2018 Integrated Resource Plan Stakeholder Meeting

February 16, 2018

2018 Integrated Resource Plan –
KCP&L and GMO

- Changes from the 2017 IRP Annual updates
  - Gas price forecasts (lower)
  - CO_2 emission allowance price forecasts (lower and delayed until 2026)
  - Retail energy and peak forecasts (KCP&L lower, GMO higher)
  - Plant retirement modeling (fixed dates for Montrose and Sibley)

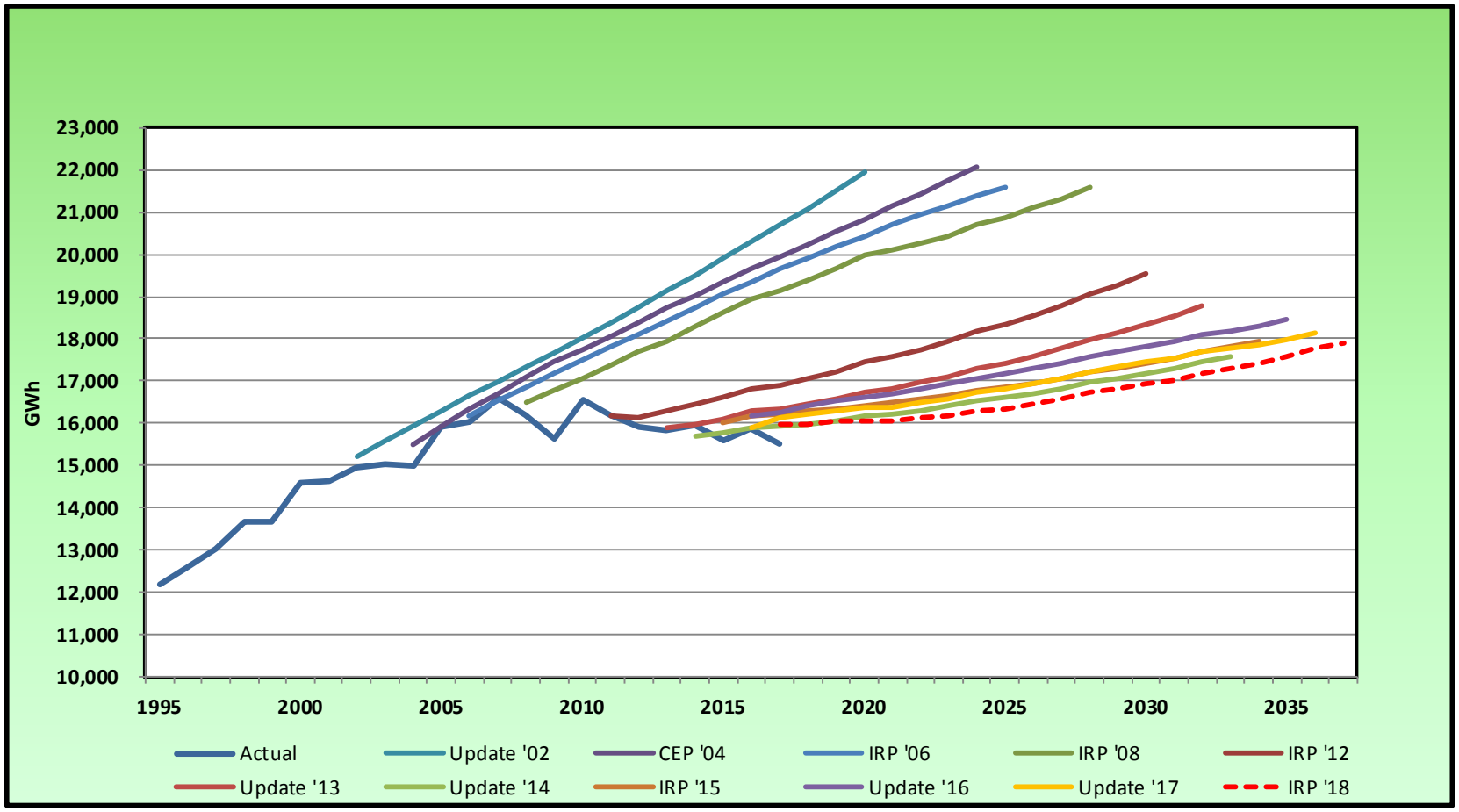
Load Forecast Analysis

Changes in Inputs to Load Forecasting Models

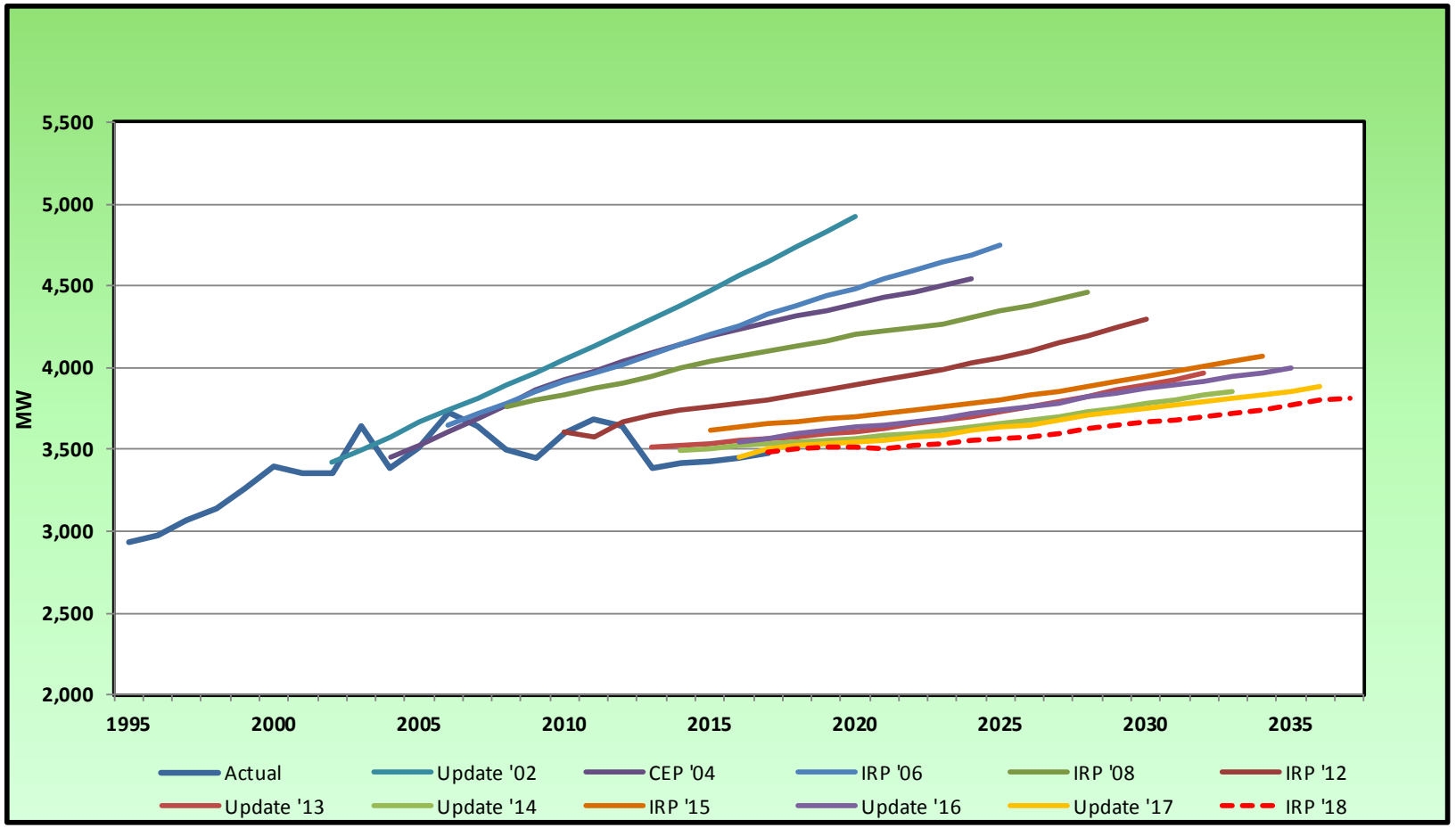
- Historical data for customers, kwh and $/kwh: June 2017 vs July 2014
- DOE forecasts of appliance and equipment saturations and kwh/unit: 2017 vs 2014
- Industrial model based on Statistically Adjusted Employment-Intensity Model in the 2018 Triennial filing. Same method was used in the 2017 Annual Update. This structure utilizes a framework that incorporates sector employment, price and sector intensities (MWh/Employee). This results in a sector weighted employment index used within the regression model.
- Peak load methodology has changed from Triennial filing bottom up approach to a standalone jurisdictional peak models which incorporates the energy end use forecast by class in to the model. The models are designed to weather normalize peak loads.
- Historical weather normalized results for billed kWh sales, calendar kWh sales and unbilled kWh sales are now calculated in a separate weather normalization model for the 2018 Triennial filing.
- Class models in the 2018 KCP&L and GMO Triennial filing are the same as the 2015 Triennial filing: residential, small commercial, big commercial (medium, large, large power) and industrial.
- The Company also re-evaluated the output elasticity used in the commercial and industrial models and the elasticity used in the residential model. Adjustments made were to improve the model fit.
- Company utilized EPRI electric vehicle study within its modeling for 2018 Triennial filing.
- EIA residential lighting technology updated and more focus on PV. Commercial CBESC updated to 2012 vs. 2003.

Load Forecast Analysis
KCP&L

KCP&L Historical and Comparison of Mid-Case Forecasts of Net System Input Excluding DSM Impacts



KCP&L Historical and Comparison of Mid-Case Forecasts of Demand Excluding DSM Impacts



KCP&L Historical and Mid-Case Forecasts

Net System Input (NSI) and Peak Forecast					
Date	Gross NSI (MWh)		Gross Peak (MW)		Gross LF
2002	14,810,168		3,229		0.5236
2003	15,100,010	2.0%	3,307	2.4%	0.5212
2004	15,434,710	2.2%	3,600	8.9%	0.4894
2005	15,735,417	1.9%	3,496	-2.9%	0.5138
2006	15,960,834	1.4%	3,416	-2.3%	0.5334
2007	16,286,867	2.0%	3,718	8.8%	0.5001
2008	16,306,299	0.1%	3,703	-0.4%	0.5027
2009	16,024,573	-1.7%	3,642	-1.6%	0.5023
2010	16,057,247	0.2%	3,605	-1.0%	0.5084
2011	15,918,871	-0.9%	3,573	-0.9%	0.5086
2012	15,642,354	-1.7%	3,401	-4.8%	0.5250
2013	15,733,616	0.6%	3,444	1.3%	0.5215
2014	15,908,170	1.1%	3,540	2.8%	0.5130
2015	15,882,360	-0.2%	3,591	1.4%	0.5193
2016	15,827,972	-0.3%	3,524	-1.9%	0.5127
2017	15,958,393	0.8%	3,485	-1.1%	0.5227
2018	15,985,476	0.2%	3,507	0.6%	0.5203
2019	16,042,698	0.4%	3,519	0.3%	0.5204
2020	16,075,808	0.2%	3,510	-0.3%	0.5228
2021	16,058,968	-0.1%	3,509	0.0%	0.5224
2022	16,118,723	0.4%	3,523	0.4%	0.5223
2023	16,193,212	0.5%	3,536	0.4%	0.5228
2024	16,294,291	0.6%	3,560	0.7%	0.5225
2025	16,345,893	0.3%	3,566	0.2%	0.5233
2026	16,451,462	0.6%	3,574	0.2%	0.5255
2027	16,562,199	0.7%	3,594	0.6%	0.5261
2028	16,721,444	1.0%	3,625	0.9%	0.5266
2029	16,809,777	0.5%	3,644	0.5%	0.5266
2030	16,920,522	0.7%	3,665	0.6%	0.5270
2031	17,037,537	0.7%	3,680	0.4%	0.5285
2032	17,197,298	0.9%	3,699	0.5%	0.5307
2033	17,288,605	0.5%	3,718	0.5%	0.5308
2034	17,428,523	0.8%	3,741	0.6%	0.5318
2035	17,579,083	0.9%	3,770	0.8%	0.5323
2036	17,772,538	1.1%	3,801	0.8%	0.5338
2037	17,891,915	0.7%	3,810	0.2%	0.5361

Historical Gross NSI is the Historical WNNSI from System LT

2017 - first 6 months are Historical WNNSI from System LT

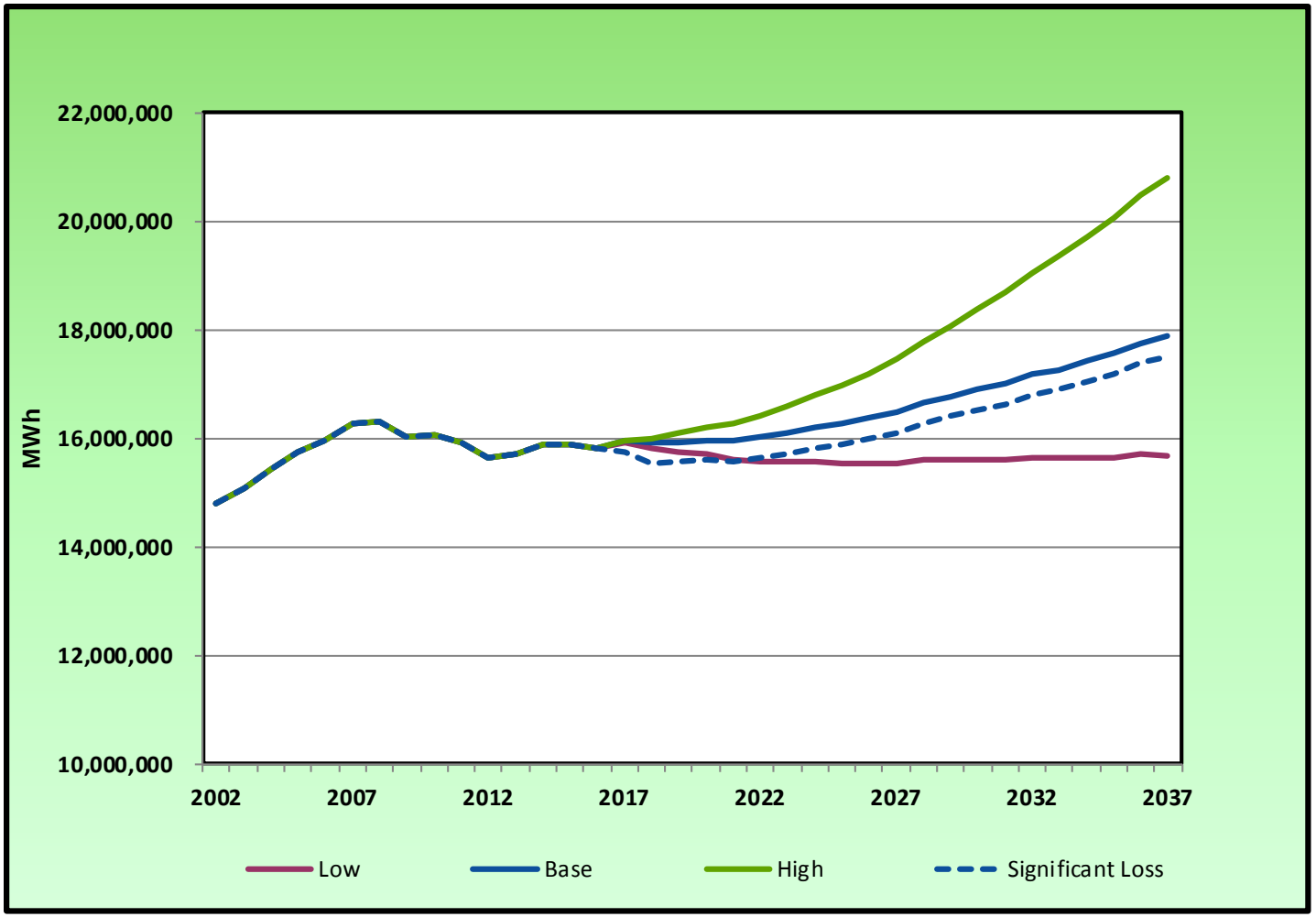
Gross NSI (MWh) - Forecast		
Forecast Year	2018 IRP	2017 IRP Update
5 Yrs	0.20%	0.50%
10 Yrs	0.37%	0.58%
15 Yrs	0.50%	0.62%
20 Yrs	0.57%	0.63%

Gross Peak (MW) - Forecast		
Forecast Year	2018 IRP	2017 IRP Update
5 Yrs	0.22%	0.58%
10 Yrs	0.31%	0.56%
15 Yrs	0.40%	0.60%
20 Yrs	0.45%	0.59%

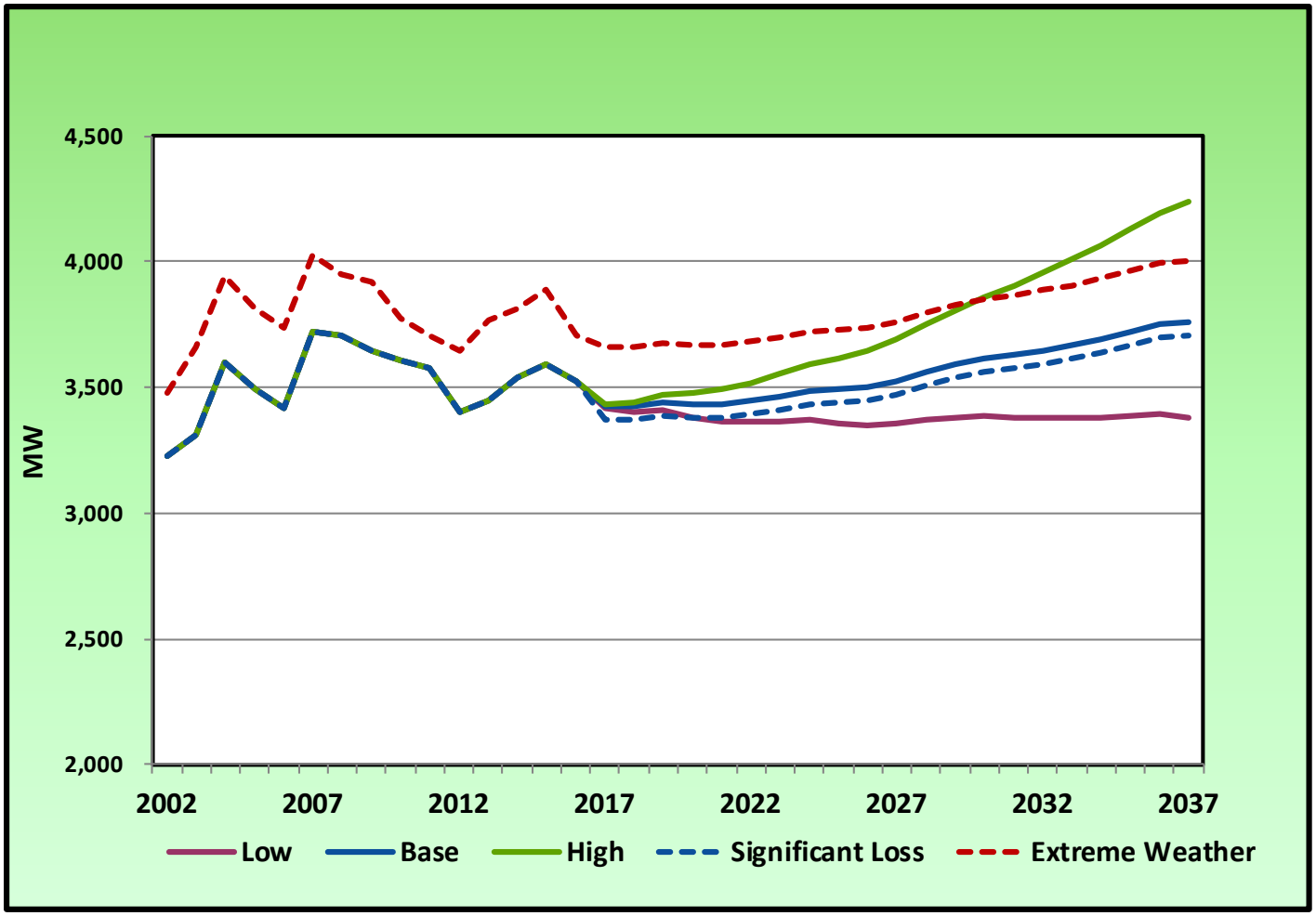
Annual growth rates for 5, 10, 15, 20 years of forecast

LF = Load Factor

KCP&L Weather Normalized Historical and Forecasted Net System Input – Includes DSM Impact

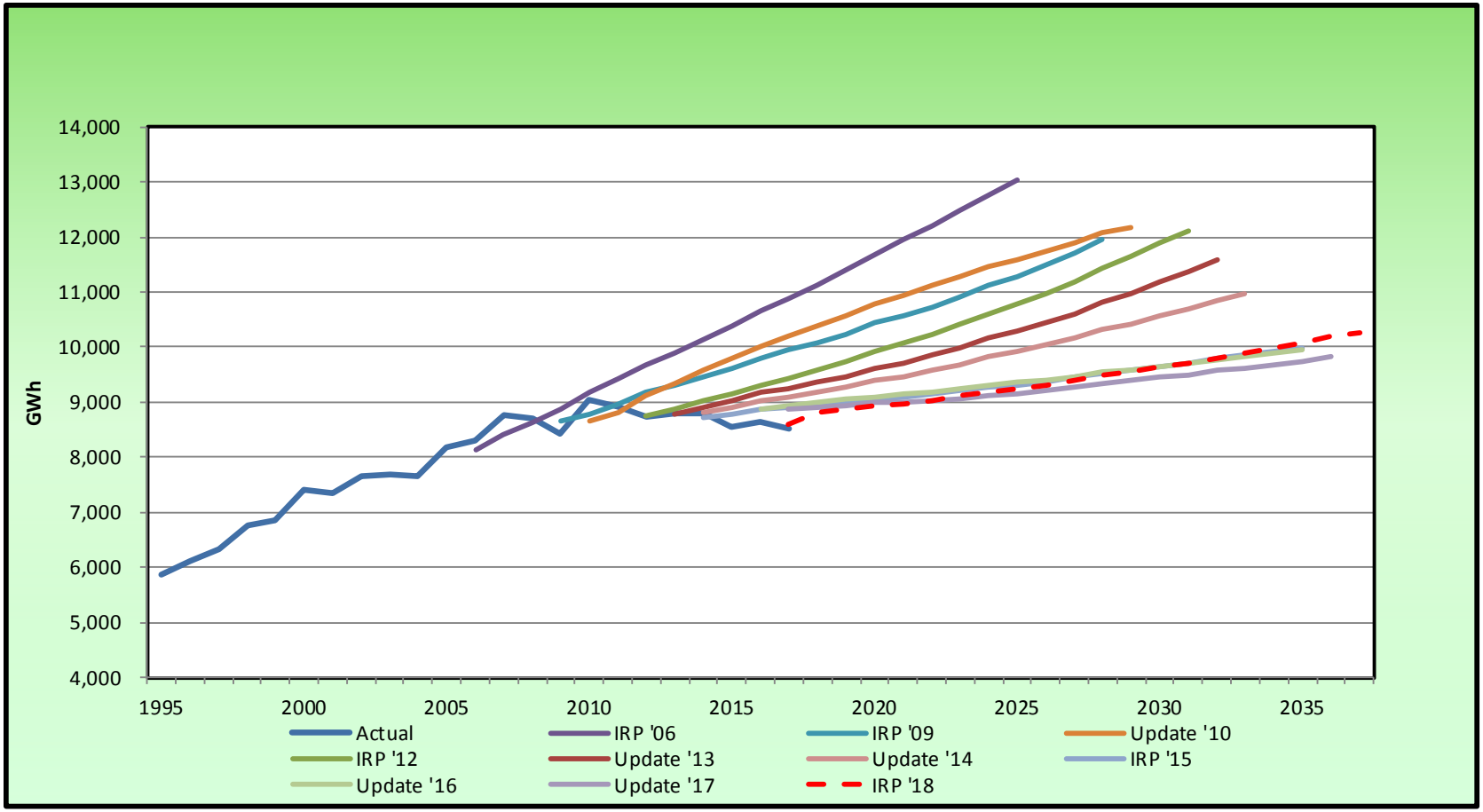


KCP&L Weather Normalized Historical and Forecasted Peak Demand – Includes DSM and DVC Impact

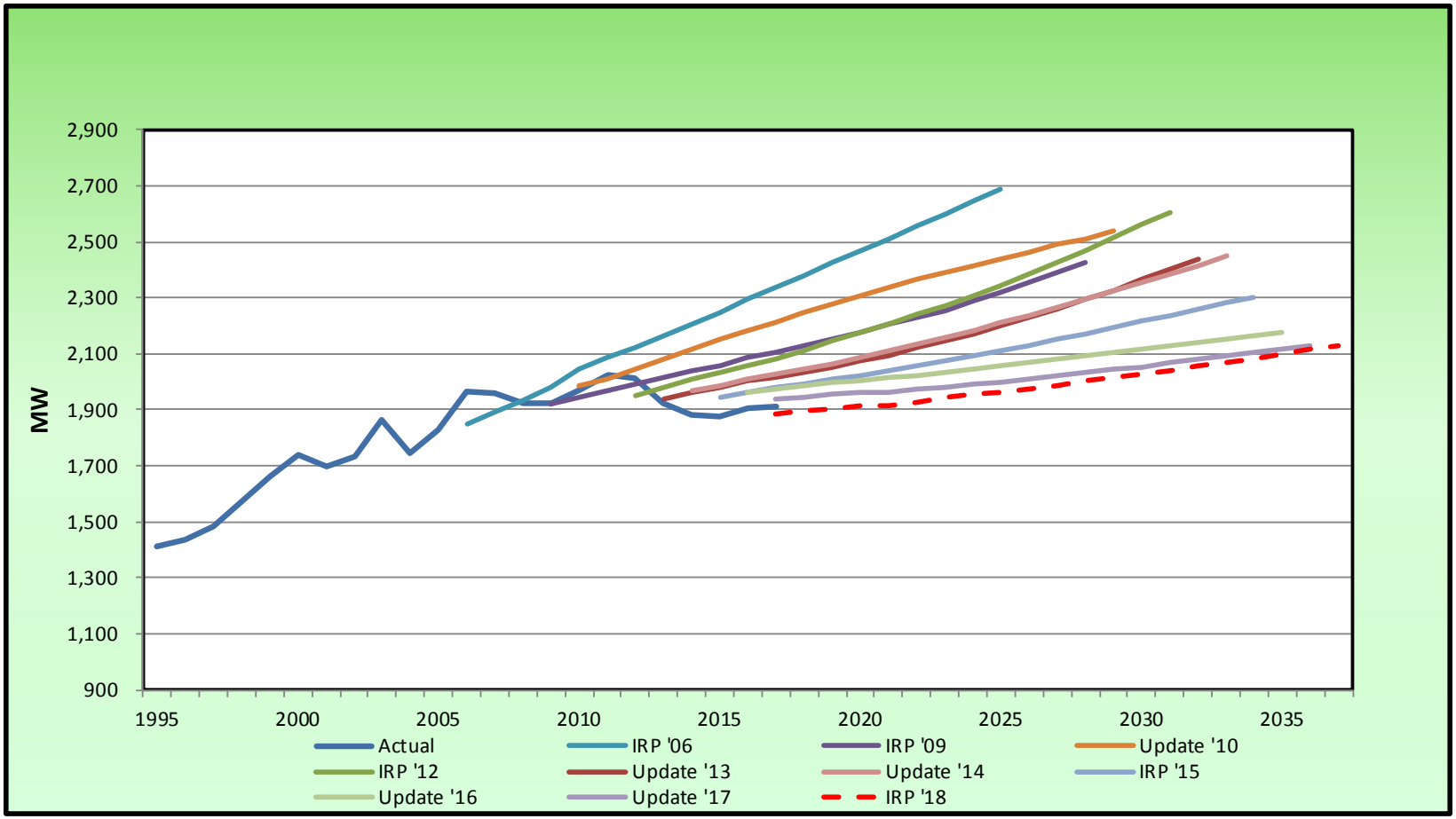


Load Forecast Analysis
GMO

GMO Historical and Comparison of Mid-Case Forecasts of Net System Input - Excluding DSM Impacts



GMO Historical and Comparison of Mid-Case Forecasts of Demand Excluding DSM Impacts



GMO Historical and Mid-Case Forecasts

Net System Input (NSI) and Peak Forecast

Date	GMO NSI (MWh)		Gross Peak (MW)		Gross LF
2002	7,472,196		1,680		0.5077
2003	7,621,565	2.0%	1,716	2.1%	0.5070
2004	7,881,521	3.4%	1,828	6.5%	0.4922
2005	8,049,913	2.1%	1,812	-0.9%	0.5071
2006	8,271,620	2.8%	1,842	1.7%	0.5126
2007	8,552,828	3.4%	1,926	4.6%	0.5069
2008	8,708,764	1.8%	1,958	1.7%	0.5077
2009	8,650,524	-0.7%	1,896	-3.2%	0.5208
2010	8,754,972	1.2%	1,890	-0.3%	0.5288
2011	8,732,993	-0.3%	1,914	1.3%	0.5209
2012	8,640,687	-1.1%	1,945	1.6%	0.5072
2013	8,694,450	0.6%	1,861	-4.3%	0.5333
2014	8,737,596	0.5%	1,870	0.5%	0.5335
2015	8,717,003	-0.2%	1,873	0.2%	0.5313
2016	8,623,847	-1.1%	1,873	0.0%	0.5257
2017	8,592,927	-0.4%	1,886	0.7%	0.5201
2018	8,822,861	2.7%	1,895	0.5%	0.5315
2019	8,887,259	0.7%	1,905	0.5%	0.5326
2020	8,935,472	0.5%	1,912	0.4%	0.5335
2021	8,964,866	0.3%	1,917	0.3%	0.5338
2022	9,036,661	0.8%	1,929	0.6%	0.5348
2023	9,110,934	0.8%	1,942	0.7%	0.5356
2024	9,184,426	0.8%	1,954	0.6%	0.5366
2025	9,237,569	0.6%	1,963	0.5%	0.5372
2026	9,314,481	0.8%	1,976	0.7%	0.5381
2027	9,391,525	0.8%	1,988	0.6%	0.5393
2028	9,489,593	1.0%	2,004	0.8%	0.5406
2029	9,556,882	0.7%	2,015	0.5%	0.5414
2030	9,633,753	0.8%	2,028	0.6%	0.5423
2031	9,714,013	0.8%	2,041	0.6%	0.5433
2032	9,812,744	1.0%	2,056	0.7%	0.5448
2033	9,883,988	0.7%	2,068	0.6%	0.5456
2034	9,975,869	0.9%	2,083	0.7%	0.5467
2035	10,074,021	1.0%	2,099	0.8%	0.5479
2036	10,190,558	1.2%	2,117	0.9%	0.5495
2037	10,275,741	0.8%	2,131	0.7%	0.5505

Historical Gross NSI is the Historical WNNSI from System LT
2017 - first 6 months are Historical WNNSI from System LT

LF = Load Factor

Gross NSI (MWh) - Forecast

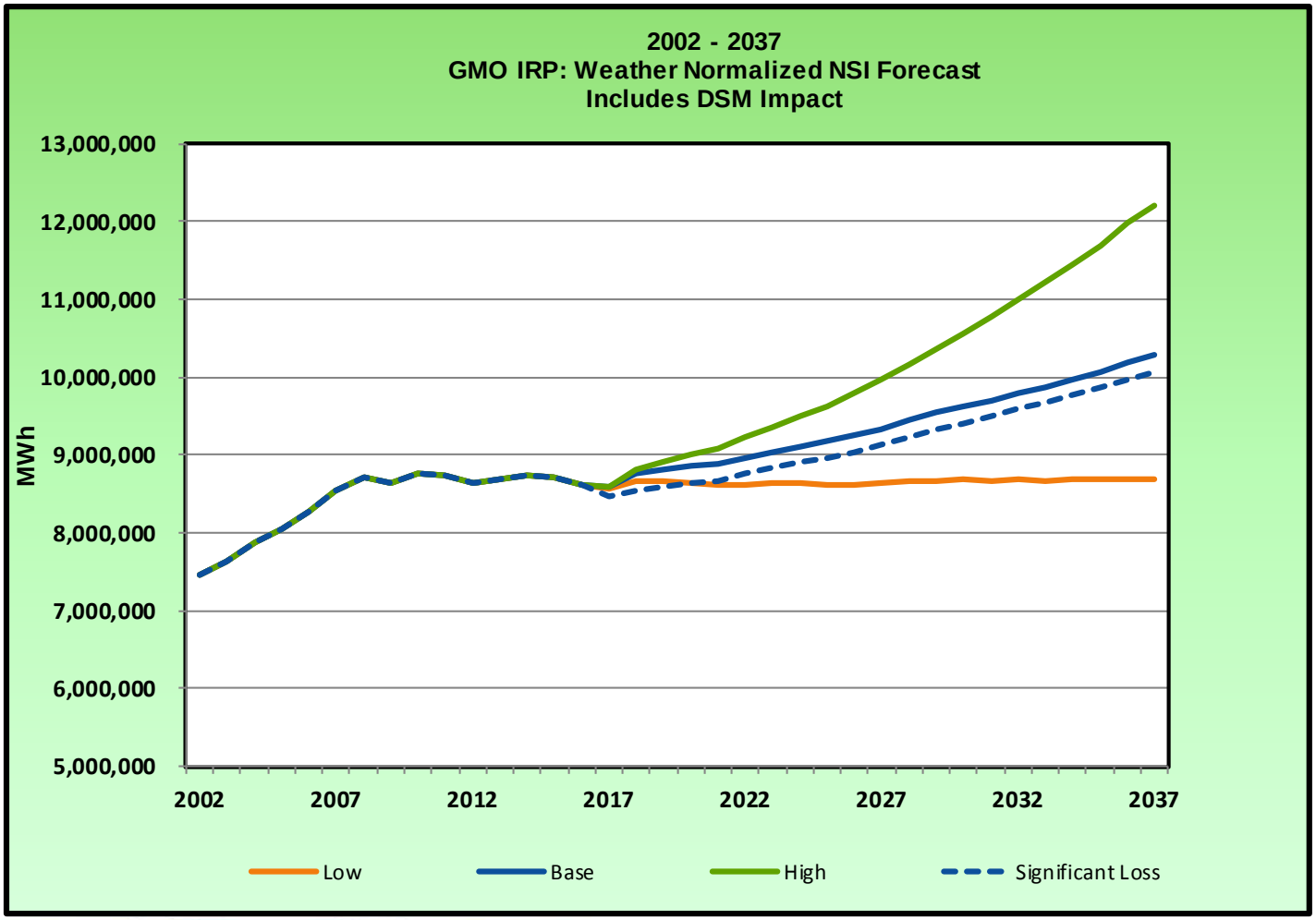
Forecast Year	2018 IRP	2017 IRP Update
5 Yrs	1.01%	0.60%
10 Yrs	0.89%	0.54%
15 Yrs	0.89%	0.57%
20 Yrs	0.90%	0.59%

Gross Peak (MW) - Forecast

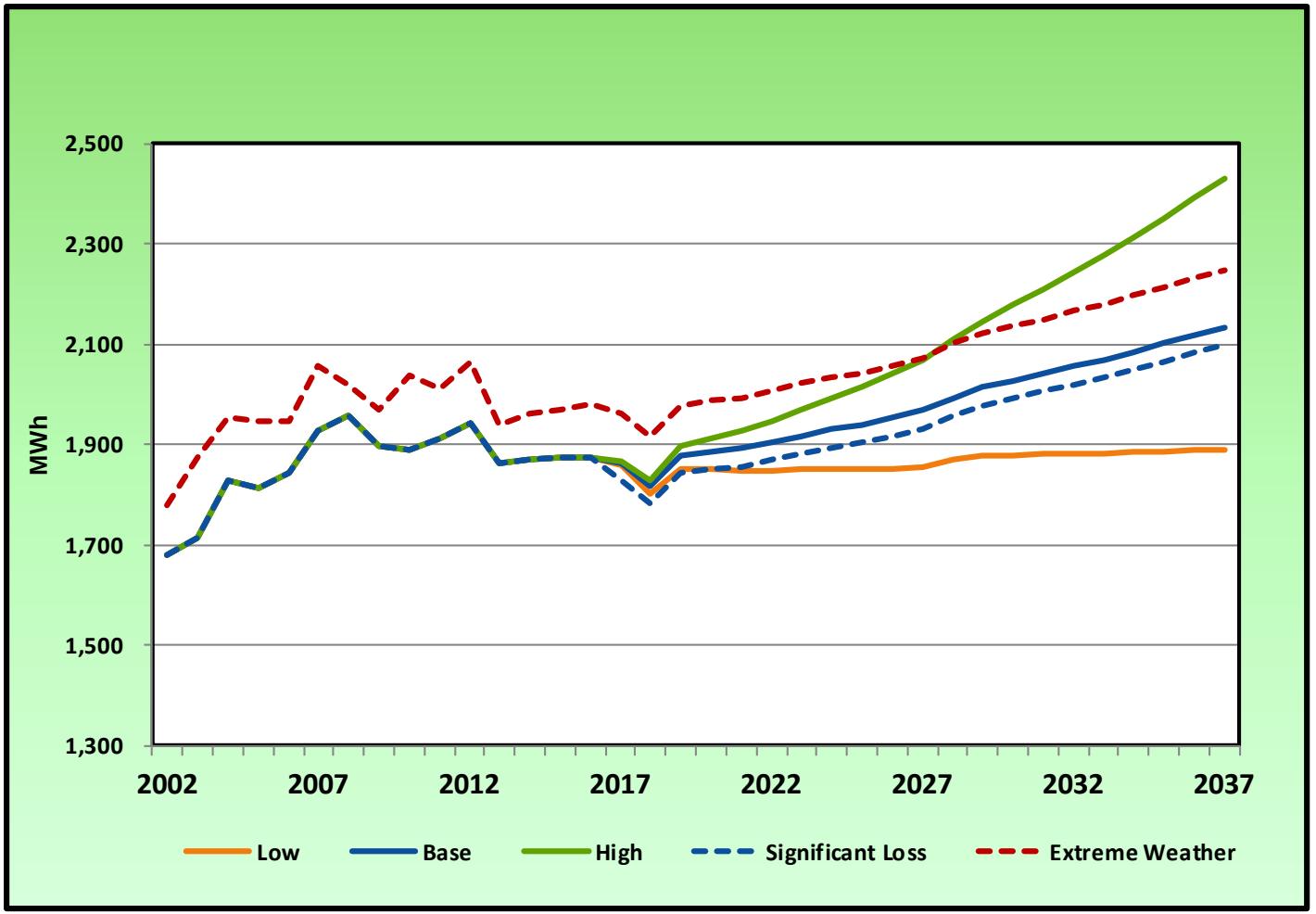
Forecast Year	2018 IRP	2017 IRP Update
5 Yrs	0.45%	0.65%
10 Yrs	0.53%	0.54%
15 Yrs	0.58%	0.56%
20 Yrs	0.61%	0.57%

Annual growth rates for 5, 10, 15, 20 years of forecast

GMO Weather Normalized Historical and Forecasted Net System Input - Includes DSM Impact



GMO Weather Normalized Historical and Forecasted Peak Demand – Includes DSM Impact



Supply-Side Resource Analysis

Fuel and Emissions Forecast Sources

Forecast Source	Coal	Natural Gas	Fuel Oil
IHS Energy	x	x	x
Energy Information Administration	x	x	x
PIRA Energy Group	x	x	x
Energy Ventures Analysis	x	x	x
JD Energy	x		
Hanou Energy Consulting	x		

Forecast Source	SO_2	NO_x	CO_2
IHS	x	x	x
PIRA	x	x	x
Energy Ventures Analysis	x	x	x
JD Energy	x	x	
Synapse			x

Natural Gas Forecast – 2017 Vs. 2018

** Confidential **

CO_2 Forecast – 2018 Vs. 2018

**** Confidential ****

Environmental Drivers and Expected Retrofits

Environmental Driver	Emittant	Compliance Year (Expected)	Status	Retrofit
Clean Water Act 316(b)	-	2021-2023	Final Rule May 2014	Fish Friendly Screens
Clean Water Act 316(b) (Fish Entrainment)	-	2022 - 2027	Final Rule May 2014	Cooling Towers
Clean Water Act 316(a) (Thermal Discharge)	-	2022-2027	Permit Conditions	Cooling Towers (river units earlier, lake units later)
Effluent Guidelines	Wastewater Constituents	2018-2023	Final Rule September 2015	Cease Wet Sluicing
Coal Combustion Residual (CCR)	Ash/Water	2018-2024	Effective October 2015	Cease Wet Sluicing/Pond Closure

Advanced Distribution Technologies Update

Near Term Advanced Distribution Technologies

KCP&L Is Implementing and Planning Targeted ADTs

- SCADA-Lite distribution monitoring and control
  - New Vendor Platform integration to KCPL OMS is in-progress.
- Fault Isolation and System Restoration (FISR) pilots
  - Utilizing loop-scheme timing and sensing – specifications developed:
    - First Auto-throwover pilot in-service 4Q17.
    - Midpoint – Tie – Midpoint FISR Field pilots planned for 2018.
- Communicating Faulted Circuit Indicator (CFCI) pilots
  - Field deployment began late 2017 on 25kV circuit.
  - Additional Field deployments targeted throughout 2018 using existing comms and SCADA-Lite.
  - Technical evaluation of additional suppliers is on-going.
- Fault Location algorithm
  - Advanced application within KCP&L's new OMS
  - Leverage CFCI's and other distribution switches & sensing – Deferred to 2018
- "4G" distribution cellular communications equipment in wide deployment in 2017 and will be on-going.

Demand-Side Resource Analysis

Updated Demand-Side Rates

- Rates updated to reflect rate design work completed with Burns & McDonnell

Rate	Steady State Participation RAP	Steady State Participation MAP	Per Customer Summer Peak Reduction (%)	Program Ramp Period (Years)	Program Start Year
Time-of-Use	28.0%	36.4%	9.8%	7	2019 – Others 2024 - KS
TOU + Demand Rate	14.0%	18.2%	17.5%	10	2019 – Others 2024 - KS
Demand Rate	14.0%	18.2%	11.1%	10	2019 – Others 2024 - KS

Updated Demand-Side Rates

Realistic Achievable Potential by Territory in 2037 (Summer Peak)

Option	KCPL-MO	GMO-MPS	GMO-SJLP	KCPL-KS	Grand Total
DLC Smart Thermostats	60.4	57.0	12.8	60.8	190.9
Time-Of-Use	25.0	21.8	5.3	34.6	86.6
Time-Of-Use w EV	8.7	3.4	2.0	2.1	16.2
TOU + Demand Rate	15.7	13.9	3.3	22.1	55.0
DLC Space Cooling	10.8	10.3	2.3	10.9	34.3
DLC Water Heating	2.0	3.3	1.4	3.1	9.8
Curtail Agreements	82.2	43.1	18.7	46.0	190.1
Demand Rate	8.5	7.3	1.8	11.6	29.2
Demand Rate w EV	7.0	2.8	1.6	1.7	13.2
Total	220.3	163.0	49.1	192.9	625.2

Updated Demand-Side Rates

Realistic Achievable Potential for Selected Years (Summer Peak)

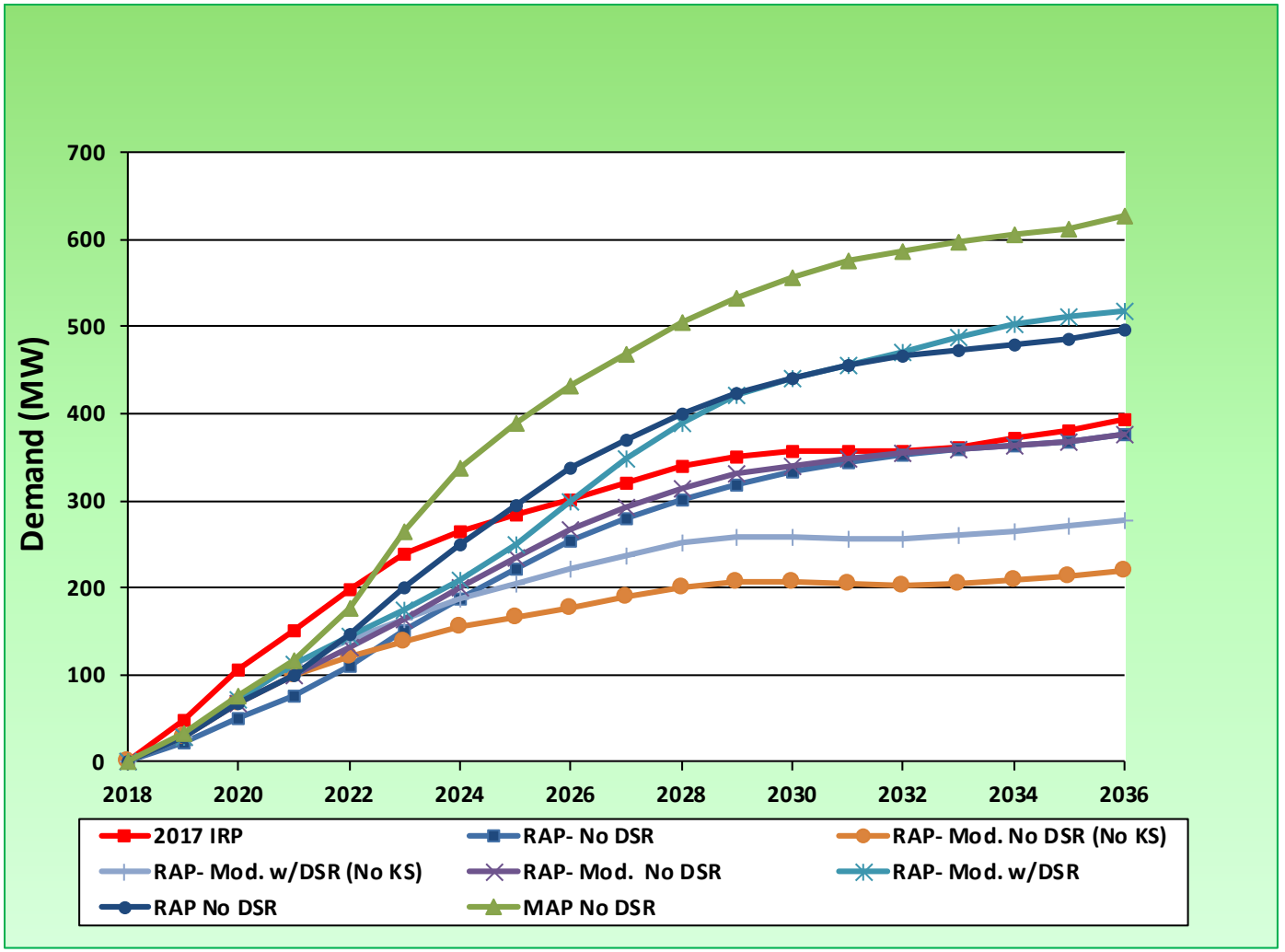
	2019	2020	2021	2027	2037
Baseline Forecast (Summer MW)	**5,548**	**5,585**	**5,615**	**5,825**	**6,150**
Achievable Potential (MW)	**128.1**	**182.0**	**244.9**	**542.6**	**625.2**
DLC Smart Thermostats	41.7	59.2	77.1	173.5	190.9
Time-Of-Use	0.3	6.7	12.6	61.3	86.6
Time-Of-Use w EV	0.3	1.0	2.7	8.8	16.2
TOU + Demand Rate	0.6	4.7	8.6	38.9	55.0
DLC Space Cooling	4.0	11.3	24.5	36.8	34.3
DLC Water Heating	0.8	2.3	5.3	9.4	9.7
Curtail Agreements	79.7	92.8	106.4	185.6	190.1
Demand Rate w EV	0.3	1.0	2.5	7.3	13.1
Demand Rate	0.3	2.9	5.1	21.0	29.2

Updated Demand-Side Rates

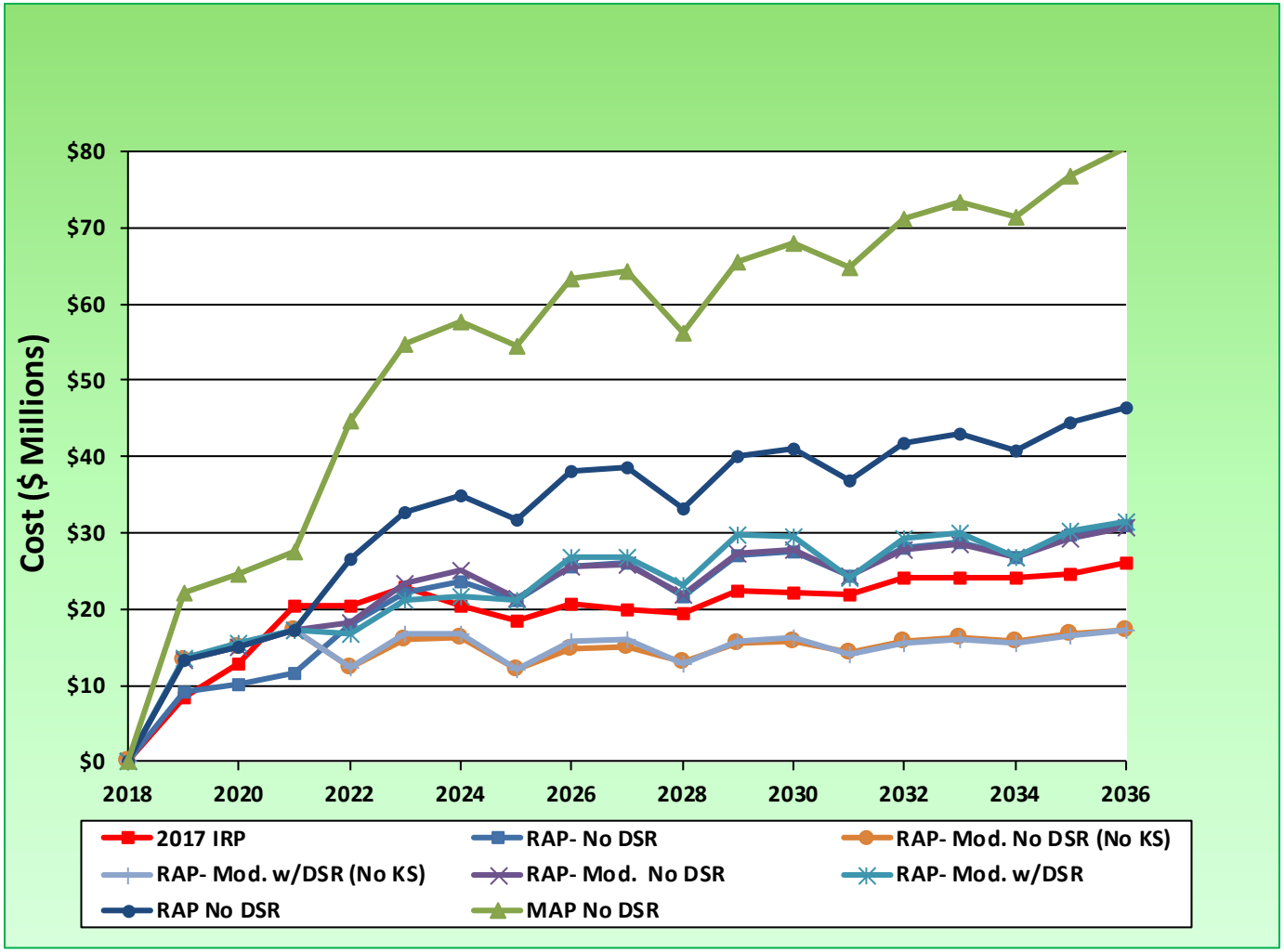
Comparison to Original Potential Study

	Original	Update	% Difference
Realistic Achievable Potential (MW)	676	625	-8%
Maximum Achievable Potential (MW)	818	722	-12%

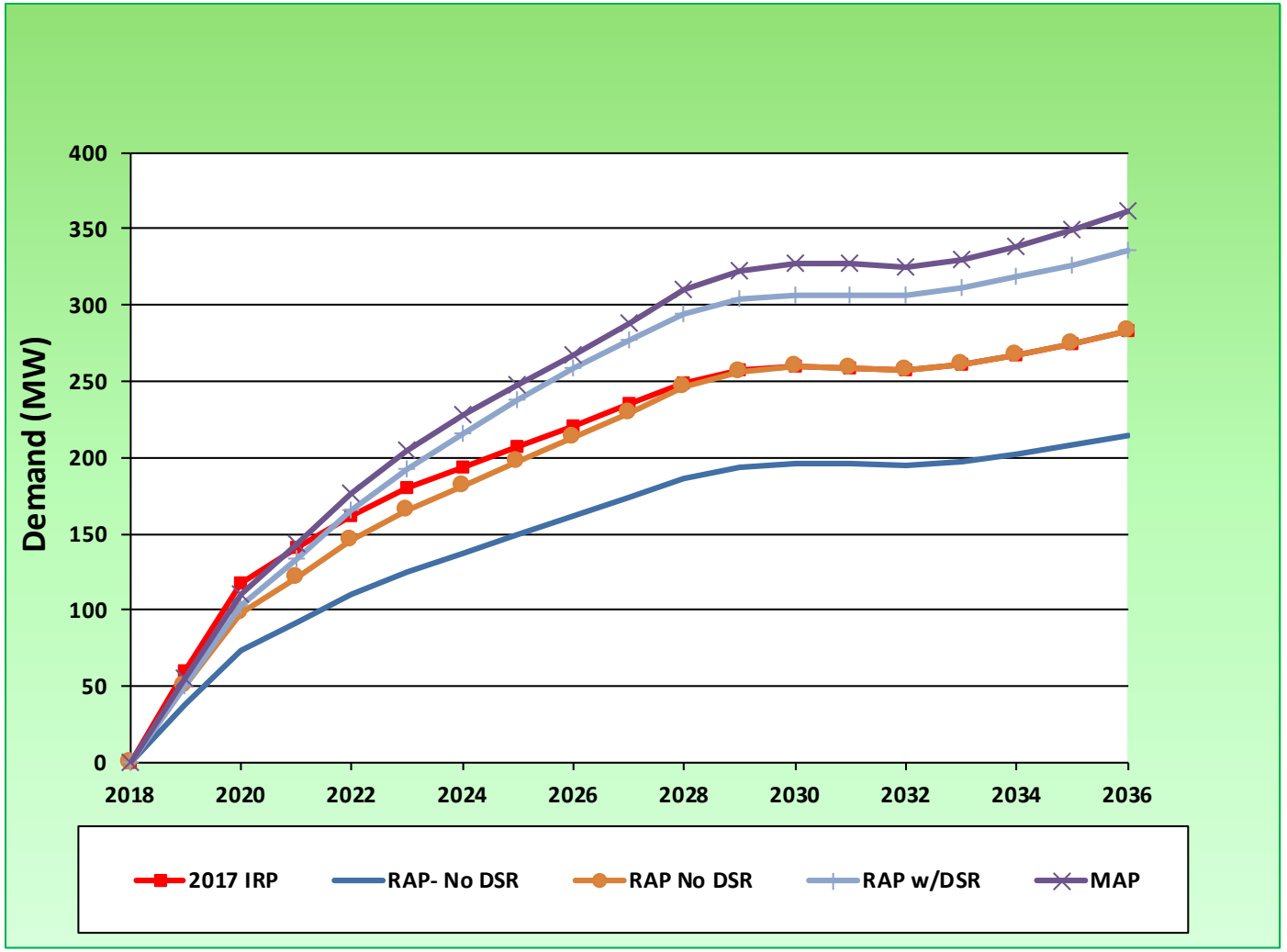
KCP&L DSM – 2017 vs 2018 IRP



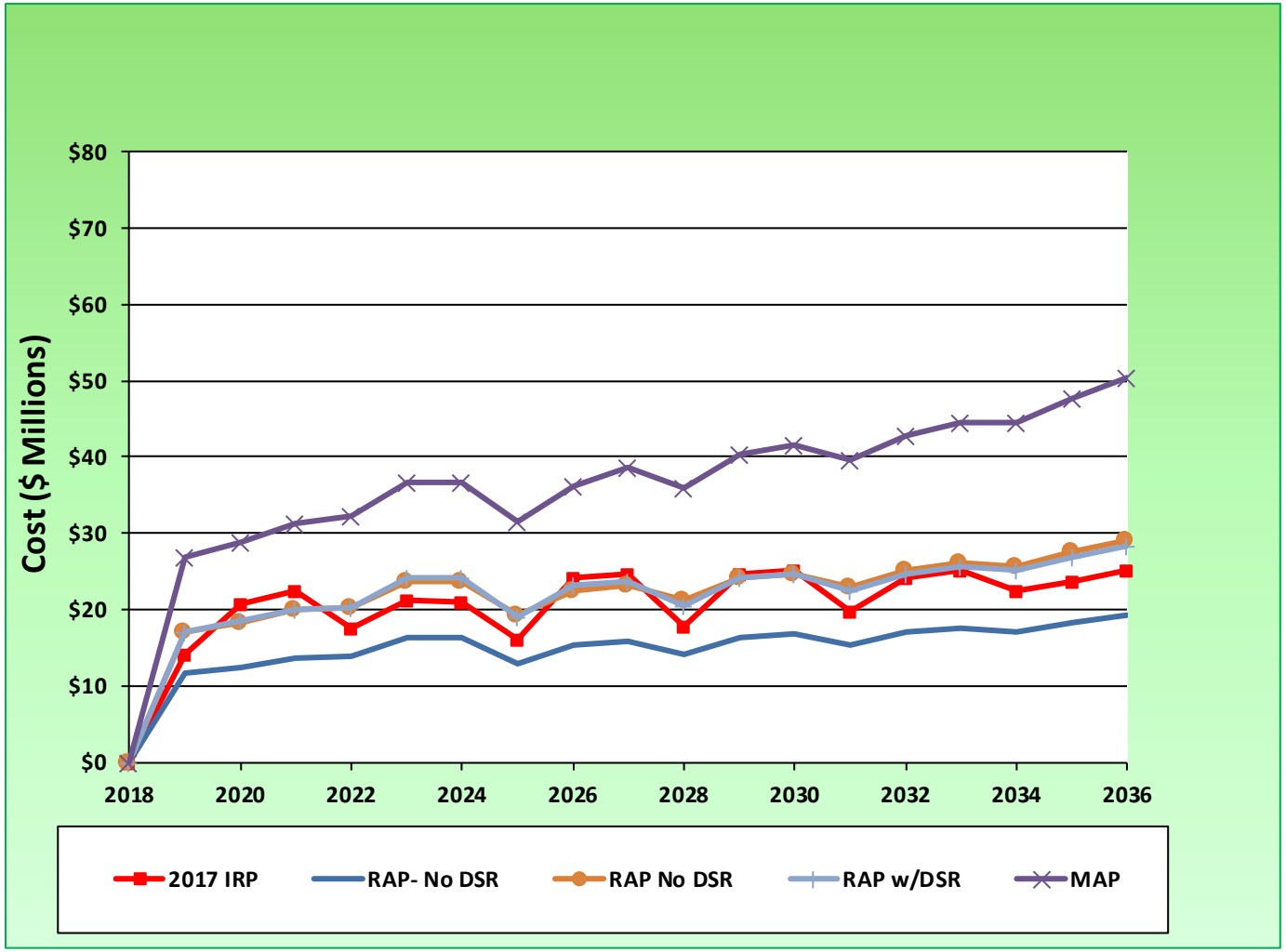
KCP&L DSM Costs – 2017 vs 2018 IRP



GMO DSM – 2017 vs 2018 IRP

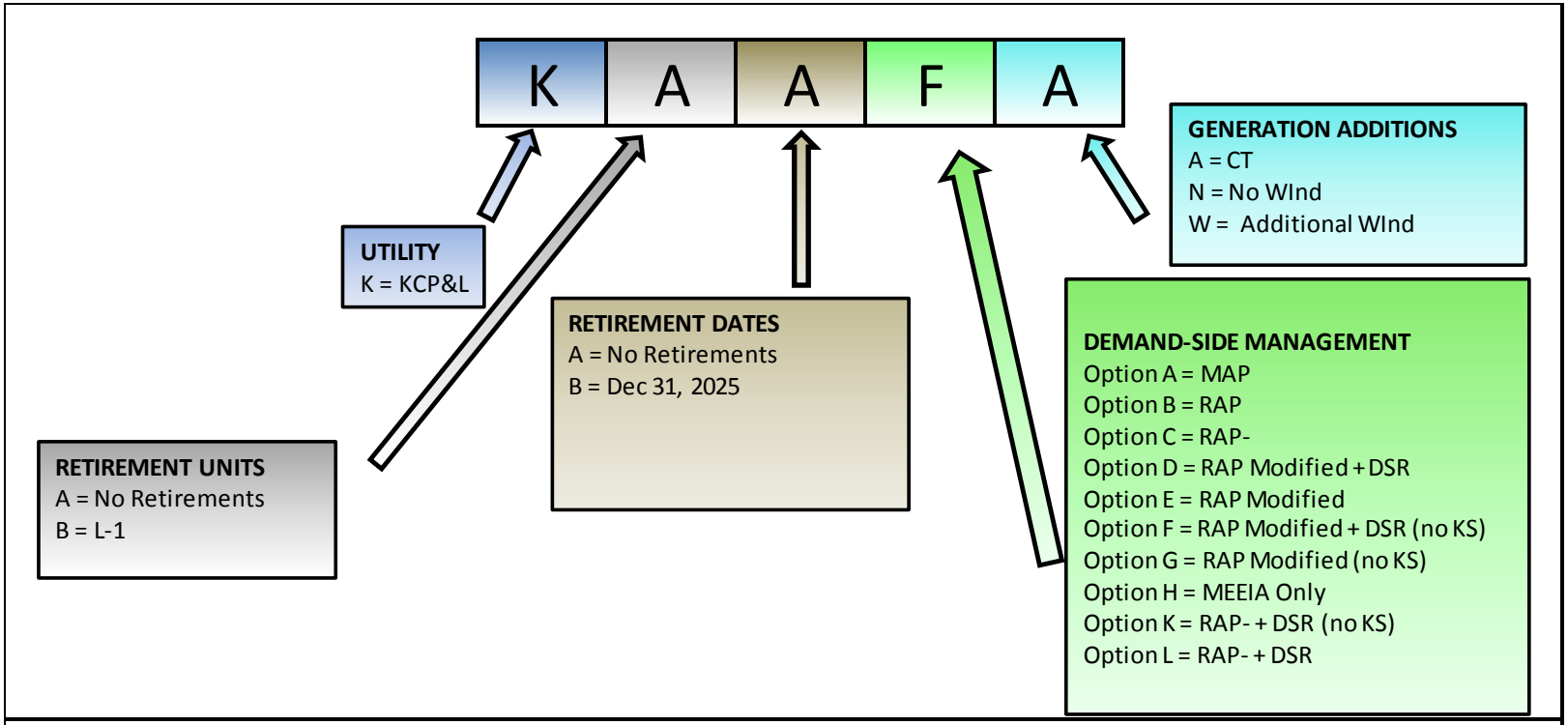


GMO DSM Costs – 2017 vs 2018 IRP



Integrated Resource Planning

2018 KCP&L TRIENNIAL IRP
ALTERNATIVE RESOURCE PLANS NAMING CONVENTION



Definitions:

L-1: LaCygne-1

CT - Combustion Turbine

MEEIA: Missouri Energy Efficiency Investment Act Cycle II

RAP: Realistic Achievable Potential

MAP: Maximum Achievable Potential

RAP-: Realistic Achievable Potential Minus DSR: Demand-Side Rates

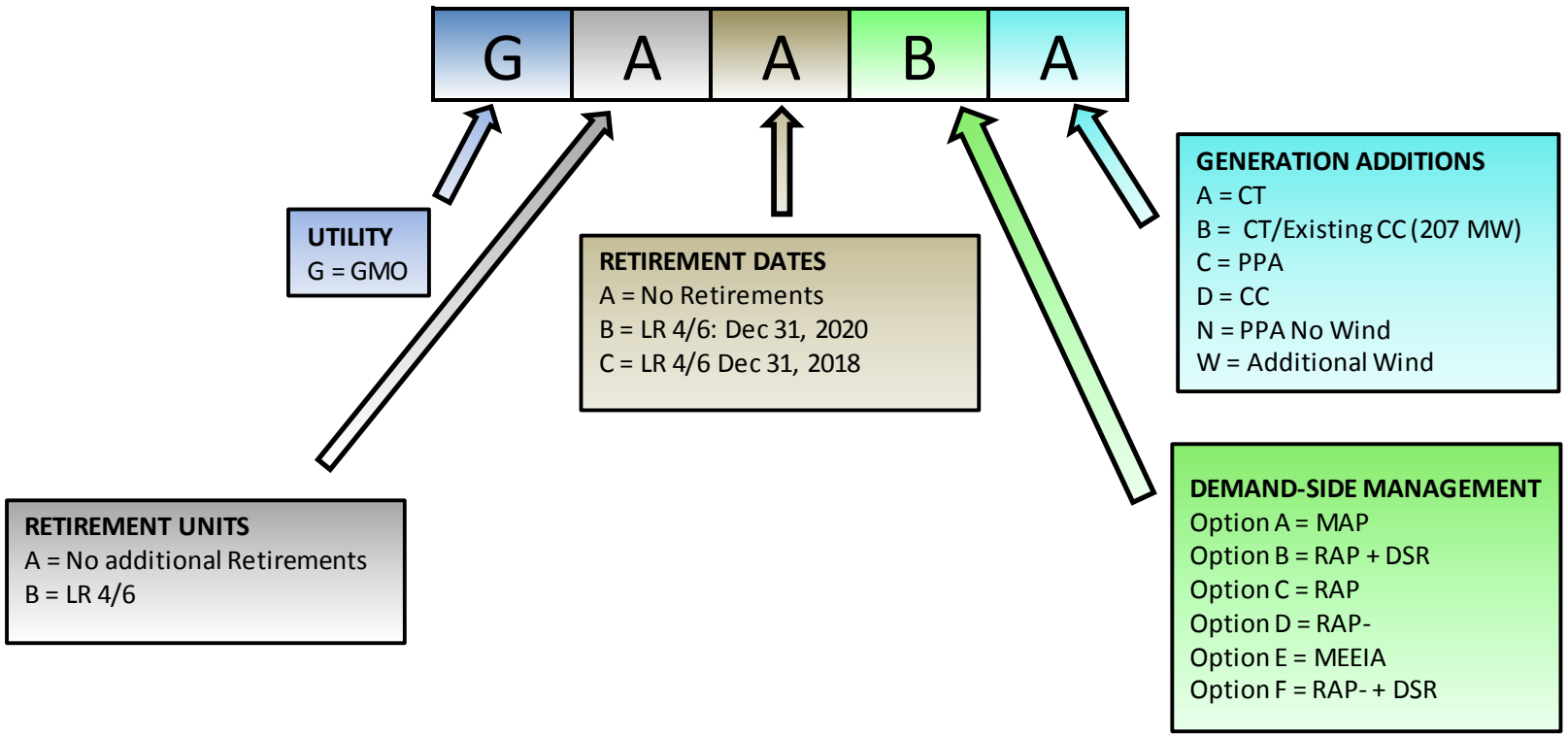
2018 KCP&L TRIENNIAL IRP - FOURTEEN ALTERNATIVE RESOURCE PLANS

Plan Name	DSM Level	Retire	Renewable Additions		Generation Addition (if needed)
KAAAA	MAP	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAABA	RAP	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAACA	RAP-	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAADA	RAP Modified + DSR	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAAEA	RAP Modified	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAAEW	RAP Modified	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW 2020 - 200 MW	n/n
KAAFA	RAP Modified + DSR (No KS DSM)	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n

2018 KCP&L TRIENNIAL IRP -
FOURTEEN ALTERNATIVE RESOURCE PLANS (CONTINUED)

Plan Name	DSM Level	Retire	Renewable Additions		Generation Addition (if needed)
KAAGA	RAP Modified (No KS DSM)	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAAHA	MEEIA	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAAKA	RAP- + DSR (No KS DSM)	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KAAKN	RAP- + DSR (No KS DSM)	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	No New Wind	n/n
KAALA	RAP- + DSR	Montrose-2: Dec 31, 2018 Montrose-3: Dec 31, 2018	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KBBAA	MAP	LaCygne-1: Dec 31, 2025	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n
KBBDA	RAP Modified + DSR	LaCygne-1: Dec 31, 2025	Solar: 2028 - 13 MW	Wind: 2018 - 98 MW 2019- 80 MW	n/n

2018 GMO TRIENNIAL IRP
ALTERNATIVE RESOURCE PLANS NAMING CONVENTION



Definitions:

LR 4/6: Lake Road 4/6

MAP: Maximum Achievable Potential

RAP: Realistic Achievable Potential

MEEIA: Missouri Energy Efficiency Investment Act Cycle II

DSR: Demand-Side Rates

CT - Combustion Turbine

CC - Combined Cycle

2018 GMO TRIENNIAL IRP - FOURTEEN ALTERNATIVE RESOURCE PLANS

Plan Name	DSM Level	Retire	Renewable Additions		Generation Additions (if needed)
GAAAA	MAP	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	414 MW of CT in 2020
GAABA	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	414 MW of CT in 2020
GAABB	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	200 MW of Exisitng CC in 2019 207 MW of CT in 2033
GAABC	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	PPA from KCP&L
GAABD	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	400 MW of CC in 2020
GAABW	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW 2020 - 200 MW	200 MW of Add'l Wind in 2020 414 MW of CT in 2020
GAACA	RAP	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	414 MW of CT in 2020

2018 GMO TRIENNIAL IRP - FOURTEEN ALTERNATIVE RESOURCE PLANS (CONTINUED)

Plan Name	DSM Level	Retire	Renewable Additions		Generation Additions (if needed)
GAADA	RAP-	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	414 MW of CT in 2020
GAAEA	MEEIA	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	207 MW of CT in 2019 207 MW of CT in 2020 207 MW of CT in 2028 207 MW of CT in 2036
GAAFA	RAP- +DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2019	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	414 MW of CT in 2020
GAAFC	RAP- +DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2020	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	PPA from KCP&L
GAAFN	RAP- +DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2020	Solar: 2028 - 10 MW	No New Wind	PPA from KCP&L 207 MW of CT in 2033 207 MW of CT in 2036
GBBBA	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2020	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	207 MW of CT in 2020 207 MW of CT in 2033
GBCBC	RAP+DSR	Sibley-2: Dec 31, 2018 Sibley-3: Dec 31, 2018 Lake Road 4/6: Oct 1, 2018	Solar: 2028 - 10 MW	Wind: 2018 - 146 MW 2019 - 120 MW	PPA from KCP&L