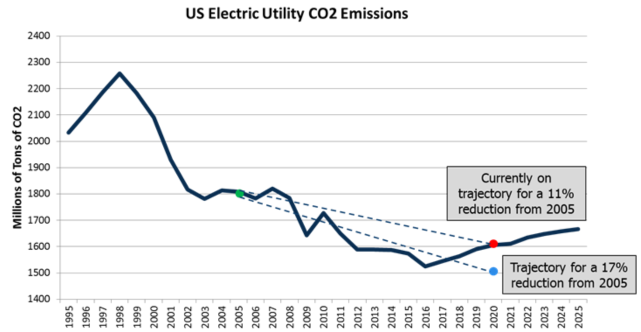
TVA Trajectory: CO_2 and a Cleaner Future

Joe Hoagland

April 3, 2015

Where We are Today…..

EPA's Proposed "Clean Power Plan"

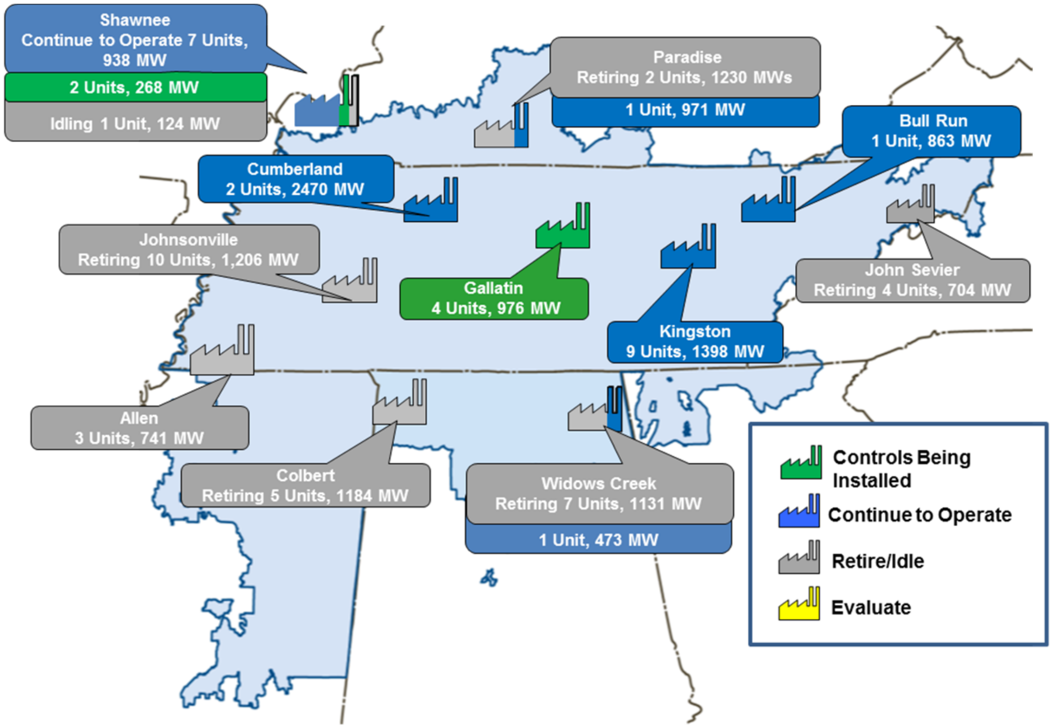


US Total CO2 Emissions historical data is sourced from Energy Information Administration's (EIA) Annual Energy Review 2011
US Total CO2 Emissions projected data is sourced from EIA's Annual Energy Outlook 2013

- **President's Climate Action Plan instructed EPA to regulate CO_2 emissions from existing power plants under CAA section 111(d)**

- **June 2, EPA released the Proposed "Clean Power Plan"**
  - **EPA's proposal defines the "Best System of Emission Reductions"**
  - **EPA is defining the "system" broadly as the state's electrical system**
  - **Sets Emission Guidelines on a state-by-state basis for existing fossil units (lbs CO_2/MWh)**
  - **EPA starts with a 2012 baseline for fossil emissions and generation**
  - **Many early actions that have reduced CO_2 emissions are being used by EPA to establish more stringent emission guidelines**

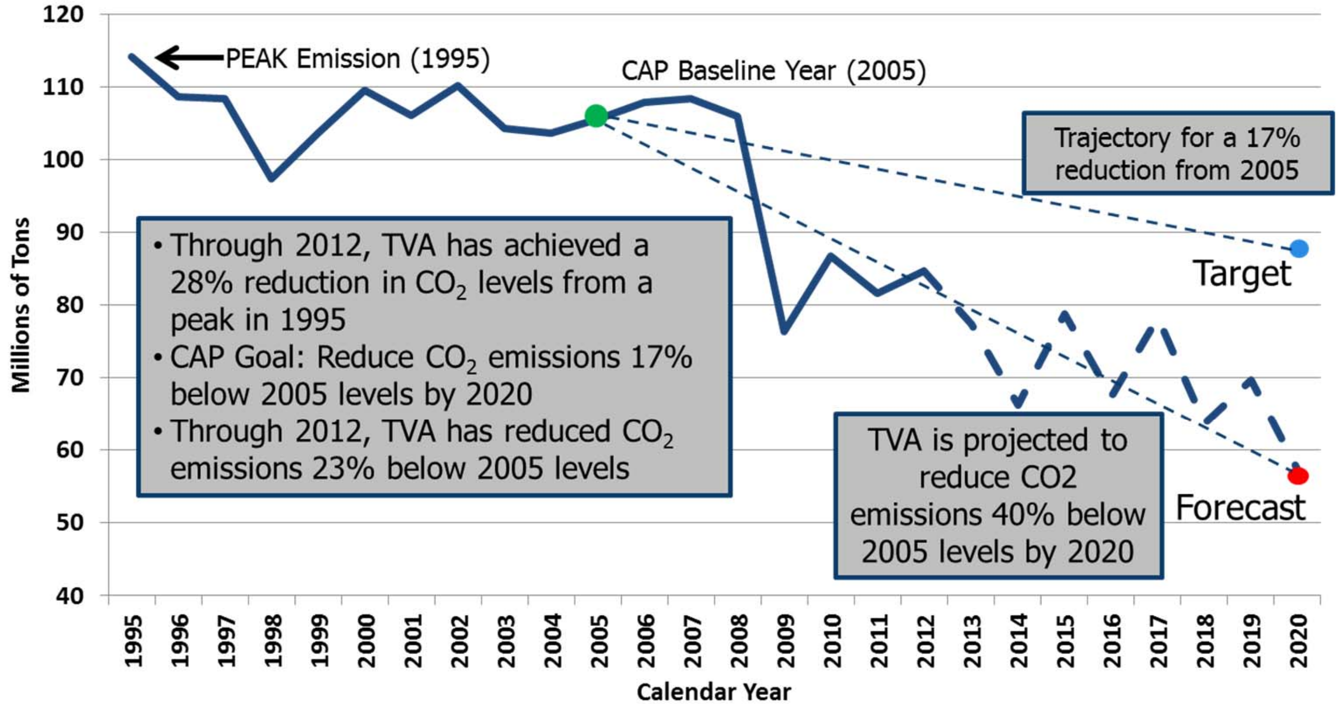
TVA's Coal Fleet: Current Status



- TVA plans to operate ~8,000 MW of coal capacity in its balanced portfolio (27 units at 7 plant sites)
- TVA plans to complete retirement of ~6,320 MW of coal capacity by 2024 (32 units at 7 plant sites)

Note: MW reflect summer net capability consistent with TVA's 10-k; chart reflects Aug 2014 Board decision to build gas plant at Allen and controls at Shawnee units 1 and 4..

TVA CO_2 Emissions

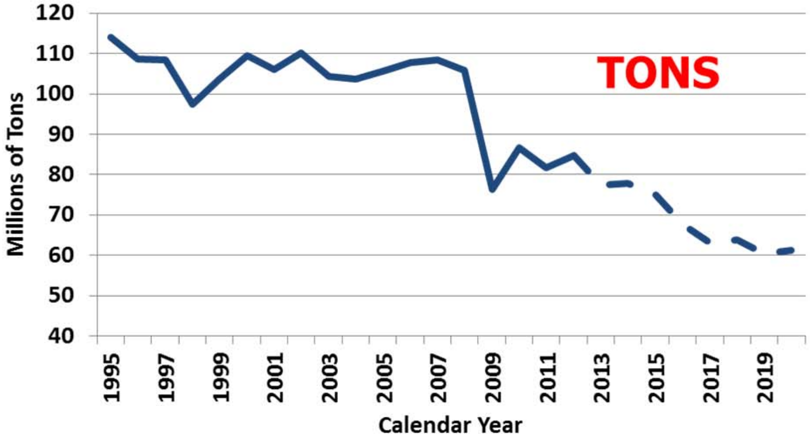


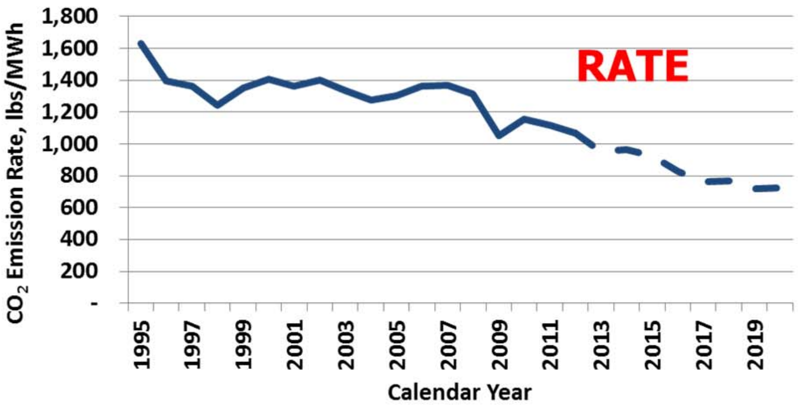
Projections based on PaR outputs FY15 sPSP

4

TVA CO_2 Emissions and Progress for our Customers

- TVA has made asset decisions that have reduced CO_2 emissions
- TVA has reduced CO_2 emissions 30% below 2005 levels
- TVA is projected to reduce CO_2 emissions 40% below 2005 levels by 2020
- TVA delivers electric power containing around 1100 lbs/MWh and is on track improve that to around 700lbs/MWh by 2020
- TVA provides an attractive combination of price (¢/kWh) and carbon content (lbs/MWh)





20 Years From Now .....

The Future of Our Energy Supply

- TVA power will still be reliable, affordable and sustainable
- We will rely more on cost-effective energy efficiency
- There will be more solar and wind power, and less coal
- Natural gas will play a bigger role
- TVA will continue to provide for economic growth in the Tennessee Valley

TVA's Mission is the Cornerstone

Energy

Environment

Economic Development

The Role of the IRP at TVA

The IRP Is …

- A planning study
- Used to identify the least cost power supply mix
- Designed to evaluate future uncertainty

The IRP Does Not …

- Set rates
- Identify sites for new generating units
- Provide all the answers we need

Stakeholder & Public Involvement Throughout the Process

Our public engagement includes:

- A stakeholder working group
- Policy advisory groups
- Customers & Valley residents

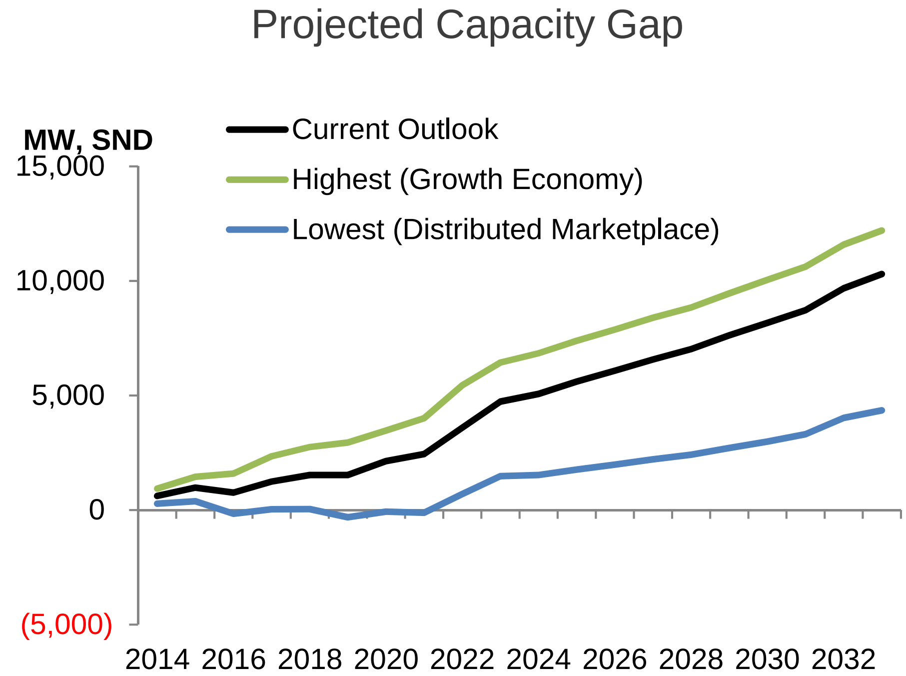
Fall 2013

Input will be incorporated throughout the process

Spring 2015

Why the Need to Look Forward

- The **capacity gap** is the difference between the need for power and today's resources
- The amount of new capacity needed will range from **4,400 to about 12,000 MW by 2033**



Scenario and Strategy Planning

External Factors Shaping the Environment

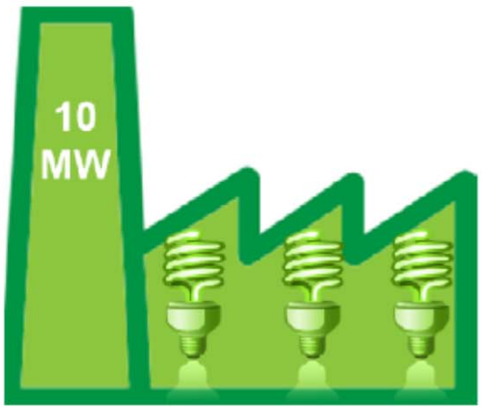
Scenarios
1 - Current Outlook
2 - Stagnant Economy
3 - Growth Economy
4 - De-Carbonized Future
5 - Distributed Marketplace

TVA's Response & Portfolio Goals

Strategies
A - The Reference Plan
B - Meet an Emissions Target
C - Focus on Long-Term, Market-Supplied Resources
D - Maximize Energy Efficiency
E - Maximize Renewables

A Unique Addition to the IRP

EE as a Resource



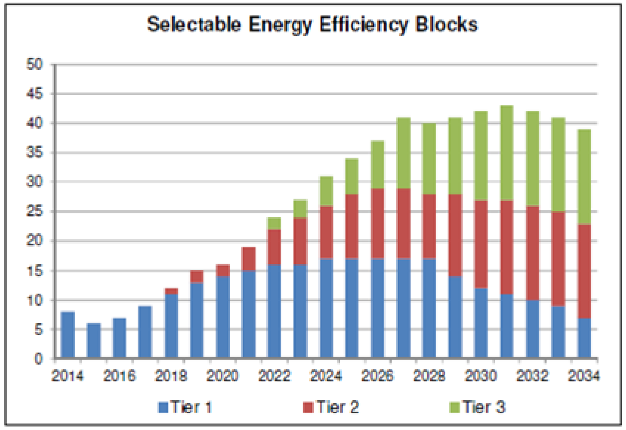
Plant built in 10 MW blocks

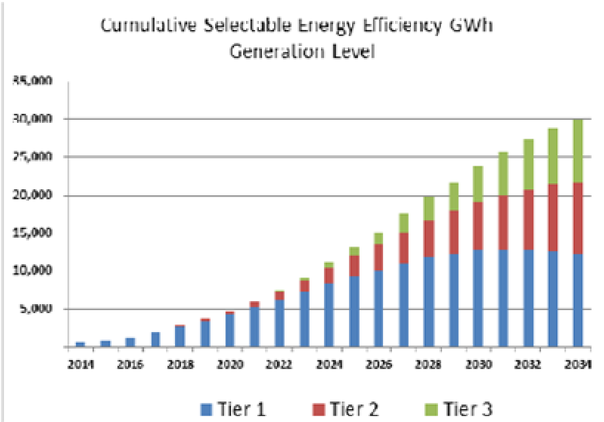
Block Characteristics:
- Capacity factor equivalent
- Load Shape
- Cost to build program
- Time to implement
- Lifetime of Program
- Installed Cost / kwh

- Three Primary Sectors: Residential, Commercial, Industrial

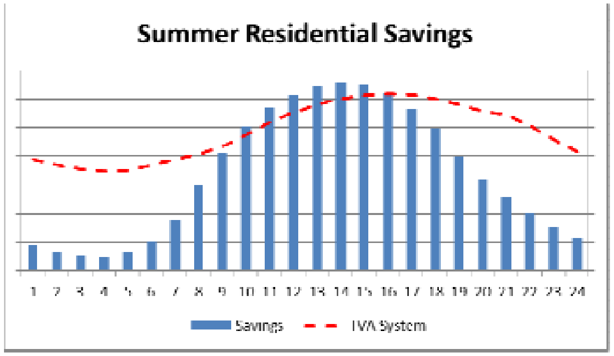
What are the Blocks

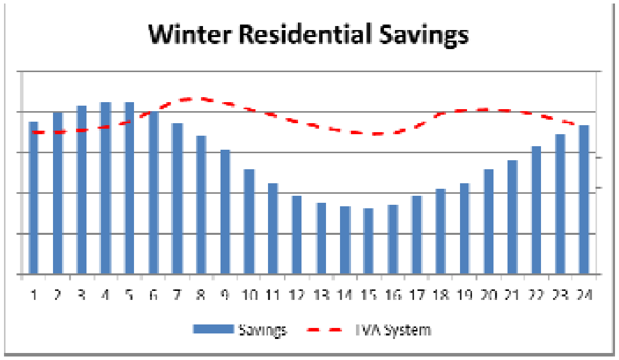
Block Parameters	Residential	Commercial	Industrial
MW per Block	10	10	10
GWh per Block	50	59	72
Ramp Rate (Yr 1 - 5)	25%	25%	25%
Ramp Rate (Yr 6 -15)	20%	20%	20%
Ramp Rate (Yr ≥ 16)	15%	15%	15%
Max Blocks per Year	23	12	8
Lifespan Tier 1	17	15	12
Lifespan Tier 2	13	13	10
Lifespan Tier 3	13	13	10
Initial Cost Ranges (Millions)	$20.7 to 38.0	$11.6 to 33.4	$11.5 to 33.0

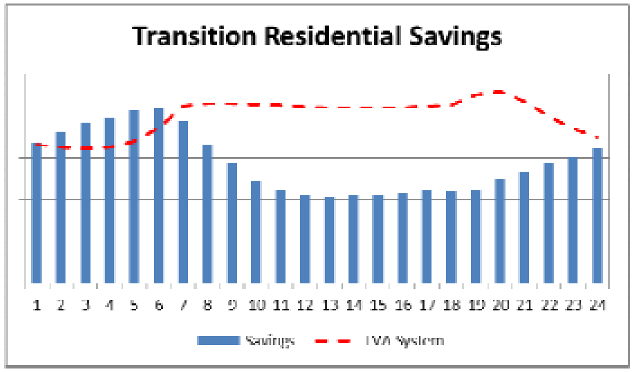




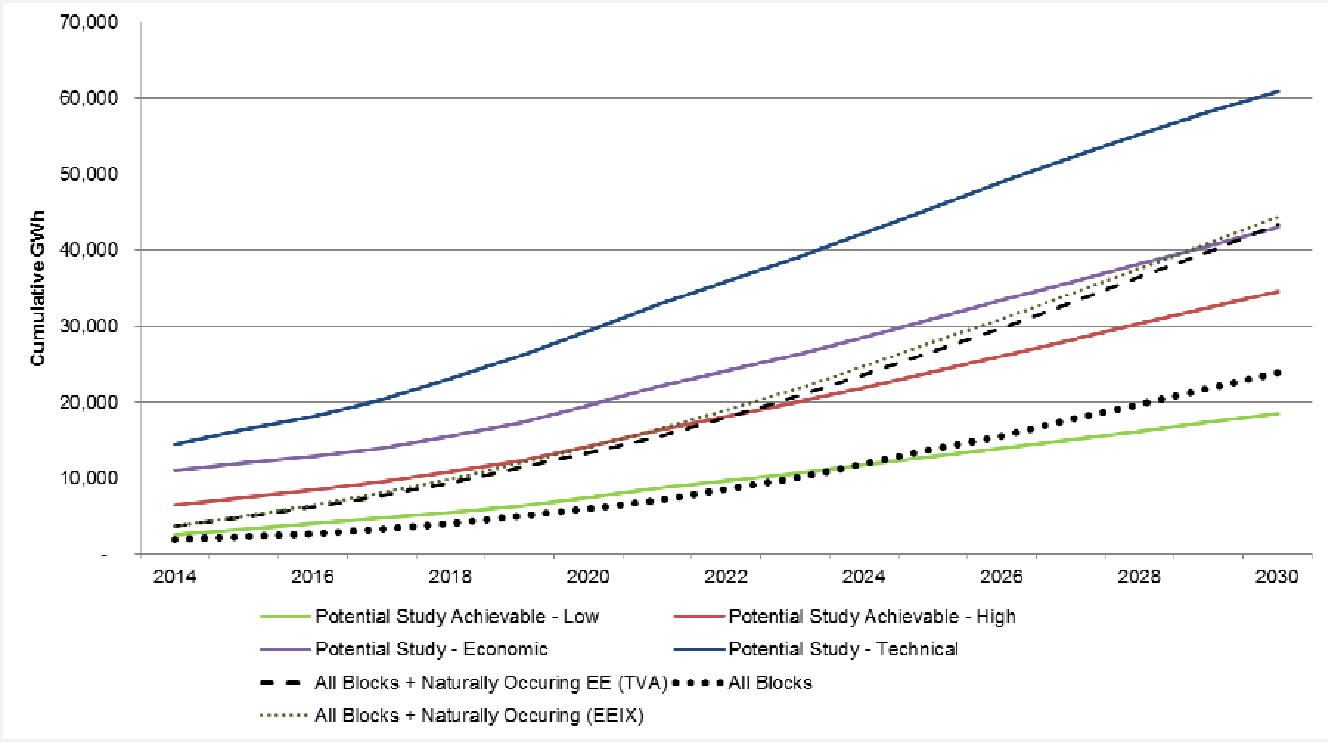
Block Load Shapes







Alignment with Valley Potential Study (Generation Level Savings)



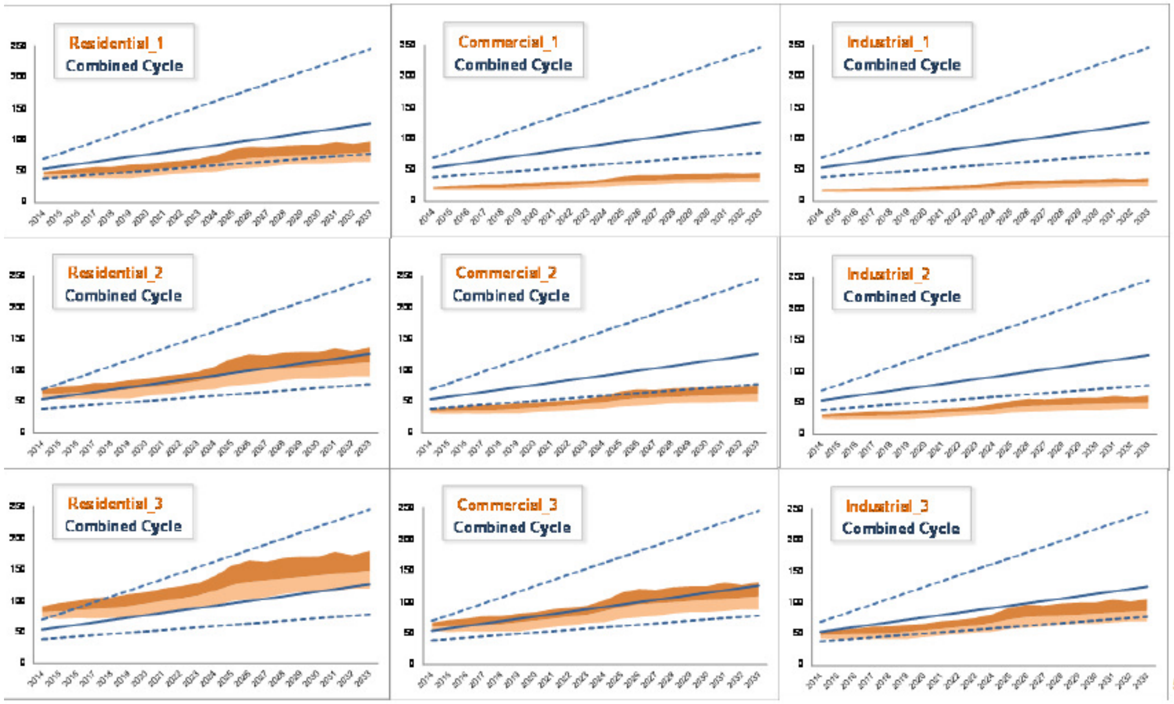
Note: Potential Study Source – Tennessee Valley Authority Energy Efficiency Potential Study 2012 Update, EnerNOC Utility Solutions Consulting, Report No. 1360.2

Considering Risk & Uncertainty

- Risk is about forecasting what the cost of a cup of coffee will be 20 years from now
- Uncertainty is about predicting whether or not the coffee will even be available 20 years from now
- We address both of these factors when choosing the least-cost option

EE Cost Uncertainty is less than the Cost Uncertainty of a Combined Cycle

- The EE uncertainty band is driven cost uncertainty on the escalation rate over time
- The uncertainty band around CC costs are much wider due to fuel, emissions, O&M, capacity factor, and capital cost uncertainty

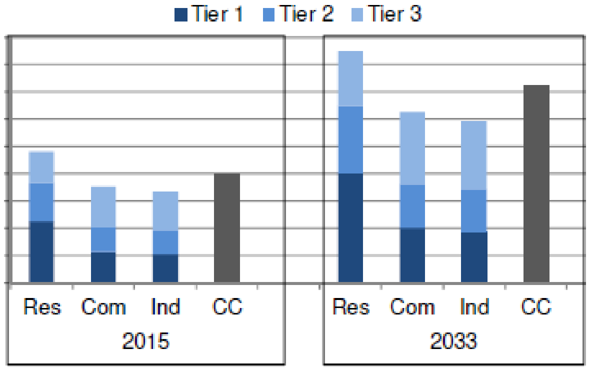


55

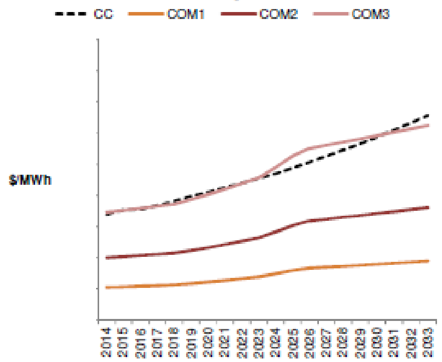
All-In EE Levelized Costs after Planning Adjustment

- Most of the EE blocks remain cheaper than a natural gas combined cycle (CC) unit over the study period

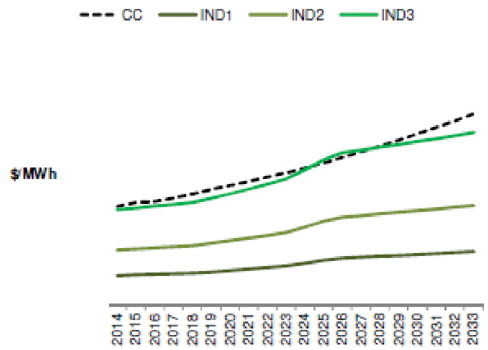
2015 & 2033
Energy Cost Comparison



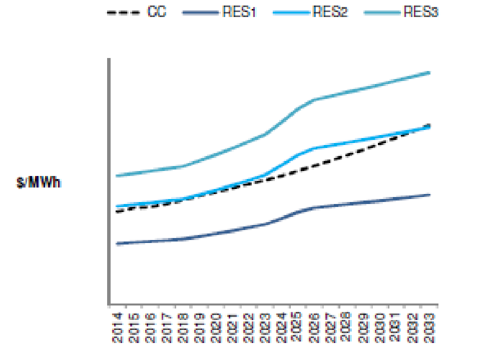
Commercial Comparison ($/MWh)



Industrial Comparison ($/MWh)



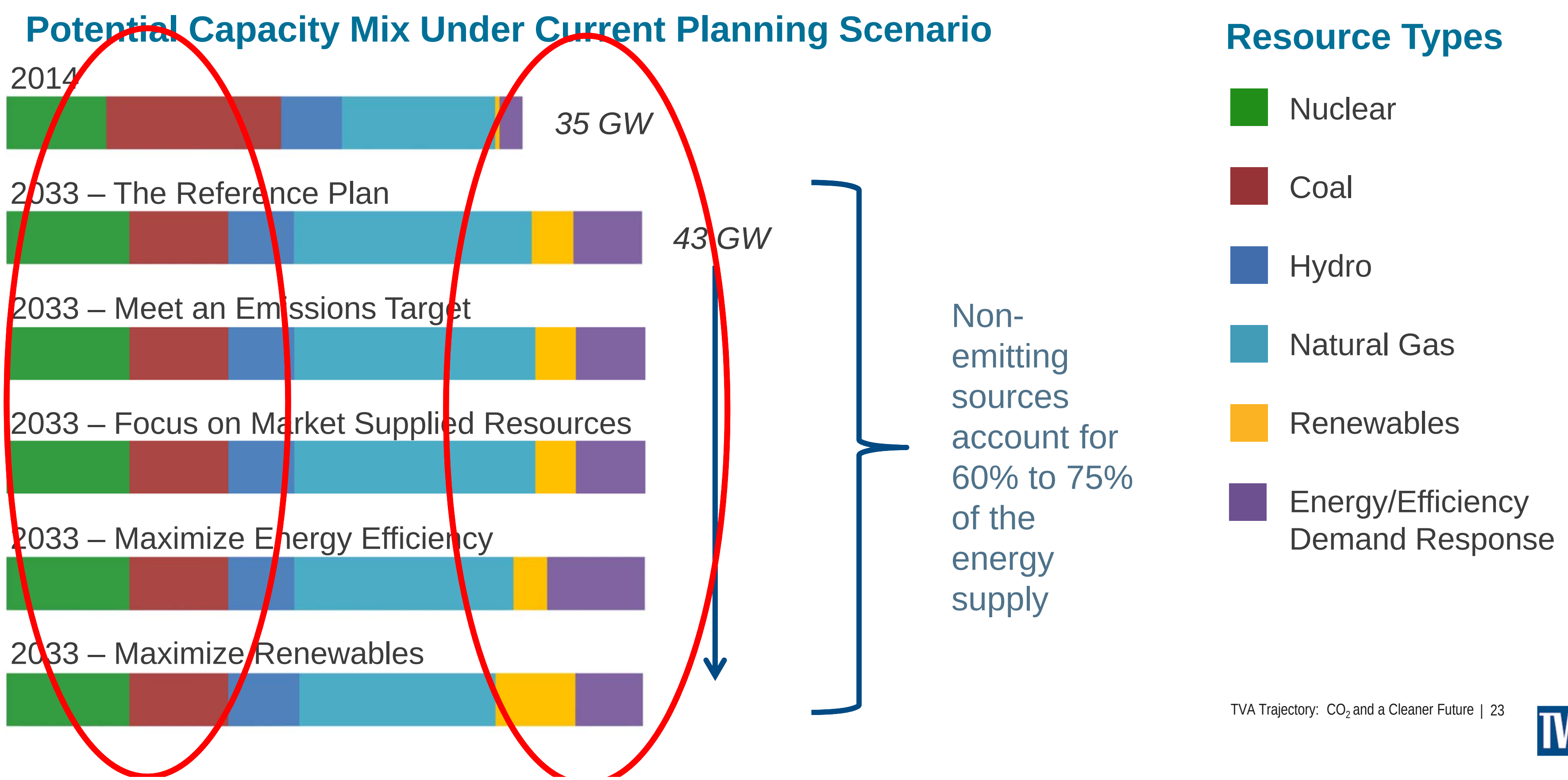
Residential Comparison ($/MWh)



*CAGR= 3% for each of the sectors

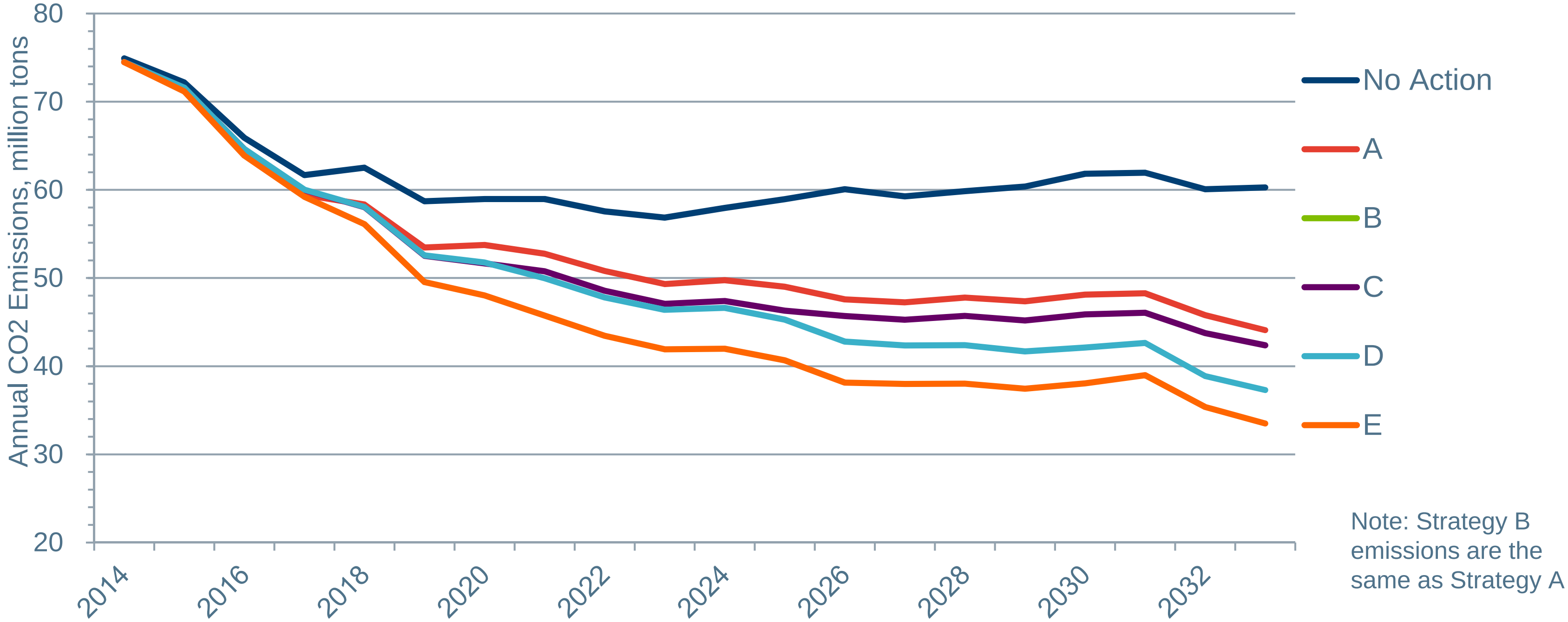
What have We Seen….

The Generation Fleet Will Be Cleaner



CO_2 Emissions Typical of Study Trends

CO_2 Emissions by Alternative Strategy



Strategies				
A - The Reference Plan	B - Meet an Emissions Target	C - Focus on Long-Term Market Supplied Resources	D - Maximize Energy Efficiency	E - Maximize Renewables

Observations and Challenges for a Cleaner Future

- Maintaining a balanced Portfolio
- Managing Energy Efficiency and Renewables as a Resource
- Managing the evolution of a Distributed Grid
- Support a clean energy future with policies that maintain reliability and competitive pricing

TVA