Building the Energy Efficiency Power Plant: TVA’s 2015 IRP

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TVA's Mission of Service

Energy

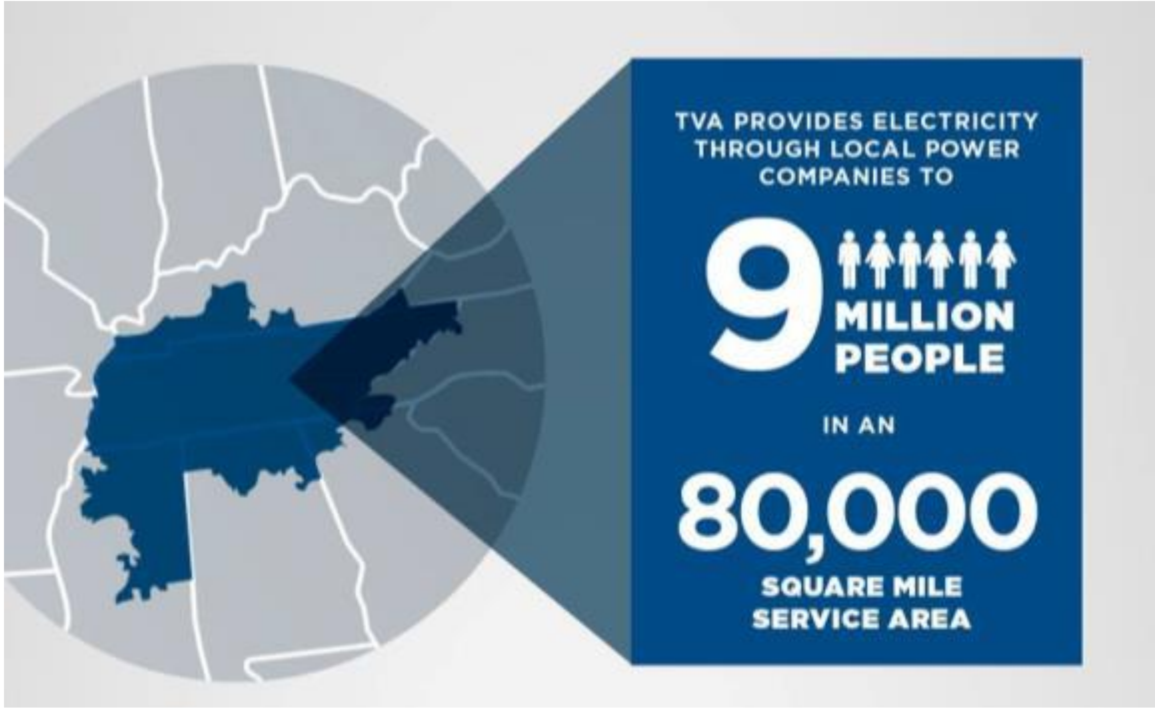
Delivering affordable, reliable power

Environment

Caring for our region's natural resources

Economic Development

Creating sustainable economic growth



Mission & Business Model Provide Clarity While Identifying Need For Balance

Energy

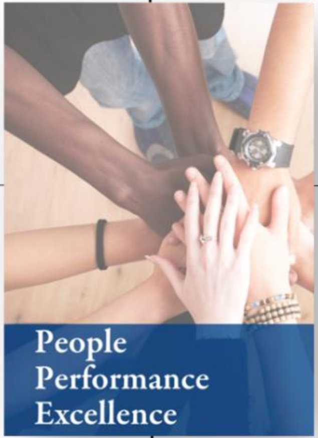
Environment

Economic Development

IRP

RATES:
maintain low rates

ASSET PORTFOLIO:
meet reliability expectations & provide a balanced portfolio



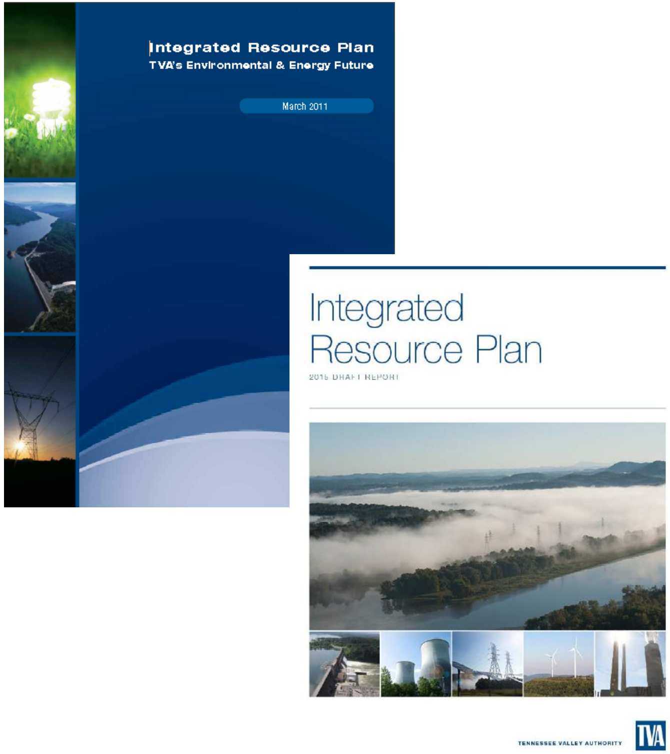
STEWARDSHIP:
be responsible stewards

DEBT:
live within our means

2015 IRP – A New Approach On EEDR

2011 IRP: Scheduled energy efficiency (EE) and Demand Response (DR) as fixed supply curves into the resource portfolio; tested multiple portfolios

2015 IRP: Goal to model EE and DR as dynamically selectable resources



Why Take A Different Approach This Time?

Both Internally and Externally

Dynamic EEDR Resource Modeling

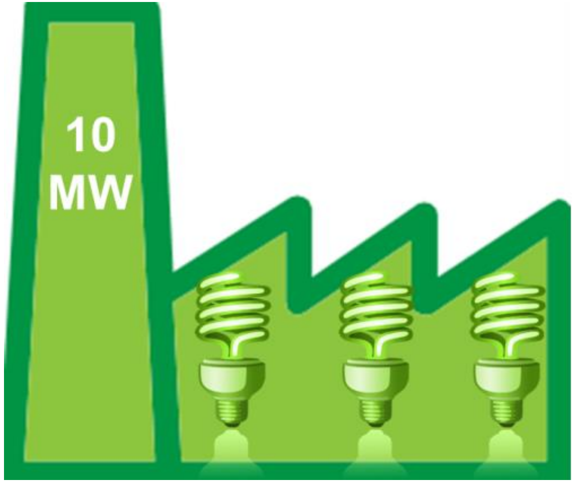
Advantages:

- Allows full portfolio optimization
- More clearly demonstrates value proposition
- Allows flexible, nimble response to changing business environments

Challenges/Considerations:

- Typical EE modeling approach (as a load modifier) doesn't lend itself to an easy transition to supply side modeling
- How to account for cost changes over time
- How to account for uncertainty on load shapes
- How to acknowledge TVA's unique structure as (primarily) a wholesale power company

The Simplified Concept



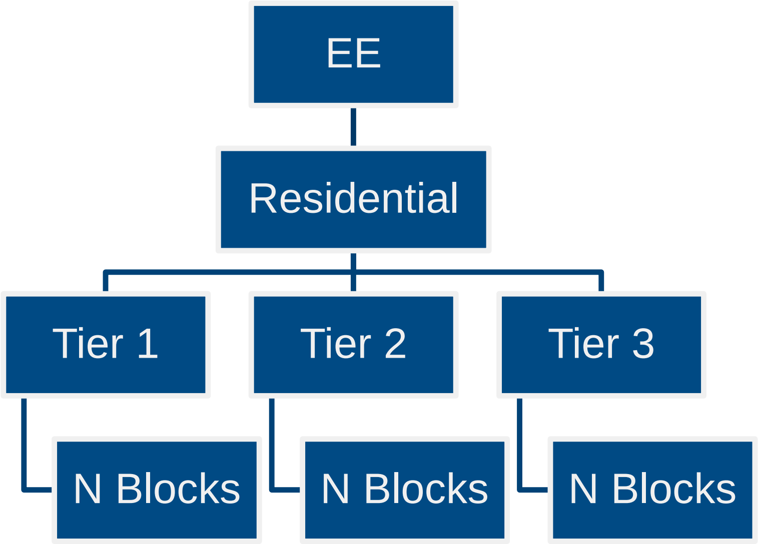
Plant built in 10 MW blocks

Block Characteristics:

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

Modeling Construct

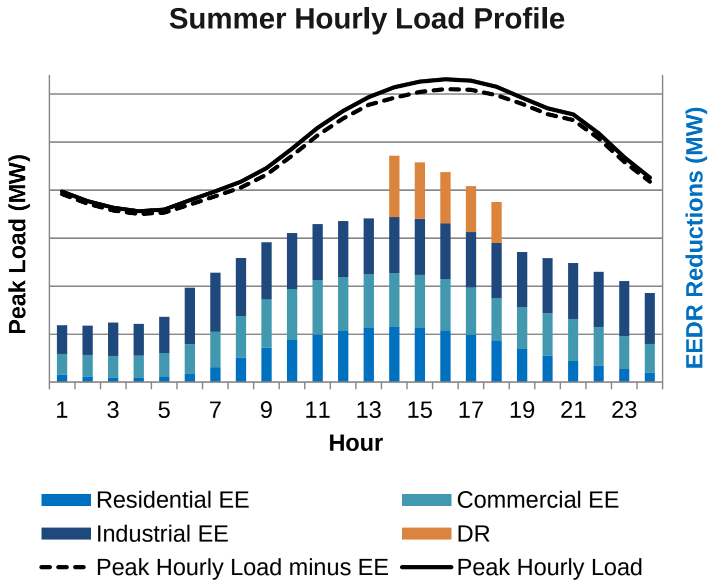
- Developed “block” concept instead of modeling individual programs
- Began with three sectors:
  - Residential
  - Commercial
  - Industrial
- Divided sectors into pricing tiers
- Divided tiers into 10 MW blocks
- Each block was included in Capacity Expansion model as a selectable unit



Unit Characteristics

- Designed to look like thermal resources
- Nameplate capacities
- Book lives
- $/kW pricing tiers by sector
- Build time, growth rates, and unit availability
- Hourly Load Shapes

	Res Tier 1	Res Tier 2	Res Tier 3	Com Tier 1	Com Tier 2	Com Tier 3	Ind Tier 1	Ind Tier 2	Ind Tier 3	DR
Nameplate Capacity (MW)	10	10	10	10	10	10	10	10	10	1
Summer Full Load Heat Rate (Btu/kWh)	-	-	-	-	-	-	-	-	-	10,132
Unit Availability (Yr)	2014	2022	2026	2014	2019	2022	2014	2018	2022	2014
Annual Outage Rate	-	-	-	-	-	-	-	-	-	-
Book Life (Yrs)	17	13	13	15	13	13	12	10	10	5



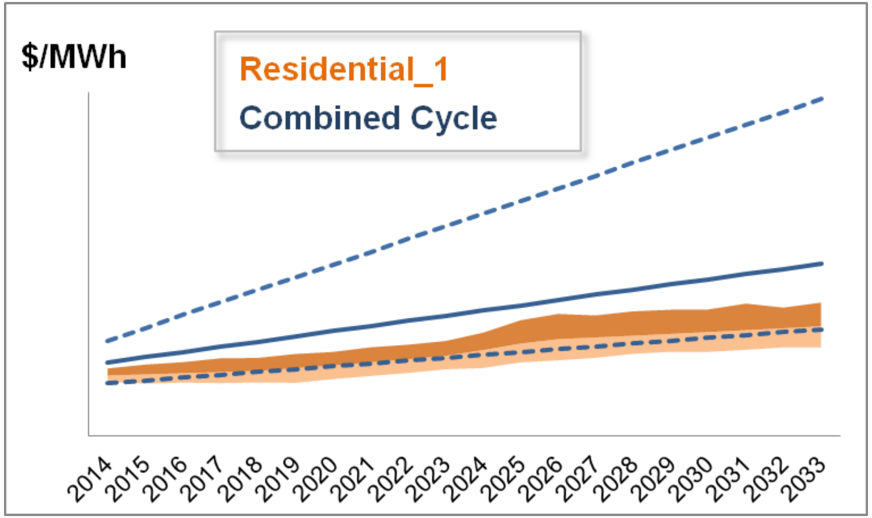
Supply-Side Comparison

- Utilities are used to supply-side resource characteristics
- Demand side resources possess characteristics that are similar to supply side, but there are key differences
- Talking the same language helps

SUPPLY SIDE COMPARISON							
	Com EE	Ind EE	Res EE	New CC	New CT	New Coal w/ CCS	AP1000
Year Available	2014	2014	2014	2019	2018	2028	2026
Outage Rate				✓	✓	✓	✓
Heat Rate				✓	✓	✓	✓
Fuel Costs				✓	✓	✓	✓
Fuel CAGR				✓	✓	✓	✓
CO_2 Costs				✓	✓	✓	✓
CO_2 CAGR (starts in 2022)				✓	✓	✓	
O&M costs	✓	✓	✓	✓	✓	✓	✓
O&M Escalation	✓	✓	✓	✓	✓	✓	✓
Transmission Contingency Cost				✓	✓	✓	✓
Project Contingency Cost				✓	✓	✓	✓
Capital Costs				✓	✓	✓	✓
Escalation of capital				✓	✓	✓	✓
Capacity Factor	✓	✓	✓	✓	✓	✓	✓
Technology shifts	✓	✓	✓				

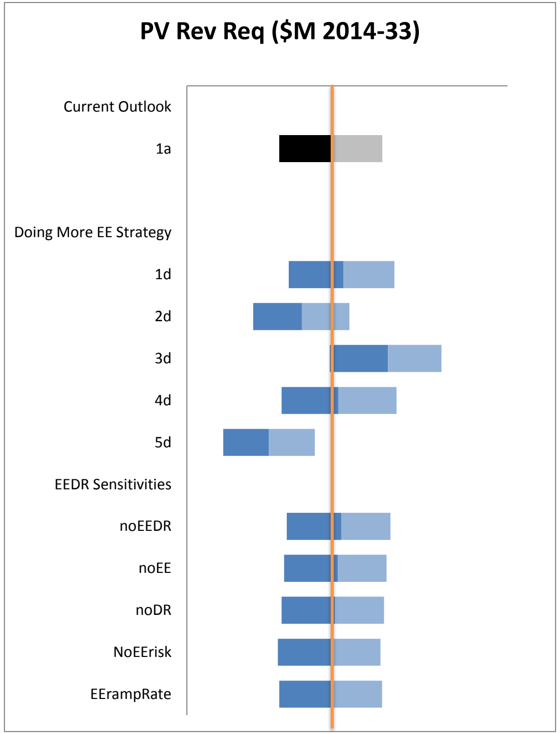
Like Conventional Resources, EE has Risks

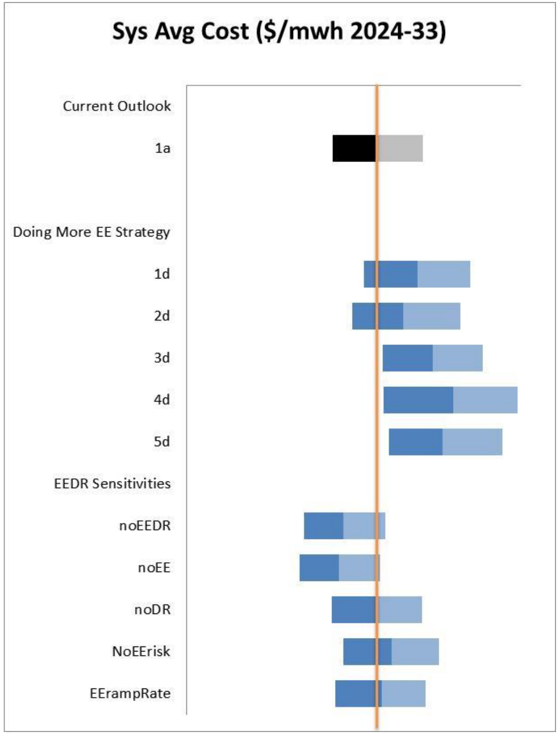
- Design Uncertainty because blocks are proxies for programs, some with different measure lives and shapes
- Delivery Uncertainty due to:
  - —Risk around non-performance (realization rate)
  - —Uncertainty around impact of future codes and standards
  - —Specific uncertainty since TVA is primarily a wholesale power provider



And, The EE Financial Equation Has Not Changed

- Results highlight total cost vs. average cost (“rate” vs. “bill”) tradeoffs with increased EE in the portfolio, particularly in later years





Results: IRP Signals Growth in EEDR

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

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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.

TVA

Conclusions

- Did we change the conversation? *We think so.*
- Was it analytically challenging? *Quite.*
- Can we improve our approach? *Of course.*
- Did we get stakeholder support for approach, if not on all particulars? *Largely.*
- What did we establish?
  - EE is a competitive resource that introduces unique uncertainties while mitigating others, and this modeling approach better demonstrates the value EE brings to the portfolio
  - We have additional work to do to leverage this dynamic approach in annual resource planning

“Our tomorrows need new and different solutions today”