2019 IRP Working Group

Meeting 4: June 6 - 7, 2018


welcome

Safety Moment

Building Emergency Plan

Agenda – June 6, 2018

12:00	Lunch	
12:45	Welcome and Introductions Today's Program	Jo Anne Lavender
12:50	Broad Overview – Resource Planning	Jane Elliott
1:30	BREAK and Set Up Panels	
1:45	Panel 1: Utility Scale Resources	Panels
3:30	BREAK	
3:45	Panel 2: Distributed Energy Resources	Panels
5:00	Networking Time	
5:30	Adjourn	

Agenda – June 7, 2018

8:30	Welcome	Jo Anne Lavender
	Recap of Meeting 3	Brian Child
9:00	About Today's Agenda	Ashley Pilakowski
9:30	BREAK	
9:45	Scenarios Recap and Voting Results Working Group Observations	Hunter Hydas / Jo Anne Lavender and Group
10:30	Attributes Overview and Discussion	Hydas and Group
11:30	Benchmarking Analysis	Randy McAdams / John Gray
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4:00	Summary of Technology Resources	Jane Elliott
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4:30	Adjourn	

Resource Planning

Jane Elliott

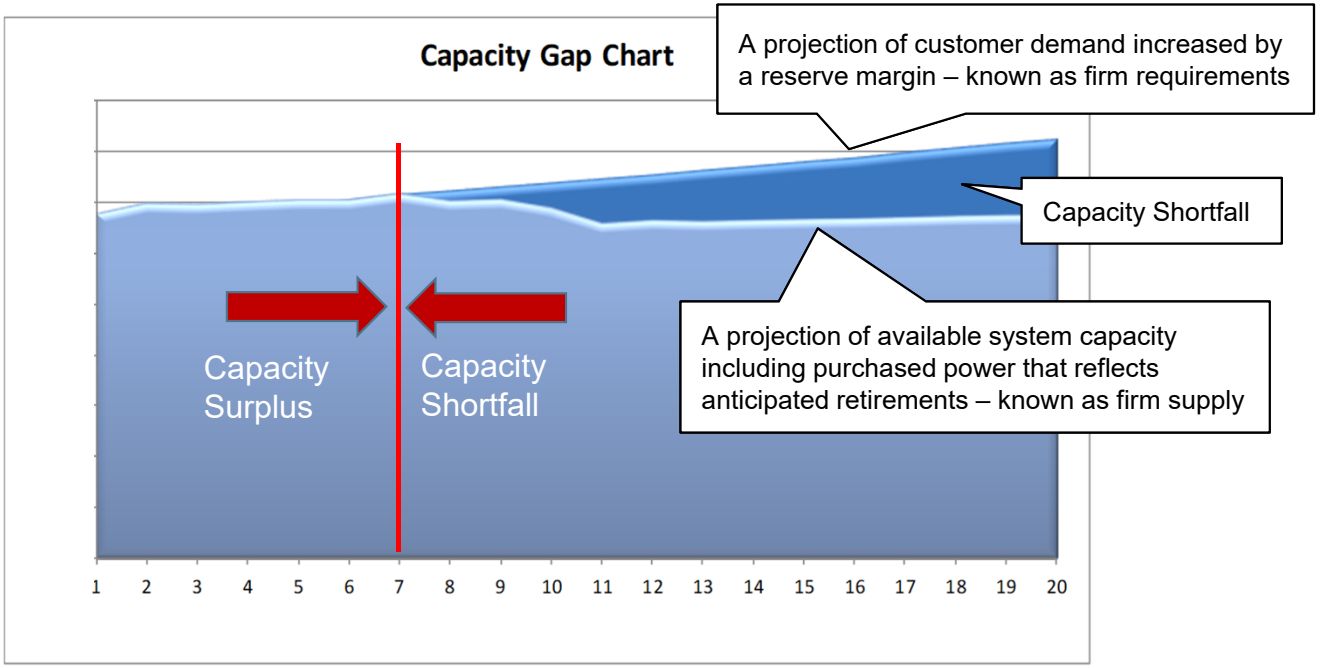
Goals for an Optimal Resource Plan

Low Cost	Risk Informed	Environmentally Responsible
Reliable	Diverse	Flexible

Resource Planning Addresses Future Capacity Needs

Resource planning is about optimizing the mix of future capacity.

Projections of capacity needed are filled by the most cost-effective resource.



Recommended path provides low cost, reliability, diversity and flexibility

Finding the Least Cost (Optimal) Resource Plan

- Using the reliability limit as a constraint, we optimize by minimizing the customer's delivered cost of power

Planning Objective Function:

Minimize Expected Present Value of Revenue Requirements

Components

- Optimization
- Time value of money
- Uncertainty

Constraints

- Planning reserve

Revenue Requirements

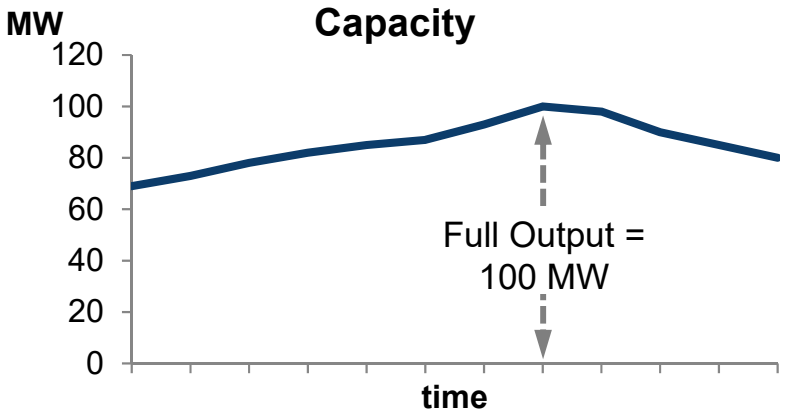
- Operating expenses
- Return of and on capital

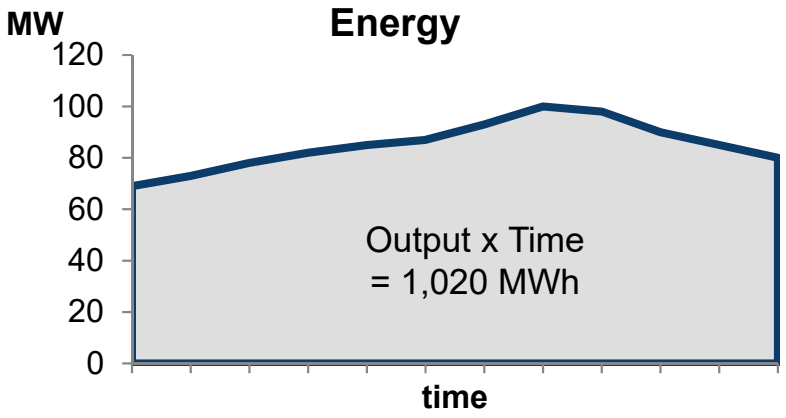
Objective is to find the capacity mix that produces the minimum cost over the planning horizon

Definitions

Capacity is the maximum electric output an electricity generator can produce under specific conditions

Energy (or generation) is the amount of electricity a generator produces over a specific period of time





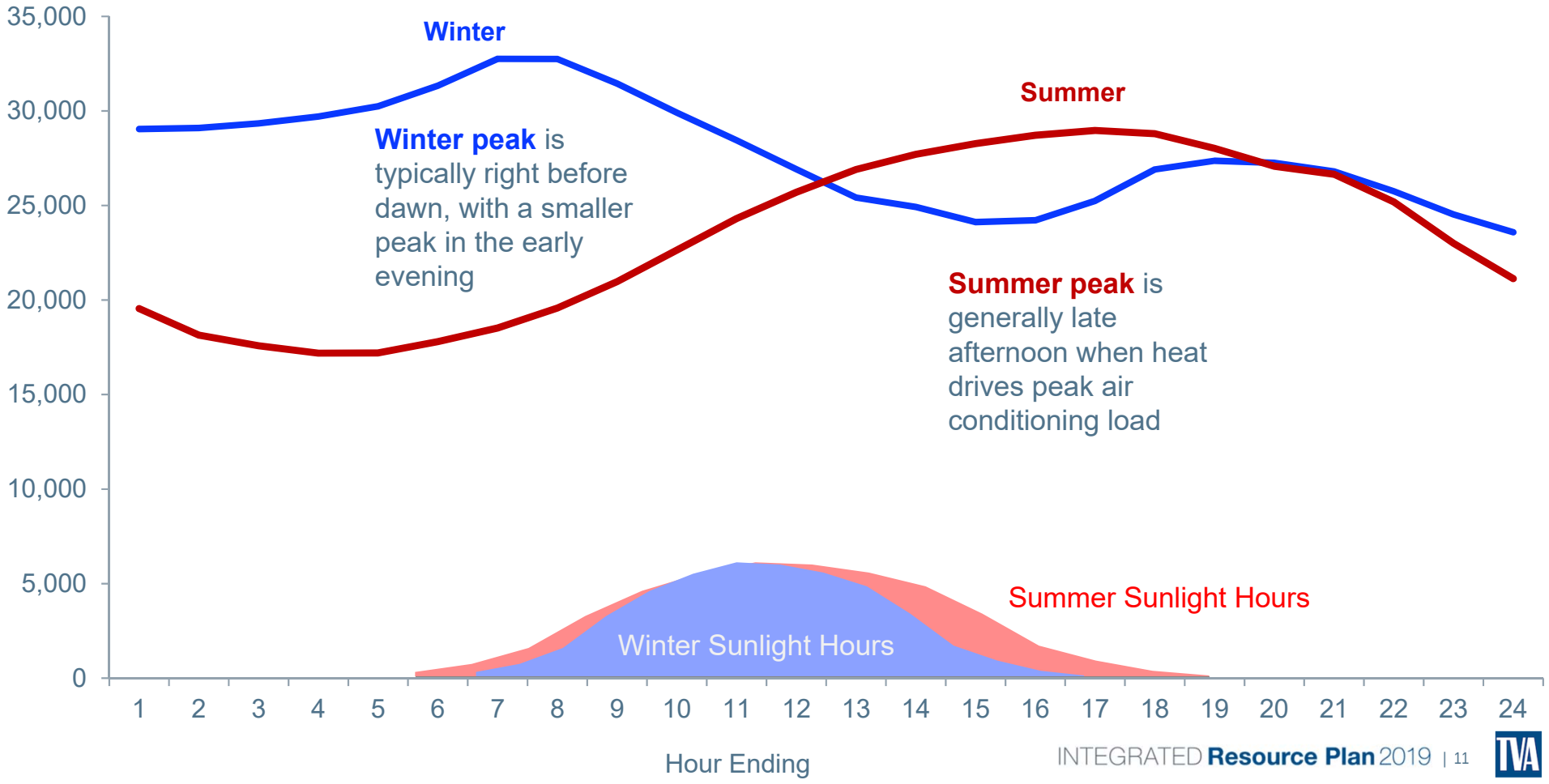
Variations

- **Nameplate Capacity** – Manufacturer-defined output under standard conditions
- **Net Dependable Capacity** – expected unit output during specific seasonal conditions (e.g., temperature)

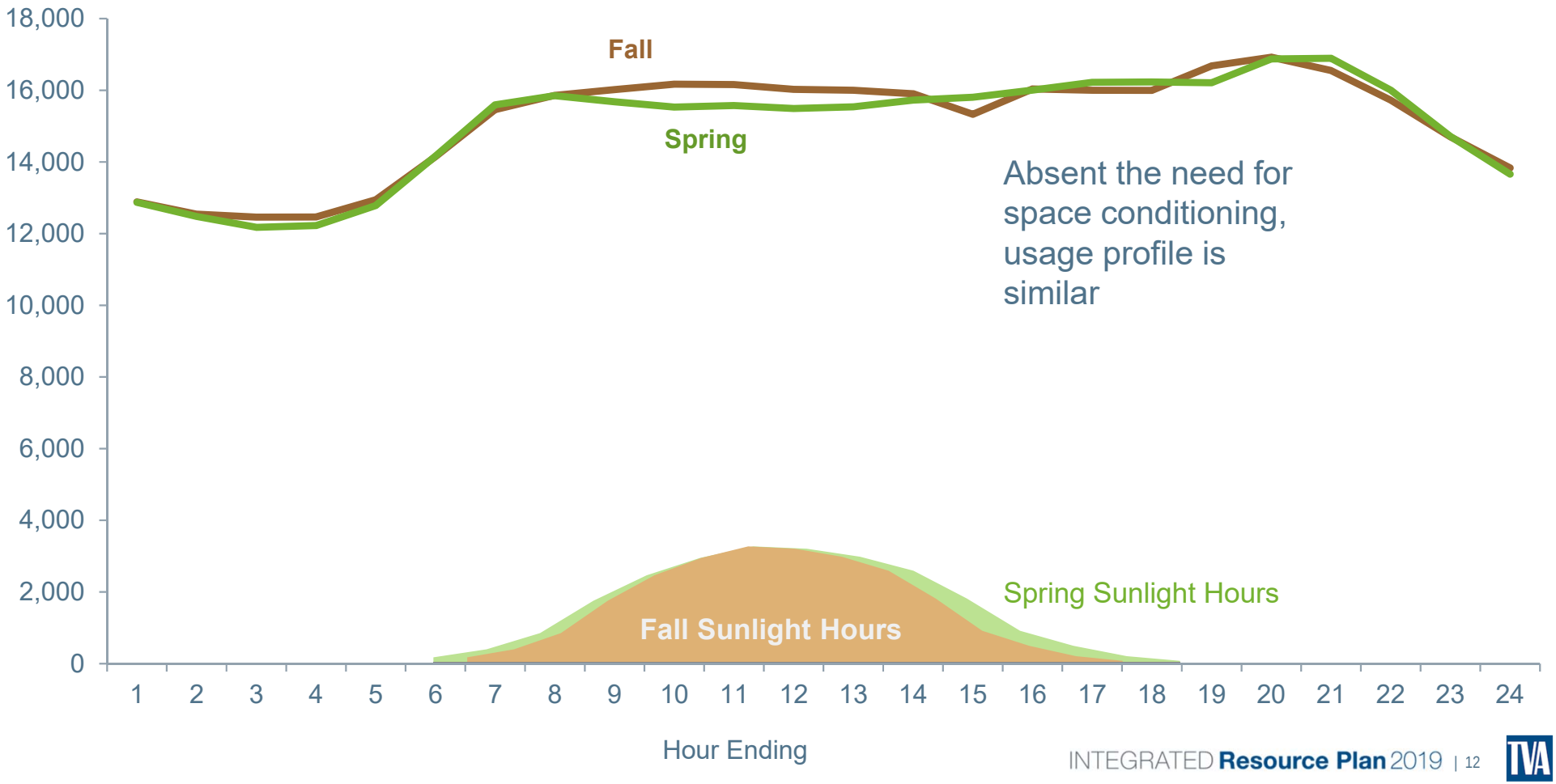
Variations

- **Capacity Factor** – Energy as a percent of the maximum output a unit could have produced over a period of time

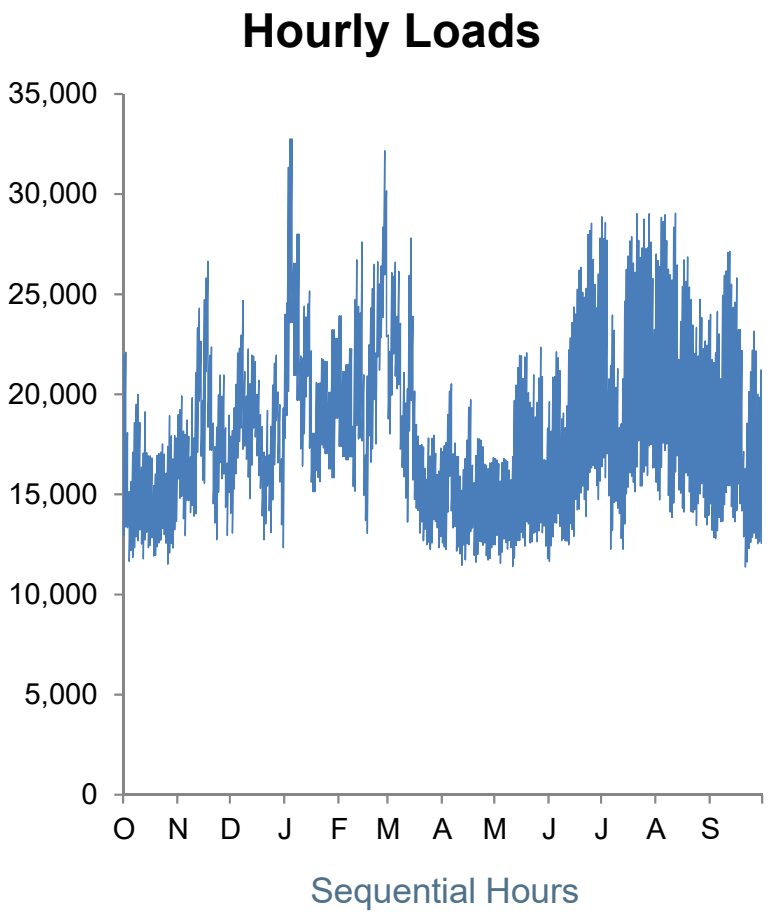
Winter and Summer Have Unique Profiles

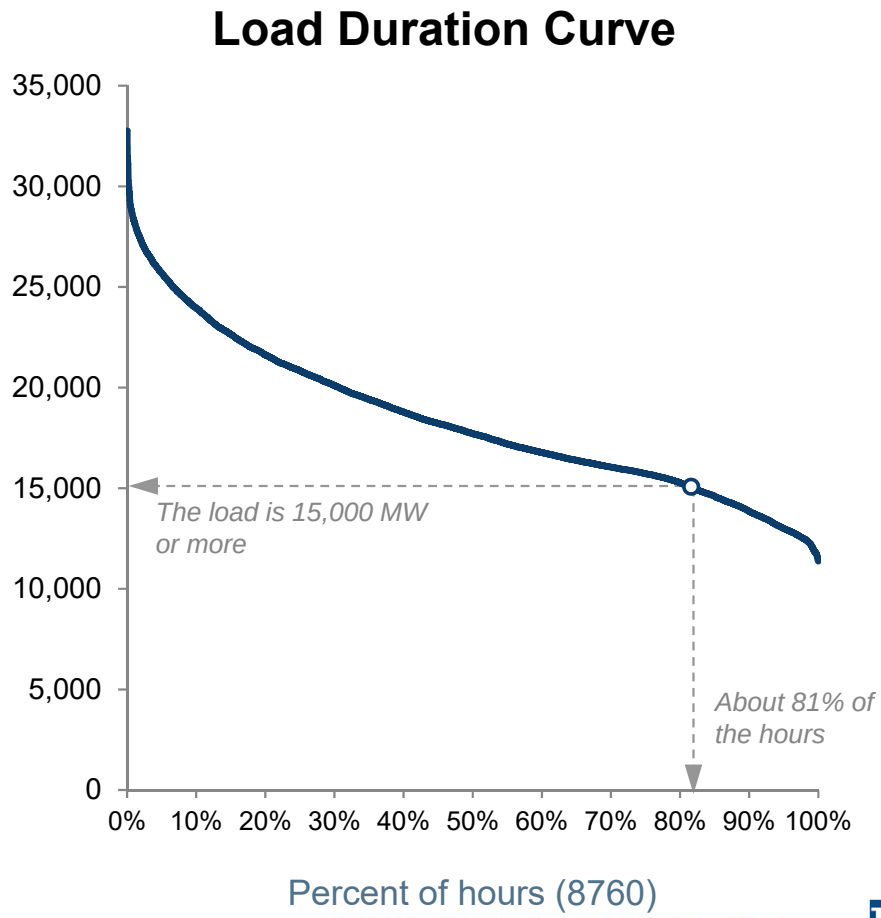


Fall and Spring Have Similar Profiles



Annual Load Profile





Generating Unit Operating Characteristics

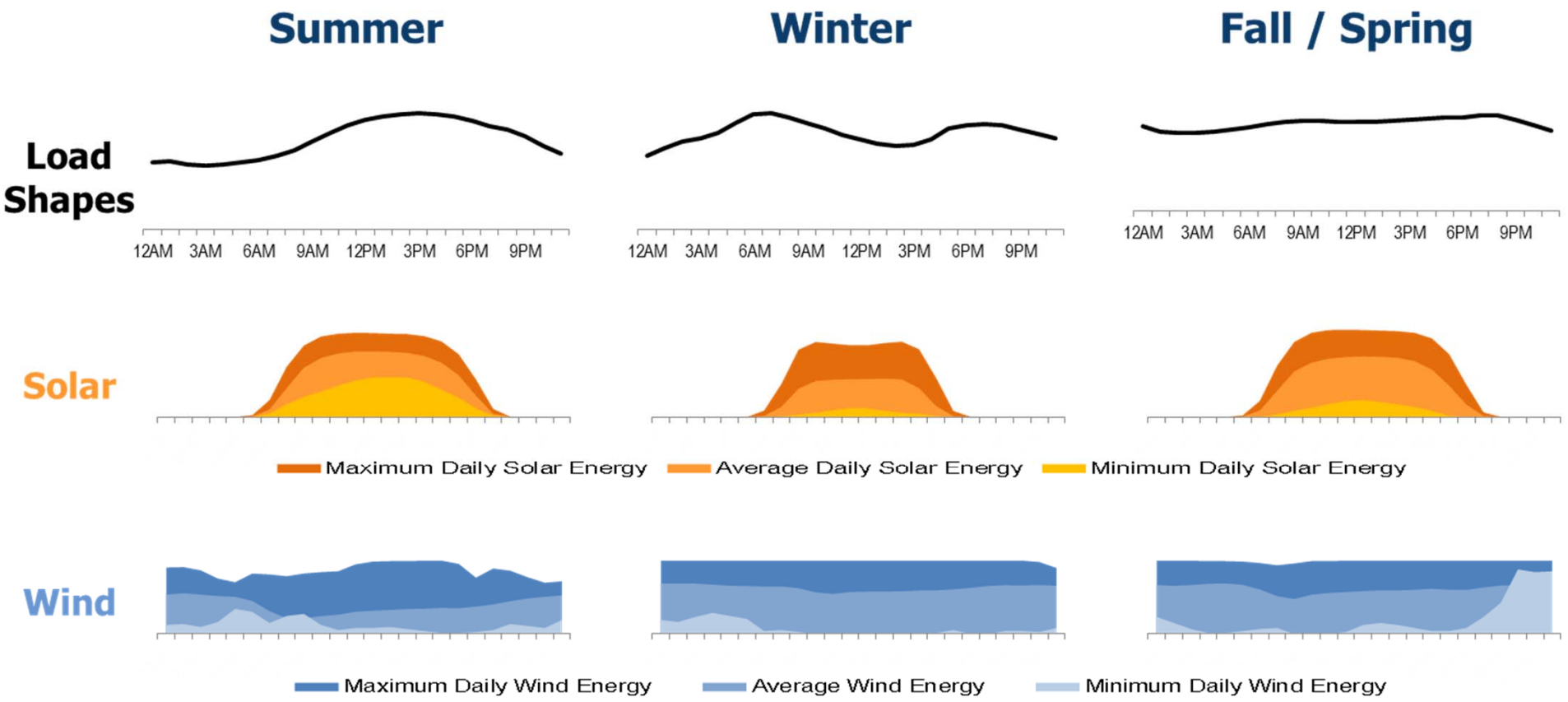
Physical

Item	Measure
Output (capacity)	MW (max dependable)
	MW (minimum)
Availability	Outage Rates
Flexibility	Ramp rate
Duty Cycle	Base, peaking
Control	Dispatchable, non-dispatchable
Fuel	Types of fuel, limits
Emissions	lbs per kWh
Other	Regulations & Constraints

Economic

Item	Measure
Capital Cost	$ - Installed cost
Efficiency	Heat rate (Btu/kWh)
Operating Cost	Fixed ($)
	Variable ($/kWh)
Fuel Cost	$/Btu
Emissions Cost	$/lb – as applicable

Seasonal Solar and Wind Shapes



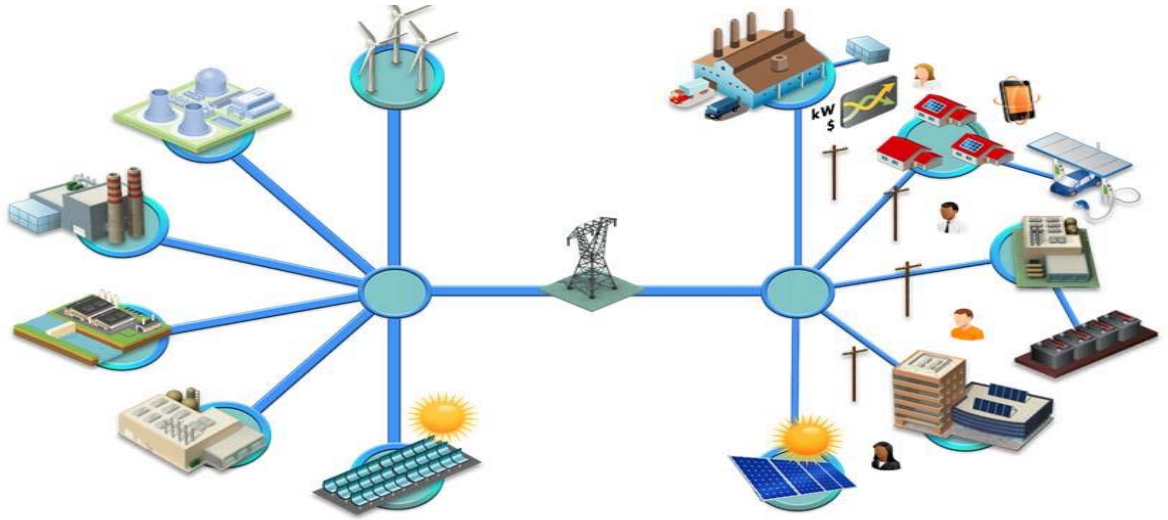
Distributed Energy Resources

Capacity (kW) and Energy (kWh)

Supply Side

Demand Side

Load Management NegaWatts & MegaWatts



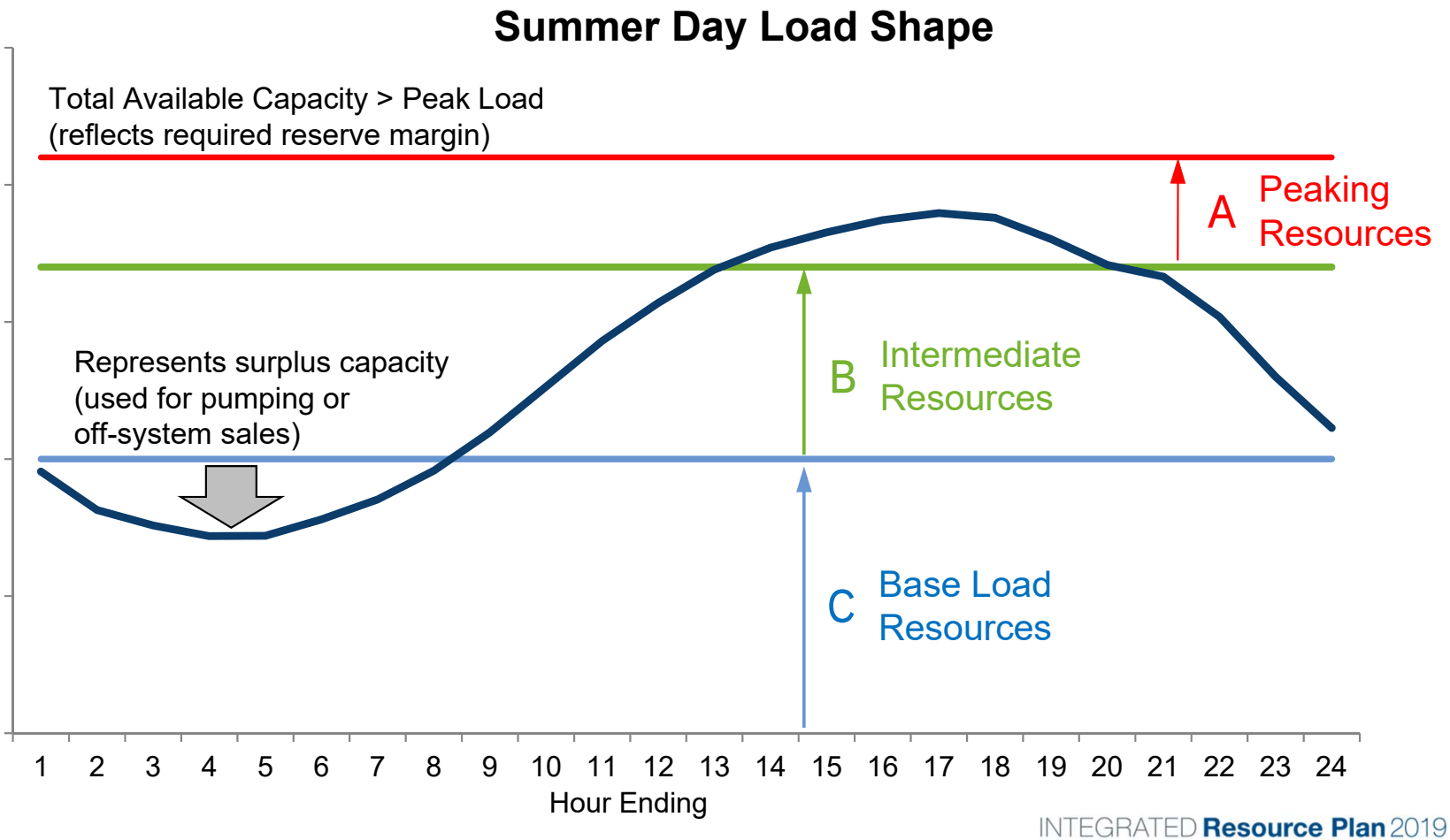
Supply Side Resources

- Nuclear
- Coal
- Gas
- Purchased Power
- Renewables
- Hydro
- Other Assets

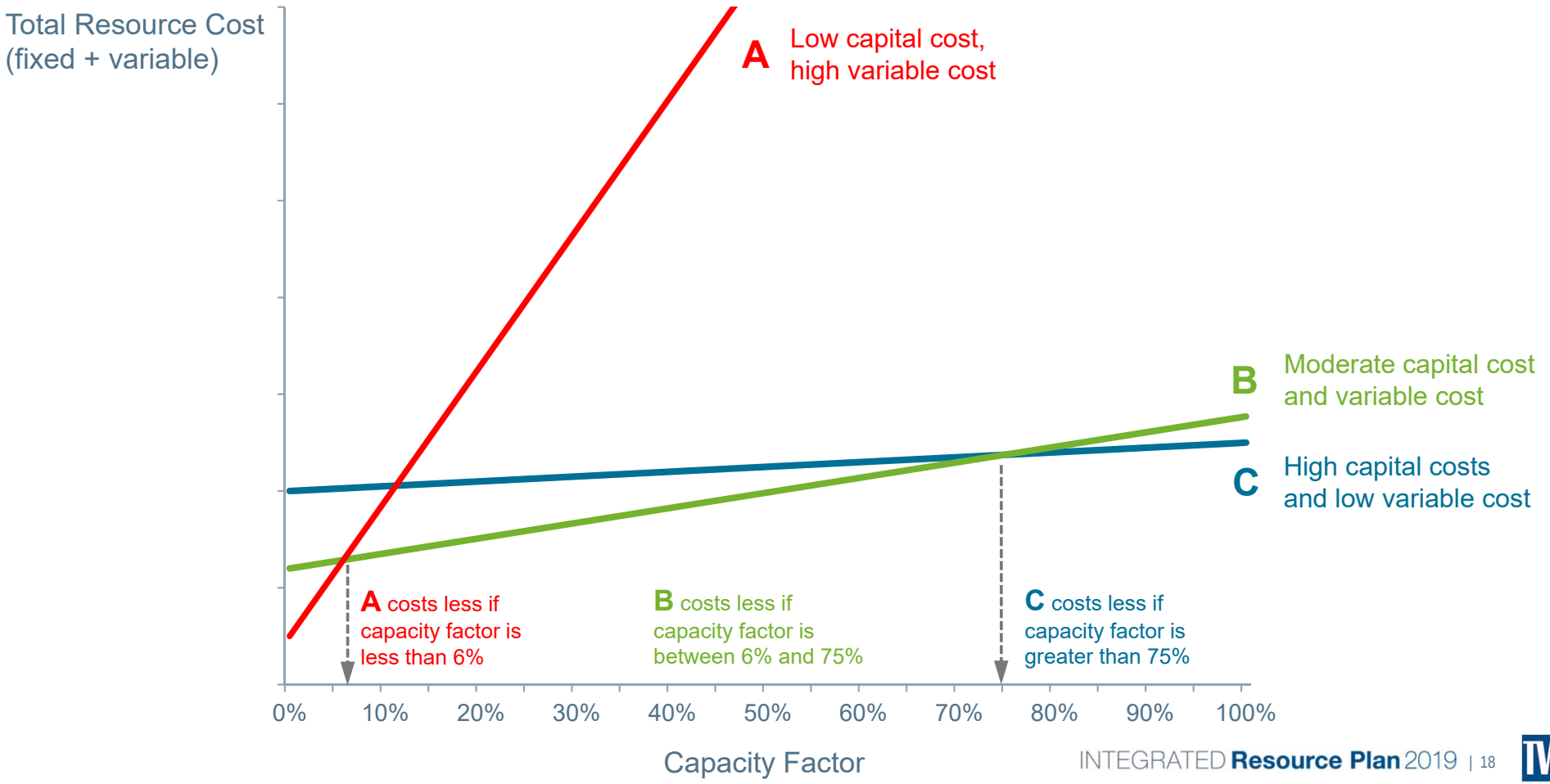
Demand Side Resources

- Energy Efficiency
- Demand Response
- Energy Services
- Distributed Generation

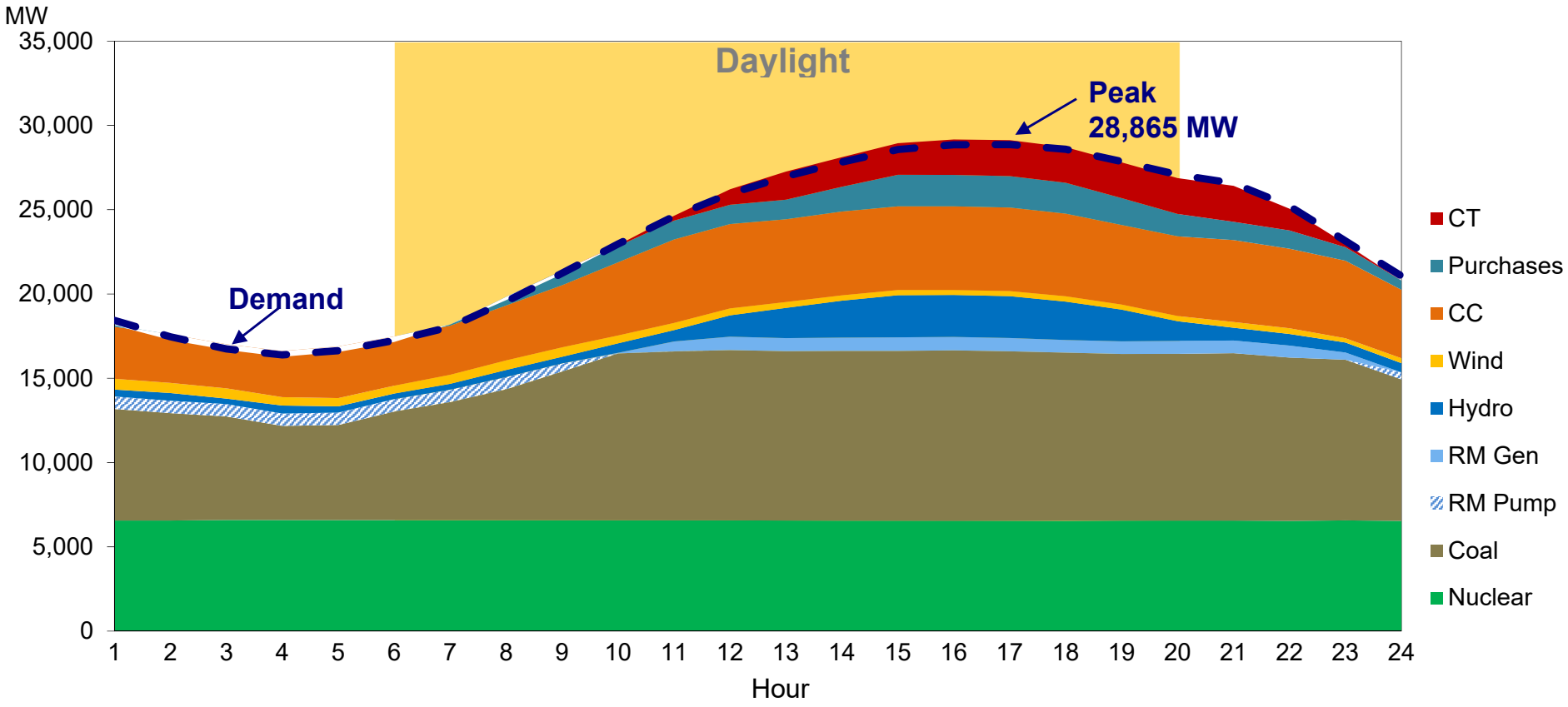
Load Shapes: Understanding Resource Needs



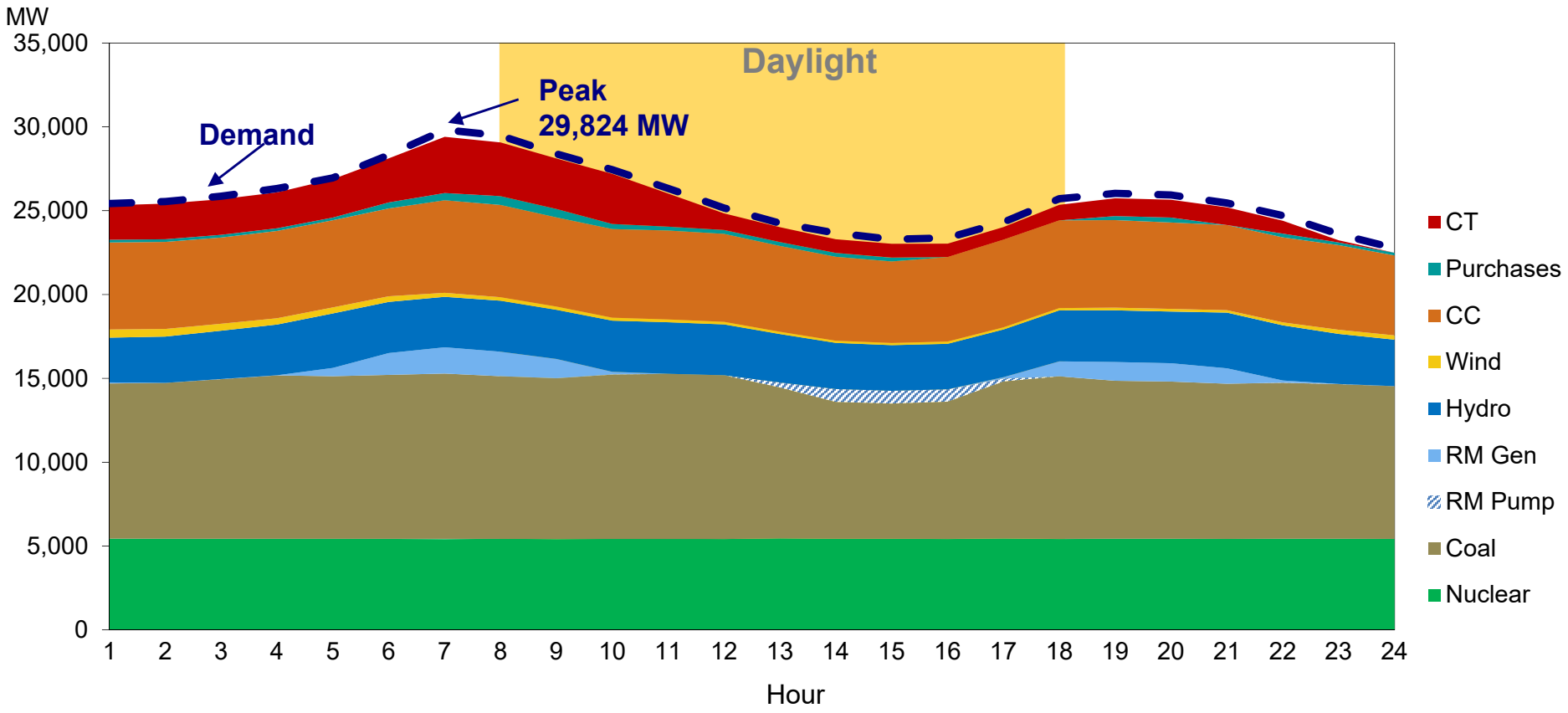
Selecting Appropriate Resource Types



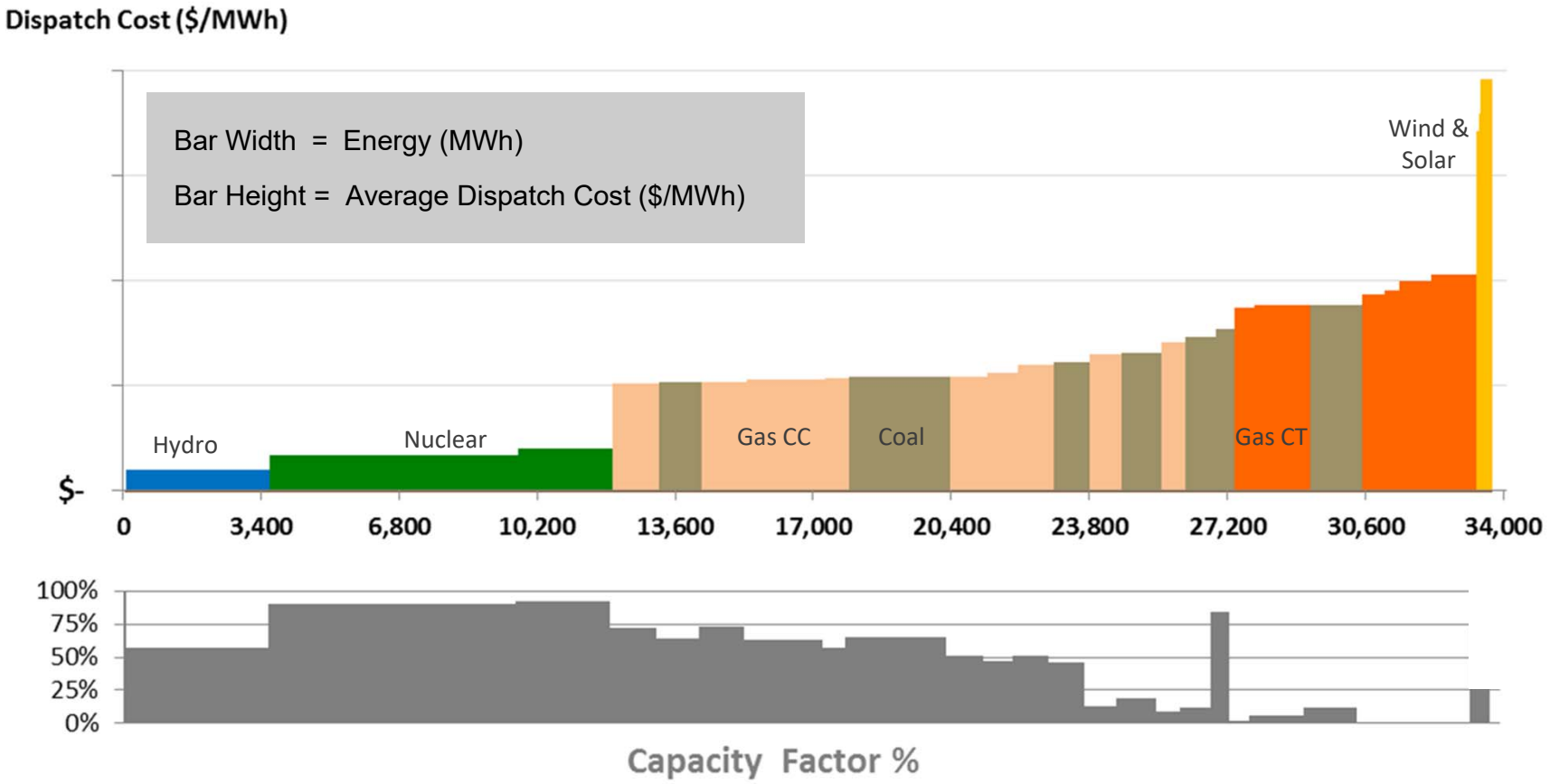
Load Dispatch on Typical Summer Day



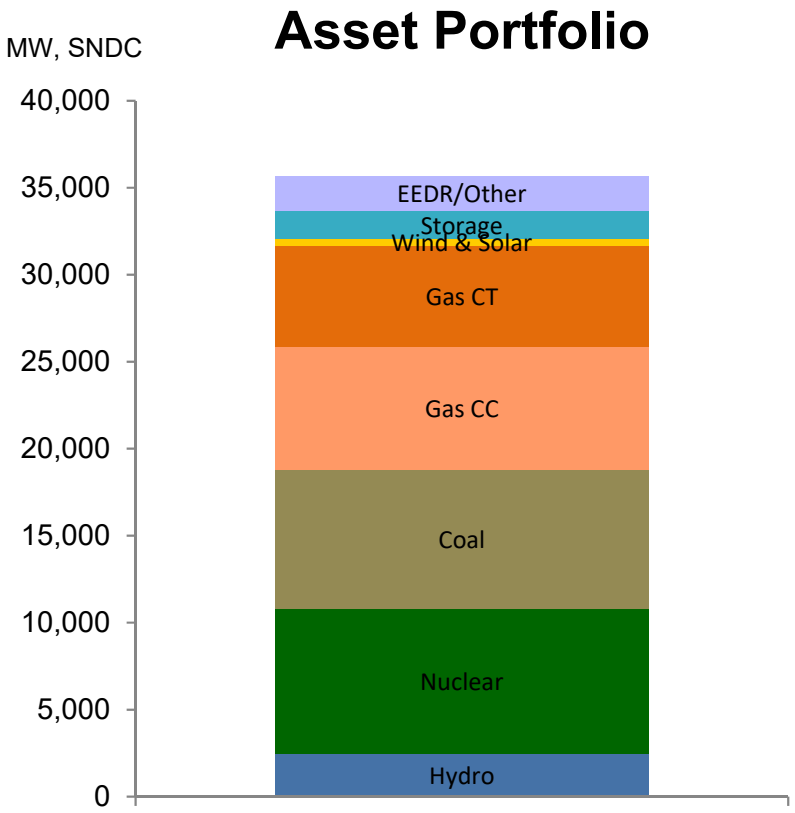
Load Dispatch on Typical Winter Day

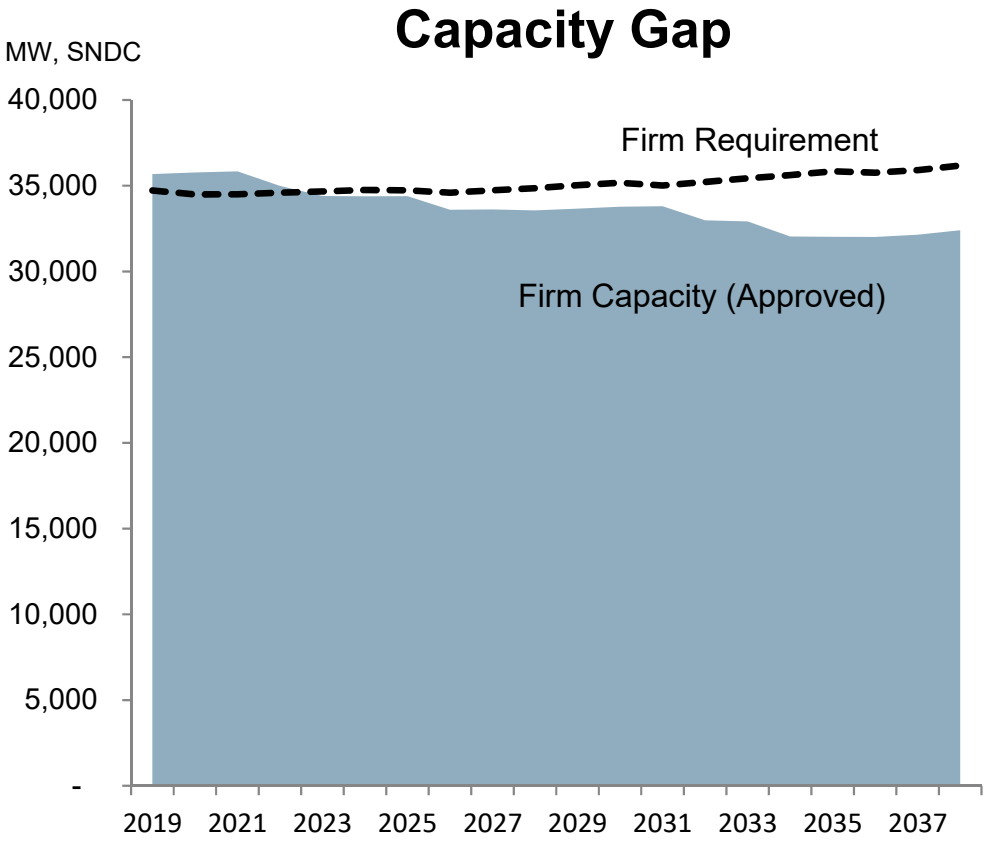


Load Dispatch to Meet Annual Demand



Current Portfolio and Projected Gap (Base Case)





Key Takeaways

- A diverse asset mix helps meet load economically and reliably over the long run
- Candidate resource technologies should be mature enough to model and select
- System flexibility enables integration of renewables and DER
- Environmental metrics can be evaluated across portfolios
- Testing the bounds with scenarios informs risk

Break

Panel 1: Utility Scale Resources

Panel 1: Utility Scale Resources

Moderator: Melanie Farrell

- Lignite Coal - David Liffrig/ North American Coal
- Small Modular Reactors - Sherri Buchanan / TVA
- Biomass - Randy Johnson/Johnson Energy Solutions
- Utility Solar- John Kemp/ E.on and TenneSEIA Board
- Aero Derivatives Natural Gas - Mike Hoy / TVA
- Utility Scale Storage - Steve Baxley / Southern Company
- Wind - Swaraj Jammalamadaka/ Apex Wind

Panel 2: Distributed Energy Resources

Panel 2: Distributed Energy Resources

Moderator: Dale Harris

- Storage –Steve Baxley / Southern Company
- CHP – Ben Edgar / White Harvest Energy
- Small Solar – Chris Koczaja / LightWave Solar and TenneSEIA
- Energy Efficiency - Mandy Mahoney / SEEA
- Demand Response - Clayton Pierce/ EnerNOC

Wrap Up

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IRPWG Meeting 3 Recap and Today's Session

Brian Child

April 26, 2018 Meeting Highlights

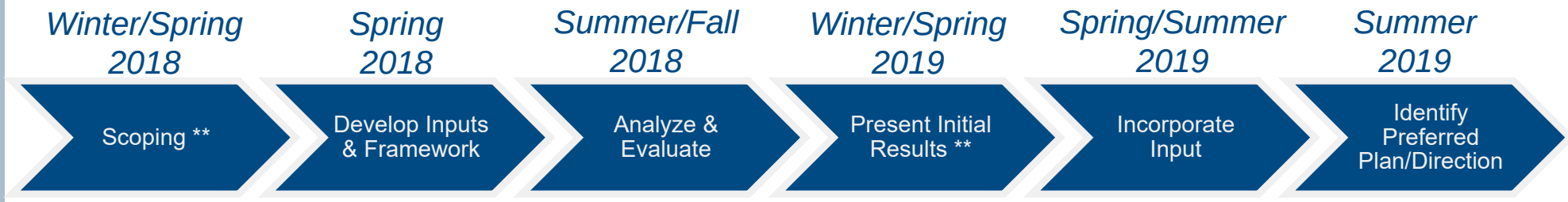
- Highlights and Themes from Scoping Comments
- Peer Utility Benchmarking on Uncertainties & Scenarios
- Group Discussion and Final List of Scenarios for Voting
- Overview of Attributes & Strategies
- Tour of River Forecast Center

2019 IRP Focus Areas

- Distributed Energy Resources
- System flexibility
- Portfolio diversity

2019 IRP Schedule: Schedule & Milestones

The 2019 IRP Study Approach is intended to ensure transparency & enable stakeholder involvement



(** indicates timing of Valley-wide public meetings)

Key Tasks/Milestones in this study timeline include:

- Establish stakeholder group and hold first meeting (Feb 2018)
- Initial modeling (June 2018)
- Publish draft EIS and IRP (Feb 2019)
- Complete public meetings (April 2019)
- Board approval and final publication of EIS and IRP (expected Summer 2019)

IRP Working Group Meeting Objectives

February 28th	March 29th	April 26th	June 7th	July 12th
• IRPWG orientation • General overview of process	• Overview of scenario design process • Review uncertainties, current forecasts, and brainstorm/review scenarios • IRPWG feedback	• Discuss IRPWG feedback • Discuss proposed scenarios • Develop short list of scenarios for voting • Overview of strategy design process	• Finalize scenarios • Review attributes and brainstorm/review strategies • Discuss proposed strategies and develop short list • Introduce resource options	• Finalize strategies • Planning assumptions • Modeling constraints
		Vote on scenarios	Vote on strategies	

Break

Scenarios:
Recap & Voting Results

Hunter Hydas

Current Outlook

Uncertainty	Outlook
Electricity Demand	Growth in customer count and large commercial & industrial offset by increased energy efficiency and distributed generation, leading to slightly declining energy sales and slightly increasing peaks
Market Power Prices	Average prices determined by marginal natural gas generators
Natural Gas Prices	Near term natural gas prices below $3.00/MMBtu and longer term average around $3.25/MMBtu
Coal Prices	Low gas prices drive lower growth in coal prices, and coal becomes more competitive in the long term as nuclear units begin to retire
Solar Prices	Solar prices becoming competitive with traditional resources
Storage Prices	Storage prices declining but still more expensive than traditional resources
Regulations	Little to no change in stringency of environmental regulations, and assume current projection of tariffs and tax credits
CO2 Regulation/Price	Given TVA's diverse portfolio and current state of regulations, carbon price of $0/ton assumed
Distributed Generation Penetration	Limited DG penetration in the Valley compared to other areas of the country, with 4% of residential and commercial customers projected to have distributed solar by 2038
Energy Efficiency Adoption	Energy efficiency gains from EIA projected saturation of codes and standards currently on the books
Economic Outlook (National/Regional)	Gross Domestic Product growth of 2% per year

Possible 2019 IRP Scenarios

Declining Economy
- *Weak Economy*

Economic Growth
- *Strong Economy*

Stringent Environmental
- *CO_2 Regulation/Legislation*
- *Limited Natural Gas Extraction*
- ~~*Water Scarcity*~~

Changing Paradigm
- *Advanced Manufacturing*
- *Decarbonized Society*
- *No Nuclear Extensions*

Emerging Technology
- *High DER*
- *Technology Breakthrough*
- *High EV Penetration* **New from IRPWG**

Combined into "Electrification" Scenario

Possible 2019 IRP Scenarios

Economics

- *Weak Economy*
- *Strong Economy*

Regulatory

- *CO_2 Regulation/Legislation*
- *Limited Natural Gas Extraction*
- *No Nuclear Extensions*

Technology

- *Electrification*
- *High DER*
- *Technology Breakthrough*

Scenario Ranking Results

	Weak Economy	Strong Economy	CO2	NG	NUKE	Electrification	High DER	Utility Scale Tech
1	7	8	4	6	5	1	2	3
2	6	8	2	1	7	5	3	4
3	3	6	4	7	8	1	2	5
4	3	4	6	5	8	2	1	7
5	5	7	2	8	6	4	1	3
6	6	4	8	7	1	5	3	2
7	1	5	3	8	7	6	4	2
8	5	4	7	3	1	6	2	8
9	1	4	5	6	7	3	2	8
10	7	8	5	1	2	4	3	6
11	6	7	4	2	3	8	1	5
12	6	2	8	7	5	3	1	4
13	1	5	6	3	8	7	2	4
14	1	2	4	5	3	6	7	8
15	2	3	8	7	6	4	1	5
16	3	7	2	4	1	5	6	8
17	3	4	2	7	5	1	8	6
18	1	6	4	3	7	5	2	8
19	2	1	7	8	5	4	3	6
20	8	7	5	3	4	1	2	6
21	1	2	4	8	5	7	3	6
22	1	2	4	7	8	5	3	6
23	7	6	4	1	3	5	2	8
24	2	4	6	8	3	5	1	7
25	2	3	7	6	5	4	1	8
26	5	1	8	7	6	3	4	2
27	7	1	5	3	4	8	2	6
28	1	6	8	7	4	5	2	3
29	1	2	8	5	4	6	3	7
30	1	2	5	8	7	6	4	3
31	1	2	8	7	4	6	3	5
32	6	7	3	2	1	5	4	8

- Participants were asked to rank the scenarios between 1 and 8, with 1 being the most preferred
- We received results from 32 participants (20 IRPWG and 12 TVA)

Scenario Ranking Results

The heat maps report the number of occurrences of each rank for each of the scenarios- e.g., in the IRPWG table, Strong Economy was ranked #1 only once, while Weak Economy was ranked #1 five times

IRPWG Sum of Occurrences by Rank Order

	Weak Economy	Strong Economy	CO2	NG	NUKE	Electrification	High DER	Utility Scale Tech
1	5	1	0	2	3	4	5	0
2	2	2	4	1	1	1	7	2
3	4	1	1	4	2	2	4	2
4	0	5	5	1	1	4	1	3
5	2	2	3	2	4	4	0	3
6	4	2	2	2	2	3	1	4
7	2	4	2	5	4	1	1	1
8	1	3	3	3	3	1	1	5

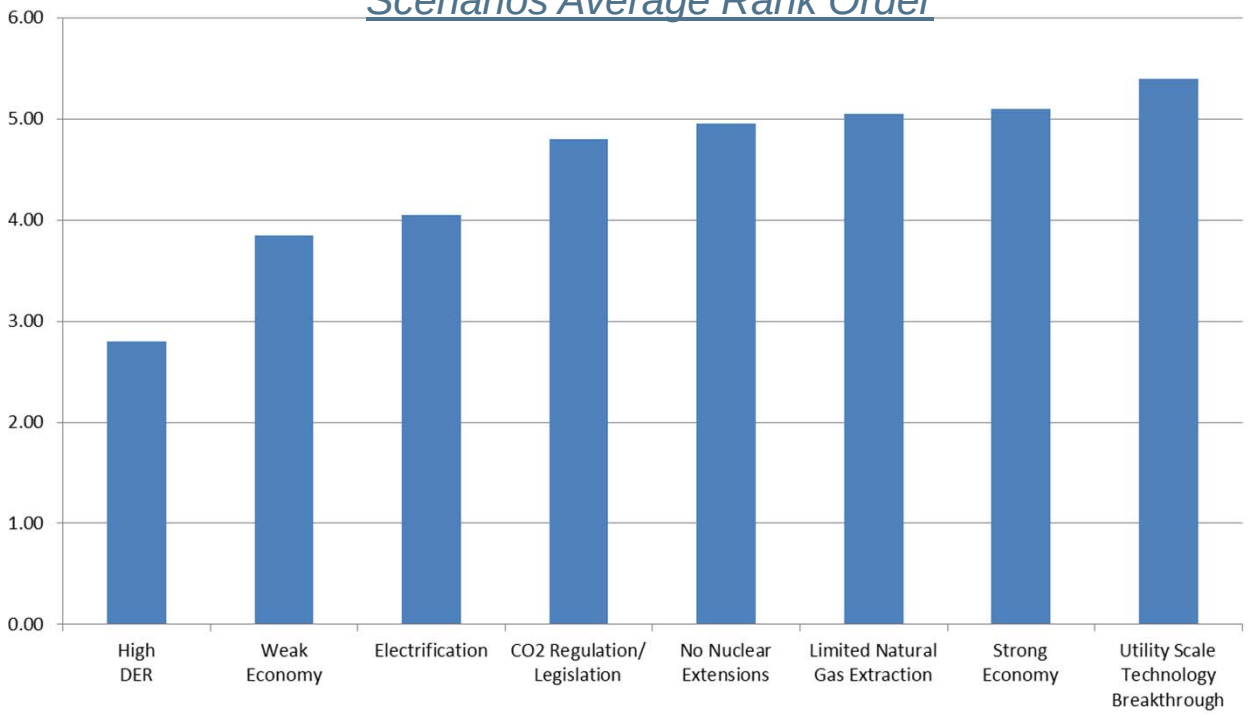
TVA Sum of Occurrences by Rank Order

	Weak Economy	Strong Economy	CO2	NG	NUKE	Electrification	High DER	Utility Scale Tech
1	6	2	0	1	1	0	2	0
2	2	5	0	1	0	0	3	1
3	0	1	1	1	2	1	4	2
4	0	1	3	0	4	1	3	0
5	1	0	2	1	2	5	0	1
6	1	2	1	1	1	3	0	3
7	2	1	1	4	1	1	0	2
8	0	0	4	3	1	1	0	3

Ranking Results by IRPWG

- The Average Rank Order is calculated as the sum of the ranking values (between 1 and 8) received by a particular scenario divided by the number of people performing the ranking (12 in the case of TVA and 20 in the case of the IRPWG)
- Since scenarios are ranked with values between 1 and 8, the lower the Average Rank Order reflects a higher preference for a particular scenario

Scenarios Average Rank Order

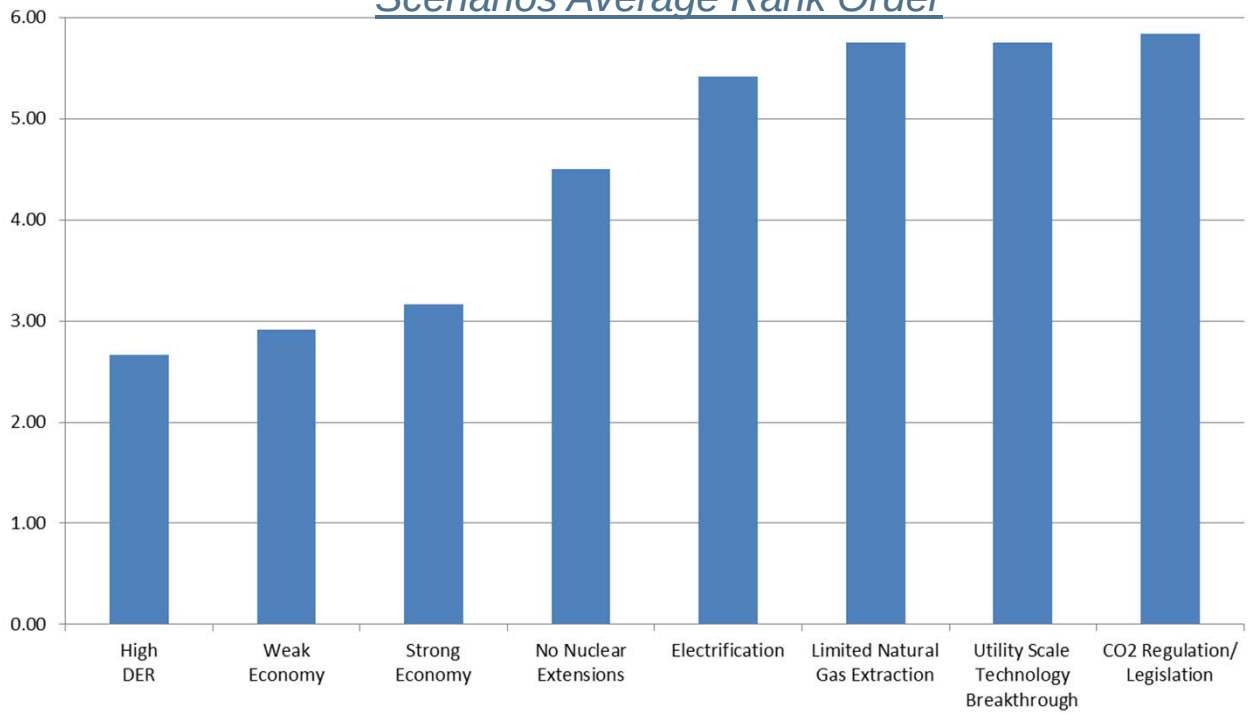


Strong preference for:
- High DER
- Weak Economy
- Electrification

Ranking Results by TVA

- The Average Rank Order is calculated as the sum of the ranking values (between 1 and 8) received by a particular scenario divided by the number of people performing the ranking (12 in the case of TVA and 20 in the case of the IRPWG)
- Since scenarios are ranked with values between 1 and 8, the lower the Average Rank Order reflects a higher preference for a particular scenario

Scenarios Average Rank Order



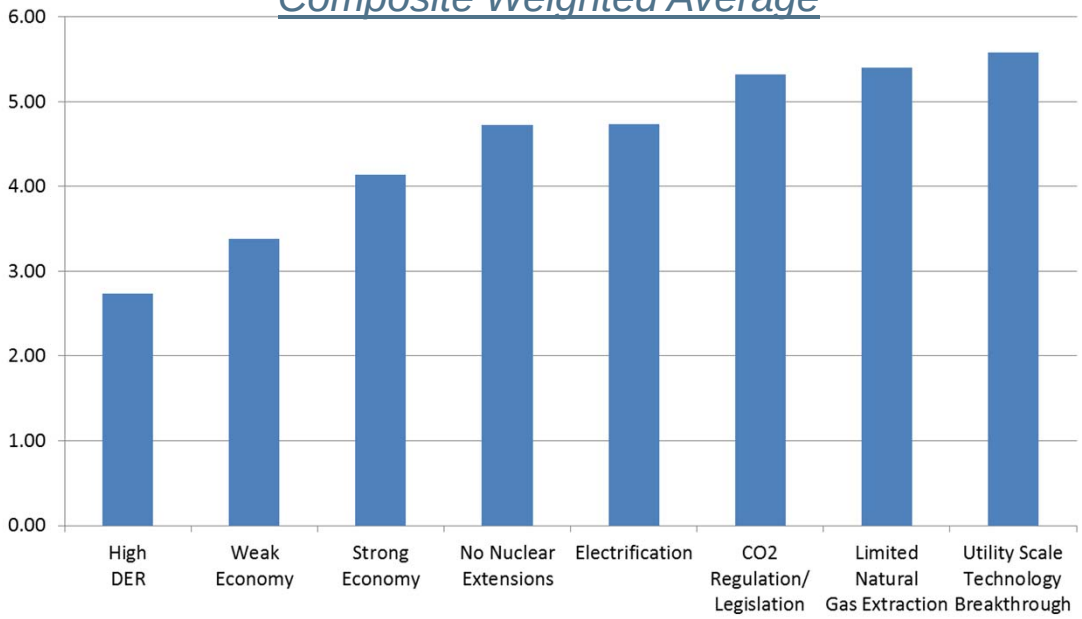
Strong preference for:
- High DER
- Weak Economy
- Strong Economy
- No Nuclear Extensions

Composite Ranking Results

Composite Sum of Occurrences by Rank Order

	Weak Economy	Strong Economy	CO2	NG	NUKE	Electrification	High DER	Utility Scale Tech
1	11	3	0	3	4	4	7	0
2	4	7	4	2	1	1	10	3
3	4	2	2	5	4	3	8	4
4	0	6	8	1	5	5	4	3
5	3	2	5	3	6	9	0	4
6	5	4	3	3	3	6	1	7
7	4	5	3	9	5	2	1	3
8	1	3	7	6	4	2	1	8

Composite Weighted Average



- The weighted average score is based on a 50/50 weighting between IRPWG and TVA
- Strong preference for:
  - –High DER
  - –Weak Economy
  - –Strong Economy

Combinations/Considerations

	Original Scenarios	Final Scenarios	Comments
	Current Outlook	**Current Outlook**	Reference Case
1	High DER	**Rapid DER Adoption**	
2	Weak Economy	**Economic Downturn**	
3	Strong Economy	**Valley Load Growth**	Will incorporate Electrification
4	No Nuclear Extensions		Handle as a Sensitivity, SMR Sensitivity
5	Electrification		Incorporate into Valley Load Growth
6	CO2 Regulation/Legislation	**De-carbonization**	Proxy for CO2 regulation/legislation, RPS
7	Limited Natural Gas Extraction		Handle as a Sensitivity on gas price
8	Utility Scale Technology Breakthrough		Eliminate

Recommended 2019 IRP Scenarios

Reference Case

- *Current Outlook*

Economics

- *Economic Downturn*
- *Valley Load Growth*

Regulatory

- *De-Carbonization*

Technology

- *Rapid DER Adoption*

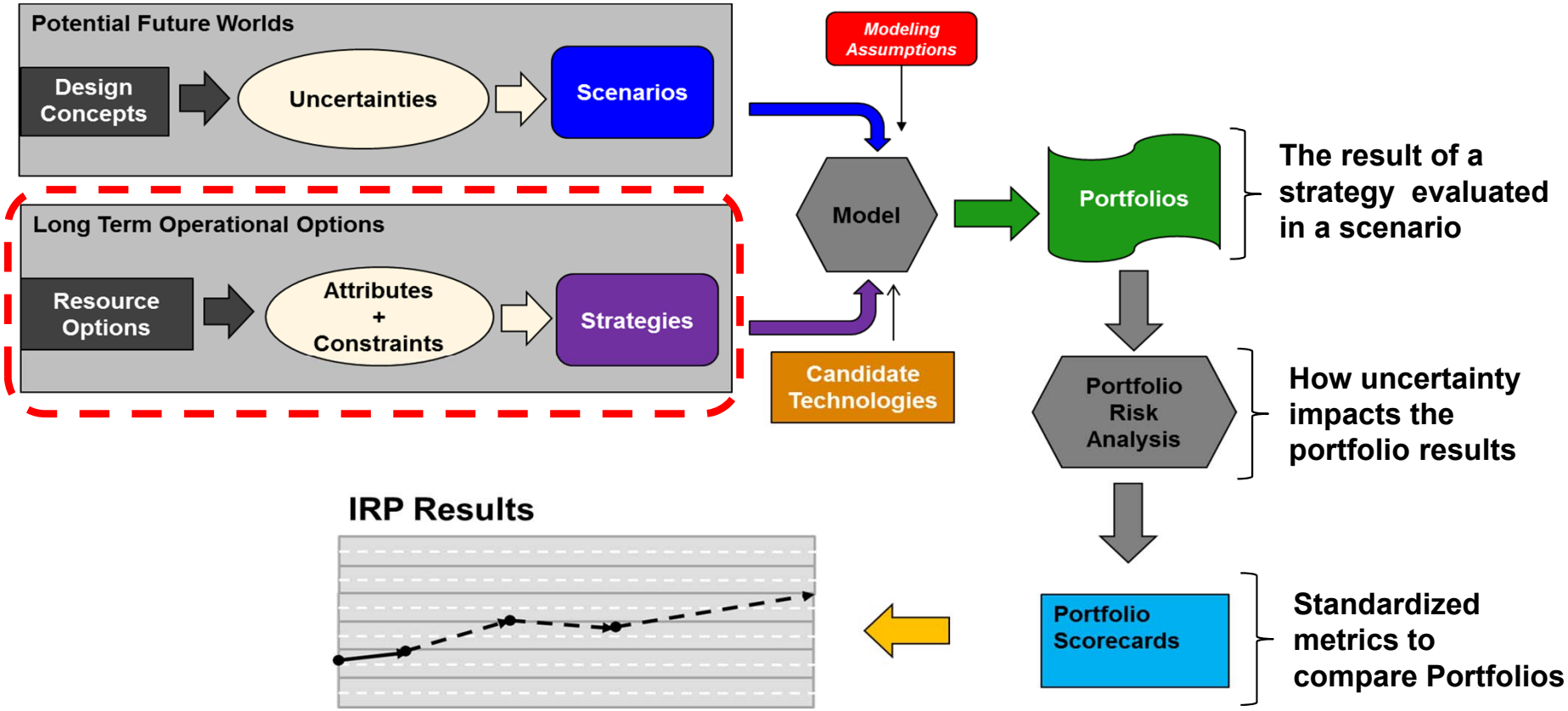
Next Steps on Scenarios

- Scenario Design- TVA will develop forecasts for each uncertainty and bring them to the IRPWG for review
- What do we mean by “Very High,” “High,” “Low,” and “Very Low?”
- Ensure we are stretching the bounds

Attributes Overview and Discussion

Hunter Hydas

How Integrated Resource Planning Works



Scenarios and Strategies Establish Framework

Scenarios
Outside TVA's Control

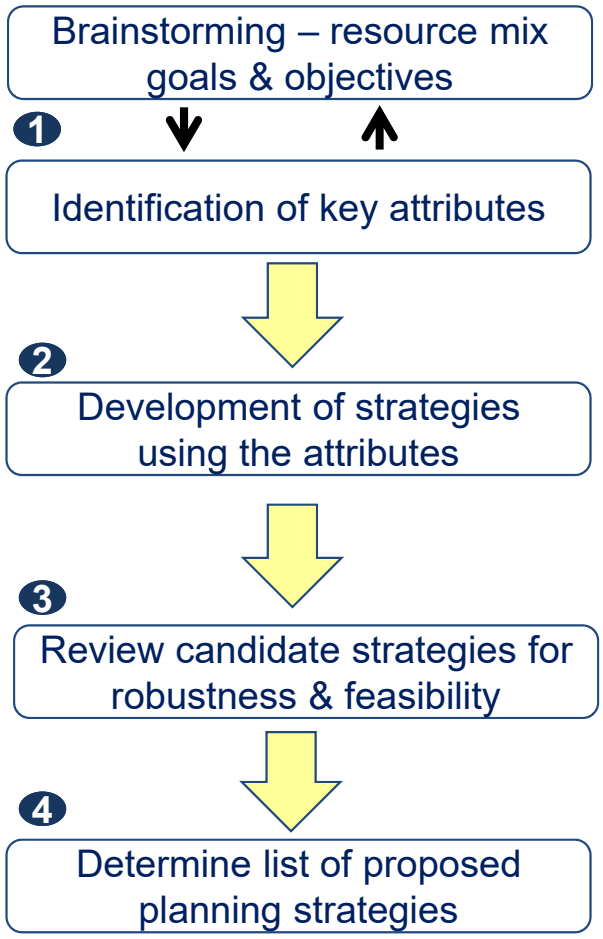
- Describe potential outcomes of factors (uncertainties) outside of TVA's control
- Represent possible conditions and are not predictions of the future
- Include uncertainties that could significantly impact operations, such as:
  - Load forecasts
  - Commodity prices
  - Environmental regulations
- Lends insight to riskiness of portfolio choices

Strategies
Within TVA's Control

- Test various business options within TVA's control
- Defined by a combination of resource assumptions, such as:
  - DER portfolio
  - Nuclear expansion
  - Energy storage
- Consider multiple viewpoints
  - Public scoping period comments
  - Assumptions that would have the greatest impact on TVA long-term

A well-designed strategy will perform well in many possible scenarios

Process for Building Strategies



- The key questions in developing our list of potential strategy attributes are
  - Is this attribute something we want to evaluate in this IRP?
  - Is this attribute something we need to define? Or can this aspect of the resource portfolio be an outcome of the modeling?
  - Does this attribute capture an existing policy of TVA?
  - Does this attribute capture work done outside the IRP to meet goals or objectives of TVA?
- Describe the intent of each candidate strategy by defining the "value" of each attribute for that strategy
- Review attributes within the strategy for correlation; also compare attribute variability across all candidate strategies to ensure robust resource portfolios will be possible
- TVA & IRPWG select a short list of strategies to be modeled
  - Define each of the proposed planning strategies including objectives and key characteristics

TVA is Proposing 9 Attributes

Attributes	Description
Existing Nuclear	Constraints related to the existing nuclear fleet; EPU's are considered part of existing nuclear
Nuclear Additions	Limitations on technologies and timing related to the addition of new nuclear capacity; A/P 1000s and SMRs are considered in this category
Existing Coal	Constraints related to the existing coal fleet
New Coal	Limitations on technology and timing on new coal-fired plants; includes CCS on conventional coal plus IGCC technology
Gas Additions	Limitations on technologies and timing related to the expansion options fueled by natural gas (CT, CC)
EEDR	Considers energy efficiency and demand response programs that are incentivized by TVA and/or LPC's (excludes impacts from naturally occurring efficiency/ conservation)
Renewables (Utility Scale)	Limitations on technologies and timing of renewable resources; considers options that would be pursued by TVA or in collaboration with LPC's
Storage (Utility Scale)	Limitations on technologies and timing of storage resources; considers utility scale storage options varying in size or storage capacity
Distributed Generation/Storage	Includes customer-driven resource options or third party projects that are distributed in nature

Did we miss any attributes that you think are important?

Examination of Peer Utilities' Integrated Resource Plans

Strategy Planning and Use for IRP Development

Randy McAdams / John Gray

Topics for Discussion

- Approach and Peer Utilities Examined
- IRP Development Process
- Summary of Strategy Planning Observations
- Comparison of Peer Strategies to TVA
- Appendix – Strategy Approaches Employed by Peer Utilities

Overview of Peer Utility IRP Benchmarking

- ScottMadden examined IRPs most recently released by 10 peer utilities
- IRPs were examined for approaches, results, and themes
- Industry developments, including the evolving IRP process in California, were reviewed along with recent planning documents from SMUD and PG&E

Today's Objectives:
- Share observations on the development and use of strategies by peer IRPs
- Discuss comparisons to TVA's approach

Peer Panel Company Profiles

	aps	Dominion Energy	DUKE ENERGY CAROLINAS	DUKE ENERGY FLORIDA	DUKE ENERGY PROGRESS
Description	Using a balanced energy mix that is nearly 50% carbon-free, APS has one of the country's cleanest energy portfolios	One of the nation's largest producers and transporters of energy, with one of the nation's largest natural gas storage systems	Regulated public utility primarily engaged in the generation, transmission, distribution, and sale of electricity in portions of NC and SC	Regulated public utility primarily engaged in the generation, transmission, distribution, and sale of electricity in portions of Florida	DEP owns nuclear, coal-fired, natural gas, renewables, and hydroelectric generation, providing service within portions of NC and SC
Total Revenue ($000,000,000)	$3.6B	$12.9B	$7.4B	$4.7B	$5.2B
IRP Filing Date/ Filing Frequency	April 2017 / Annually	May 2017 / Biennially	Sept. 2017 / Annually	April 2017 / Annually	Sept. 2017 / Annually
IRP Planning Horizon	15 Years	25 Years	15 Years	10 Years	15 Years
Customers	1,221,485	2,588,084	2,571,820	1,800,000	1,556,402
Capacity	6,450 MW	26,268 MW	20,475 MW	9,869 MW	14,197 MW

Peer Panel Company Profiles (Cont'd)

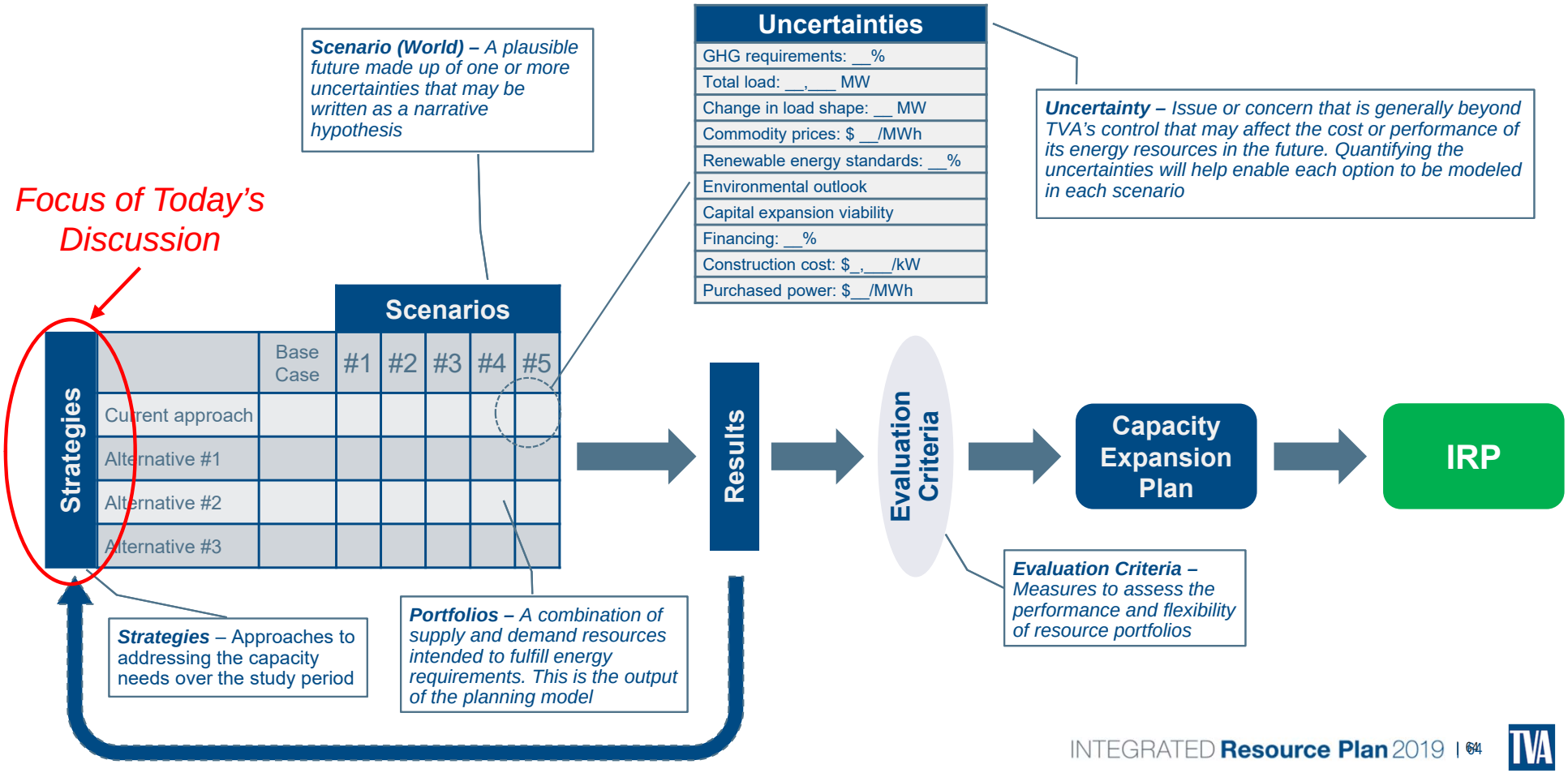
	Entergy	FPL	Georgia Power	PacifiCorp	PGE
Description	Integrated energy company engaged primarily in electric power production and retail distribution operations	A subsidiary of Juno Beach, Florida-based NextEra Energy, Inc., FPL is the third-largest electric utility in the U.S.	The largest electric subsidiary of Southern Company, with a diverse and innovative generation mix	A subsidiary of Berkshire Hathaway Energy, the electric utility serves customers across six states	Vertically integrated electric utility that serves customers in the Portland / Salem metropolitan area of Oregon
Total Revenue ($000,000,000)	$11.4B	$12.0B	$8.3B	$2.3B	$2.0B
IRP Filing Date/ Filing Frequency	Aug. 2015 / Every Three Years	April 2017 / Annually	Jan. 2016 / Every Three Years	April 2017 / Biennially	Nov. 2016 / Every Three Years
IRP Planning Horizon	20 Years	10 Years	20 Years	20 Years	25 Years
Customers	2,884,881	4,922,000	2,515,131	1,867,000	875,000
Capacity	24,168 MW	27,122 MW	16,422 MW	1,132 MW	4,005 MW

Peer Panel Company Profiles (Cont'd)

	PG&E	SMUD	TVA
Description	A subsidiary of PG&E Corp., PG&E serves Californians across a 70,000 square mile service area in Northern California	Sixth-largest community-owned electric service provider, with a power mix that is 50% non-carbon emitting	Federally owned agency providing electricity, flood control, navigation, land management, and economic development in seven states
Total Revenue ($000,000,000)	$17.2B	$1.6B	$10.7B
IRP Filing Date/ Filing Frequency	N/A	N/A	Aug 2015 / Every Four Years
IRP Planning Horizon			20 Years
Customers	5,384,525	628,953	>9,000,000[1]
Capacity	7,715 MW	1,043 MW	36,153 MW

[1]TVA customer count reflects retail customers serviced by independent power distributors

A Typical IRP Development Process



Summary of Strategy Planning Observations

Development and Use of Strategies

- The majority of peers created strategies (in some cases referred to as ‘portfolios’) as a means to test different scenarios and uncertainties
  - The results from each test case enabled the identification of optimal portfolios of supply and demand resources
- In some cases, the peers elected to bypass the creation of separate strategies and focused instead on directly testing their scenarios against a range of uncertainties and assumptions
  - This method also allowed for developing optimal portfolios but through broad testing
- Every peer used a traditional least cost planning strategy as a base case for evaluating performance or utilized least cost analysis as part of alternative strategy evaluation
- Due to the high level of complexity involved with evaluating strategies against a range of scenarios, most analysis was performed via some type of simulation software (e.g., AuroraXMP, System Optimizer)

Summary of Strategy Planning Observations

Characteristics of Peer Strategies

- About half of the peer companies, in particular those in the regulated southeast region (DOM, DEP, DEC), included a strategy to ensure compliance with the CPP or to meet the intent of that regulation in the event the CPP is modified or not enforced
- Almost every peer included one or more strategies that were focused on the growth of renewables and distributed generation resources
- Some strategies identified specific emerging resource and technology options like energy efficiency, demand response, storage, and direct load control (APS, DEC, DEP, PCQ, PGE)
- Traditional base sources, including coal and nuclear, were generally absent from the developed strategies, but gas remains a potential option for several peers

Summary of Strategy Planning Observations

Strategy Use in Portfolio Selection

- Peers typically perform an analysis to assess the performance of each strategy against each scenario
  - The lowest cost strategy that meets demand is generally selected for the portfolio
- In the case of ETR, a scorecard was developed that established a ranking of each strategy based on its performance under the varying scenarios
- In the case of PCQ, a complex Planning and Risk analysis encompassing 200 studies, each tested through 50 iterations, resulted in over 10,000 simulation runs to inform portfolio development
- In the case of DEF, a single Integrated Optimal Plan (IOP) was created and then tested with various sensitivities to refine and develop the composition for the final portfolio

Peer Strategy Comparisons

IRP Strategy Theme	APS	DOM	DEC	DEF	DEP	ETR	FPL	GPC	PCQ	PGE
"Traditional" Least Cost Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Do Gas Only / Focus on Gas			✓	Detailed Strategies Considered were Not Available	✓	✓✓✓	Detailed Strategies Considered were Not Available	Detailed Strategies Considered were Not Available		
Doing More EE / DR	✓		✓		✓					✓
Flexible Resources									✓✓	
Promoting Renewables	✓		✓		✓	✓			✓✓✓✓	✓✓✓✓✓✓
Focus on Nuclear	✓	✓								
Direct Load Control									✓	
CPP Compliance	✓	✓✓✓✓	✓✓		✓✓					
CPP Compliance with Trading		✓✓								
Coal Retirement	✓									
Energy Storage Systems	✓									
Efficiency Capacity										✓✓

Multiple checks indicate a number of strategies with the same theme

Possible TVA IRP Strategic Options

Emissions

- Meet an Emission Target

Market Reliance

- No TVA Builds

Renewables/DER

- Promote DER
- Promote Renewables
- Promote Resiliency

Flexibility

- Promote Efficient Energy Usage
- Add Small, Agile Capacity

Narratives for Proposed TVA Strategies

Strategy	Narrative
Meet an Emission Target	TVA makes a commitment to meet a long-term carbon emission target consistent with customer expectations and international climate agreements. New coal builds are excluded, while existing coal and gas additions are limited due to their carbon emissions.
No TVA Builds	TVA makes a decision to rely on the market to meet incremental capacity and energy needs as opposed to building assets. TVA builds and acquisitions are limited to PPAs only instead of self builds. Transmission build out may be required to make the PPAs a fully deliverable firm product.
Promote DER	TVA incents DER to achieve high-end of long-term penetration levels. Existing coal is limited and new coal is excluded. All other technologies are available while EEDR and distributed generation and storage are promoted.
Promote Renewables	TVA makes a commitment to renewables at all scales to meet growing prospective or existing customer demands for renewable energy. Existing coal is limited and new coal is excluded. All other technologies are available while renewables are promoted.
Promote Resiliency	TVA promotes resiliency as a pursuit of a more sustainable future. Nuclear additions (SMRs), gas additions (aero derivatives, RICE), DR, storage, and distributed generation are promoted. Flexible loads and DERs are aggregated to provide synthetic reserves to the grid to promote resiliency.
Promote Efficient Energy Usage	TVA incents electrification, demand and energy management to minimize peaks and troughs across a daily load shape and promote efficient energy usage. All technologies are available, but those that minimize load swings are promoted (e.g., EEDR, storage, distributed generation).
Add Small, Agile Capacity	TVA adds small, agile capacity to minimize flexibility. All technologies are available while gas additions (aero derivatives, RICE), demand response, and distributed generation/storage are promoted.

Comparison of Peer Strategies to TVA

Company	Meet an Emissions Target	No TVA Builds	Promote DER	Promote Renewables	Promote Resiliency	Promote Efficient Energy Useage	Add Small, Agile Capacity
	Emissions	Market Reliance	Renewables / DER			Flexibility	
Tennessee Valley Authority (TVA)	✓	✓	✓	✓	✓	✓	✓
Arizona Public Service (APS)	✓			✓		✓	
Dominion (DOM)	✓✓✓✓✓✓✓						
Duke Energy Carolinas (DEC)	✓			✓		✓	
Duke Energy Progress (DEP)	✓✓			✓		✓	
Entergy (ETR)				✓			
Portland General Electric (PGE)				✓✓✓✓		✓	
PacifiCorp (PCQ)				✓✓✓✓✓	✓✓		
Duke Energy Florida (DEF)	DEF did not disclose specific strategies developed as part of the IRP						
Florida Power & Light (FPL)	FPL did not disclose specific strategies developed as part of the IRP						
Georgia Power Company (GPC)	GPC did not develop separate strategies for evaluation						

- Although peers often included DER promotion as a component of strategies, the focus of the strategy was growth of renewables or EE/DR expansion

Comparison of Peer Strategies to TVA

Key Takeaways

- TVA shares similar strategies with many of the peer group related to renewables, energy efficiency, and working to meet the intent of the CPP
- TVA is unique in its inclusion of a “No Build” strategy that relies on available market options and the potential build out of transmission to support power delivery from outside the territory
- Although growth of DER is identified as a potential scenario by most peers, no other utility includes a strategy to “Promote DER”
- TVA has a well-defined approach to Small and Agile capacity adds, with the goal of promoting Flexibility, which is something that is not explicitly called out in most peer strategies

Comparison of Peer Strategies to TVA

Use of Attributes

- The approach by TVA to include sub-category “Attributes” to describe each strategy, based on utilization of resource types, was unique across the peer group
- Although peers would be required to assign resource selection for each defined strategy, in order to model and test each scenario / strategy combination, this detail was not disclosed in the IRPs
- This approach affords TVA with an additional layer of resource detail that can clearly define the intent of each strategy and define composition of resources for the final portfolio
- Compared to exhaustive analysis of all resource combinations for all strategies, constraint of attributes for each strategy could limit full consideration of all resource combinations

Lunch

Strategies Overview and Discussion

Hunter Hydas

Definitions for Strategies

Across the various strategies, specific candidate resource selection will be:

- Promoted (given an incentive)
- Available (no promotion, limitation, or exclusion)
- Limited (type, amount)
- Excluded (not available)

Promotions, limitations, and exclusions are applied, and then portfolios are optimized given those parameters

TVA is Considering 7 Strategies*

Emissions

- Meet an Emission Target

Market Reliance

- No TVA builds

Renewables/DER

- Promote DER
- Promote Renewables
- Promote Resiliency

Flexibility

- Promote Efficient Energy Usage
- Add Small, Agile Capacity

* In addition to the Reference Plan based on Least Cost Planning

Emissions

Meet an Emissions Target

- TVA makes a commitment to long-term carbon emission target consistent with customer expectations and international climate agreements.
- New coal builds are excluded, while existing coal and gas additions are limited due to their carbon emissions.

Market Reliance
No TVA Builds

- TVA makes a decision to rely on the market to meet incremental capacity and energy needs as opposed to building assets.
- TVA builds and acquisitions are limited to PPAs only instead of self builds.
- Transmission build out may be required to make the PPAs a fully deliverable firm product.

Renewables/DER
Promote DER

- TVA incents DER to achieve high-end of long-term penetration levels.
- Existing coal is limited and new coal is excluded.
- All other technologies are available while EEDR and distributed generation and storage are promoted.

Renewables/DER
Promote Renewables

- TVA makes a commitment to renewables at all scales to meet growing prospective or existing customer demands for renewable energy.
- Existing coal is limited and new coal is excluded.
- All other technologies are available while renewables are promoted.

Renewables/DER
Promote Resiliency

- TVA promotes resiliency as a pursuit of a more sustainable future.
- Nuclear additions (SMRs), gas additions (aero derivatives, RICE), DR, storage and distributed generation are promoted.
- Flexible loads and DERs are aggregated to provide synthetic reserves to the grid to promote resiliency.

Flexibility
Promote Efficient Energy Usage

- TVA incents electrification, demand and energy management to minimize peaks and troughs across a daily load shape and promote efficient energy usage.

- All technologies are available but those that minimize load swings are promoted (e.g., EEDR, storage, distributed generation).

Flexibility
Add Small, Agile Capacity

- TVA adds small, agile capacity to maximize flexibility.
- All technologies are available while gas additions (aero derivatives, RICE), demand response, and distributed generation/storage are promoted.

TVA is Considering 7 Strategies

		Potential Strategies						
		Emissions	Market Reliance	Renewables/DER			Flexibility	
		Meet an Emission Target	No TVA Builds	Promote DER	Promote Renewables	Promote Resiliency	Promote Efficient Energy Usage	Add Small, Agile Capacity
Attributes	Existing Nuclear	Available	Limited	Available	Available	Available	Available	Available
	Nuclear Additions	Available	Limited	Available	Available	Promoted	Available	Available
	Existing Coal	Limited	Available	Limited	Limited	Limited	Available	Available
	New Coal	Excluded	Limited	Excluded	Excluded	Excluded	Available	Available
	Gas Additions	Limited	Limited	Available	Available	Promoted	Available	Promoted
	Energy Efficiency and Demand Response	Available	Available	Promoted	Available	Promoted	Promoted	Promoted
	Renewables (Utility Scale)	Available	Limited	Available	Promoted	Promoted	Available	Available
	Storage (Utility Scale)	Available	Limited	Available	Available	Promoted	Promoted	Available
	Distributed Generation/Storage	Available	Available	Promoted	Available	Promoted	Promoted	Promoted

Attribute Diversity

Strategy Attributes	Promoted	Available	Limited	Excluded
Existing Nuclear	0	6	1	0
Nuclear Additions	1	5	1	0
Existing Coal	0	3	4	0
New Coal	0	2	1	4
Gas Additions	2	3	2	0
EEDR	4	3	0	0
Renewables (Utility Scale)	2	4	1	0
Storage (Utility Scale)	2	4	1	0
DG/DER	4	3	0	0

Key Points

- The selected strategies represent a ample breadth of potential business options
- The strategies include ample variation of the critical attributes

Note: Numbers reflect the number of strategies in which the attribute falls into one of these 4 classifications

Strategies: Discussion/Group Exercise

Hunter Hydas

Part 1: Small Group Exercise

1. Divide into Small Groups of 3-4 People
2. If you could develop a strategy for TVA, what would it be?
3. Record your Team Strategy on a Flip Chart
4. Teams report out and Post Strategies

Part 2: Individual Feedback on Strategies

1. If you have a suggestion, addition or question on any Strategy *(TVA and IRPWG Proposed)* please write it on a sticky note and place it on the appropriate Strategy.

2. After the break, we will work through all the questions and concerns together as a group.

Break

Discussion of Comments

Hunter Hydas

Check In – Strategy List

Jo Anne Lavender

Resource Technologies – Next Steps

Jane Elliott

Resource Technologies – Next Steps

- Deep dive into the current portfolio and projected firm capacity
- Reserve margin planning targets
- Capacity expansion options
  - Characteristics and costs
  - Integration cost and flexibility benefit
  - Third party review
- Modeling approach overview

Wrap Up

Next Steps on Strategies

- Individual ranking will occur between the June and July meeting
- TVA will send a ballot out after this meeting and ask for your responses by June 21 (2 weeks after the meeting)
- We plan to share the results at the July Meeting

Thank you!