Energy Efficiency as a Resource

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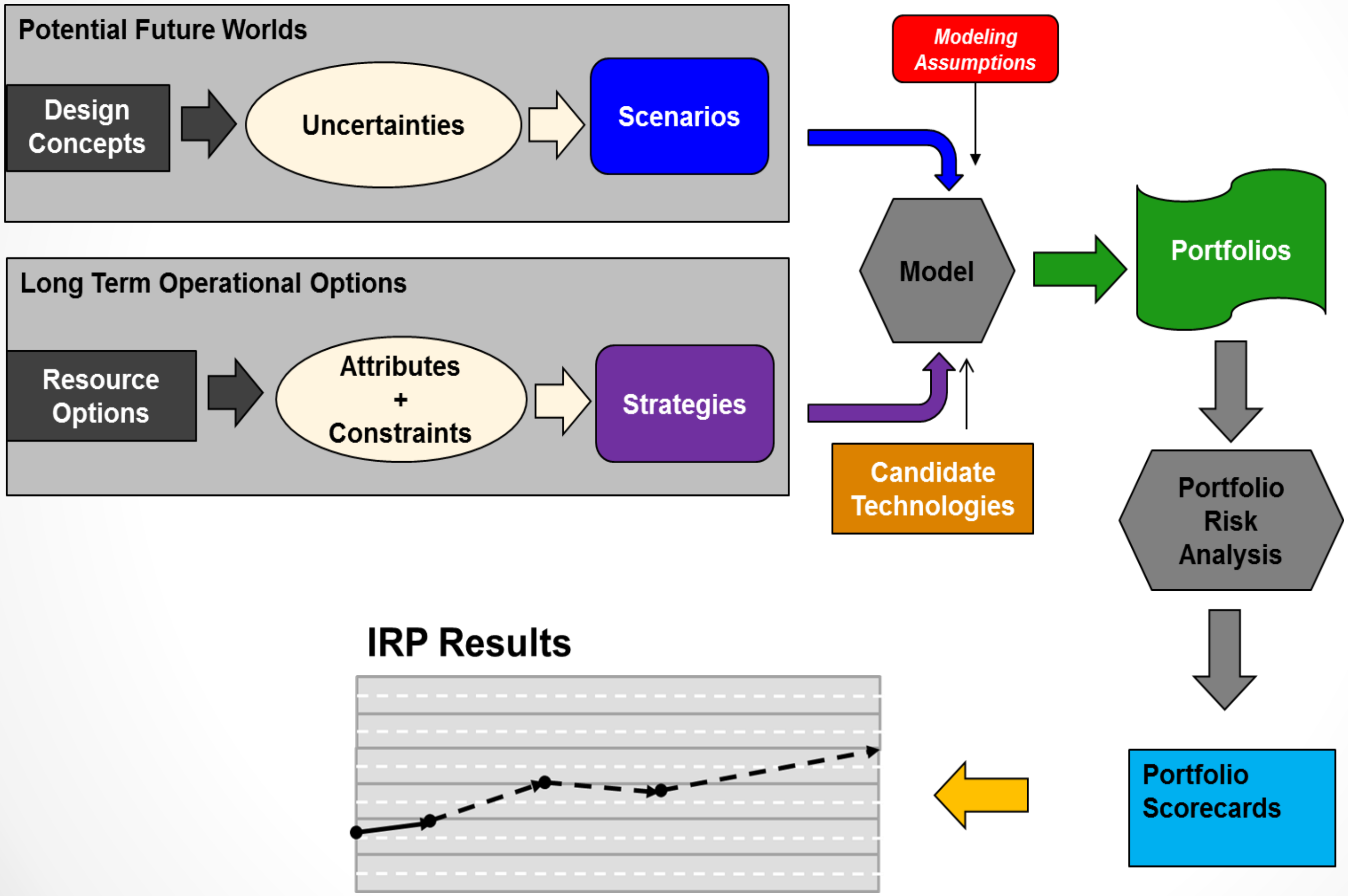
What did the world look like 30 years ago?

What it looks like today

Resources to meet loads

How do Utilities think about Resources?



The result of a strategy evaluated in a scenario

How uncertainty impacts the Portfolio results

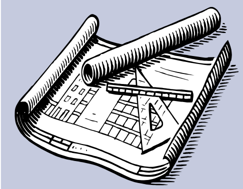
Standardized metrics to compare Portfolios

Enhancing EE Resource Modeling

Attributes	2011 IRP	2015 IRP
Structure	Discrete Portfolios	Sector Blocks
Basis	Multiple Detailed Program Designs	Pricing Tiers Extrapolated from Single Portfolio
Assumption Level	Program Design Details	Pricing Tier Break Points
Number of Detailed Portfolios	Six	One for each resource plan (strategies x scenarios)
Labor Intensity	High	Moderate
Ease of Modification	Very Low	Moderate
Selection Flexibility	All or None	Block by Block
Modeling Outcome	Preferred Path/Portfolio	Preferred Path/EE Level
Model Compatibility	Relatively High	New Approach

The EE Modeling Concept

- Enhanced approach to modeling and selection of EE as a resource in the IRP study
- Involves a 2-step process
  - Design of selectable "blocks" of EE that represent program bundles organized by customer sector (residential, commercial, industrial)
  - The optimization of the timing and quantity of EE in the resource plan by treating EE as a resource that competes with other options



Part 1:

Block Design

Development of fundamental design parameters for the EE blocks.

Part 2:

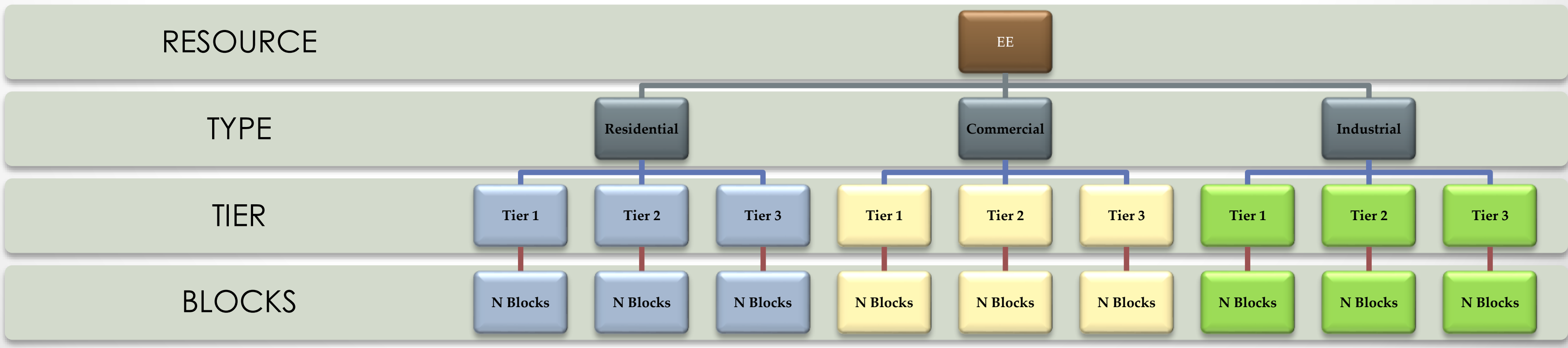
Block Selection

Identify the quantity and schedule of EE blocks using the resource optimization model.

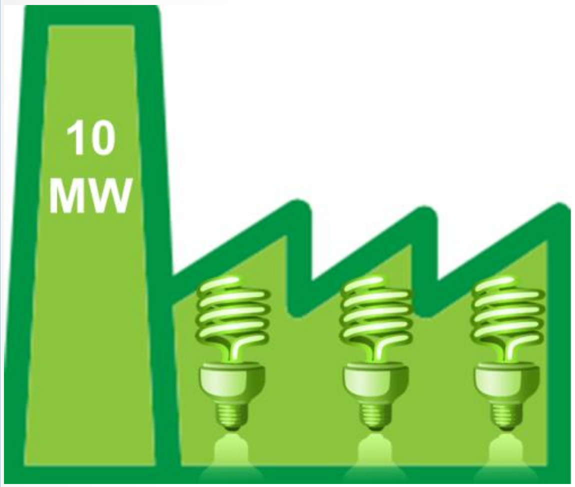
Iteration required

Modeling EE as a Resource

- There are two basic ways to incorporate the EEDR shapes into System Planning models:
  - As a load-modifier
  - As a resource: in-line with how all other resources are modeled (e.g. nuclear, coal, gas, hydro, etc.)
- Each EE resource has a defined cost and energy shape
  - Costs are modeled as up-front payments
  - Converted to a $/kW value for input into CapEx



Making EE into a Power Plant



Plant built in 10 MW/ 50 GWh Blocks

Block Characteristics:

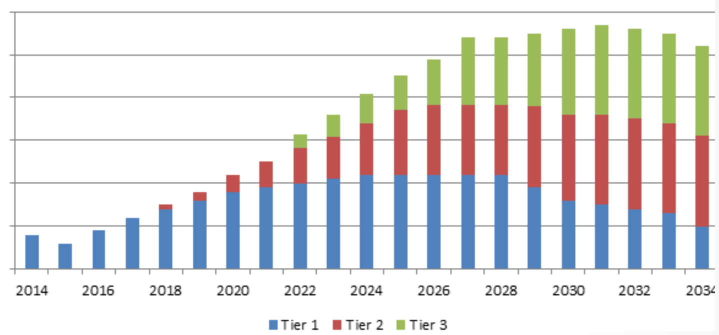
- Capacity factor equivalent
- Load Shape
- Cost to build program
- Time to implement
- Lifetime of Program
- Installed Cost / kwh

- Three Primary Sectors: Residential, Commercial, Industrial
- Blocks were grouped based on commonality of market and similarity of load shape
- Blocks are proxies of program designs, not actual programs or increases to existing programs

Definition of a Block

- 3 cost tiers for each sector
- Blocks based on commonality of market and similarity of load shape
- Minimum block sized set at 10 MW and 50 GWh, impacts vary by sector

Illustrative Selectable Blocks



Block Parameters	Residential	Commercial	Industrial
MW per Block	10	10	10
GWh per Block	50	59	72
Ramp Rate (Yr 1 - 5)	25%	25%	25%
Ramp Rate (Yr 6 -15)	20%	20%	20%
Ramp Rate (Yr ≥ 16)	15%	15%	15%
Max Blocks per Year	23	12	8
Lifespan Tier 1	17	15	12
Lifespan Tier 2	13	13	10
Lifespan Tier 3	13	13	10

Translating Customer Impact to System Impact (Illustrative)

Savings @ End-Use Meter → Net-to-Gross Factor → T&D Losses → System Impact

10 MW
50 GWh

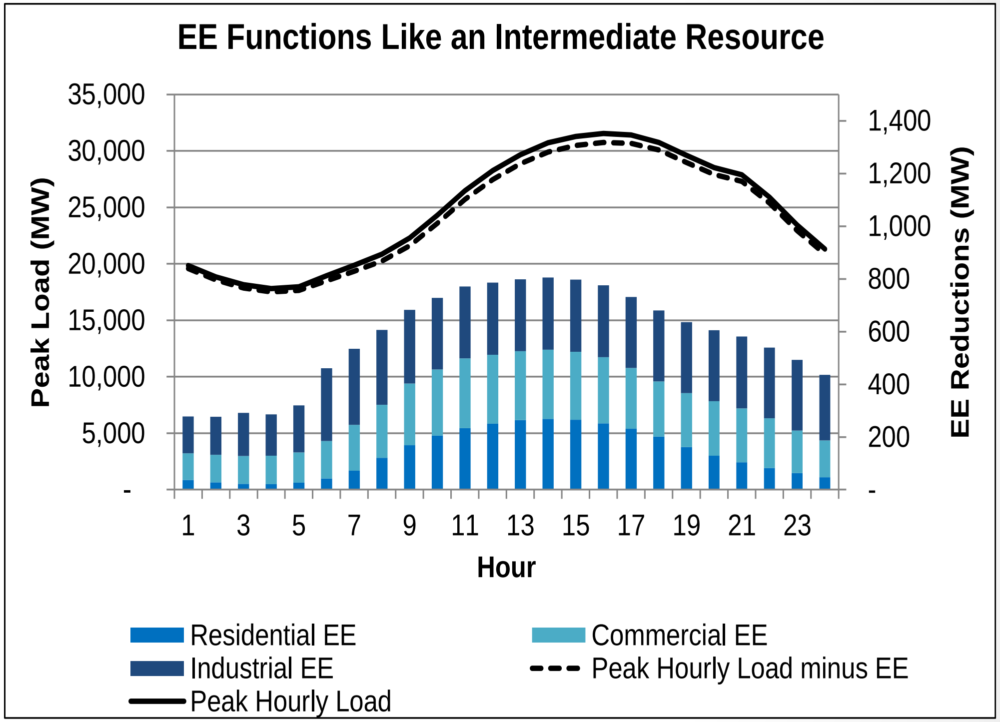
X 77 % X 1.065

8.2 MW
41 GWh

0.82 System Blocks

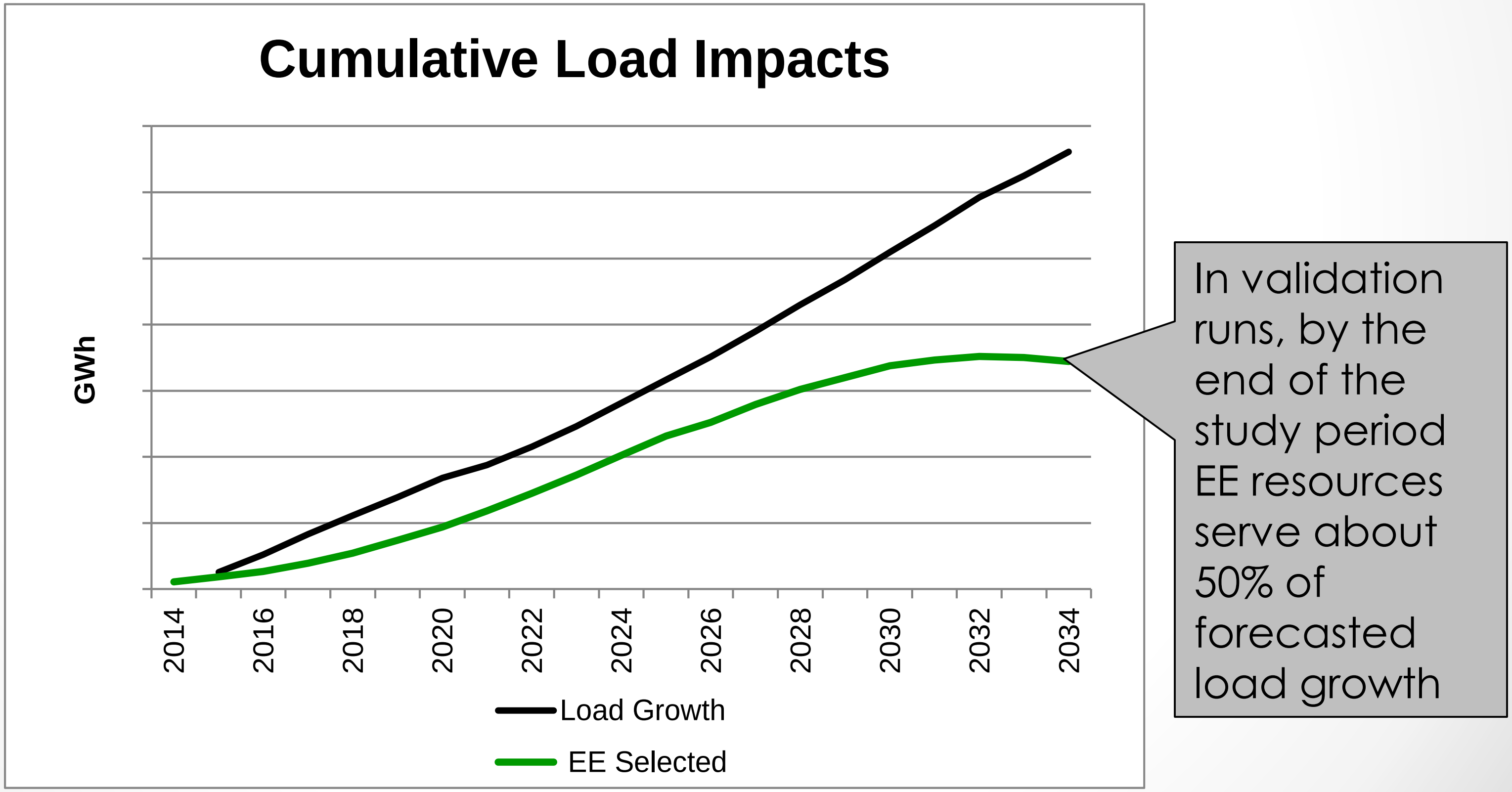
Block Selection

- All tiers within each sector utilize the same energy profile with annual energy capacity factors as follows:
  - Residential – 57%
  - Commercial – 68%
  - Industrial – 80%
- Annual energy patterns do not change over the time horizon
- This chart illustrates the impact of energy efficiency on the hourly load shape for a typical summer day



Methodology Validation

This chart compares the load grow to the cumulative impact of EE resource selection from the latest validation runs. This result is intended to be illustrative, and has not been evaluated using the financial models



Results

ENERGY EFFICIENCY

- Achieve savings between 900 - 1,300 MW by 2023
- Achieve savings between 2,000 - 2,800 MW by 2033
- Work with our local power company partners to refine delivery mechanisms, program designs, and program efficiencies with the goal of lowering total cost

DEMAND RESPONSE

- Add between 450 - 575 MW of demand reduction by 2023 and similar amounts by 2033, dependent on availability and cost of this customer-owned resource.

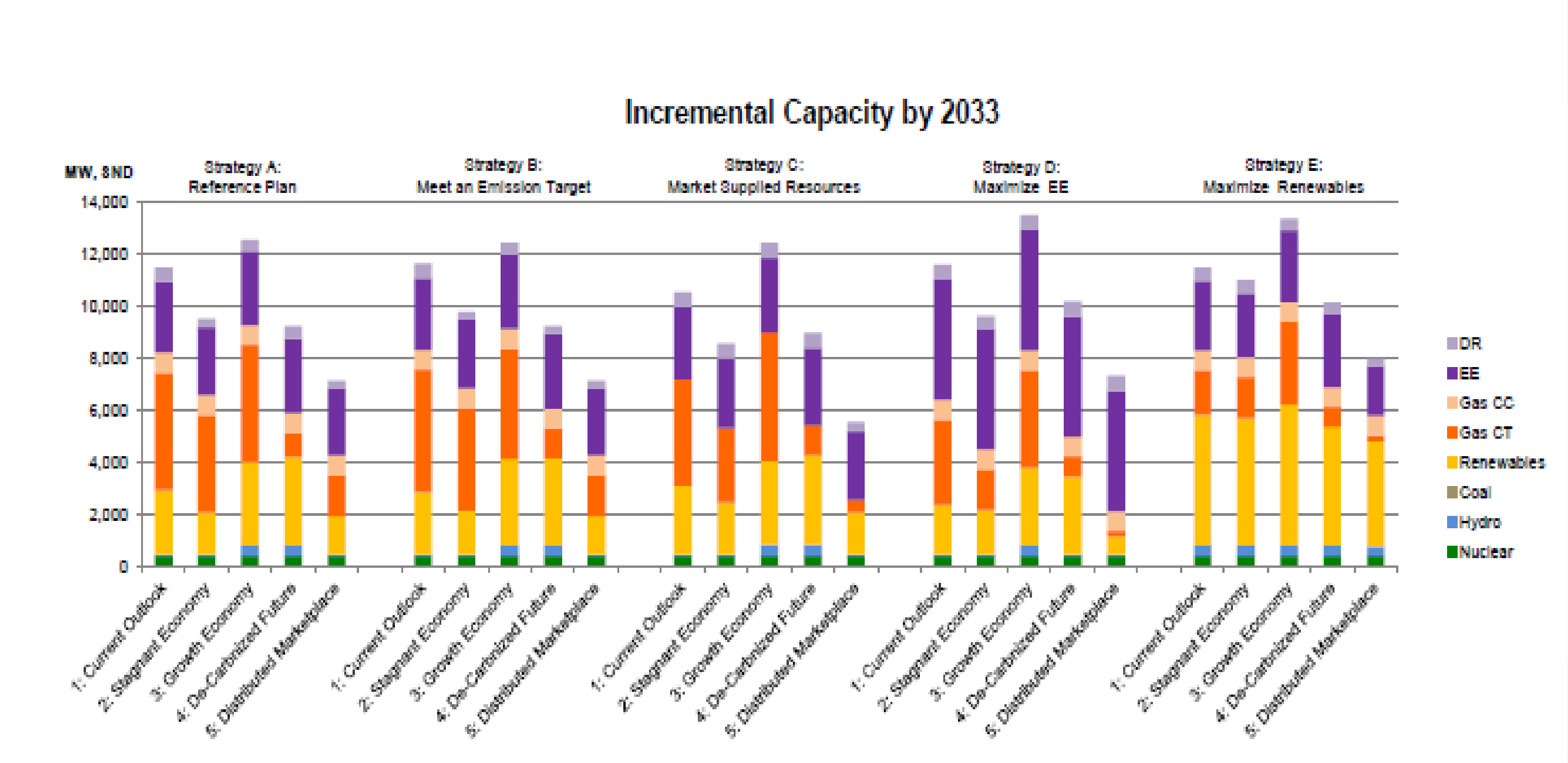
SOLAR

- Add between 150 - 800 MW of large-scale solar by 2023
- Add between 3,150- 3,800 MW of large-scale solar by 2033
- The trajectory / timing dependent on pricing, performance, and integration costs

WIND

- Add between 500 - 1,750 MW by 2033, dependent on pricing, performance, and integration costs
- Given the variability of wind selections in the scenarios, evaluate accelerating wind deliveries into the first 10 years of the plan if operational characteristics and pricing result in lower-cost options

Results



Incremental Capacity by 2033
MW, SND
Strategy A: Reference Plan
Strategy B: Meet an Emission Target
Strategy C: Market Supplied Resources
Strategy D: Maximize EE
Strategy E: Maximize Renewables
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1: Current Outlook
2: Stagnant Economy
3: Growth Economy
4: De-Carbonized Future
5: Distributed Marketplace
DR
EE
Gas CC
Gas CT
Renewables
Coal
Hydro
Nuclear

Summary

Process

Part 1:
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Development of fundamental design parameters for the EE blocks.

Part 2:
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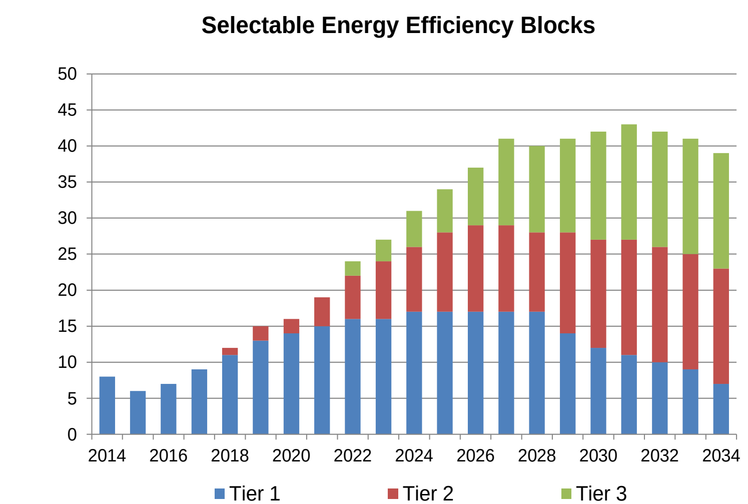
Iteration required

Block Design



Block Selection

- Significant efforts have resulted in the ability to model energy efficiency as a selectable expansion option
- Preliminary results indicate the energy efficiency could meet nearly 50% of load growth by 2034

Lessons Learned

- The block design is acceptable for high-level strategic reviews
- Revenue erosion is not factored into the capacity expansion model and will need to be analyzed in financial model

Questions and Thoughts?

- **When modeling EE as a resource, what level of uncertainty does your planning organization place on delivery of energy savings?**
- **What is a reasonable achievable ramp rate for EE programs?**

Questions??

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