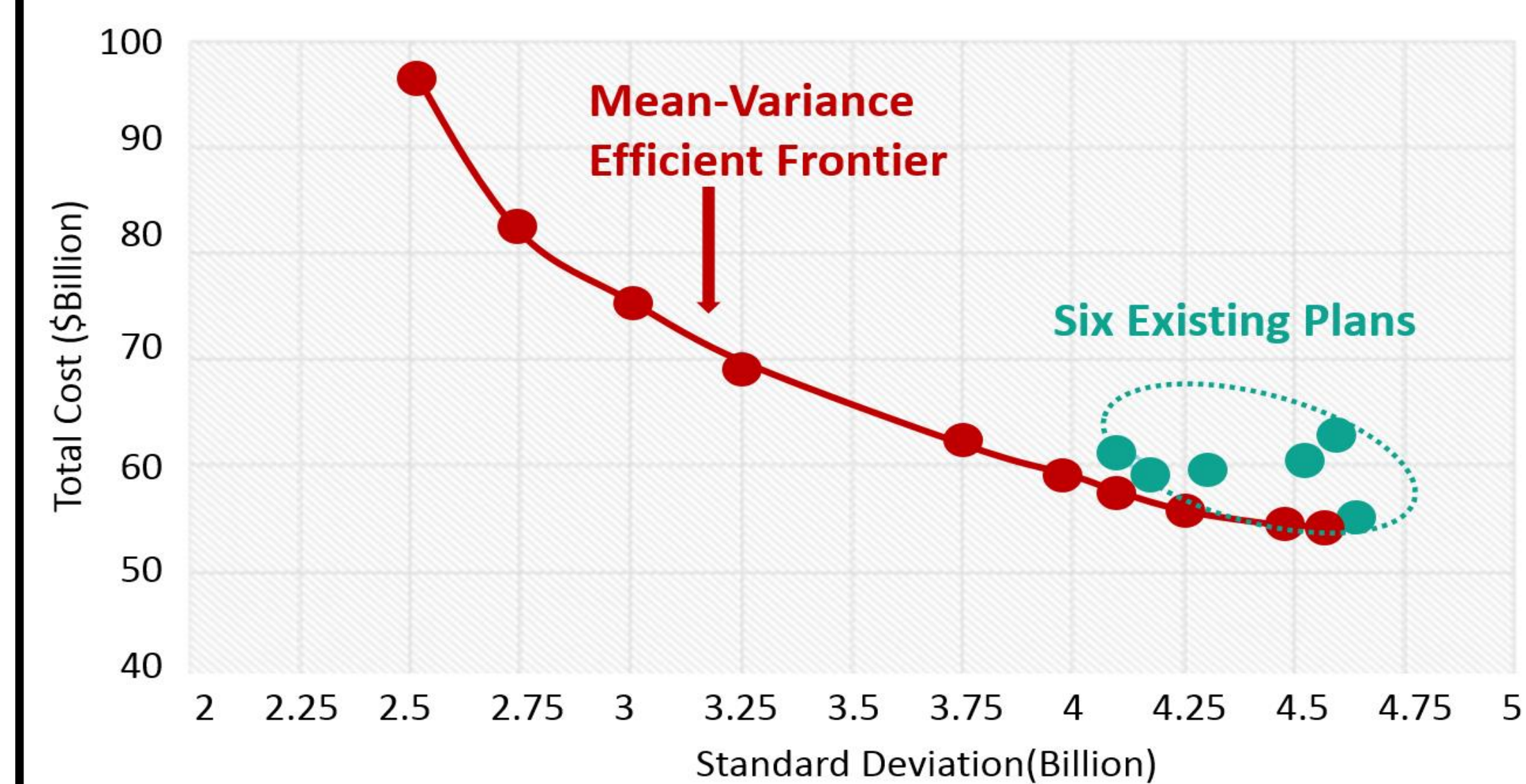
Portfolio Variance Constraint

Expected Shortfall Constraint

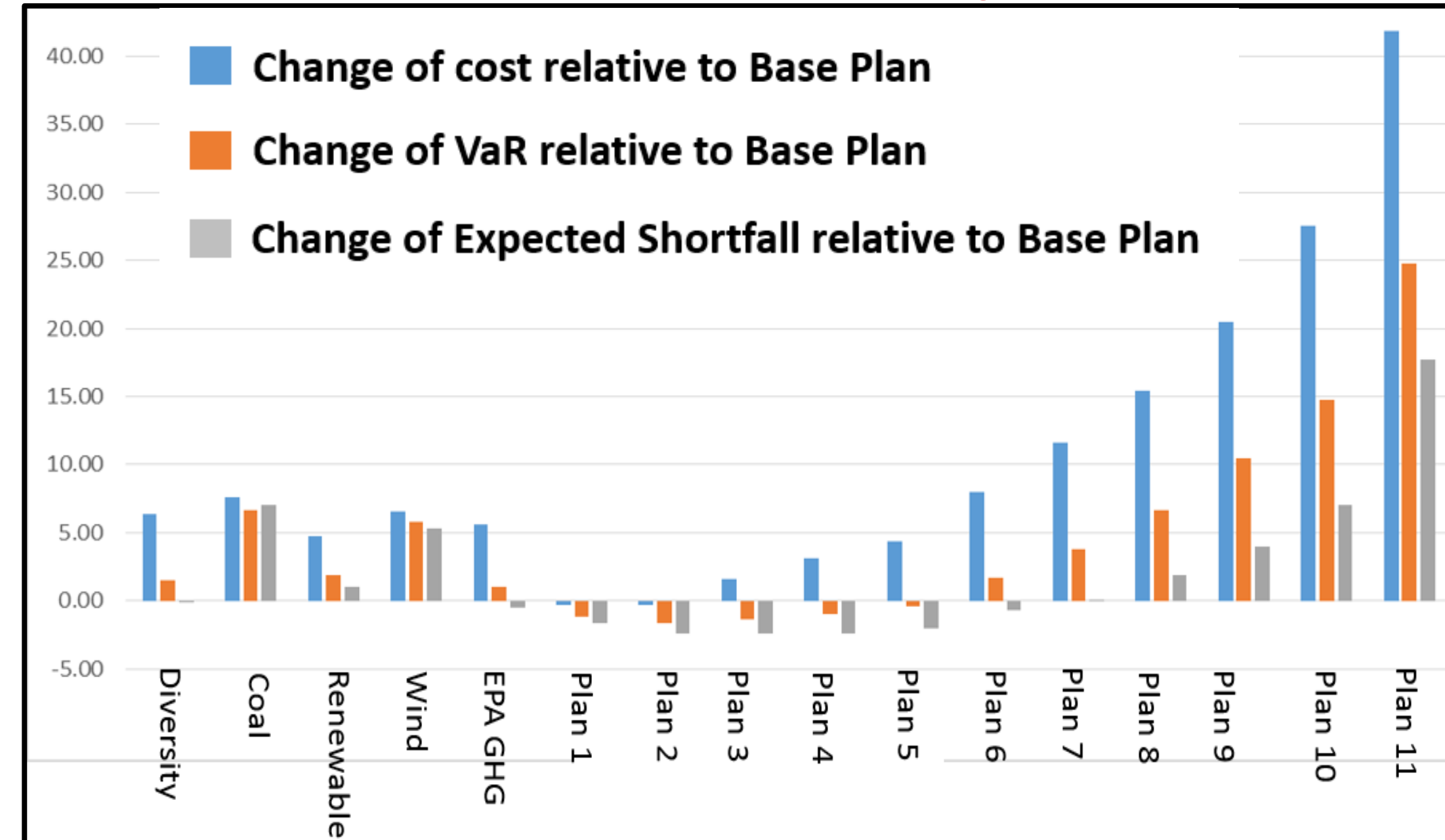
Lead Time Constraint

## Deliverables

### Mean-Variance Efficient Frontier



### Tail Risk Analysis



## Project Valuation

### Percentage Change in Standard Deviation and Total Cost of Each Plan relative to Plan A(Base Plan)

