

Introduction to the Florida Municipal Power Pool (FMPP)

Board of Directors and Staff October 18th, 2023

Agenda

- Basic Pool Functions
 - Unit Commitment, Economy Energy and CHP Settlement
 - Keeping the Lights On
 - Beyond CHP: Ancillaries
- Pool Value Proposition to FMPA
- Expansion Efforts and Opportunities





Big Picture – FMPP Has Two Key Roles

Energy Market & Keeping the Lights On

- The Power Pool can be thought of as having two primary roles
 - Economy Energy Market resources of FMPA ARP, OUC, and Lakeland Electric are "pooled" to serve total load least-cost every hour
 - **Buyers** have more load than economic generation in a given hour
 - Sellers have more economic generation than load in a given hour
 - Generation that is cheapest runs the most, regardless of who owns what
 - Keeping the Lights On forecasting load, balancing actual load with generation each second, reserves and reserve sharing, managing constraints (day-ahead and real-time)



Before We Dive In, Some Brief History

Pool Has Been Around for Many Decades

- Florida Municipal Power Pool is born
 - Agreement forming FMPP signed on May 27, 1988
 - 3 Members: FMPA ARP, OUC, and Lakeland
 - KUA participated as fourth full member from 1997 to 2002
 - Began operating on July 1, 1988





Economy Energy Market and CHP Settlement

What is Economy Energy?

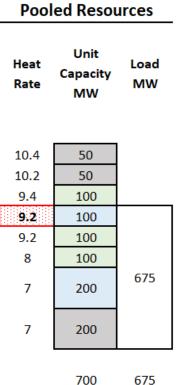
Energy That Gets Bought and Sold by Hour

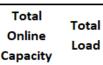
- The FMPP can "commit" (plan to run) resources generally based on how expensive they are to run ("supply curve")
- Resource cost in given hour based primarily on fuel consumption required to generate "X" megawatts ("heat rate") and cost of fuel ("fuel price")
- Example: \$3.00/MMBtu gas price and 7.0 MMBtu/MWh heat rate = \$3.00*7, or \$21/MWh energy cost (excluding startup and other variable)
- Renewable resources (solar) are "as available" they dispatch when there is useful sunlight and are planned around (zero variable cost)
- If one pool partner has excess generation lower cost than another, total cost of pool is minimized by allowing low-cost energy to be "sold"



Units Committed to Serve Load Most Efficient Group *Drives Lower Overall Cost of Production*

Stand Alone		
Heat Rate	Unit Capacity MW	Load MW
9.2	100	
7	200	225
9.4	100	
9.2	100	225
8	100	
10.4	50	
10.2	50	
7	200	225
	850	675
	Total Online Capacity	Total Load





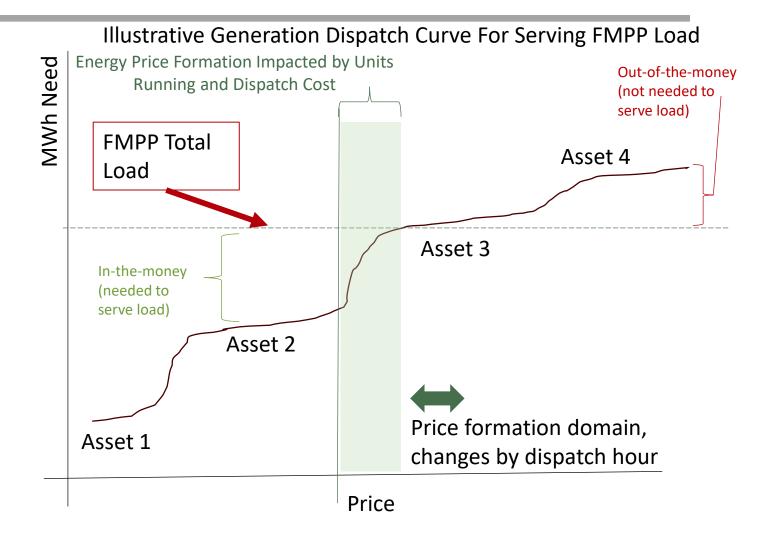
- Standalone unit sizes and characteristics would drive alternative mix of resources committed (made ready) to serve individual entity (Stand Alone) load
- Commitment as a group leads to the more efficient use of resources
- Drives lower overall cost of production due to lower heat rates and alignment of MWs with need in total



Dispatch a Function of Heat Rate, Fuel Cost, & VOM

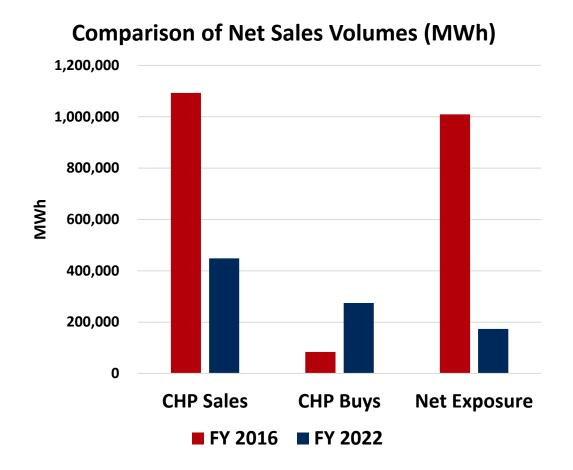
Unit Produces Based on Economics of Cost vs. FMPP Needed MWhs

- Every unit has parameters that determine how it will dispatch MWhs:
 - Heat Rate
 - Delivered fuel cost
 - Variable O&M
 - Start-up cost
 - Minimum run time
- FMPP dispatches resources to serve FMPP total load





ARP Pool Energy Seller's Exposure Down ~83% vs. '16 *Strategy to Sell Excess and Reduce Sales at Low Margin*

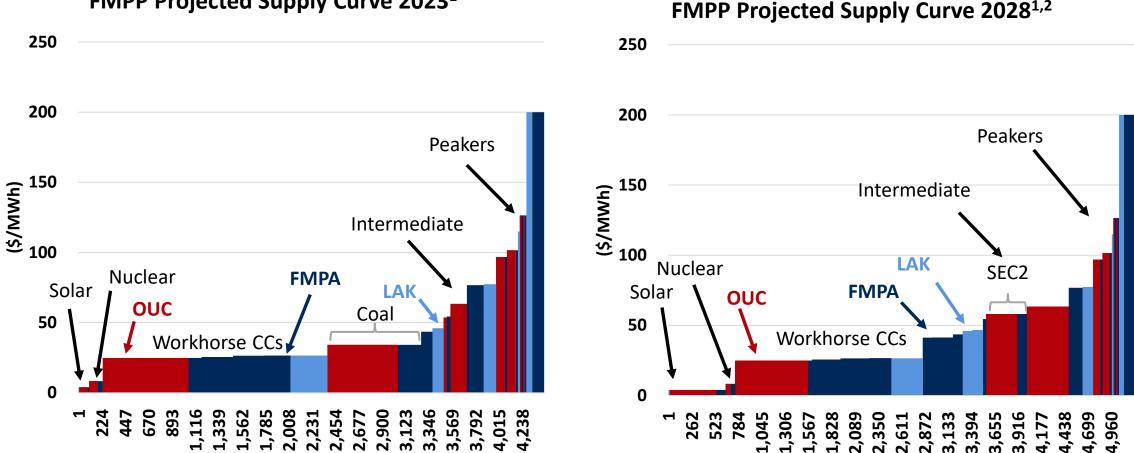


- Residual capacity and energy sales strategy over 5-6 years to lower ARP costs
- Reduces sales to FMPP partners at low margin
- Move to a more balanced position and purchasing more



The Most Economical Energy Runs First

FMPA New Resource Adds Will Further Displace Coal/Peakers



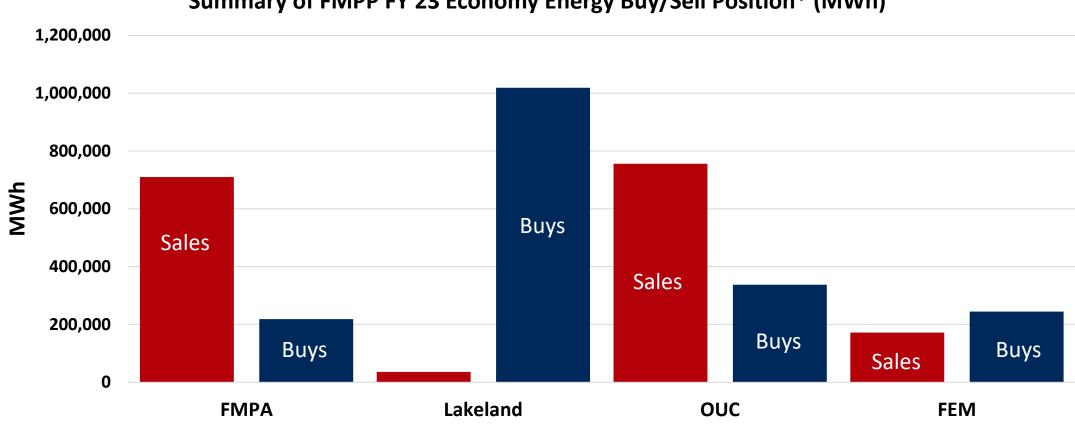
FMPP Projected Supply Curve 2023¹



- 1 Some infrequently used peaker and diesel generation costs capped at \$200/MWh for visual.
- 2 2028 merit order assumes 2023 fuel prices.

Member Buy and Sell Position Differs

Driven By Available Economy Energy After Load Is Served



Summary of FMPP FY 23 Economy Energy Buy/Sell Position* (MWh)



*Based on most recently available FMPP billing. Actual volumes subject to adjustments.

Settlement Based on Clearing Price

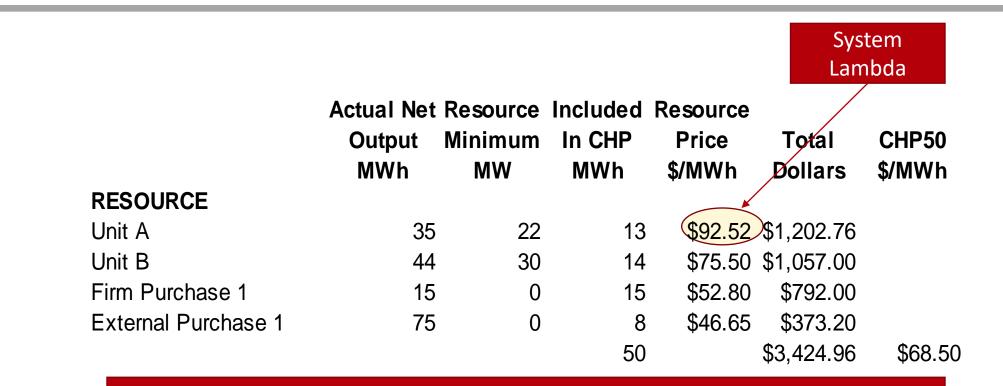
Price That Buyers Pay Sellers in Each Hour

- CHP stands for Clearinghouse Price
- Agreed to method for pricing energy that pool members buy from and sell to the pool
- Currently, CHP is weighted average price of highest cost 50 MW that can ramp down in any given hour (referred to as "CHP50")
- Various exclusions exist for taking a resource out of the CHP price, most notably (1) units that are "must run" to manage other constraints, (2) units running at minimum load, plus other situations



CHP50 Calculations Are Tricky, Reflect Bias to Buyer

Ramp Down Capability Blending Reduces Clearing Price



CHP 50 differs from system lambda (highest cost unit that's on) because of the weighted average concept, which works from highest cost down to lower cost until 50 MW of ramp-down capability has been reached.



Other Factors Impact CHP Prices

Production Cost Includes VOM, PPAs May Differ

- Generating unit price (production cost) is sum of its:
 - Incremental cost (heat rate* fuel cost)
 - Non-fuel variable costs (VOM)
 - Other special costs
- Firm Power Purchase Agreements can also influence CHP, which may be based on contractual prices



I Know CHP50 – Now What?

Buyers and Sellers Must Be Determined

Load is Compared Against **ONLINE** Resources – Pool "balances" to zero unserved MW by multiplying CHP50 by MWs bought. Buyers pay that amount to sellers.

RESOURCES	MEMBER 1	MEMBER 2	MEMBER 3	FEM
Generation	350	825	1175	
Firm Purchase	0	330	15	
Total Resources	350	1155	1190	
OBLIGATIONS				
Native Load	442	1175	1099	
Firm Sales	50	0	0	
Total Obligations	492	1175	1099	
Selling <mark>(Buying)</mark> from the Pool	(142)	(20)	91	71

FEM = Florida Energy Marketing – buys for or sells from pool resources, among other functions (external buyer and seller representing pool assets).



Florida Energy Marketing External Agent

Short-Term Purchases and Sales Outside Pool

- FEM makes a purchase in the external market to:
 - Save Members money relative to running our own resources
 - Mitigate transmission or capacity issues
 - Avoid starting a Member resource
- FEM makes a sale in the external market to:
 - Decrease Member cost by making a profit
 - Reduce "cycling" of units by selling excess in off-peak periods
- Sales are generally "non-firm" can curtail the sale
- FEM activity impacts CHP50 much like our own resources



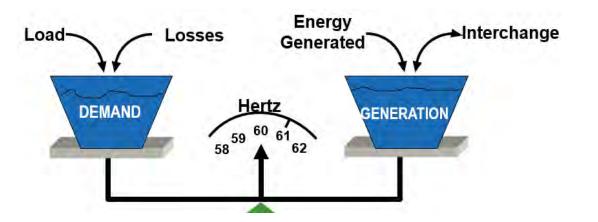


Keeping the Lights On

Balancing Authority Role Fundamental to Reliability

Required Even Without an Energy Market

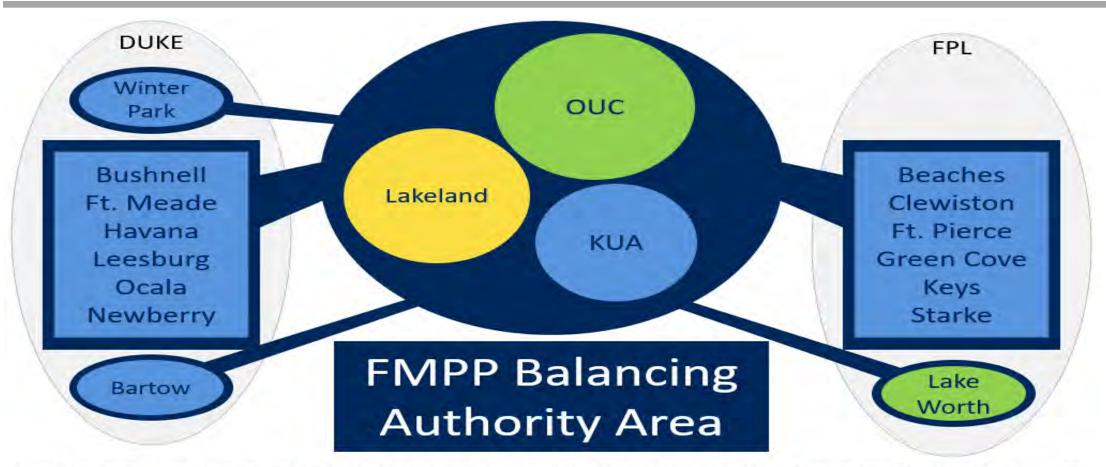
- **Balancing Authority (BA):** responsible entity that integrates resource plans ahead of time, maintains loadinterchange-generation balance within a...*metered boundary containing generation, transmission, and loads...,* and supports Interconnection frequency in real-time.
 - Hour to hour: compiles forecasted load and generation needs, inadvertent energy accounting
 - Minute to minute: load following, supplemental reserves
 - Second to second: spinning reserves





BA Has Generation, Transmission, Load

Must Manage Interconnection Constraints



Note: some sales are scheduled via energy tags rather than being incorporated in the Pool.



A Typical Day Involves Many Tasks Across Timeframes *Based Primarily on Next Day + Real Time & Info Handoffs*

Days/Weeks/Months Ahead	 Load Forecast Outage Planning Transmission Service 	
Next Day	 Load Forecast Unit Commitment Fuel Burn Forecast 	
Real Time	 Dispatch of Resources Ancillary Services Managing forced outages 	



Commitment and Dispatch Critical

Must Forecast Load and Serve It Reliably

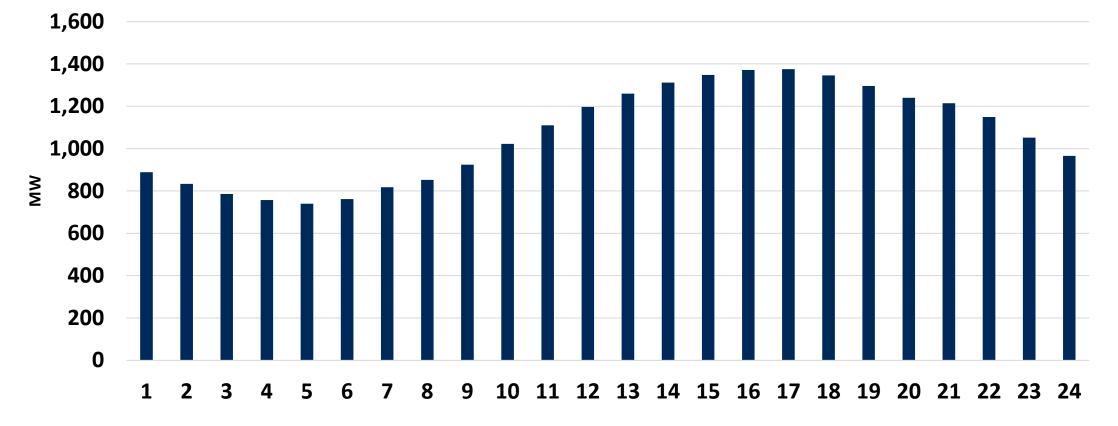
- Unit commitment is deciding what units will start and when to meet forecasted loads
 - Heavily focused on next-day operations
 - Influenced by needs for the next several days
- The FEM group performs this function
 - Uses Gentrader production simulation model



Dispatch Adjusts to Real Time Load

Load Ramps Up and Generation Must Match

Typical ARP Daily Load by Hour (Summer) (MW)





Other Constraints Besides Load Daily

All Must be Managed by BA/Control Center

Constraint	Impact
Transmission Availability	The "roadway" for generation to get to load is blocked.
Minimum Run Time/Must-Run	A generator can't be turned off unless it runs at least X hours.
Ramp Rate	If load changes, a generator can only respond by X MW per unit of time.
Unit Minimum Load	A generator cannot operate below a certain MW threshold.
Power Purchase Agreements	Notice may need to be given in advance to run purchased resource for the pool.
Florida Reserve Sharing Group	Pool provides certain reserves to manage emergency situations within FRCC.



Ancillary (Support) Activities Complex

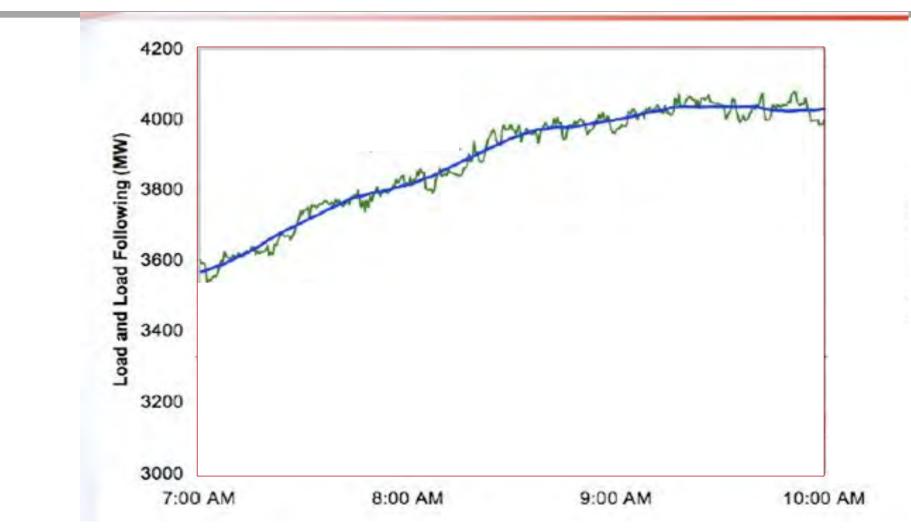
Load Following Must Occur Instantaneously

- Regulation service is generation that follows changes in load within the hour
 - Area Control Error (ACE) is the calculated difference between a BA's actual and scheduled interchange
 - Automatic Generation Control (AGC) sends signals from the Energy Management System (EMS) to the generators
- Typically, our natural gas resources are placed in AGC mode to follow fluctuations in load, with our other committed generation staying on to serve the portion of load that is there every second



Load Must Match Within the Hour

Generator Control Sends Load Following Signal





Basics of Ancillary Services

Spinning Reserve / Frequency Response/Supplemental/Quick

- Spin/Frequency: Generation online and running but kept below maximum output to immediately respond to frequency deviations due to a unit forced outage
 - Shared responsibility across the Eastern Interconnection
 - Determined by size, responsiveness of generators
- **Supplemental/Quick Start**: An amount of generation that can start within 15 minutes to replace a unit after a forced outage
 - May also be online generation that can ramp up within 15 minutes
- FMPA units provide supplemental reserves for FMPP
 - Cane Island 1
 - Indian River





Beyond CHP: Ancillaries

Other Market Mechanisms Exist

More Complex Settlement beyond CHP50

- Start cost allocations
- Pool transmission service cost
- Emergency energy service (deficiency calculation)
- Ancillary service charges
- Incurred generation & priority list, including revenue and cost determinations



Pool Transmission Service Variable Pass-Through Allocated Based on Ownership Share of Pool Transmission

- Members pay the Pool for use of its transmission system for every MWh sold to or purchased from the Pool
- The transmission charge per MWh is equal to: \$0.125/MWh plus 0.5% for losses priced at CHP
- The Pool allocates 100% of the transmission dollars collected to the Members based on their ownership share of the pool transmission system



Emergency Energy Service Based on Time Domain

Situational Drivers Result in Markup Over CHP for Scarcity

 If a Member's total available capacity is <u>insufficient</u> to meet its native load, firm sales obligations and its share of the Pool's Operating Reserve then the Member is <u>capacity deficient</u>

	PRICING OF UNSERVED ENERGY		
SITUATION	FIRST 72 HOURS	HOURS 73 - 216	AFTER 216 HOURS
CURTAILABLE SALES WERE CURTAILED	120% of CHP	CHP or 100% of the weighted average cost of	The greater of 150% of CHP or 100% of the weighted average cost of FEM Transactions
CURTAILABLE SALES WERE NOT CURTAILED	The greater of 150% of CHP or 100% of the highest FEM transaction or price of FEM sale	highest FEM transaction	The greater of 200% of CHP or 100% of the highest FEM transaction or price of FEM sale
OUTAGE MOVED BY FMPP	100% of CHP - up to the MWs Moved	100% of CHP - up to the MWs Moved	100% of CHP - up to the MWs Moved



Other Ancillaries Op Reserve Starts, Spin, Load Follow *Cost Allocation Approaches Vary Based on Service Provided*

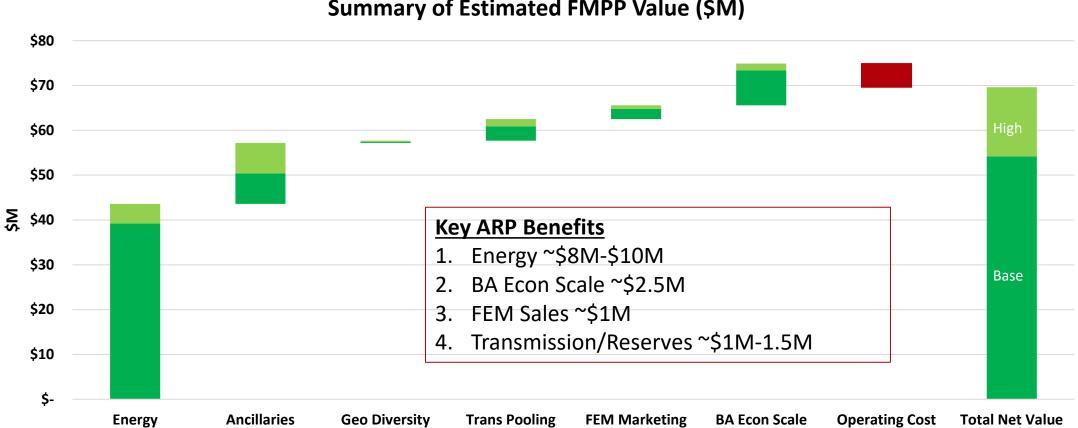
Ancillary Service	Compensation/Cost Allocation Approach
Member's quick-start unit starts in response to a call for reserves from the state (excluded from CHP) (Florida Reserve Sharing Group).	Cost of unit = start cost plus difference between unit marginal cost and CHP times energy generated. Allocated to all Members based on Member's share of Pool's Operating Reserves
Members carry 25% on-line spinning reserve for other Members and themselves	\$/MW hourly charge equal to hourly dispatch price of fuel gas multiplied by 1.45 plus compensation for ramp-rate/unit MW pick-up capability paid to carrying Member(s)
Resources that follow load and must constantly move up and down to achieve instantaneous balance	3 elements paid to Member: \$/MWh unit cost difference from CHP, portion of VOM attributed to load following, and heat rate degradation resulting from constant movements





Pool Value Proposition to FMPA

FMPP Delivering ~\$54M-\$70M in Annual Value ARP Share ~\$10M-\$15M Net of Operating Cost Allocation

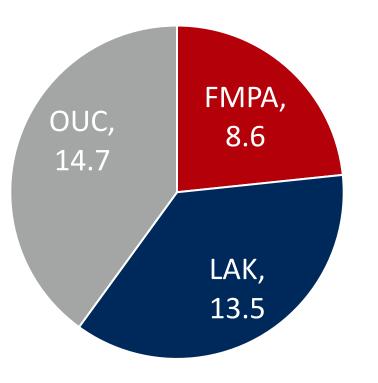






ARP Energy Value Share ~\$8M - \$10M Last 3 Years Separate and Distinct from Settlement Refinements

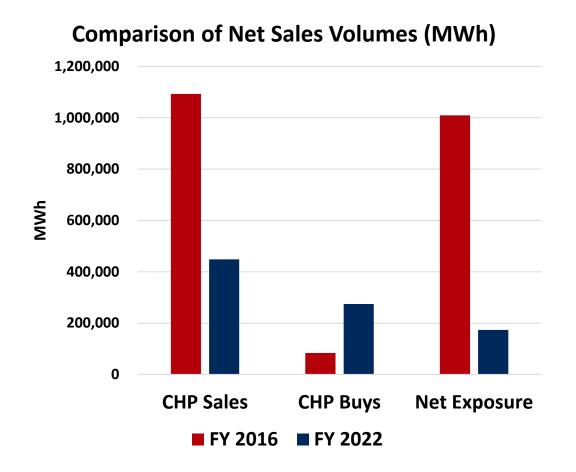
Adjusted Benefit Shares (\$M) - Energy



- Production Cost Benefits reflect <u>exchange</u> at modeling estimate of "CHP"
 - More expensive units do not run
 - Sell into/buy from exchange at marginal cost
- Does not reflect exclusions or rule applications within FMPP
 - Could alter slice allocations of benefits
- Benefits are dynamic and driven from
 - Fuel cost changes
 - Load and position changes
 - Portfolio & asset changes
 - Transmission constraints and rules



ARP Pool Energy Seller's Exposure Down ~83% vs. '16 External Strategy Mitigates Sell Exposure, Buys Mostly On-Peak

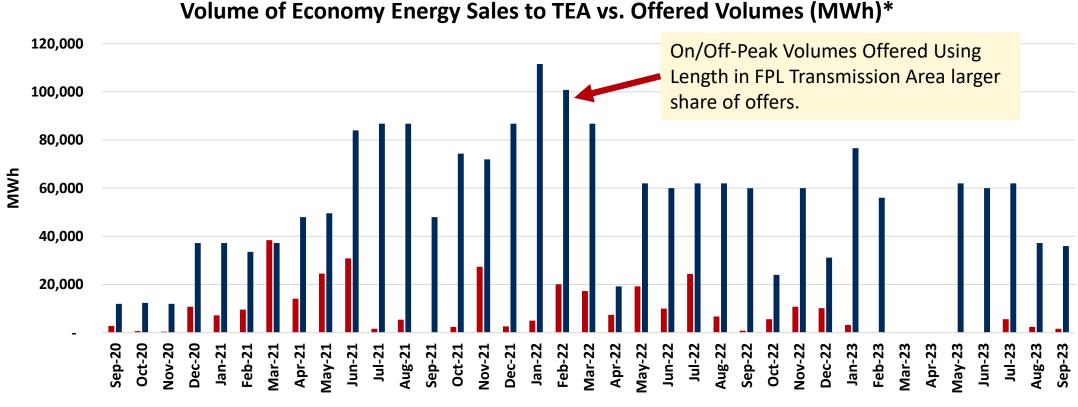


- Residual capacity and energy sales strategy over 5-6 years to lower ARP costs
- Reduces net seller's FMPP exposure (sales net of purchases) subject to FMPP settlement for sellers
- CHP buys reflect avoided costs related to economy resources servicing ARP Native + Wholesale Native and tolling energy needs – contributes to lower ARP costs
- Assuming parity between buy and sell side settlement bias, potential lost opportunity significantly reduced



Remaining Economy Energy Offered Externally

We Move Every MWh We Can Subject to Limited Liquidity

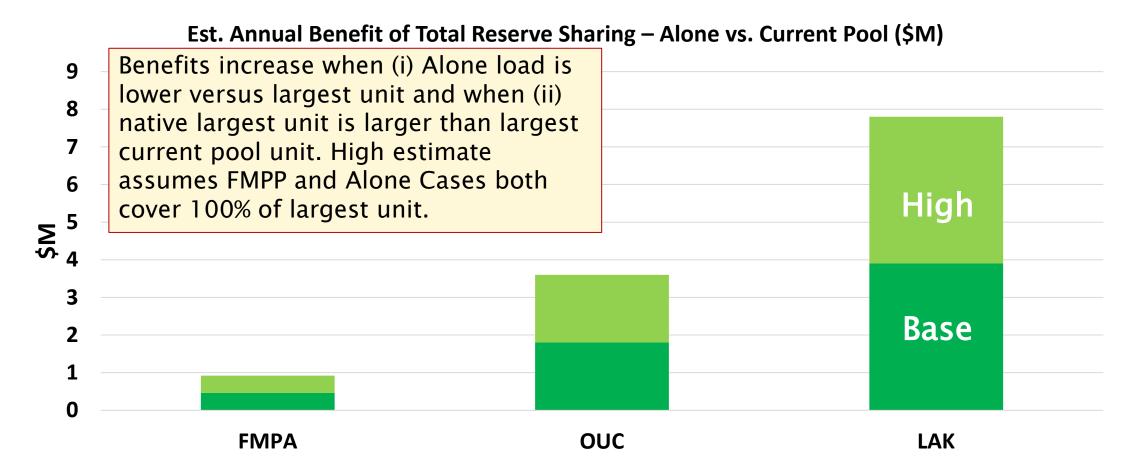


MWh Sold MWh Offered



*Products available for on-peak, off-peak, and ATC with associated pricing to ensure energy margin if sold to matched buyers. Excludes energy sales paired with capacity and other direct sales. Some volumes shown reflect partial periods within the month or average of sub-periods within a month.

FL Reserve Share Working Est. FMPP Value \$6-\$12M *FMPA Contingency Vs. Load Less Significant (\$0.5-\$1M Value)*





ARP's Share of Other FMPP Value Covers Cost Share *Future Opportunities and Certain Values Areas To Come*

- FMPA Budget Allocation for FMPP ~\$3M annually
- BA Economies of Scale Benefit ~\$2M-\$2.5M
 - 26% of estimated scale value based on current allocation methods for FMPP's operating expenses
- Pooled Transmission Value ~\$190k
 - Small portion of value estimated based on network service and KUA transmission flexibility for ARP
 - OUC and Lakeland lack of NITs skews value for Members
- Spinning Reserve Value ~\$190k \$380k
 - Economy spin provided in FMPP
 - If Alone, increased risk aversion for n-1 type events means more spin (20% risk aversion)
 - Other ancillary services will be evaluated in future cycles (e.g. load following) + new products
- FEM Marketing ~\$700k \$1M leveraging FMPP economy assets or through purchases

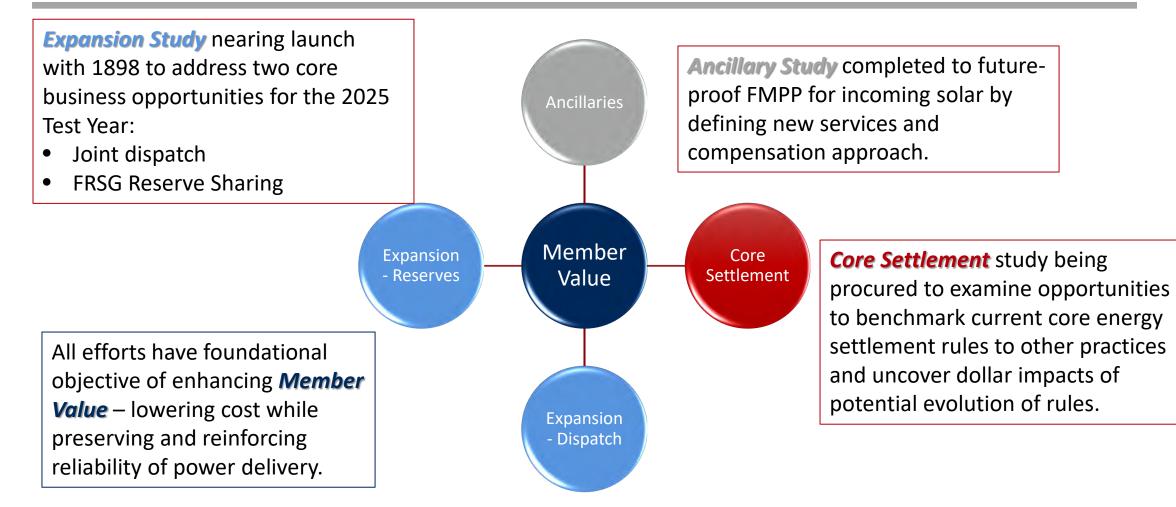




Expansion Efforts and Opportunities

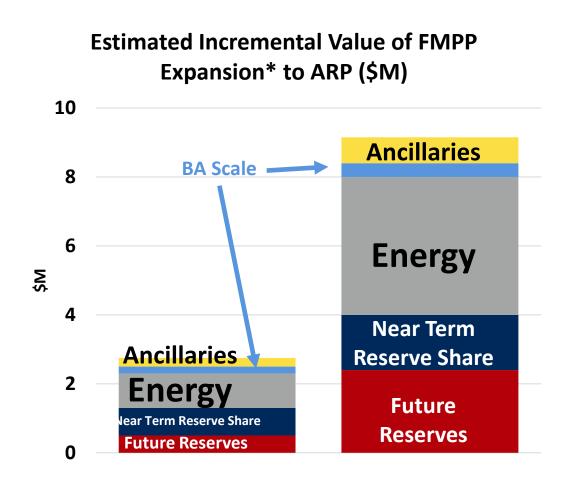
Opportunities in Various Areas Converge for Value

Some Work Completed, Other Studies Getting Started





Major FMPP Expansion Could Bring ARP ~\$3M-\$9M *Based On ~10%-20% (~\$5-10M) Energy Benefit for FMPP*



- Reserve sharing for solar integration reduces reserves by ~ 20%, could deliver ~\$6M annually by 2030
 - ARP Share ~\$2.4M
- Reserve management in the near term could reduce required reserves by as much as 1,700 MW assuming 14,000 MW size
 - ARP Reduced capacity hold for contingency of ~141 MW could bring ~\$1.6M in additional value even at \$1/kW-mo. sale
- Applying 10%-20% incremental benefit from commitment /dispatch of larger asset base delivers ~\$5M-\$10M annually
 - ARP Share ~\$1M-\$4M
- Spin provision and other ancillaries' benefits could double to \$0.75M for ARP (~\$400k benefit today for spin)
- Scale and technology/teaming benefits at ~\$1M annually with gradual efficiencies built up over time
 - ARP Share ~\$400k



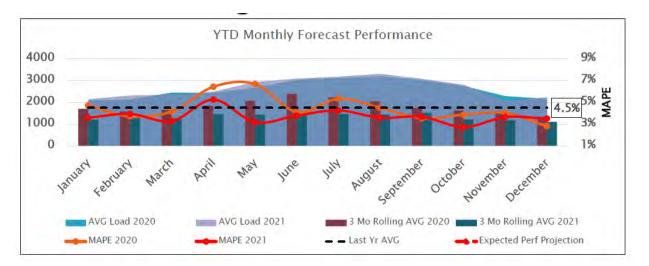
*Assumes significant expansion to ~14,000 MW pool with like-minded parties, with certain benefits realized over time.

Outage Planning & Better Forecasting ~\$2.5M/Year

ARP Load Ratio Share ~\$1M in Savings

Estimated Production Cost Savings (\$M) from Outage Optimizing (Jan '23 - June '23) \$300 \$312,000 \$225 ટ્ટ્ર \$150 **\$75 \$0 Current Case Optimizer Case**

Forecast Error Reduced from >5% to 2-3%

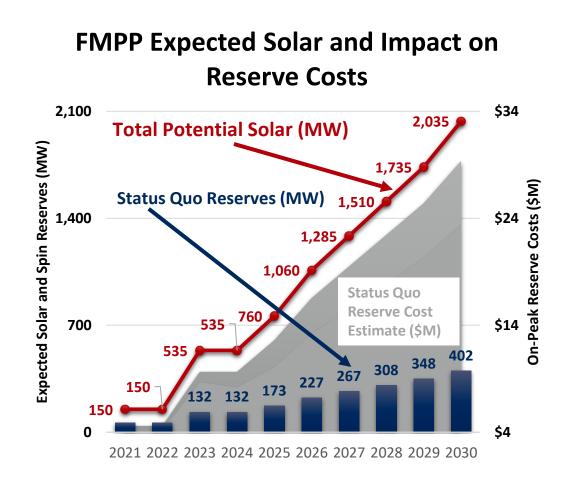


- More frequent forecasting enhances ability to commit and dispatch resources
- Avoids over-commitment cost
- Proactive action in extreme weather events
- More granular forecasts & fewer resources



Revised Reserve Approach Could Bring ~\$6M by 2030 ARP Could Add ~\$2.4M, Reserve Sharing Today ~\$1M Value

- Solar MWs could expand to as much as 2 GWs by 2030
- Application of improved reserve management and larger base can support reduction in reserves
- Geographic diversity of solar through joint coordination with other like-minded entities
- Current FMPP Total Reserve Management (sharing of FRSG reserve and coverage for loss of largest unit) already yielding \$6M-12M in total benefits and \$0.5M-\$1M benefit for ARP*





as a group.

Economic Evaluation of FMPP Expansion In Progress

Energy and Reserve Cost Savings With Expanded Resource Mix

- Acceleration of solar integration key driver in potential expansion
- Economies of scale/resource diversification can manage risks
- Evaluation likely completed mid-2024
- FMPP generation portfolio going through significant transformation with added solar, new gas units for the pool and retirement/ conversion of Stanton 1 & 2
- New pool products that provide revenues for ancillary services will be required to support cost recovery of key unit attributes
- ARP and FMPP adding scale could reduce contingency/spin shares



Maintaining Reliability Comes at High Costs

Seeking New Relationships Can Help Mitigate Impacts

More Spin

- Required to adjust for PV intermittency
- Higher energy costs
- Other ancillary service products required

More Starts

- Increased cycling
- Higher maintenance costs

Reserves

- PV capacity is not guaranteed
- Higher operational and planning capacity reserves
- Idle capacity costs

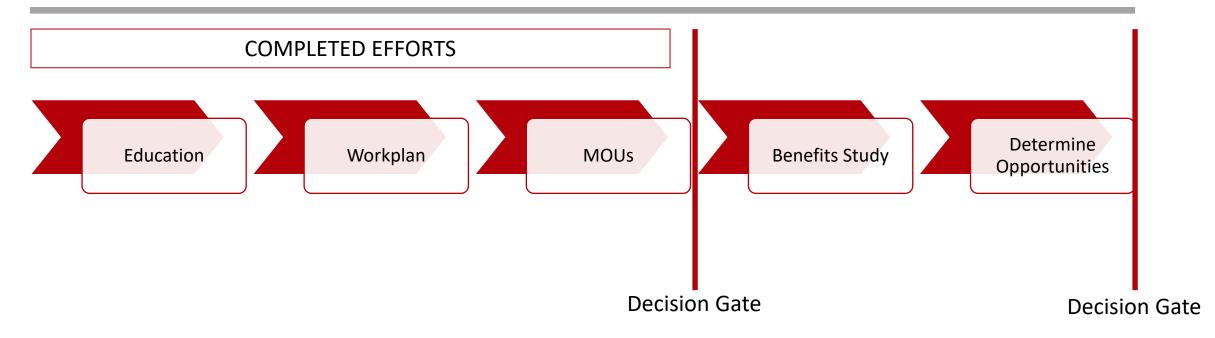
People

- Increased staffing
- Increased training
- Tech investments
- Increased coordination between entities



Milestone Expected after Benefits Analysis Q2 2024

Timeline Delayed Due to Coordination Requirements



- Educational sessions well received with good engagement
- Workplan and MOU development required extensive multi-party coordination
- Benefits study scoping and procurement completed, with kickoff of 1898 study mid-October



Reserve Flex Key Ancillary Products From Study

2022 External Review Drives Potential New Products/Services

- <u>30 Minute Flexible Reserves</u> for net load variability and contingency reserves
- <u>Downward Flexible Reserves</u> 12 or 30 minutes to make room for solar output during low load / high solar periods
- <u>90 Minute Replacement Reserves</u>
- <u>Offline Reserves</u> Explicit settlement / inclusion of
- Updates to include solar intermittency (E.g., Load Following, Solar Spin, etc.)

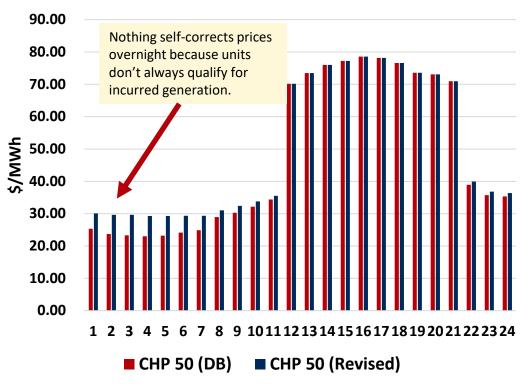


Opportunities Remain to Evolve Energy Settlement

Requires Further Work to Ensure Reliable Power Delivery

- Ramp-down weighted avg. (CHP 50) concept vs. benchmarks
- Units at minimum -
- Incurred Generation
 - Other make-whole payments
- Evaluate whether comparable outcomes to benchmark practices for buyers and sellers

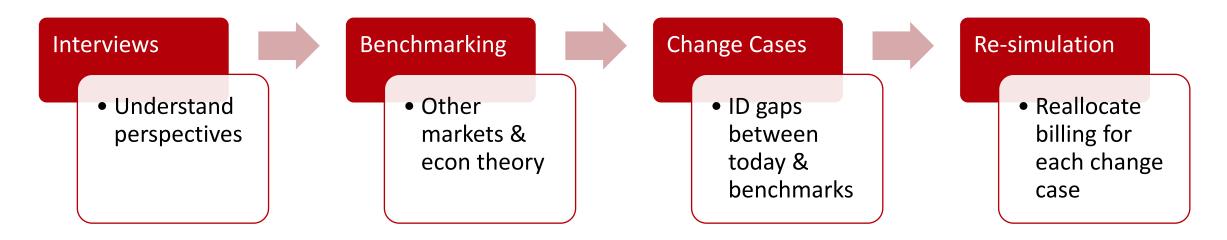
Original and FMPP CHP50 w/Units at Min October 1, 2018 (\$/MWh)





Internal Settlement Study Bids Received

Overall Objective: Determine if key elements of existing FMPP Settlement rules (i) align with industry best practices and (ii) achieve outcomes for buyers and sellers of a comparable level of equity to benchmarks to be defined within the study by the consultant.



A "change case" is a defined difference in settlement rules between current practice in a given area and the consultant's benchmark as based on industry practices and economic theory. No re-dispatch is required to reallocate billing between buyers and sellers.

Core Energy Settlement Focus of Study

Core Energy Settlement Area		Key Issues
Energy Settlement		CHP 50 vs. viable alternatives; exclusionary provisions vs. best practices
Make-Whole Provisions		Energy and capacity incurred – complexity, uncertain recovery, scarcity signals; potential opportunity for simplification
FEM Margin Allocation		Alignment with industry practices for bilateral sales margin (revenue less cost)
Transmission Service		Energy-based pass-through and reallocation compared to other methods; review of transmission charge basis for legacy regional tariff rates comparable to existing FMPP
Individual Resource Pricing Inputs		Cursory review only of gas price, start-up, VOM approaches.*
	*Not included in change cases since this layer of adjustment would require full re-dispatch of historical period.	



Q&A Session

FMPP Market Hybrid of Traditional Market & RTO

FMPA Striving To Maximize Member Value With Future Decisions

Traditional Market

- **Bilateral Energy Markets**
 - Transactions are primarily physical between counterparties at fixed prices
- **Control Area Reserves**
 - Bilateral contingency reserve sharing groups exist
- Ancillary Services
 - Services provided by traditional balancing areas and priced per tariff requirements
- Transmission Congestion managed by Transmission Loading Relief ("TLR").
 - Manage risk associated with congestion through purchase of firm transmission.



Centralized Energy Economic Dispatch

- Day ahead energy supplemented with bilateral transactions
- Transactions are primarily physical
- **FMPP** Reserves
 - FMPP sets requirements for day-ahead and operating reserves
- **Ancillary Services**
 - Services provided as needed with generation that is economically dispatched
- Transmission
 - FMPA typically only participant with need for new transmission reservations
 - FEM periodically makes sales and purchases from outside FMPP that require some transmission management that can only come from available FPL/DUKE ATC

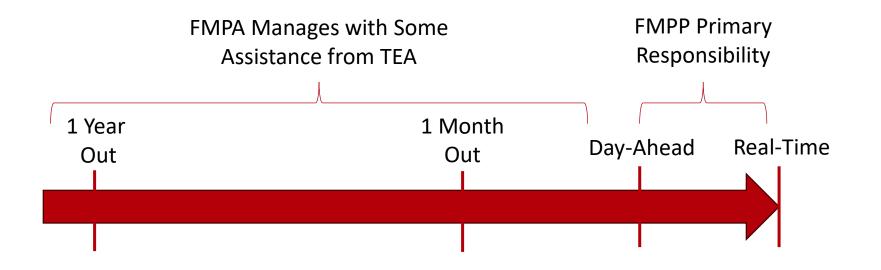
RTO Market

- **Centralized Energy Market** •
 - Day ahead and real time energy and reserves supplemented with bilateral transactions
 - Transactions are primarily financial (fixed for float swaps)
- **Control Area Reserves** •
 - One RTO area optimizes both quantity and price for all reserves
- **Ancillary Services** •
 - Reliability requirements built into economic dispatch requirements
- Transmission Congestion •
 - Managed by Locational Marginal Pricing ("LMP").
 - Manage risk associated with congestion through purchase of financial transmission instruments. 52



Most FMPP Services Provided Day-ahead to Real-Time

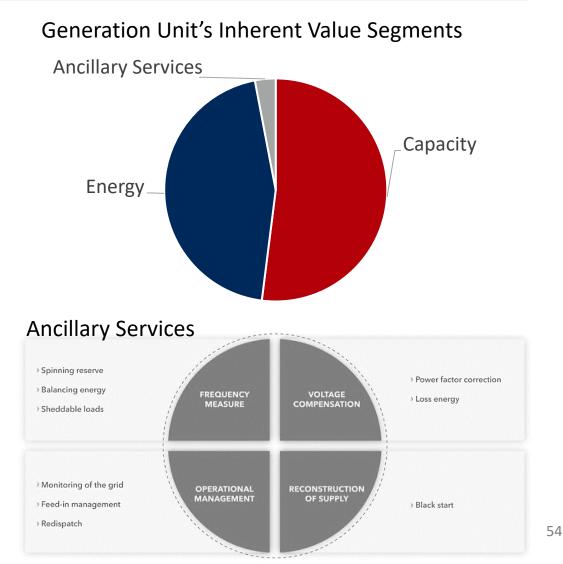
FMPA Manages Position Internally In Periods Further Beyond Day-Ahead





A Generator's Value Typically Broken Into 3 Segments Value of Energy and Capacity Can Vary Through Life of Units

- Energy is the MWhs that flow, FMPP values this via CHP process
- FMPP does not have a capacity market but does require participants to carry a certain level of firm reserves
- FMPP has limited compensation mechanisms for ancillary services.
 FMPA has pseudo tied loads that fall in the Duke/FPL footprint back to FMPP. This allows FMPP to balance and supply the services





Incurred Generation Primary Make Whole Payment

Only Qualify If Seller Did Not Need For Entire Day

- A generating unit or firm purchase that was economically committed by the Pool that the Member did not need to meet its obligation for any hour from HE 0100 – 2400 is incurred generation (IG)
- Such a resource may qualify to receive compensation equal to the difference between the resource's total cost and the revenues it received from the Pool attributed to that resource
- Attempt to create "make whole" for seller relative to CHP
- Unit start costs are amortized over all energy generated during a run period and are reimbursed by buyers



Certain Resources Excluded from CHP 50 In Context *Resources At Minimum Still Part of Least Cost Dispatch Plan*

- A resource committed by request of the Member for testing, voltage support, etc.
- A resource at its minimum loading level
 - Opportunity for engagement on potential evolution of structure (more on that later)
- A unit that is started for an Operating Reserves call
- Member Specific purchases
- Unit startup until released to the System Operator
- FEM Sales



Will Use 2025 as the Base Year for Analysis

Consultant Leads All Transfer Limit* Structure Determinations

2025 Case	FMPP, SEC, JEA, TECO – Business As Usual	Expanded FMPP (CHP)
Existing Transfer Limits**	Х	X
Limits + Buy (Firm Point-to- Point)	Х	X
Fuel Sensitivity	Х	X

*Transfer limits are mission-critical to the evaluation.

** Consultant has also proposed infinite transfer simulations for benchmarking purposes.

