LPEA Long-Term Strategies Committee

2018 PRESENTATION

Chair: Dan Huntington

Committee Members: Britt Bassett, Bob Lynch, Guinn Unger

1. Vision

This committee will produce a report that will examine LPEA's financial and operational future based on several possible energy supply and distribution scenarios.

2. Mission

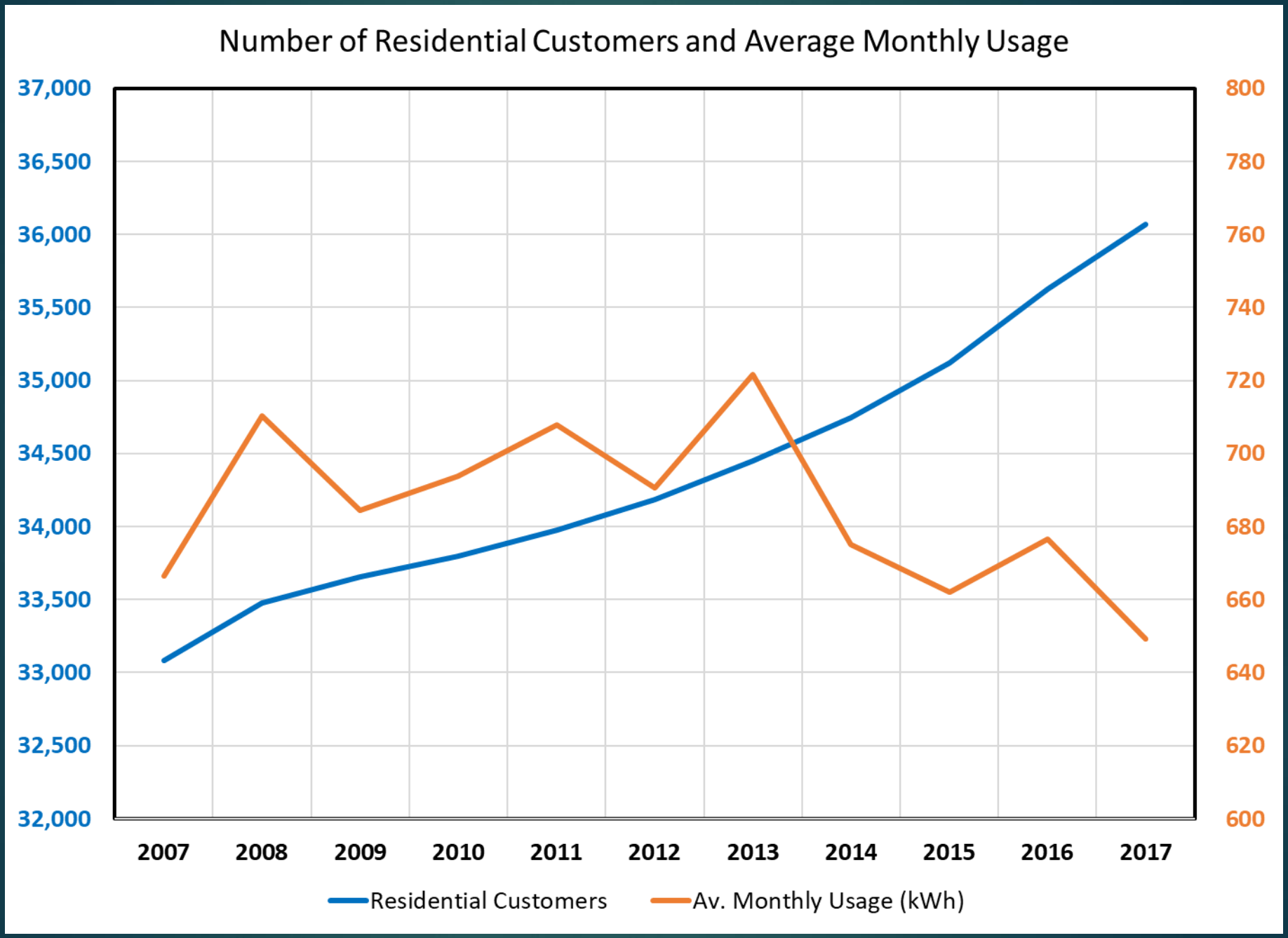
To identify several possible energy scenarios and emerging trends that LPEA could pursue over the next 15 years. To provide organized prediction methodologies to illustrate how LPEA's financial and operational future might look under each of them.

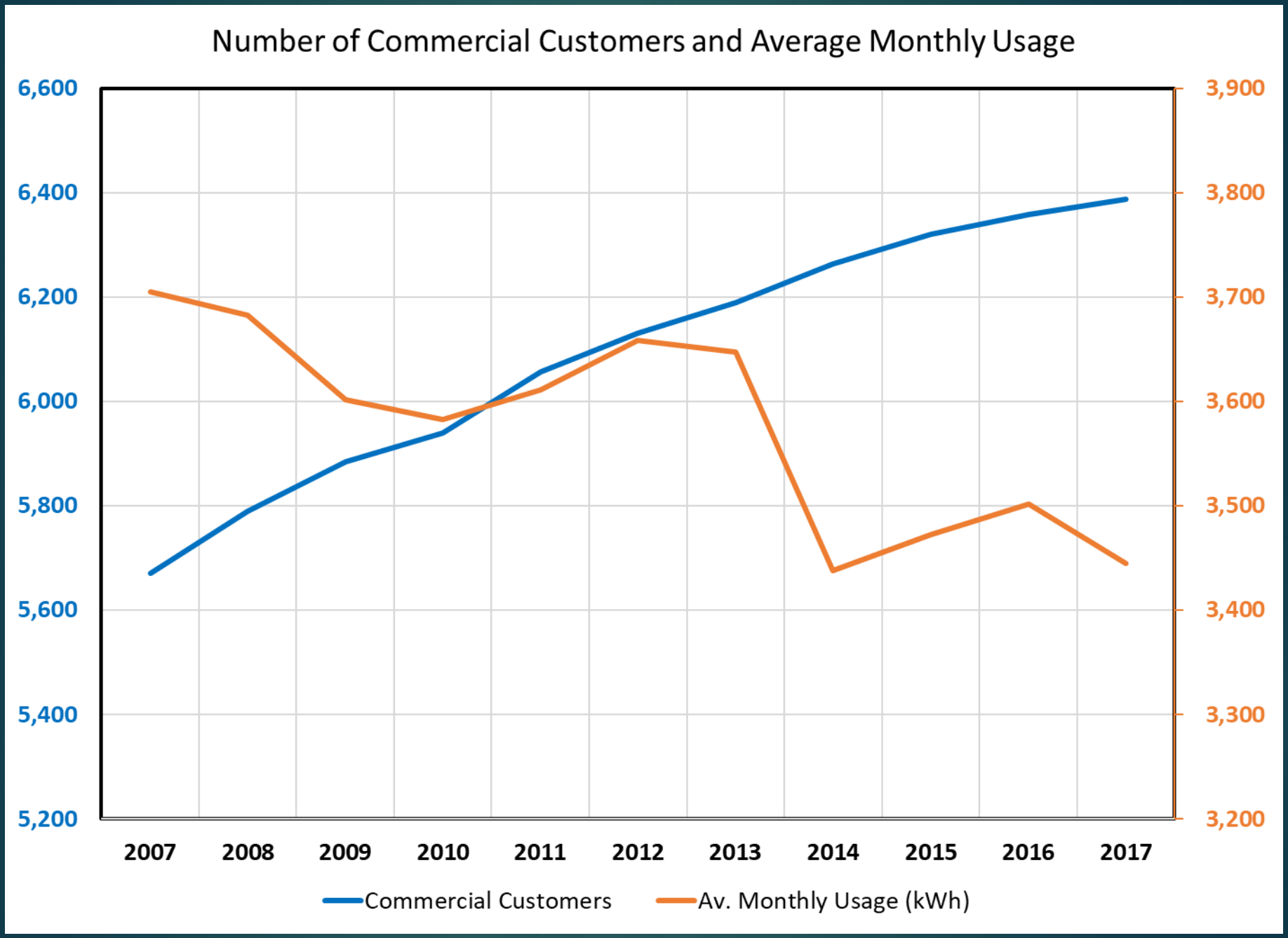
3. Tasks

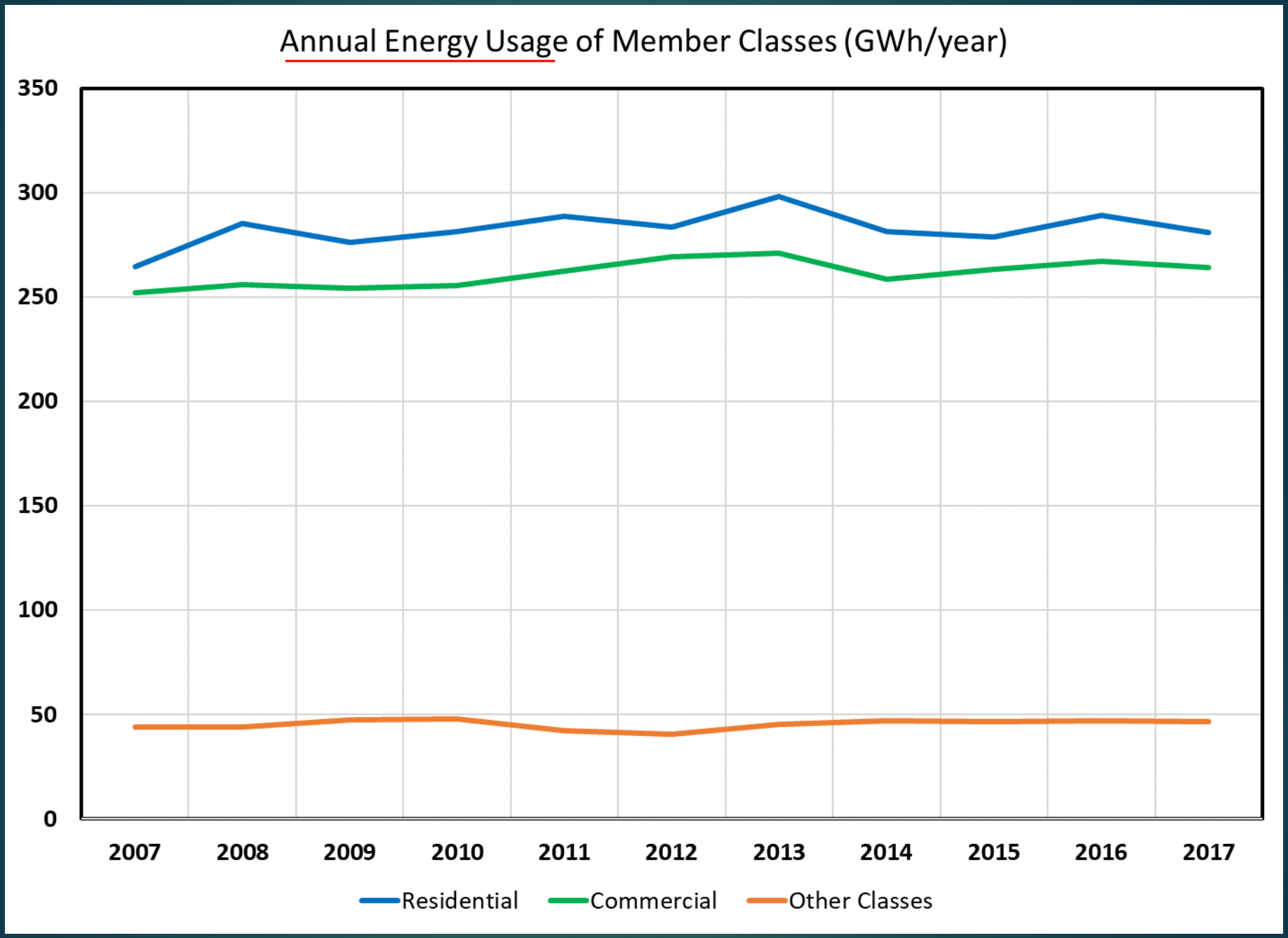
- 3.1 Load Forecast (BB)
- 3.2 Current Supplier (BB)
- 3.3 Government Regulations (GU)
- 3.4 Net Metering (GU)
- 3.5 Wholesale Marketplace (BB)
- 3.6 Electric Vehicles (BL)
- 3.7 Energy Storage (BL)
- 3.8 Distributed Generation (GU)
- 3.9 Micro-grid and Self-generation (DH)
- 3.10 Vision of the Future Grid (DH)

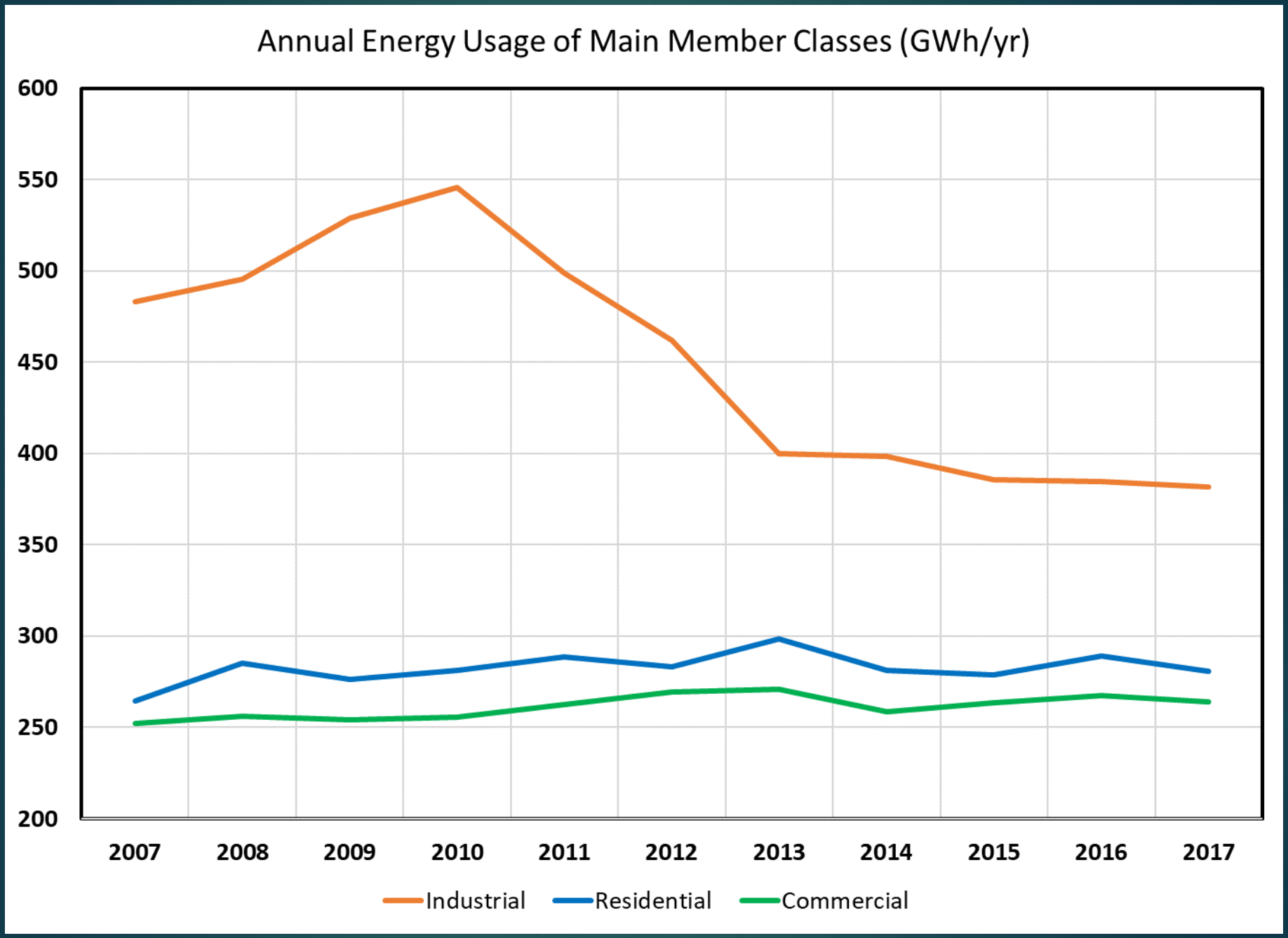
3.1 Load Forecast

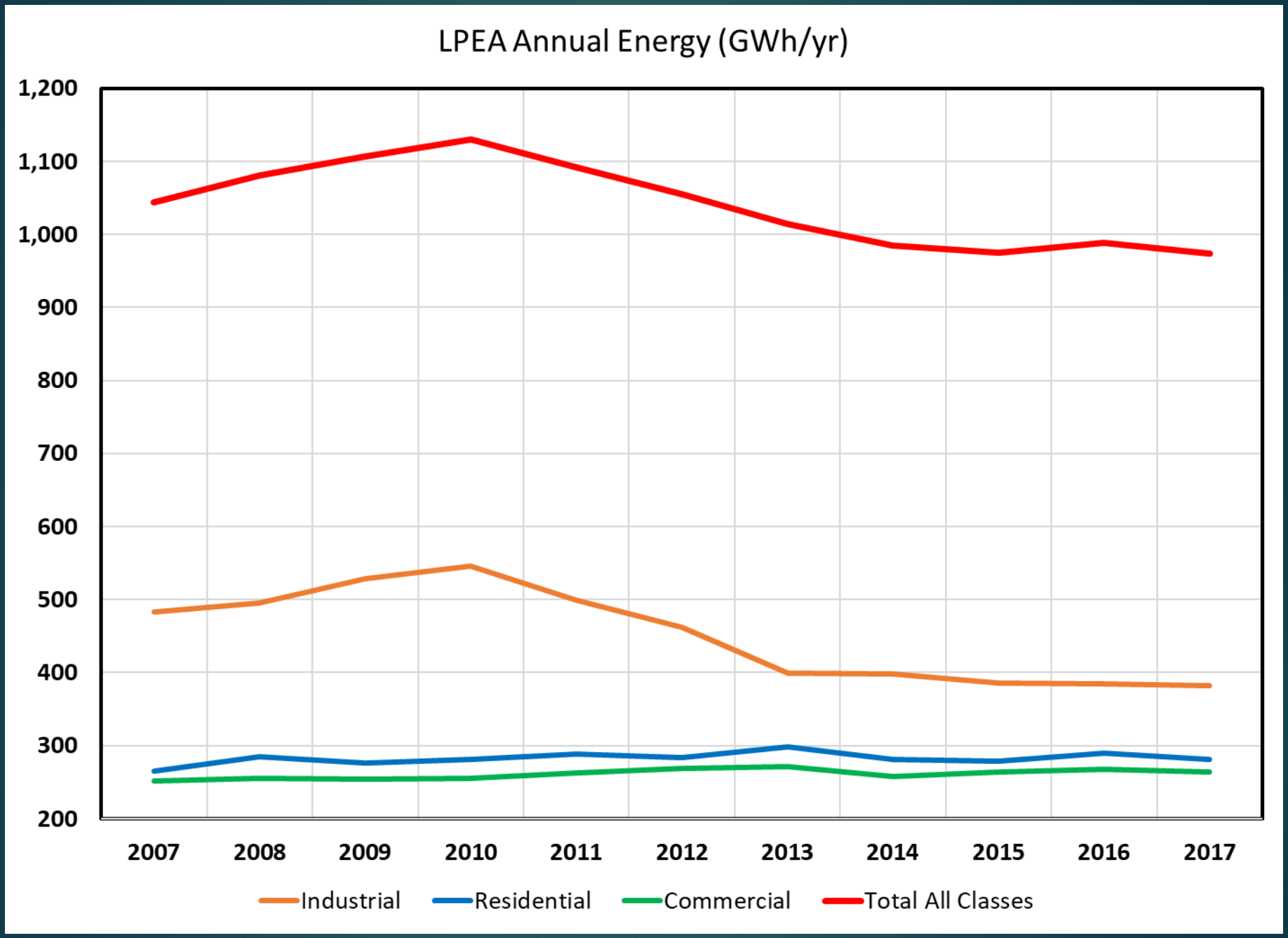
BRITT BASSETT


Number of Residential Customers and Average Monthly Usage
37,000
36,500
36,000
35,500
35,000
34,500
34,000
33,500
33,000
32,500
32,000
800
780
760
740
720
700
680
660
640
620
600
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Residential Customers
Av. Monthly Usage (kWh)


Number of Commercial Customers and Average Monthly Usage
6,600
6,400
6,200
6,000
5,800
5,600
5,400
5,200
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Commercial Customers
Av. Monthly Usage (kWh)

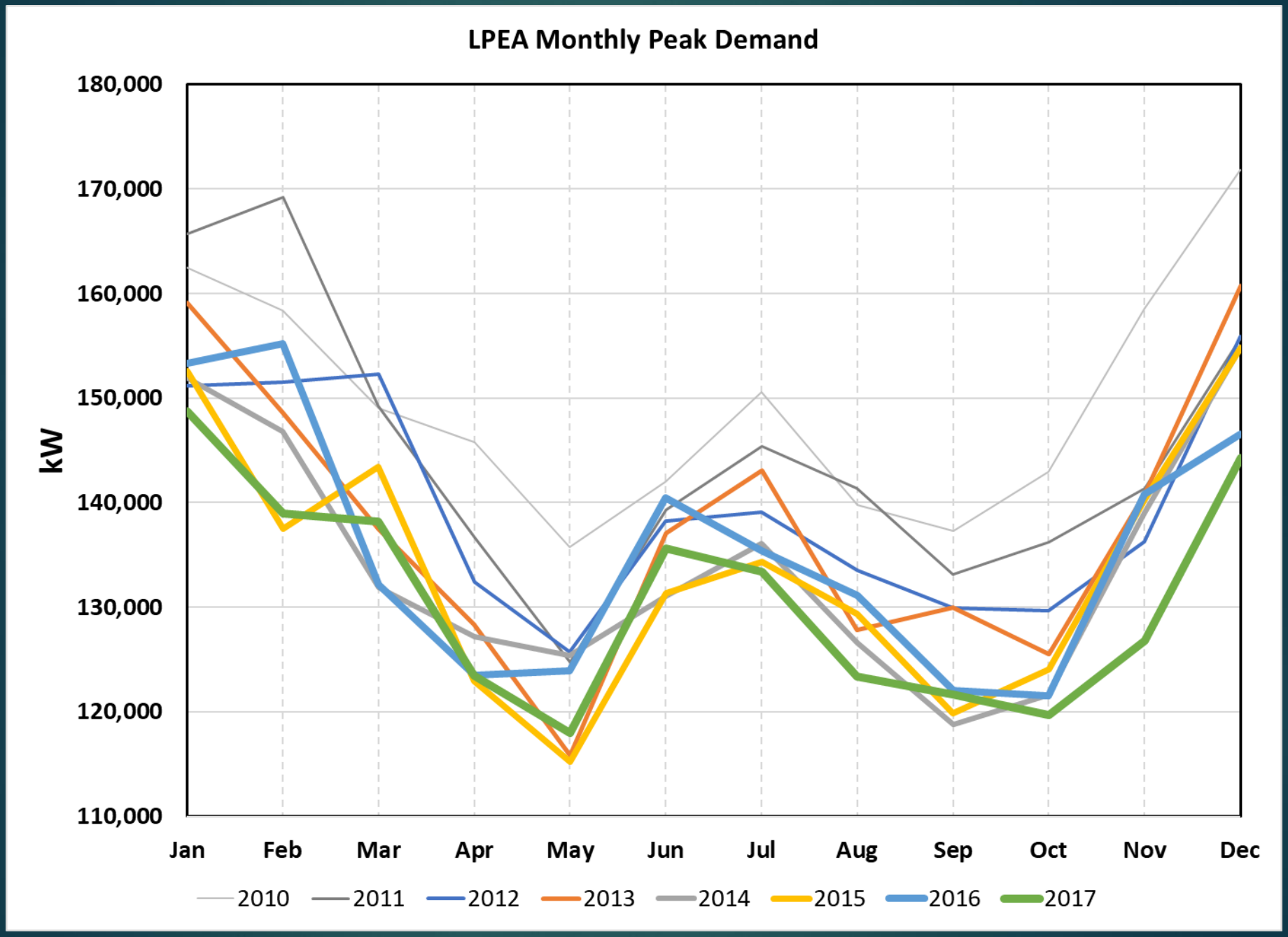

Annual Energy Usage of Member Classes (GWh/year)
350
300
250
200
150
100
50
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Residential
Commercial
Other Classes

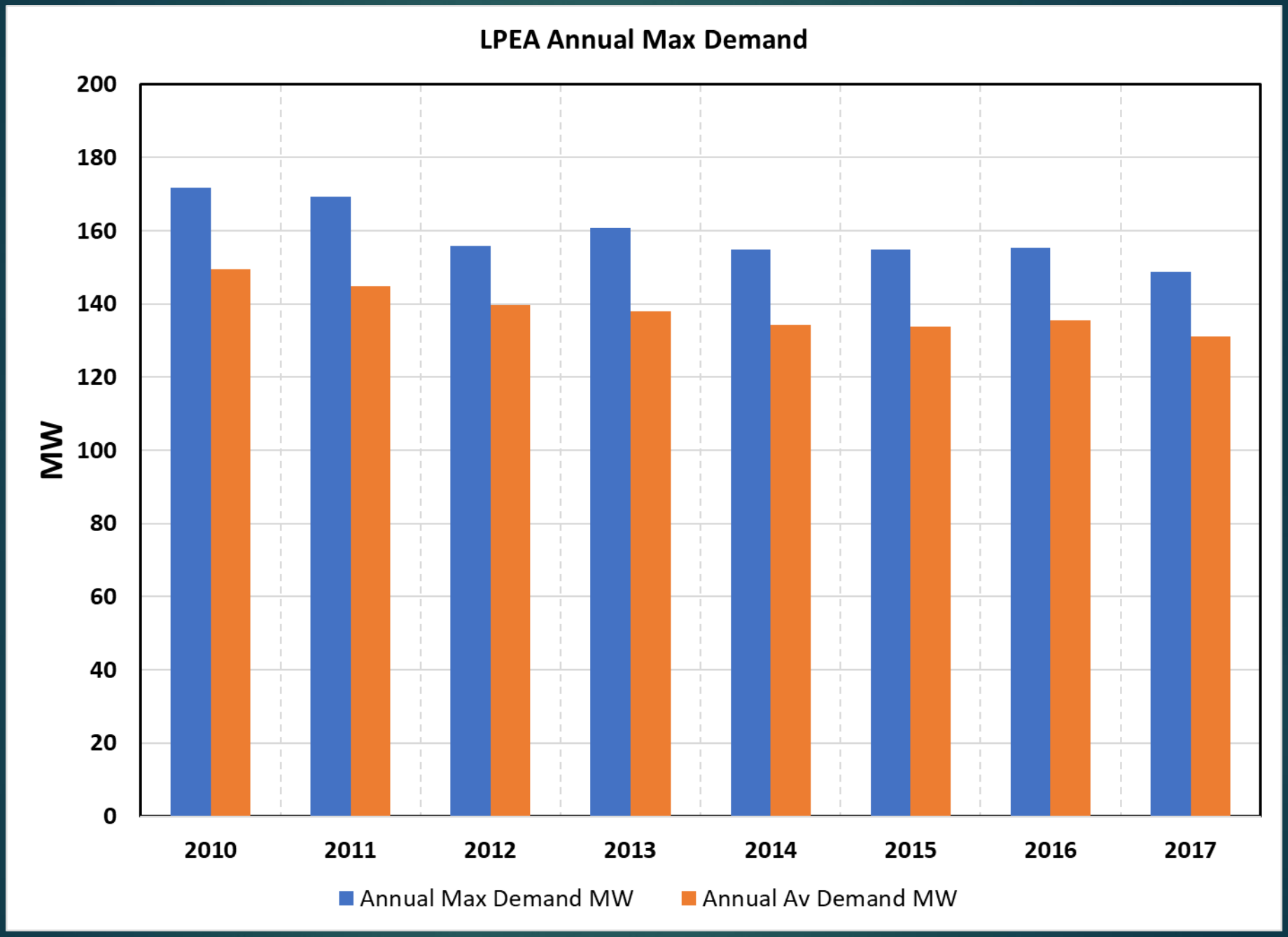

Annual Energy Usage of Main Member Classes (GWh/yr)
600
550
500
450
400
350
300
250
200
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Industrial
Residential
Commercial

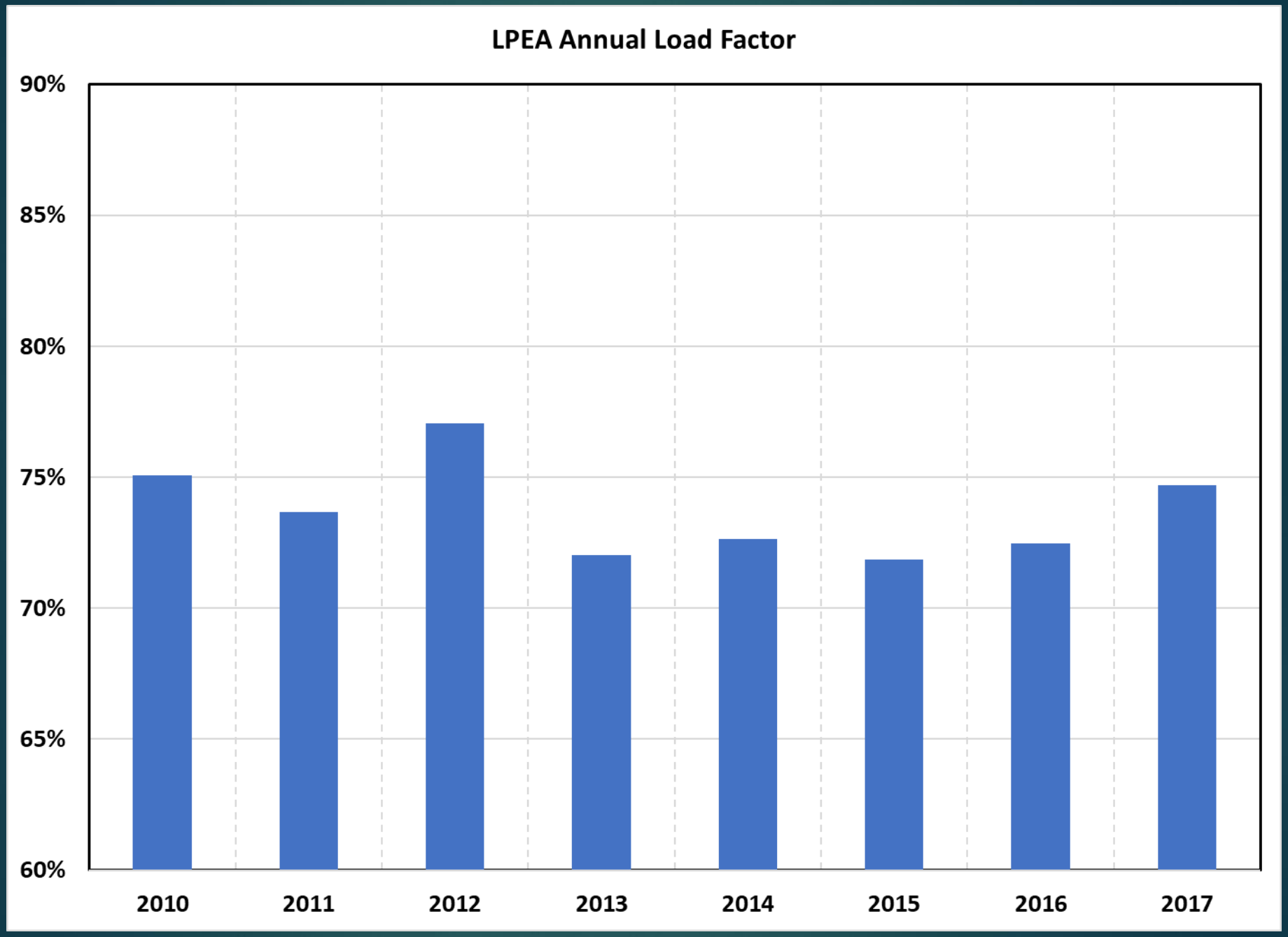

LPEA Annual Energy (GWh/yr)
1,200
1,100
1,000
900
800
700
600
500
400
300
200
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Industrial
Residential
Commercial
Total All Classes

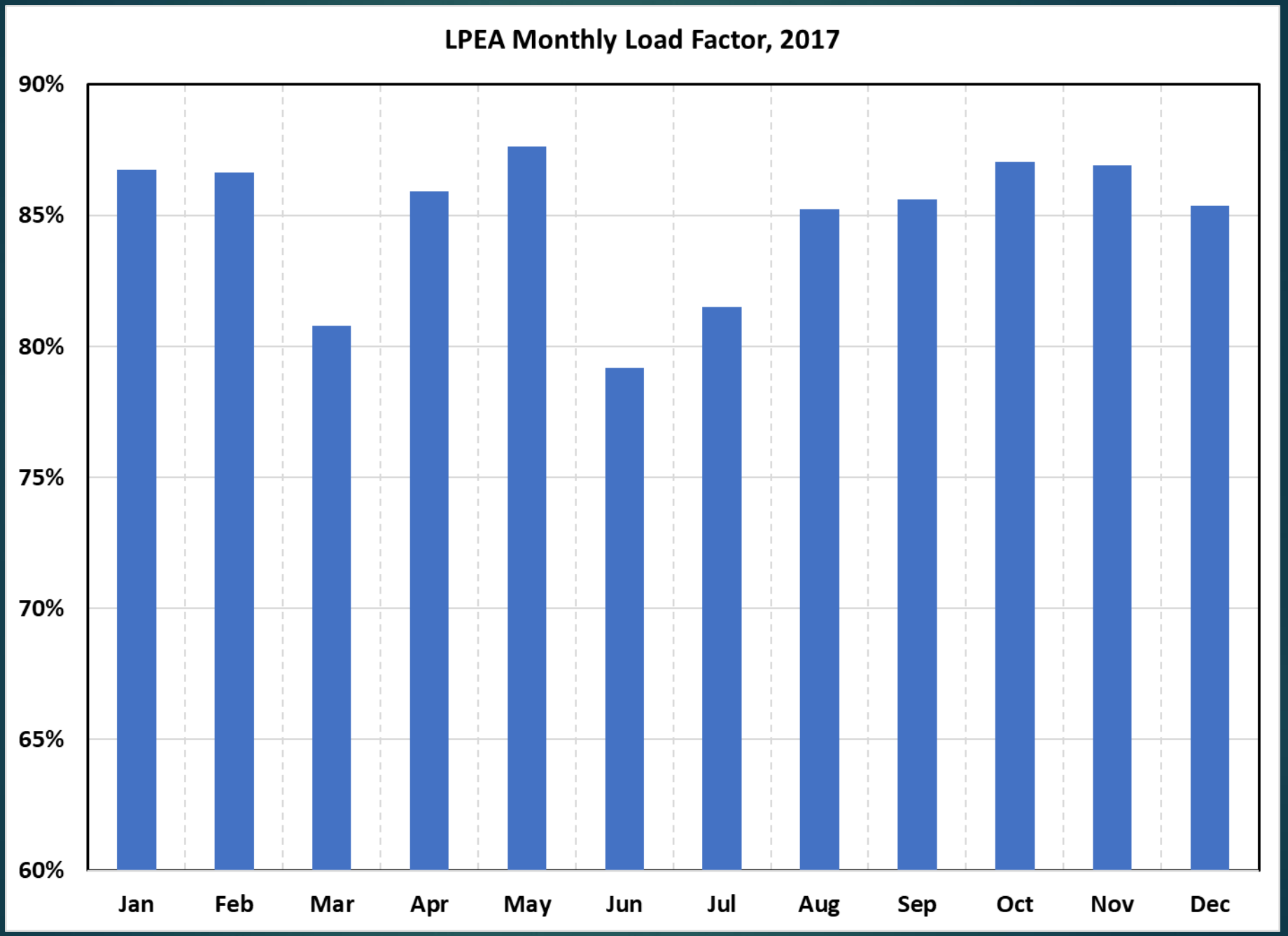
LPEA Load Data, Last 10 Years

- Energy by major customer class
  - Industrial – decreased by -2.3% / yr
  - Commercial – increase by 0.5% / yr
  - Residential – increase by 0.6% / yr
- Demand
- Load Factor


LPEA Monthly Peak Demand
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
kW
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2010
2011
2012
2013
2014
2015
2016
2017

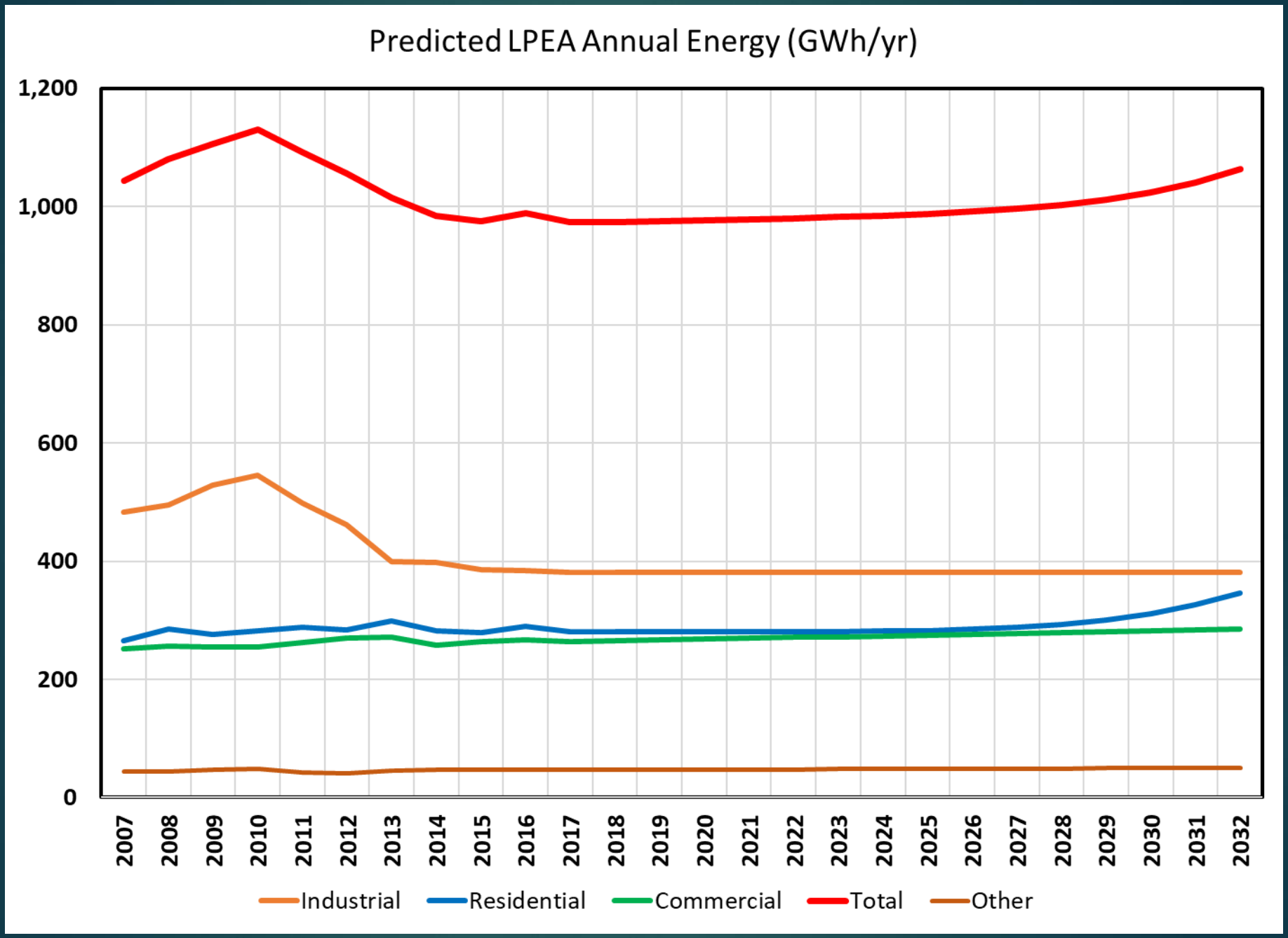

LPEA Annual Max Demand
MW
200
180
160
140
120
100
80
60
40
20
0
2010
2011
2012
2013
2014
2015
2016
2017
Annual Max Demand MW
Annual Av Demand MW


LPEA Annual Load Factor
90%
85%
80%
75%
70%
65%
60%
2010
2011
2012
2013
2014
2015
2016
2017


LPEA Monthly Load Factor, 2017
90%
85%
80%
75%
70%
65%
60%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

LPEA Load Data, Next 15 Years?

- Energy prediction by major customer class
  - Industrial – increase by 0% / year
  - Commercial – increase by 0.5% / year
  - Residential – increase by 2.1% / year (not linear)
    - Increase in home building increases load – offset by PV installs
    - Predict increased PV installations reduces annual usage by -0.25% / yr
    - EV usage increases from near 0 now to add 75 GWh /yr
      (See Section 3.6 - EV growth rate of 40% / yr)
- Demand Prediction
  - Flat, around 150 MW
- Load Factor Prediction
  - Slightly improving, monthly to 90% and annually to 85%

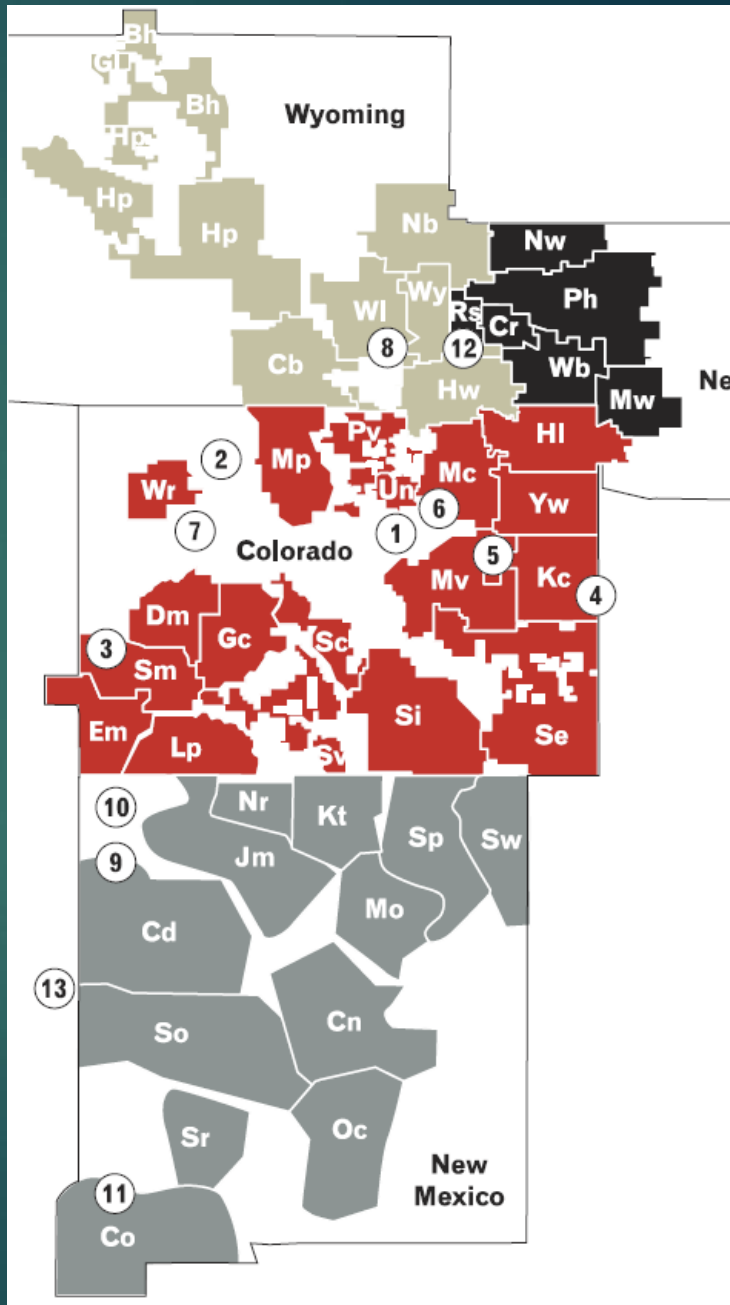

Predicted LPEA Annual Energy (GWh/yr)
1,200
1,000
800
600
400
200
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Industrial
Residential
Commercial
Total
Other

3.2 Current Supplier

BRITT BASSETT

TS now in 5 States

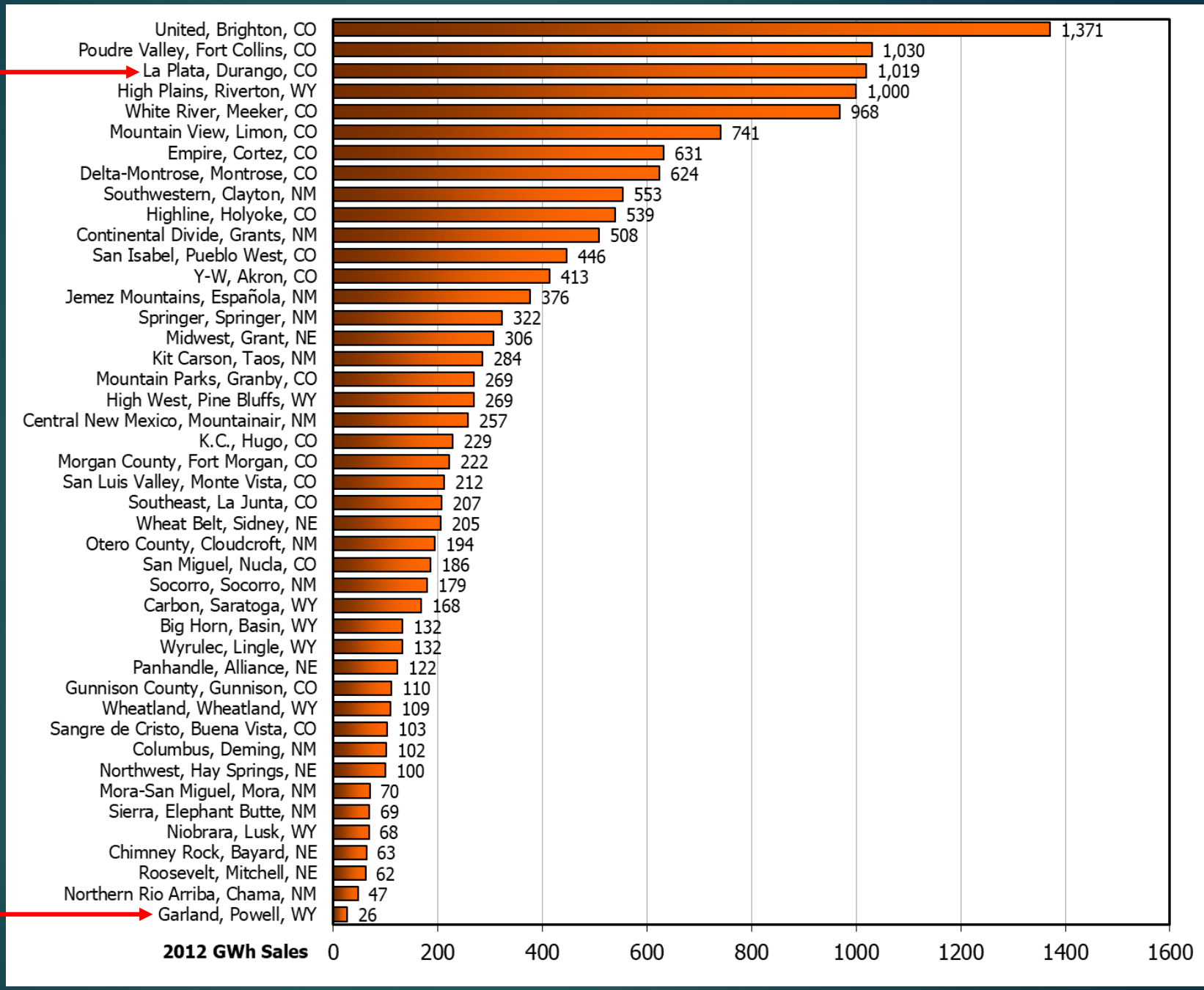
- 6 Coal Generation Plants
- 2 Coal Mines (under Western Fuels)
- 7 Gas Generation Plants
- Provides ~25% Renewable Energy via PPAs
  - WAPA Hydro – 13%
  - Wind – 9%
  - Solar – 3%
- ~5,400 miles of Transmission Lines
- 43 "Member Owner" Cooperatives



LPEA, 3rd largest, ~1,000 GWh

2012

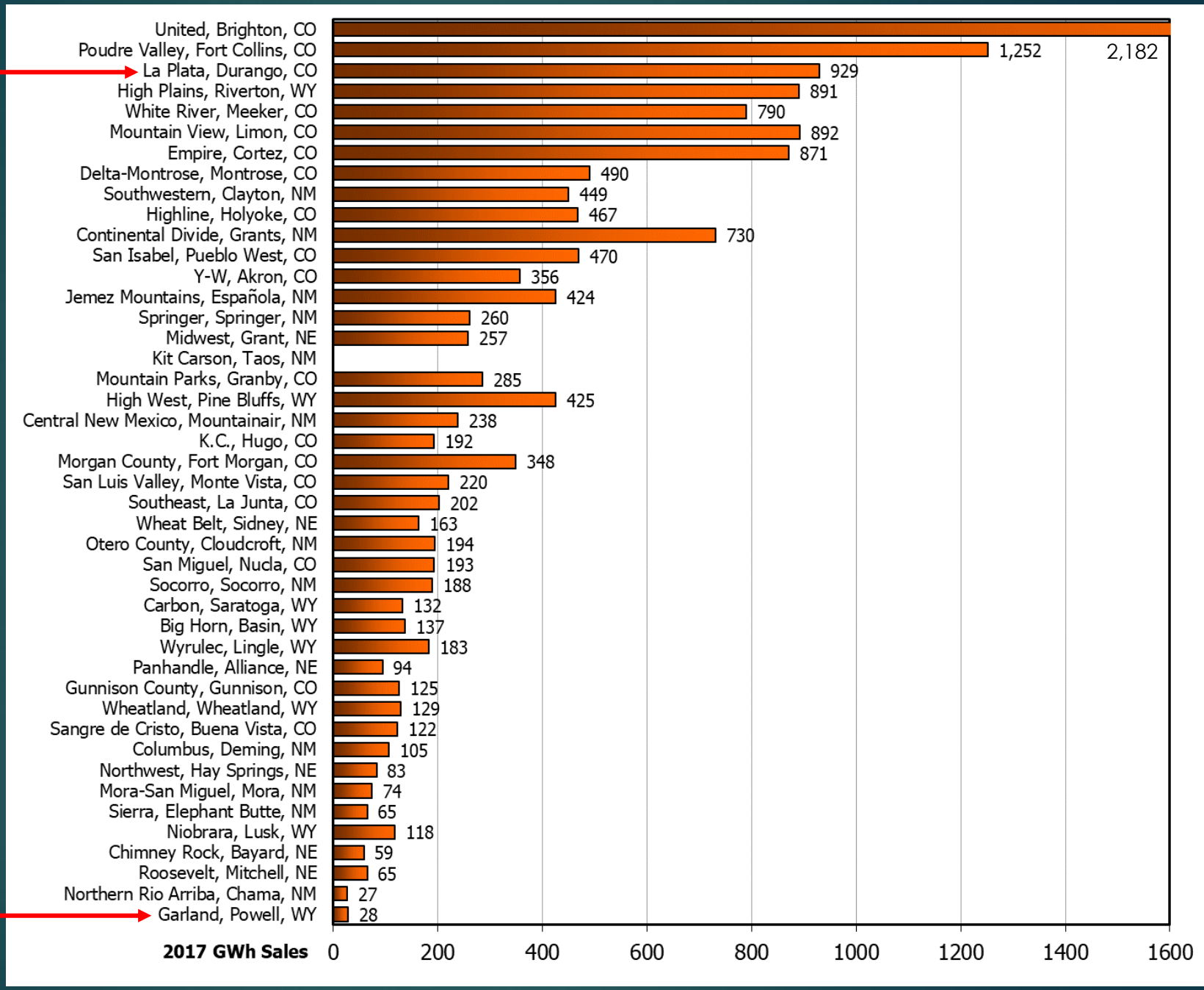
~30 GWh 33 times smaller!



LPEA, 3rd largest, ~1,000 GWh

2017

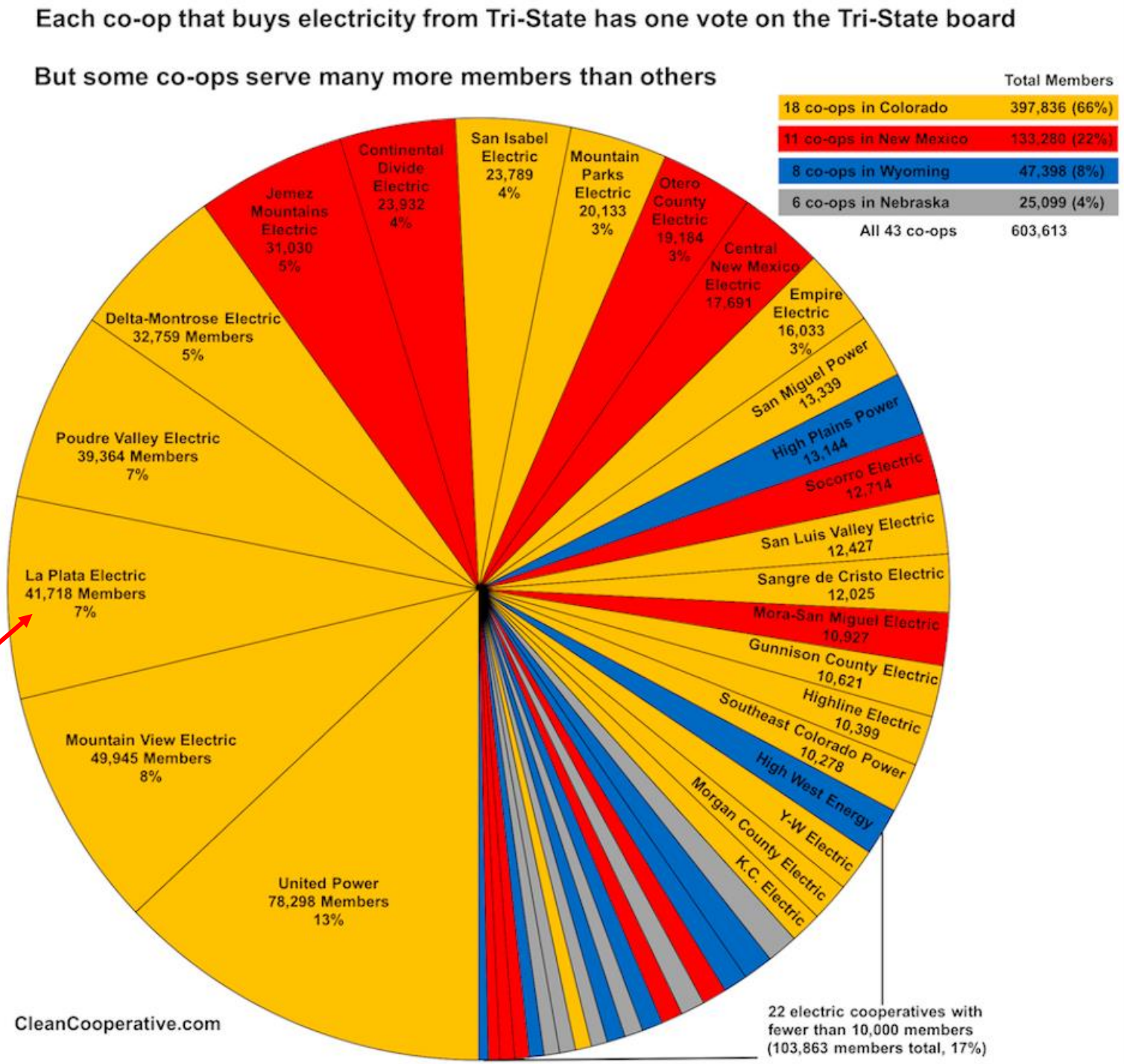
~30 GWh 33 times smaller!



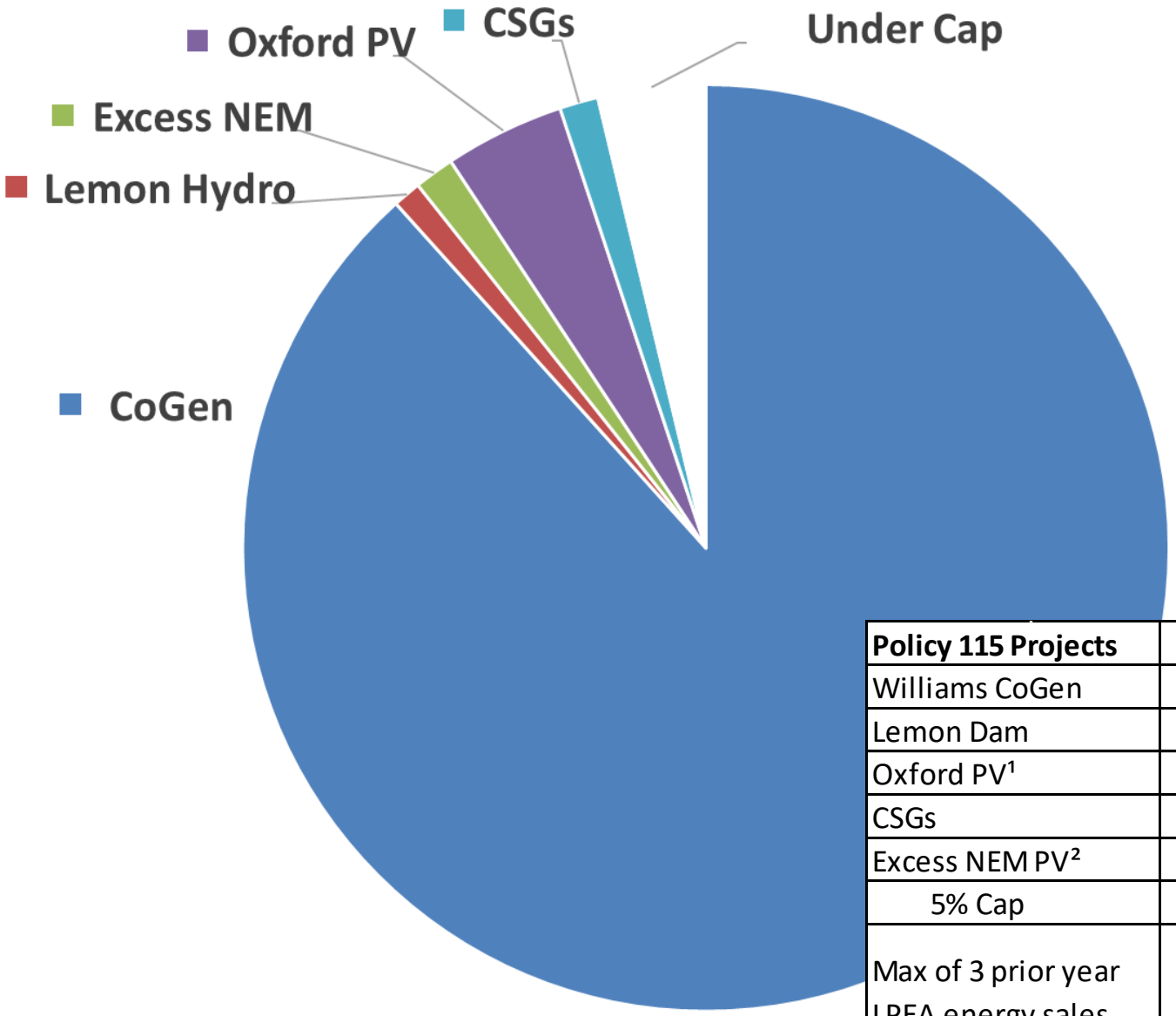
Tiny co-ops rule!

The 22 smallest coops hold the majority vote.

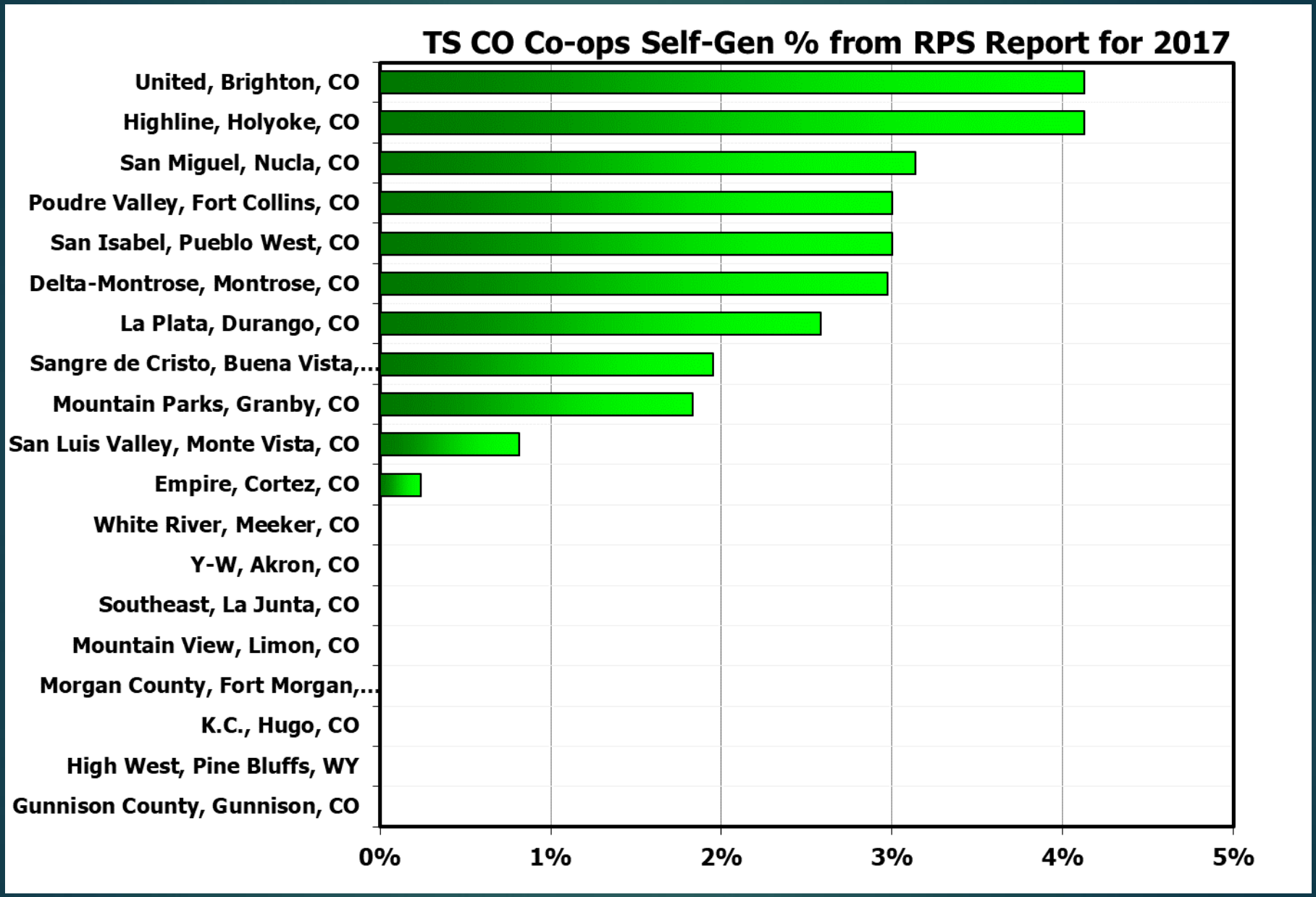
LPEA



LPEA Used Most of 5% in 2017

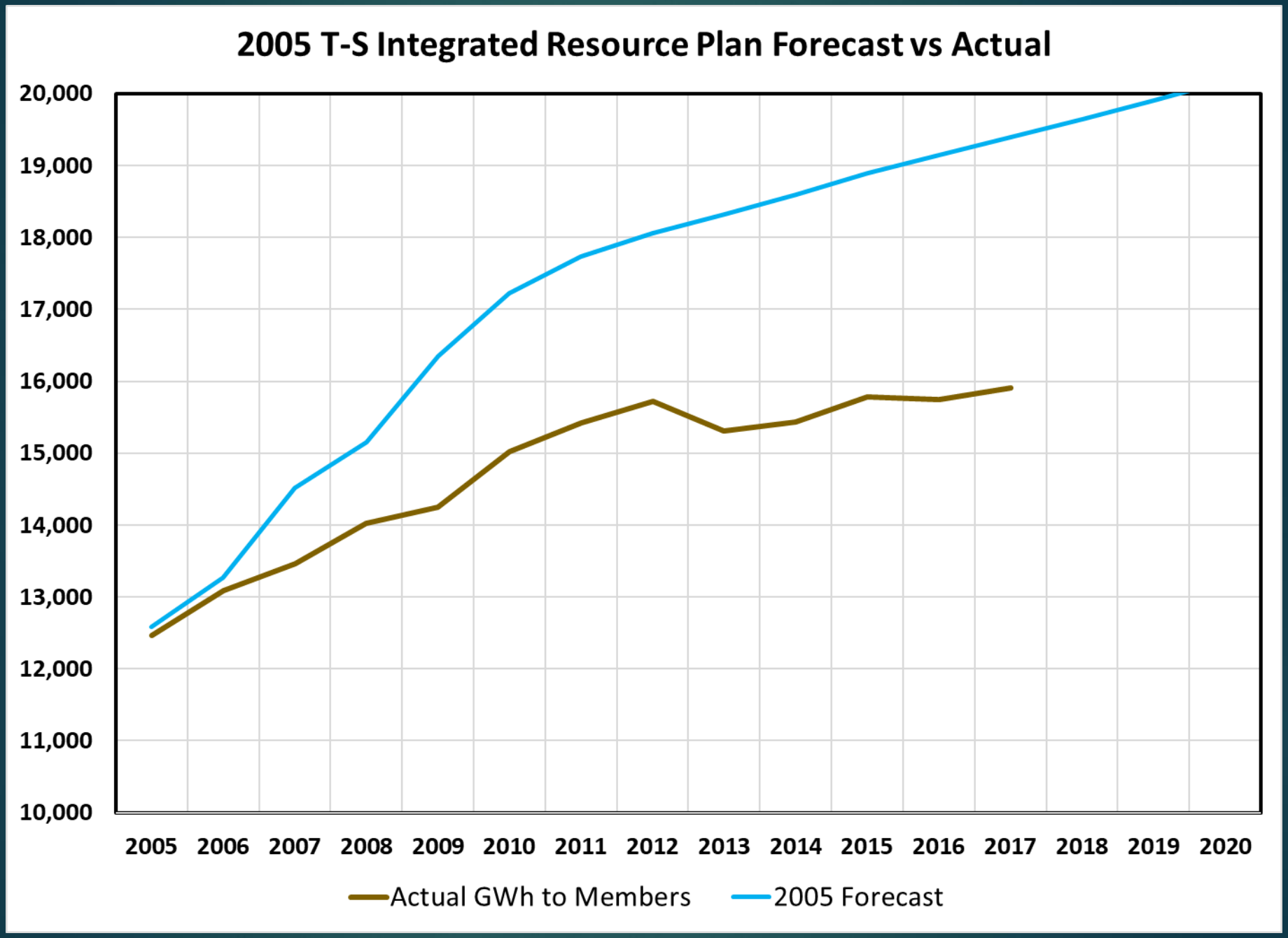


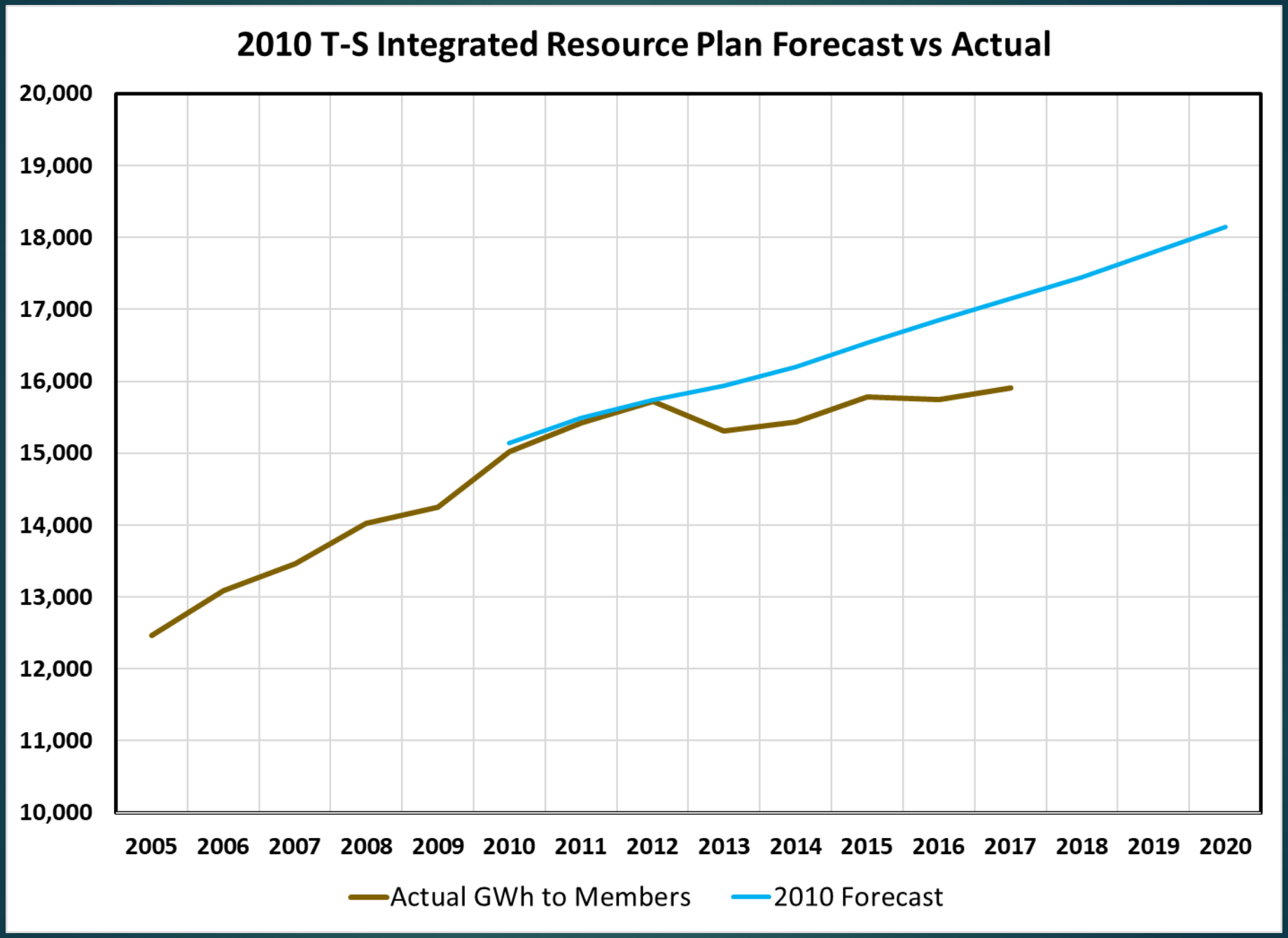
Policy 115 Projects	MWh/yr	%
Williams CoGen	41,778	91.7%
Lemon Dam	467	1.0%
Oxford PV[1]	1,979	4.3%
CSGs	639	1.4%
Excess NEM PV[2]	711	1.6%
5% Cap	45,574	100%
Max of 3 prior year LPEA energy sales	47,296	
Remainder under cap	1,722	3.64%


TS CO Co-ops Self-Gen % from RPS Report for 2017
United, Brighton, CO
Highline, Holyoke, CO
San Miguel, Nucla, CO
Poudre Valley, Fort Collins, CO
San Isabel, Pueblo West, CO
Delta-Montrose, Montrose, CO
La Plata, Durango, CO
Sangre de Cristo, Buena Vista,...
Mountain Parks, Granby, CO
San Luis Valley, Monte Vista, CO
Empire, Cortez, CO
White River, Meeker, CO
Y-W, Akron, CO
Southeast, La Junta, CO
Mountain View, Limon, CO
Morgan County, Fort Morgan,...
K.C., Hugo, CO
High West, Pine Bluffs, WY
Gunnison County, Gunnison, CO
0%
1%
2%
3%
4%
5%

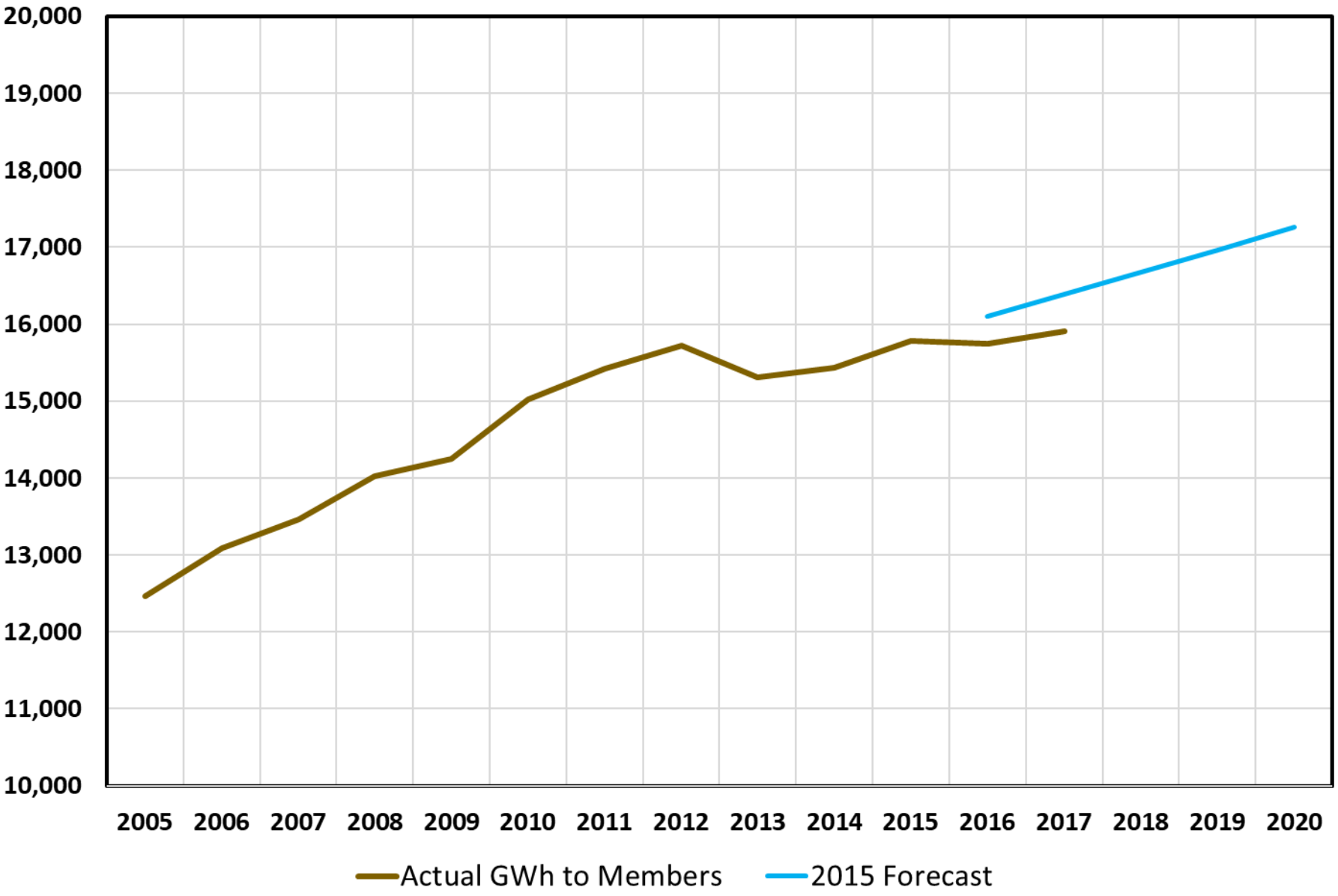
TS Growth Forecast

- TS predicts 1.75% annual growth in member electrical consumption over next 10 years.
- Best to balance this with their past growth forecasts published every 5 years in their Integrated Resource Plan (IRP).


2005 T-S Integrated Resource Plan Forecast vs Actual
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Actual GWh to Members
2005 Forecast


2010 T-S Integrated Resource Plan Forecast vs Actual
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Actual GWh to Members
2010 Forecast

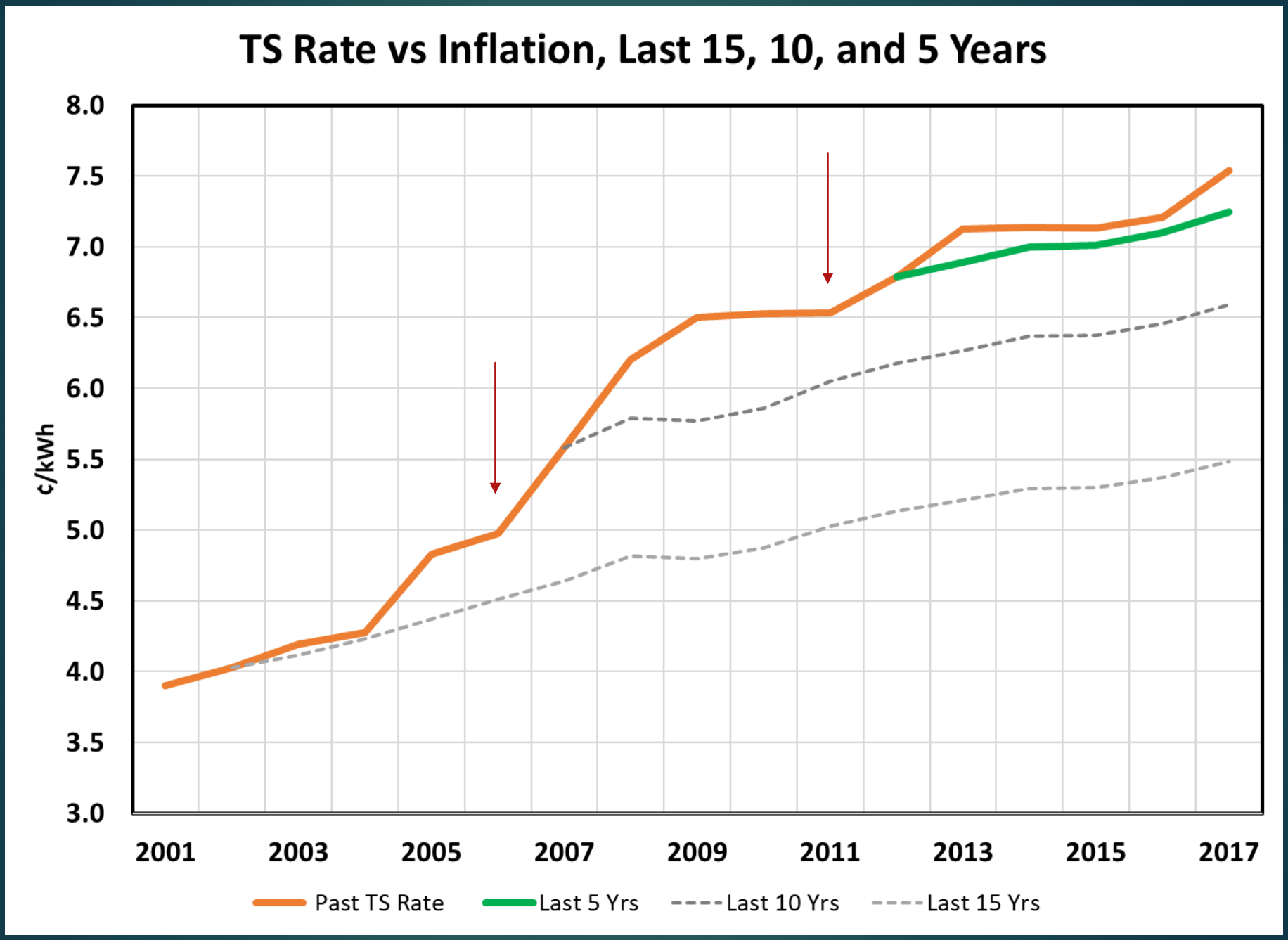
2015 T-S Integrated Resource Plan Forecast vs Actual

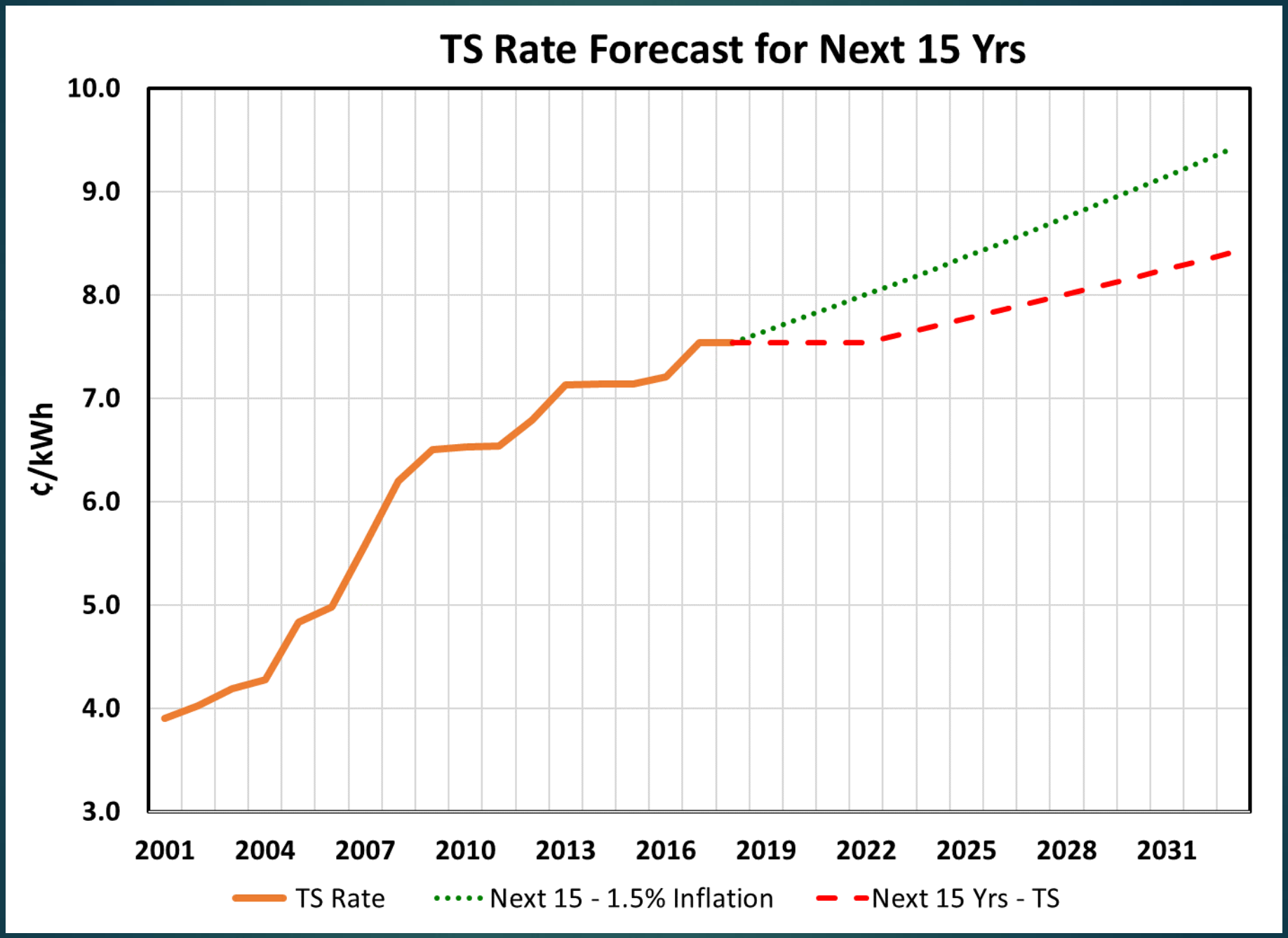


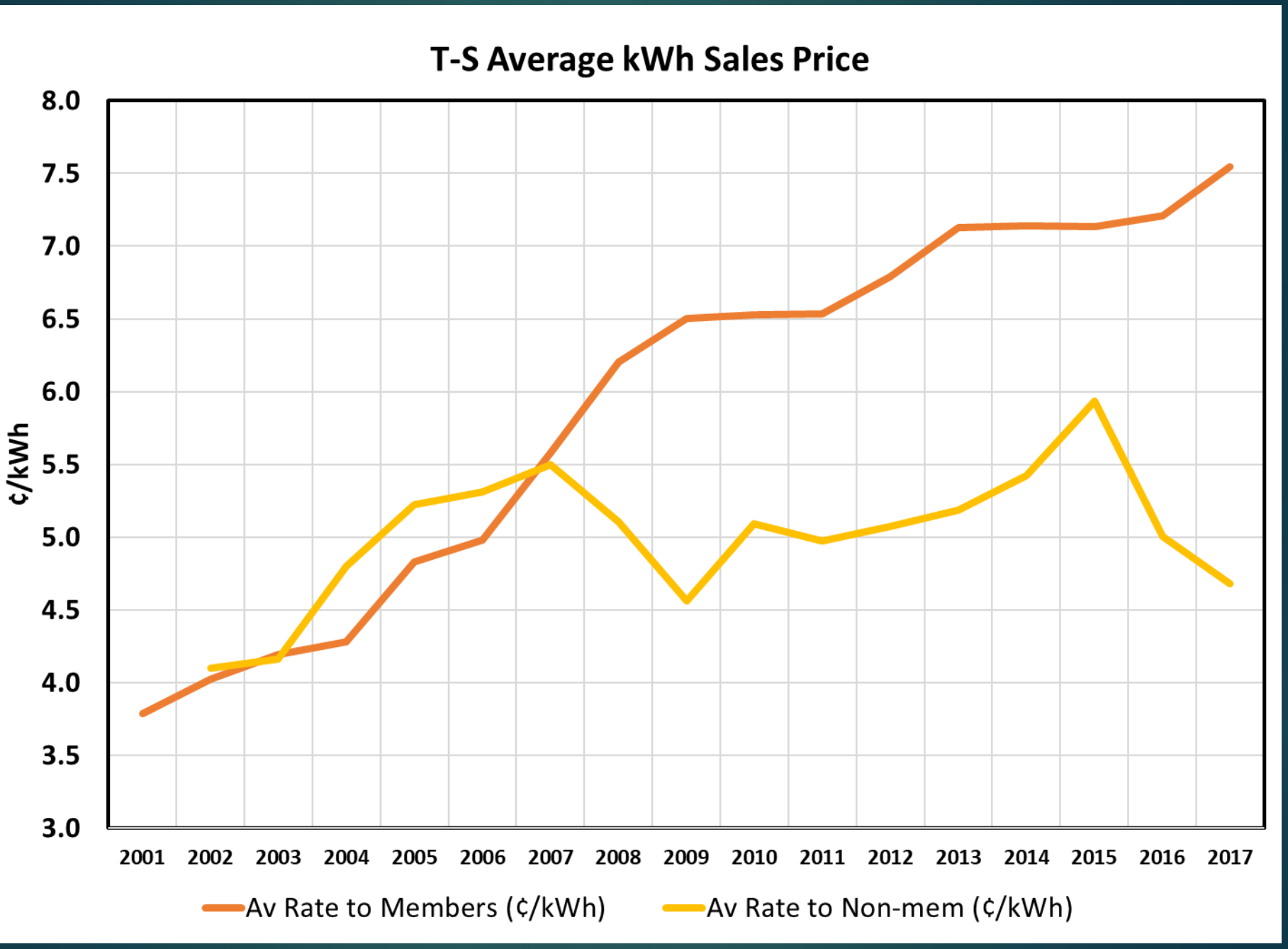
TS Rate Increase Forecast

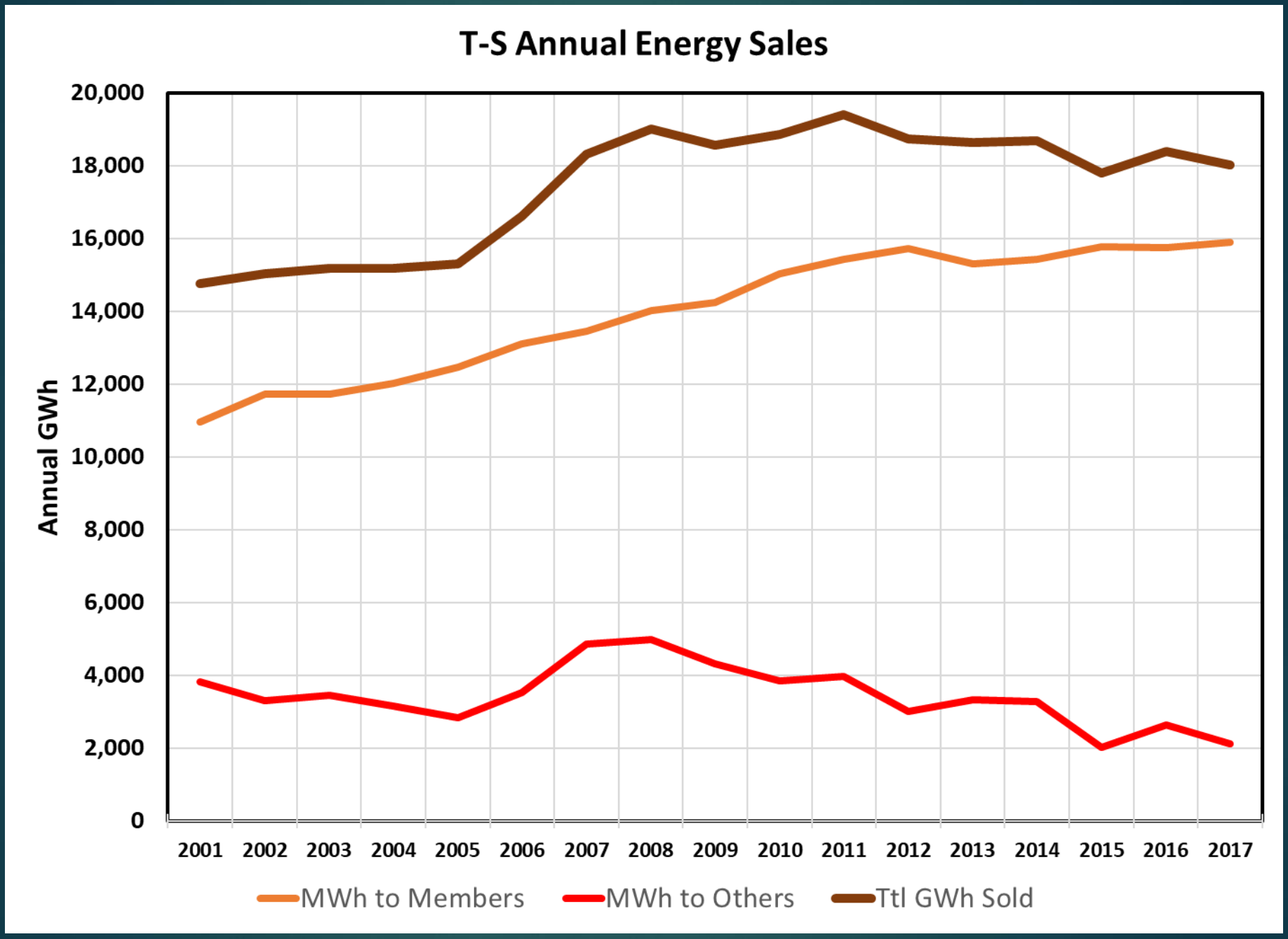
- TS predicts no rate increase for 5 years, then a rate increase of 1% per year.
- 2017 Inflation Rate was 2.1%
- Future Inflation Rate predictions vary but generally show a slowly increasing rate staying well below 3%

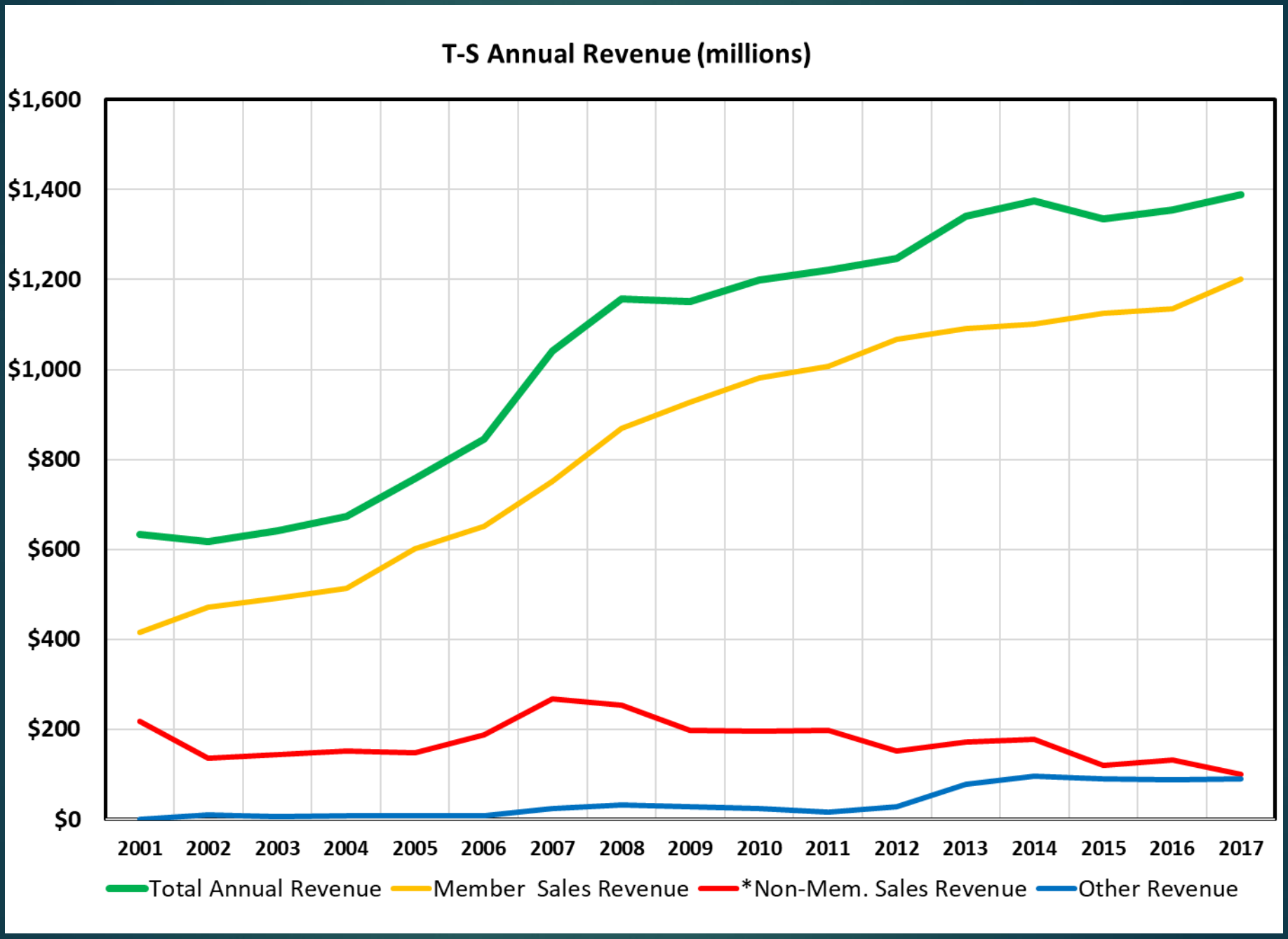
- Can TS actually do this?
- Without taking on more debt?

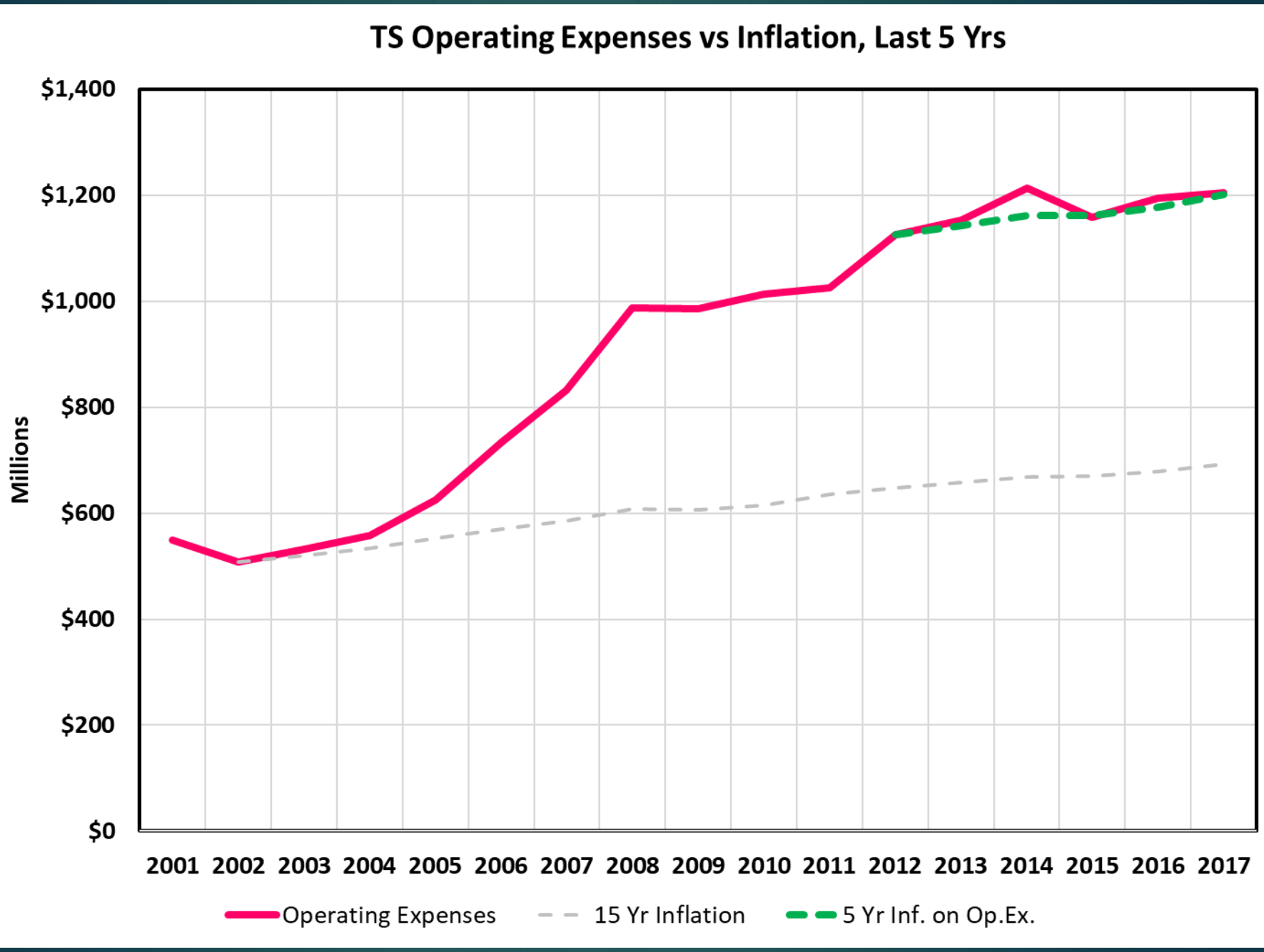

TS Rate vs Inflation, Last 15, 10, and 5 Years
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
¢/kWh
2001
2003
2005
2007
2009
2011
2013
2015
2017
Past TS Rate
Last 5 Yrs
Last 10 Yrs
Last 15 Yrs

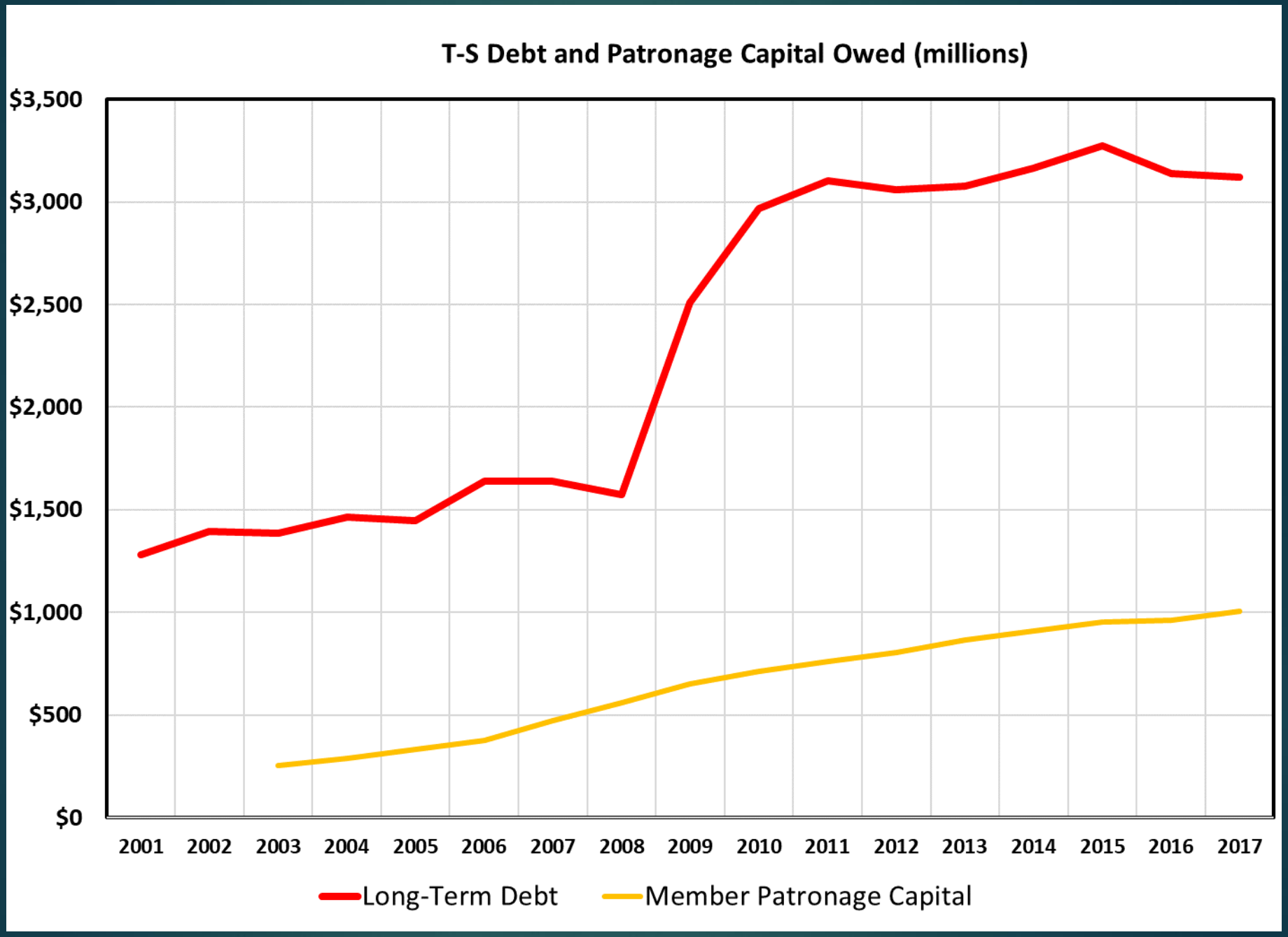

TS Rate Forecast for Next 15 Yrs
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
¢/kWh
2001
2004
2007
2010
2013
2016
2019
2022
2025
2028
2031
TS Rate
Next 15 - 1.5% Inflation
Next 15 Yrs - TS


T-S Average kWh Sales Price
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
¢/kWh
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Av Rate to Members (¢/kWh)
Av Rate to Non-mem (¢/kWh)


T-S Annual Energy Sales
Annual GWh
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
MWh to Members
MWh to Others
Ttl GWh Sold

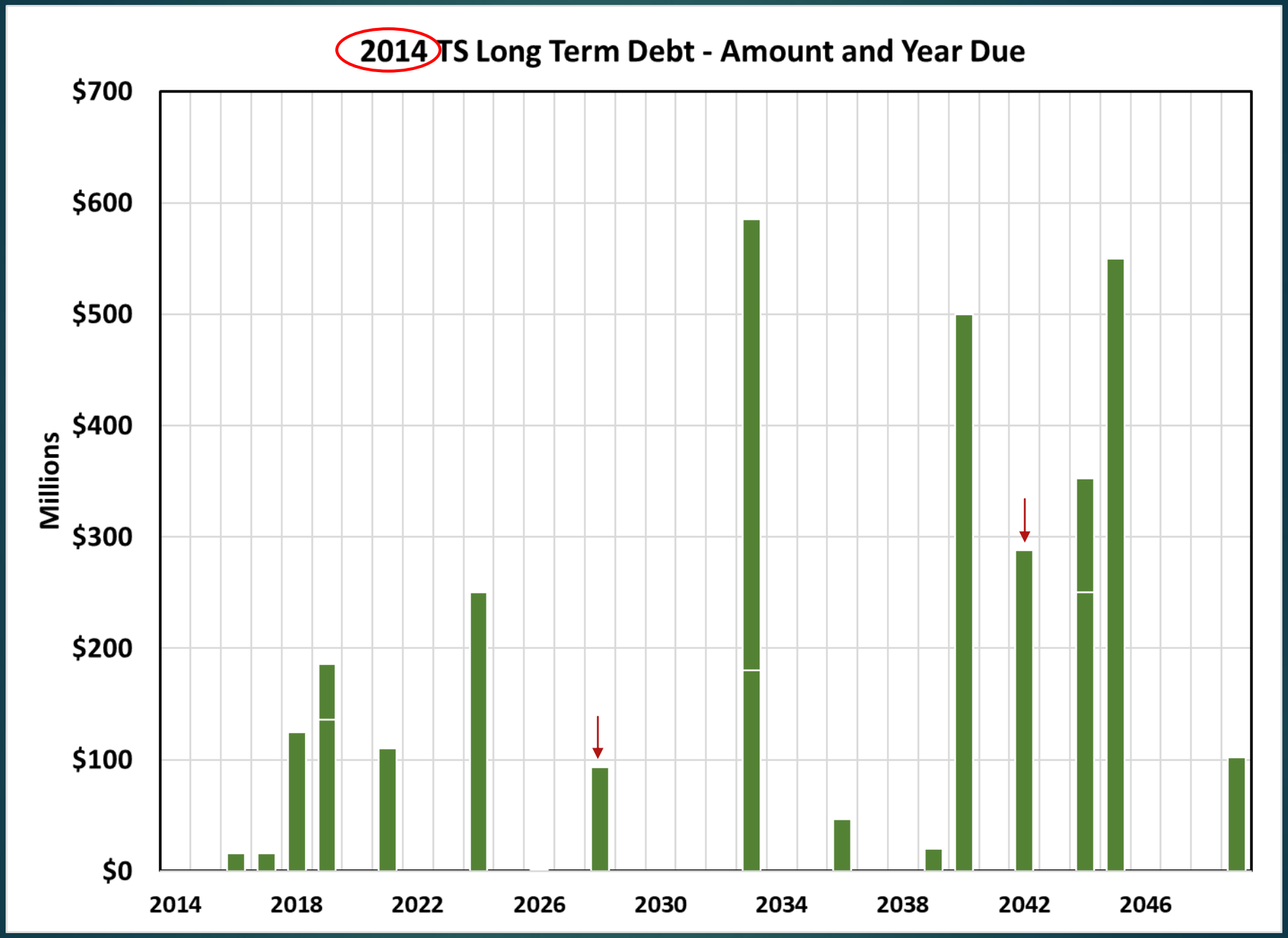

T-S Annual Revenue (millions)
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Total Annual Revenue
Member Sales Revenue
*Non-Mem. Sales Revenue
Other Revenue

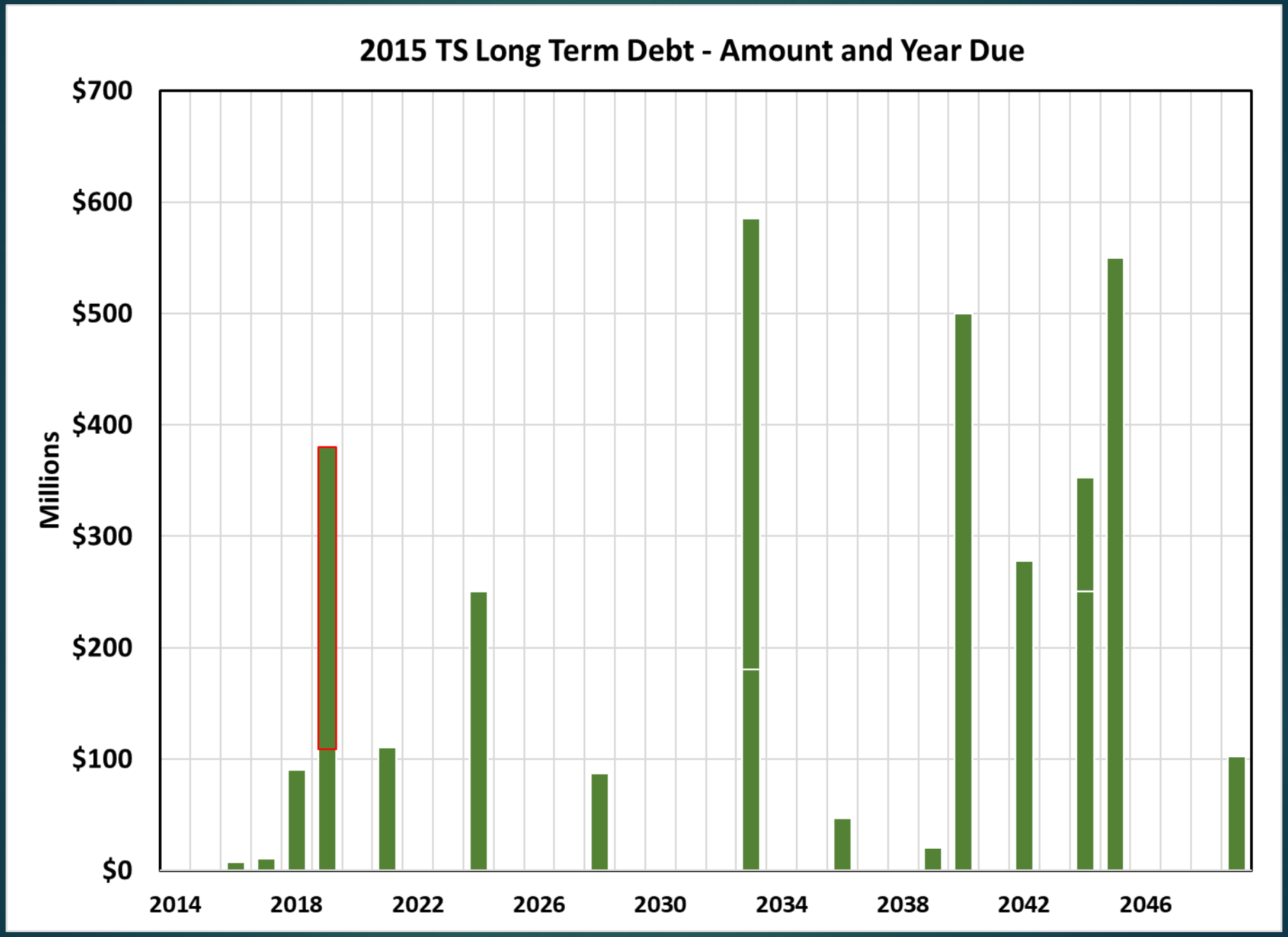

TS Operating Expenses vs Inflation, Last 5 Yrs
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Millions
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
Operating Expenses
15 Yr Inflation
5 Yr Inf. on Op.Ex.

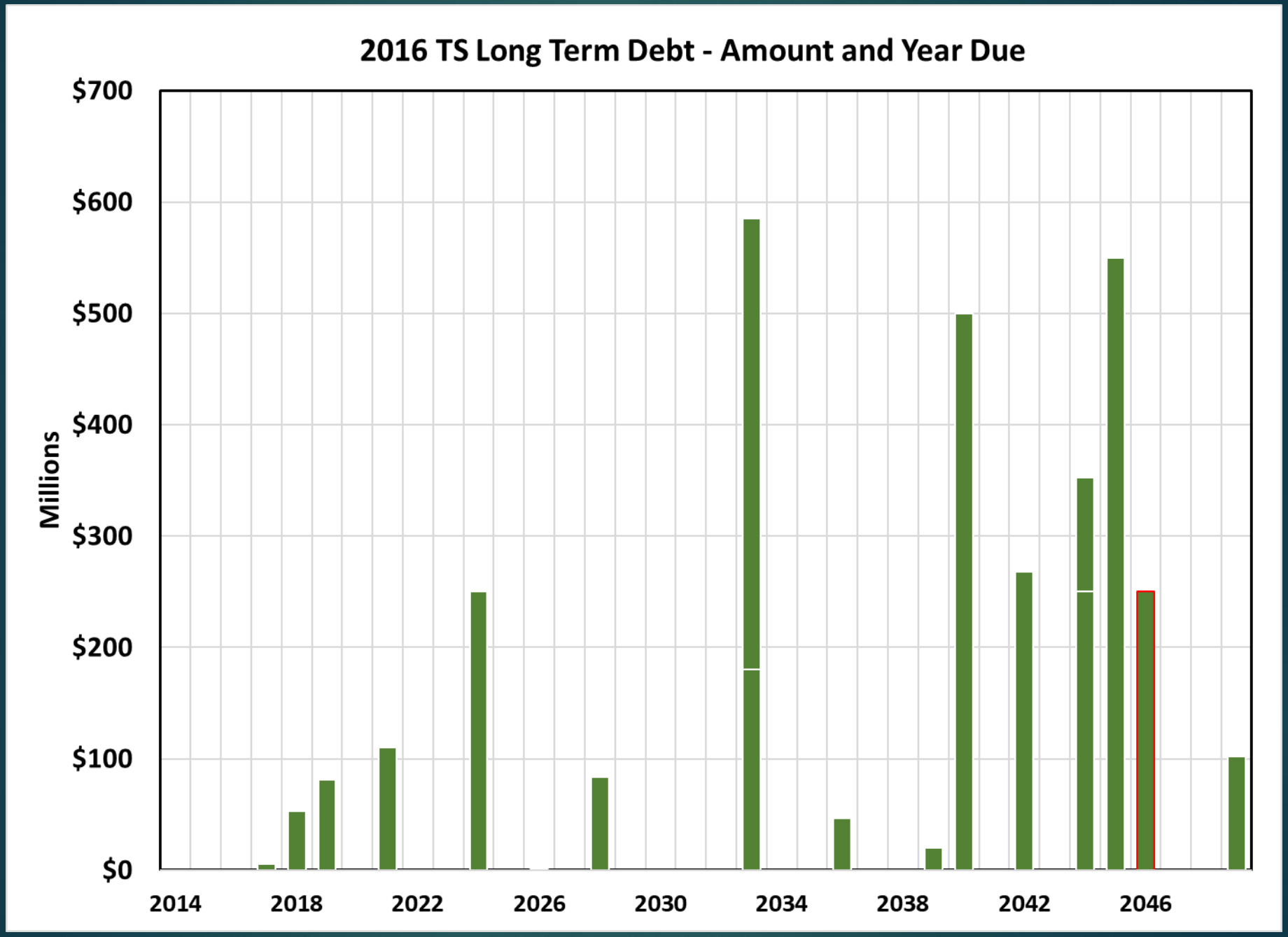

T-S Debt and Patronage Capital Owed (millions)
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Long-Term Debt
Member Patronage Capital

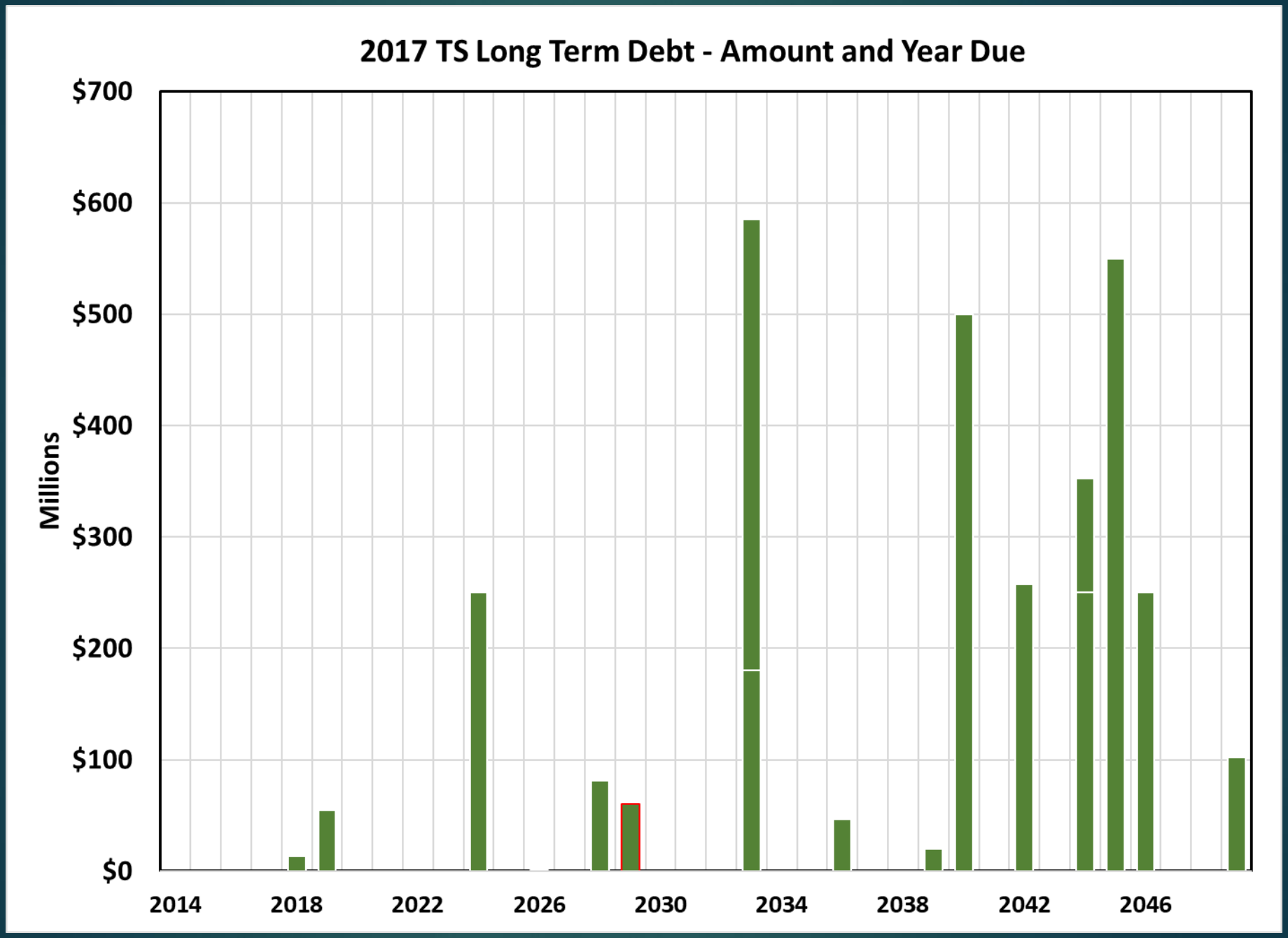
TS Long-Term Debt ($k)

	December 31, 2017
Mortgage notes payable	
3.66% to 8.08% CFC, due through 2028	$ 80,948
2.63% to 6.17% CoBank, ACB, due through 2042	257,630
First Mortgage Obligations, Series 2017A, Tranche 1, 3.34%, due through 2029	60,000
First Mortgage Bonds, Series 2016A, 4.25% due 2046	250,000
First Mortgage Bonds, Series 2014E-1, 3.70% due 2024	250,000
First Mortgage Bonds, Series 2014E-2, 4.70% due 2044	250,000
First Mortgage Bonds, Series 2010A, 6.00% due 2040	500,000
First Mortgage Obligations, Series 2014B, Tranche 1, 3.90%, due through 2033	180,000
First Mortgage Obligations, Series 2014B, Tranche 2, 4.30%, due through 2039	20,000
First Mortgage Obligations, Series 2014B, Tranche 3, 4.45%, due through 2045	550,000
First Mortgage Obligations, Series 2009C, Tranche 1, 6.00%, due through 2019	54,286
First Mortgage Obligations, Series 2009C, Tranche 2, 6.31%, due through 2021	88,000
Variable rate CFC, as determined by CFC, due through 2026	549
Variable rate CFC, LIBOR-based term loan, due through 2049	102,220
Variable rate CoBank, ACB, LIBOR-based term loan, due through 2044	102,220
Pollution control revenue bonds	
City of Gallup, NM, 5.00%, Series 2005, due through 2017	—
Moffat County, CO, 2.00% term rate through October 2022, Series 2009, due 2036	46,800
Springerville certificates	
Series A, 6.04%, due through 2018	13,721
Series B, 7.14%, due through 2033	405,000


2014 TS Long Term Debt - Amount and Year Due
$700
$600
$500
$400
$300
$200
$100
$0
Millions
2014
2018
2022
2026
2030
2034
2038
2042
2046


2015 TS Long Term Debt - Amount and Year Due
Millions
$700
$600
$500
$400
$300
$200
$100
$0
2014
2018
2022
2026
2030
2034
2038
2042
2046


2016 TS Long Term Debt - Amount and Year Due
Millions
$700
$600
$500
$400
$300
$200
$100
$0
2014
2018
2022
2026
2030
2034
2038
2042
2046


2017 TS Long Term Debt - Amount and Year Due
Millions
$700
$600
$500
$400
$300
$200
$100
$0
2014
2018
2022
2026
2030
2034
2038
2042
2046

Conclusions

- Member sales flat
- Non-member sales decreasing
- Expenses have been rising about same as inflation
- Significant debt in “out years”

3.3 Government Regulations

GUINN UNGER

Government Regulations

PURPA (Public Utility Regulatory Policies Act)

- Large utilities, including TS, and energy industry trade groups, including NRECA, are trying to undermine PURPA
  - Either with changes to Congressional Laws
  - Or, more likely through FERC filings
- Changes include:
  - Eliminating the “avoided cost” methodology
  - Eliminate the “single meter” rule so costly multi-meters can be required
  - Limiting contract terms to unreasonably short lengths (2 year PPAs!)
  - Reducing size of projects that qualify (currently 20MW or less)
- Combined with Tri-State’s appeal to FERC to add a rate penalty, the industry is currently very cautious in proposing lawful implementation of PURPA projects in our area

Government Regulations

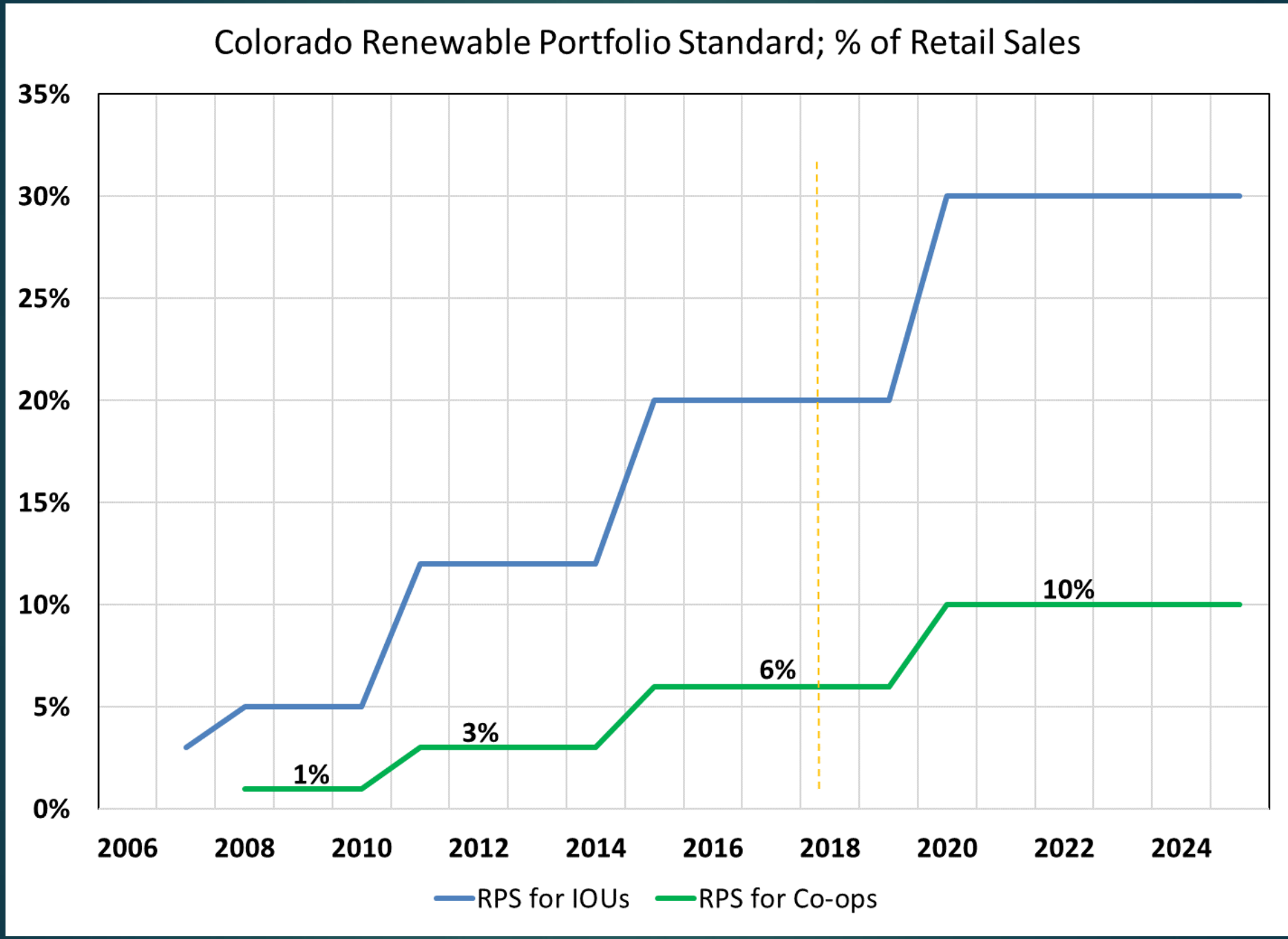
Retail Choice

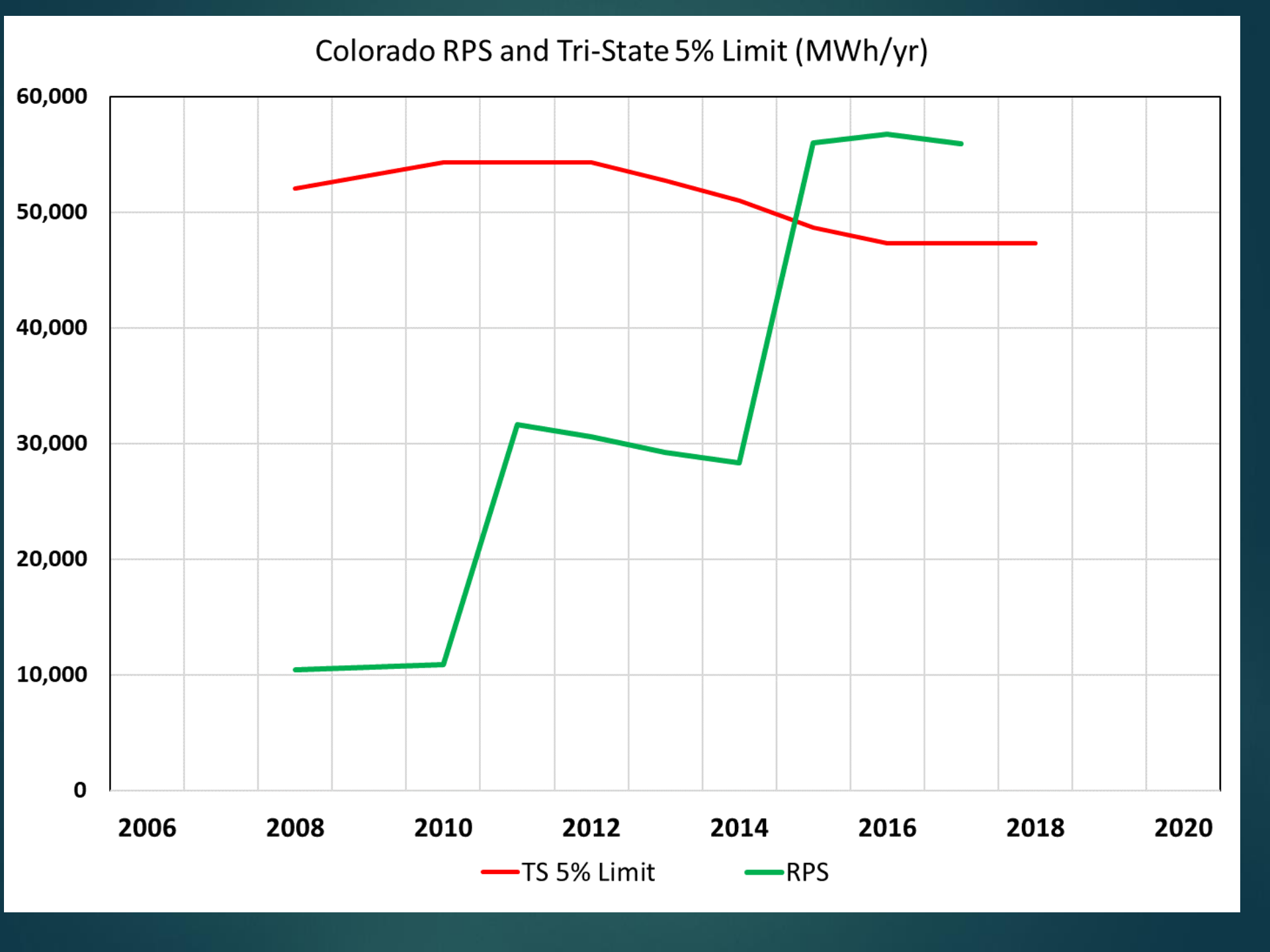
- This could have major implications for LPEA depending on how the law was written.
- This might allow LPEA to become a “wires only” company if it was determined that this was in the best interests of our members.
- We may want to get involved in lobbying if and when retail choice starts to move forward.
- About a dozen states have some form of Retail Choice
  - https://www.electricchoice.com/map-deregulated-energy-markets/

Government Regulations

Renewable Energy Standard

- If the State of Colorado were to increase the RES, or to “carve out” local generation requirements, how would this be handled?
  - LPEA?
  - Tri-State?
  - Other?


Colorado Renewable Portfolio Standard; % of Retail Sales
35%
30%
25%
20%
15%
10%
5%
0%
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
1%
3%
6%
10%
RPS for IOUs
RPS for Co-ops


Colorado RPS and Tri-State 5% Limit (MWh/yr)
60,000
50,000
40,000
30,000
20,000
10,000
0
2006
2008
2010
2012
2014
2016
2018
2020
TS 5% Limit
RPS

Government Regulations

PV Import Tariffs

- An import tax of 30% is currently in place
- Tariff declines 5% per year and ends after 4 years
- This is having a negative effect on solar installations according to local installers.
- If using PV affected by tariff, would drive up install cost on a home by ~$500-800 depending on system size.

- (However, as a result of recent reduction in China's support for in-county PV, Bloomberg New Energy Finance predicts a 34% decline in PV prices by the end of 2018.)

Government Regulations

Reduction of Investment Tax Credit

- The 30% Investment Tax Credit (ITC) on solar installations starts to roll back after 2019.
  - 26% in 2020
  - 22% in 2021
  - 10% in 2022
  - 10% thereafter
- This will likely have a negative effect on solar installation economics.
- Effect will likely be reduced if PV installation costs continue to decline.

Government Regulations

Addition of Carbon Fee

- A carbon fee would be designed to increase the cost of carbon-based fuels.
- Electricity generated from coal, gas, and oil would potentially become much more expensive.
- There is bi-partisan support for this, but it does not seem likely that it will pass any time soon.

Government Regulations – Misc.

City of Durango Franchise Agreement

- Expires in 2032

Virtual Net Metering

- Allowed in CA under certain circumstances (e.g. big Ag)
- If implemented in CO could make solar viable for more LPEA members.

Net Metering Changes

- Various state legislature or state PUCs have made NEM changes
- AZ, ME, AK, NY, NH, NV, IA, ID, etc.

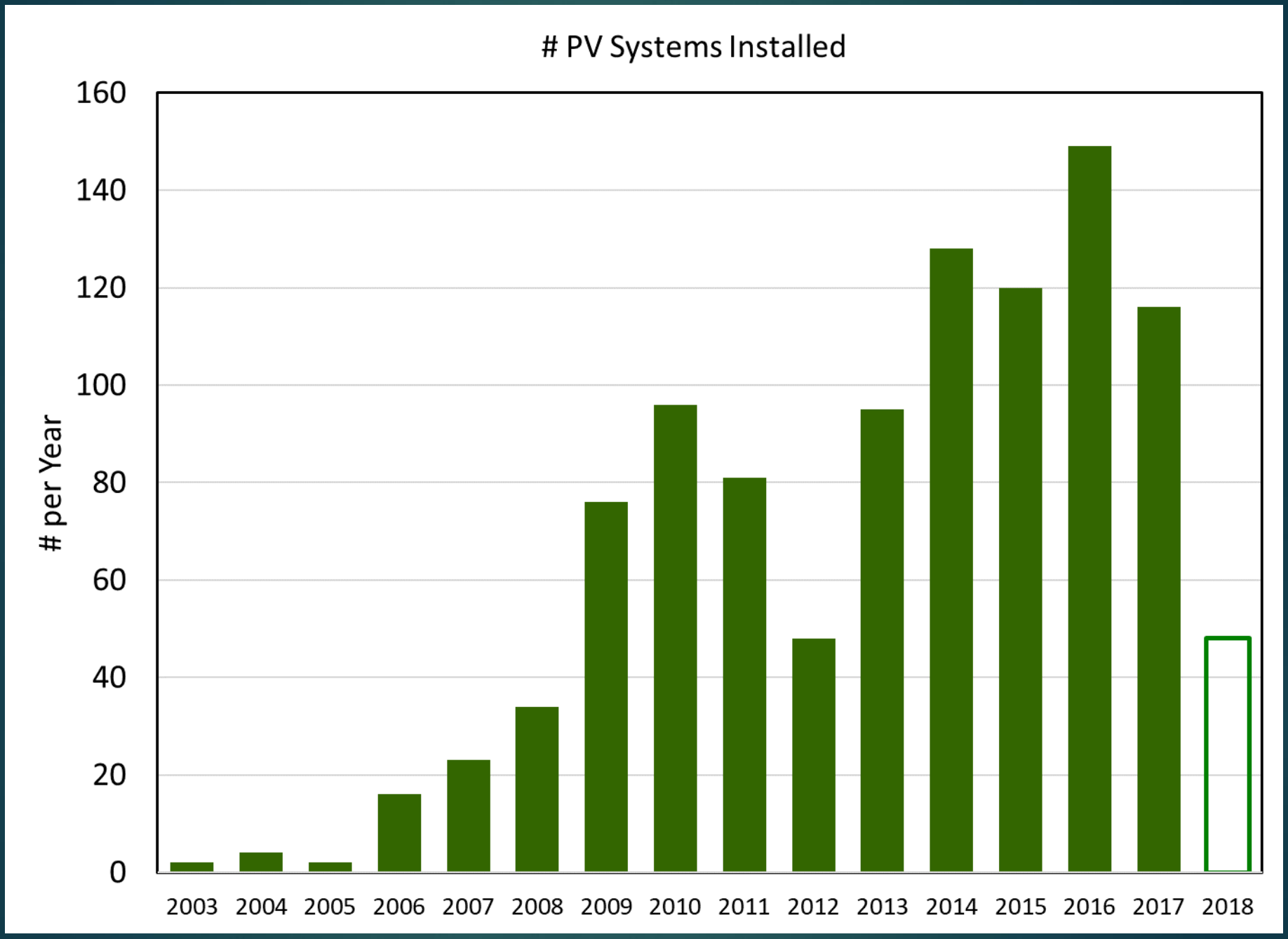
Wholesale Electric Marketplace (Section 3.6)

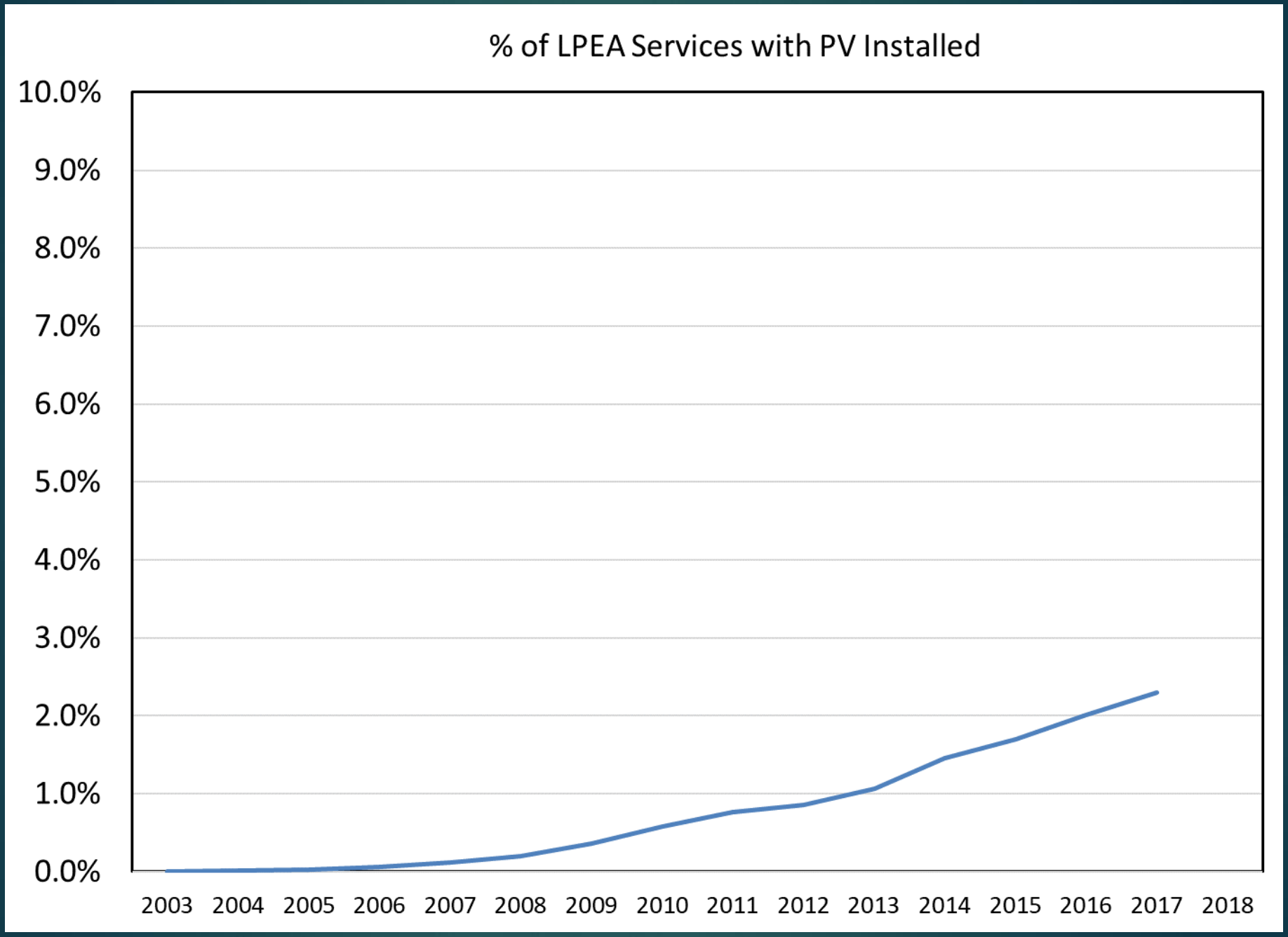
- Regulation or legislation changes most likely to encourage expansion

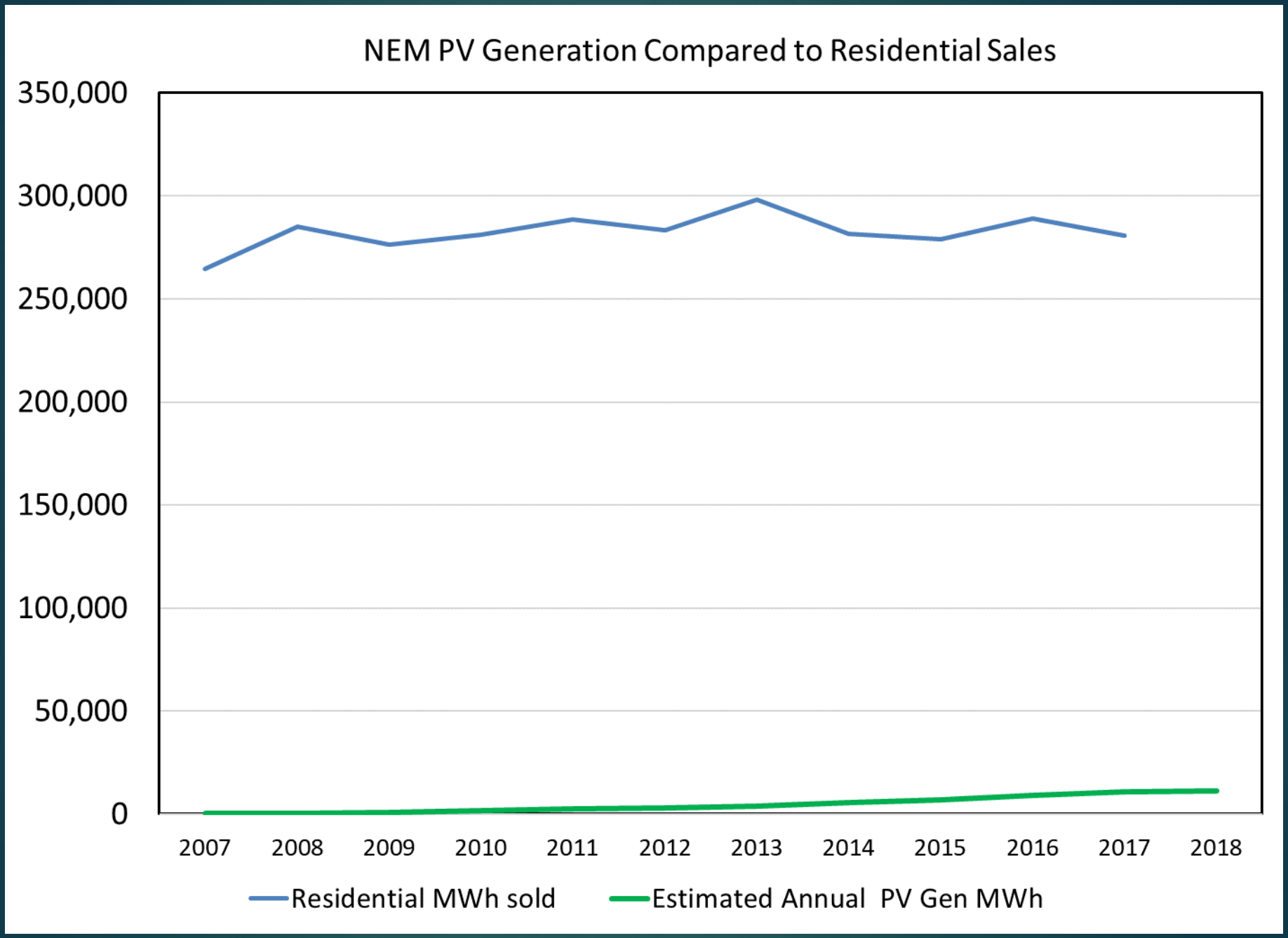
Storage, Evs (Section 3.7 and 8)

3.4 Net Metering

GUINN UNGER


PV Systems Installed
per Year
160
140
120
100
80
60
40
20
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

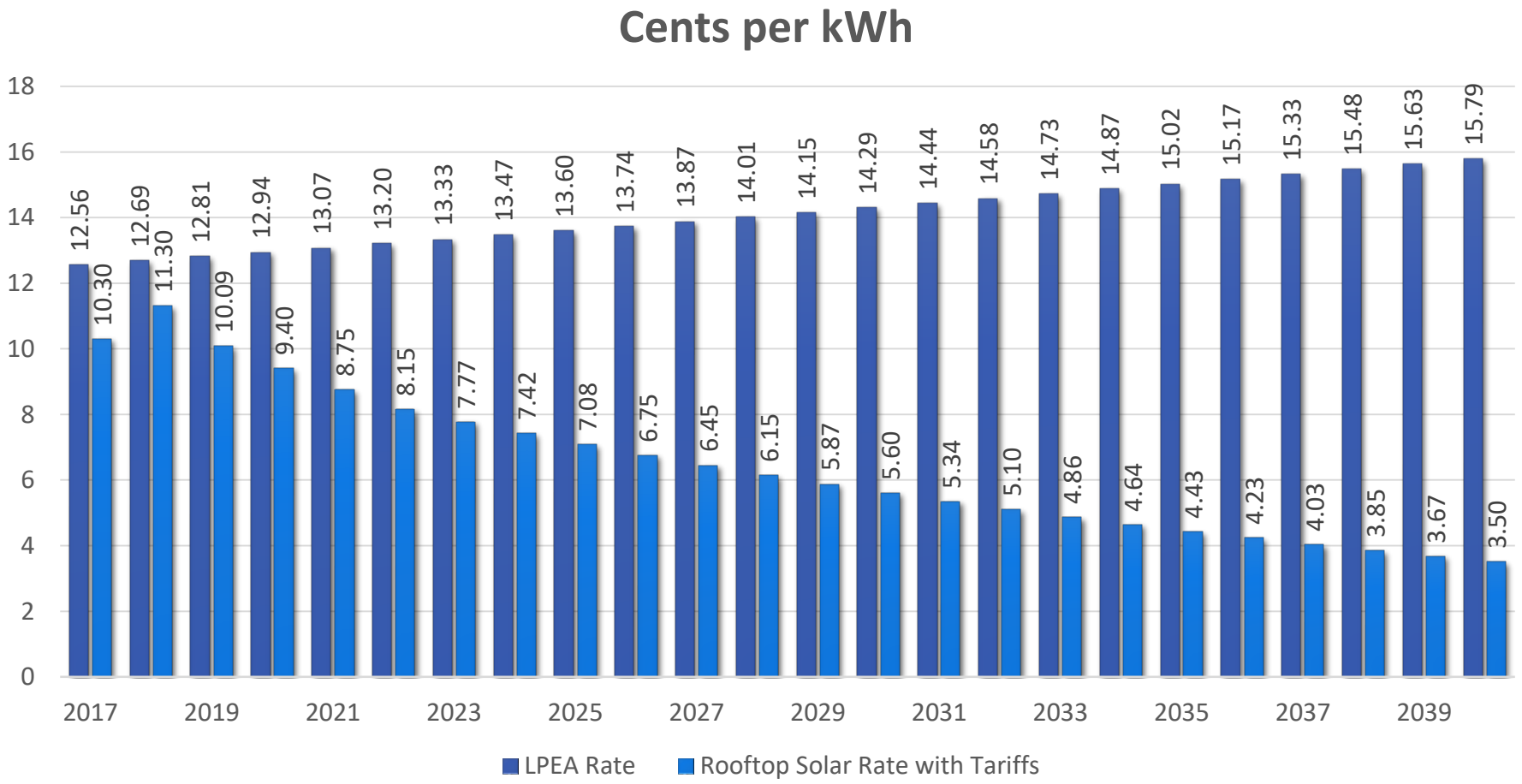

% of LPEA Services with PV Installed
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018


NEM PV Generation Compared to Residential Sales
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Residential MWh sold
Estimated Annual PV Gen MWh

Assumptions – Base Solar Case

- LPEA rate increases 1% per year
- Solar rates from Tri-State presentation
- Solar rate decrease based on Bloomberg New Energy Outlook Report 2017
- Existing PV Tariffs included
- Same NEM rate structure as we have today

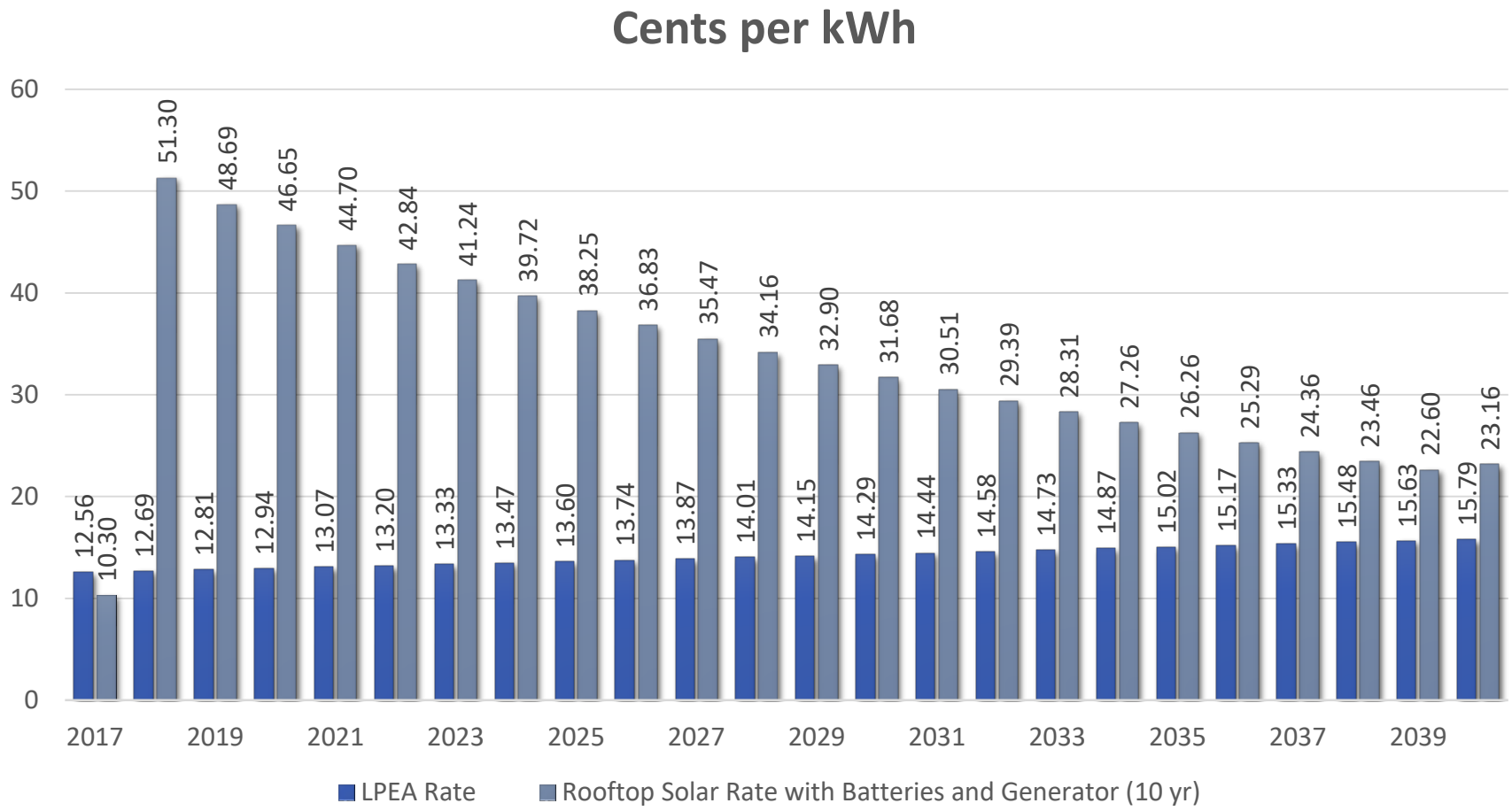
Future Energy Costs – Residential w/ PV



Assumptions – 10 year battery life case

- LPEA rate increases 1% per year
- Solar rates from Tri-State presentation
- Solar rate decrease based on Bloomberg New Energy Outlook Report 2017
- Existing PV Tariffs included
- Battery costs for Tesla 13.5 kWh Powerwall x 3
- Battery rate decreases based on Chemistry World article (https://www.chemistryworld.com/news/energy-storage-prices-forecast-to-tumble/3007717.article)
- Generator costs based on 11kW at $3,000 installed
- Same NEM rate structure

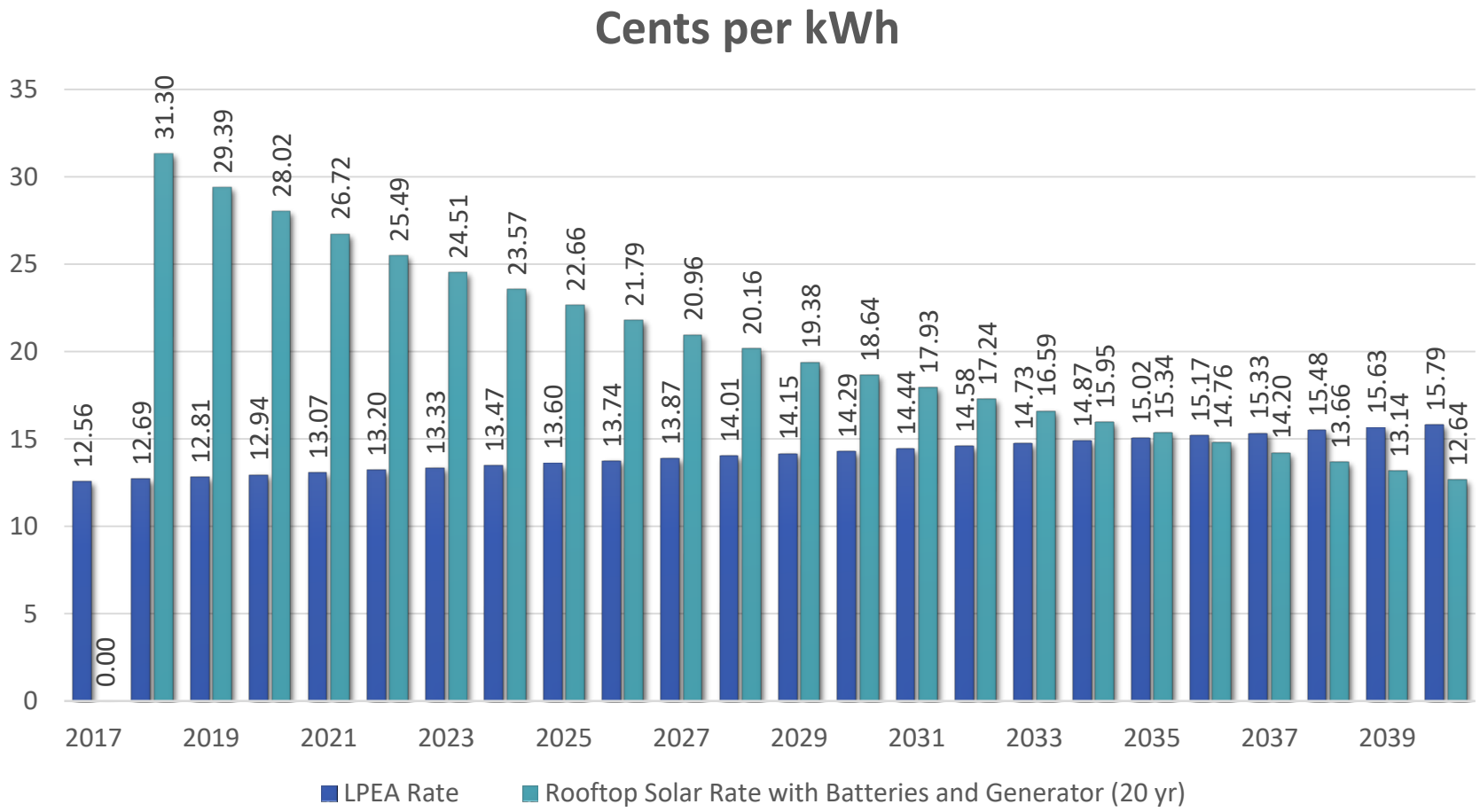
Future Energy Costs – Residential w/ PV + 10 yr Battery



Assumptions – 20-year battery life case

- LPEA rate increases 1% per year
- Solar rates from Tri-State presentation
- Solar rate decrease based on Bloomberg New Energy Outlook Report 2017
- Existing PV Tariffs included
- Battery costs for Tesla 13.5 kWh Powerwall x 3
- Battery rate decreases based on Chemistry World article (https://www.chemistryworld.com/news/energy-storage-prices-forecast-to-tumble/3007717.article)
- Generator costs based on 11kW at $3,000 installed
- Same NEM rate structure

Future Energy Costs – Residential w/ PV + 20yr Battery



An NREL study from 2016 shows that a high percentage of rooftops in our area are suitable for solar.

The following map shows suitability across the country.

As solar panel prices come down, buildings without south-facing roofs can still have economical solar by putting larger numbers of panels on east and west-facing roofs.

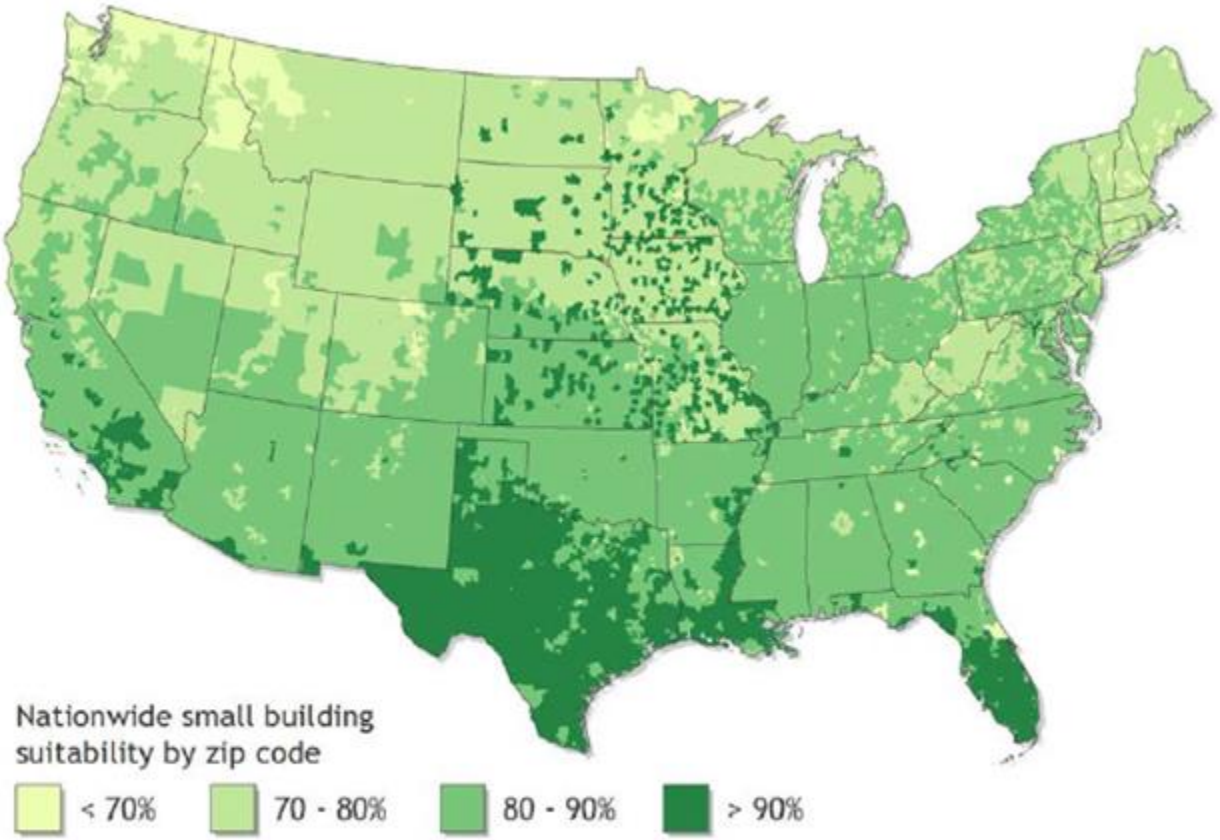


Figure ES-1. Percentage of small buildings suitable for PV in each ZIP code

The same report shows that 35% to 45% of the total electricity sales in 2013 could be generated from small buildings in Colorado.

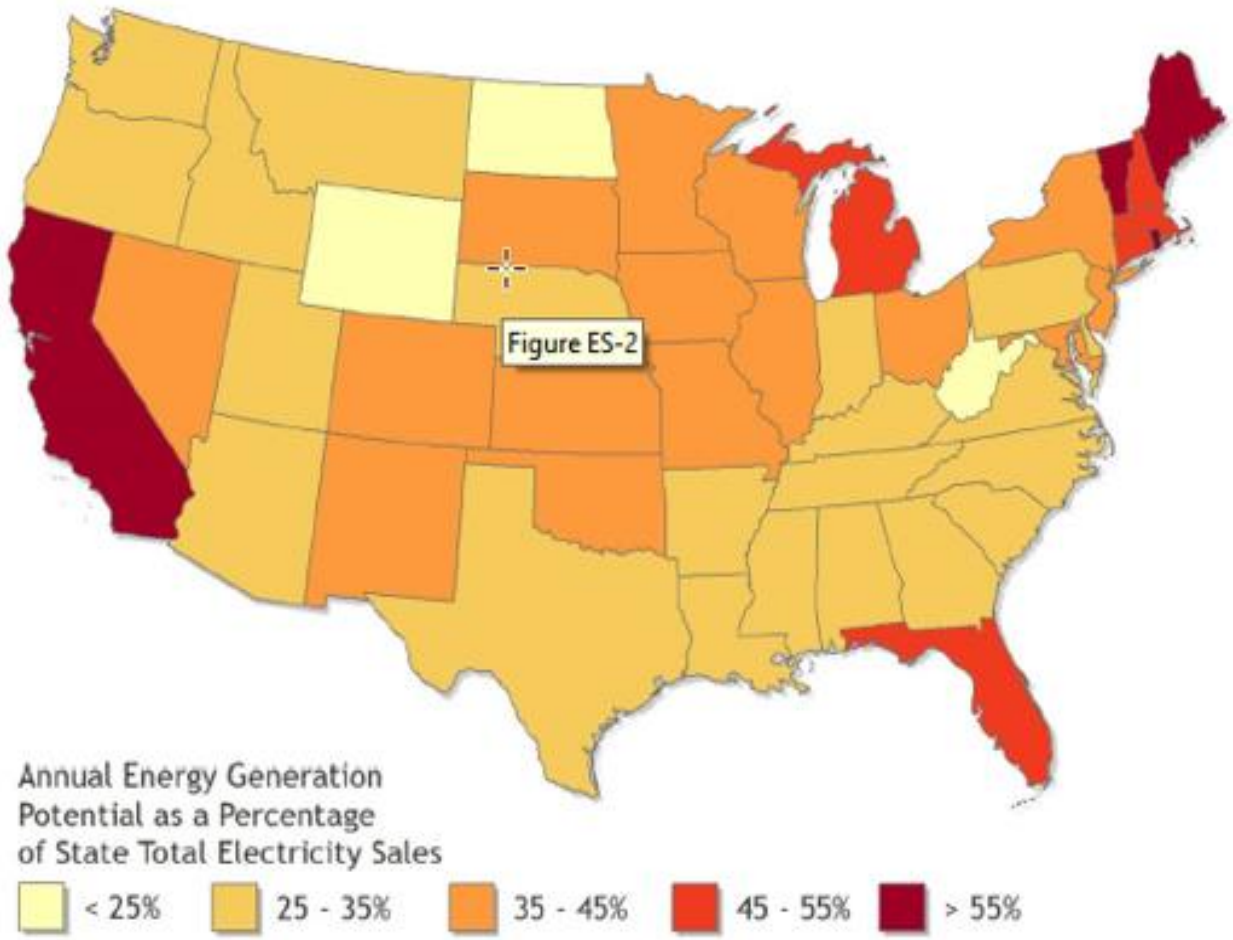


Figure ES-2. Potential rooftop PV annual generation from all buildings as a percentage of each state's total electricity sales in 2013

3.5 Wholesale Marketplace

BRITT BASSETT

La Plata Electric Association, Inc. provides its members safe, reliable electricity at the lowest reasonable cost while being environmentally responsible.

Safety is priority #1. Never to be forgotten but not addressed further in this presentation.

Reliability is key both within our territory, and with our power supply.

North American Electric Reliability Corporation (NERC)

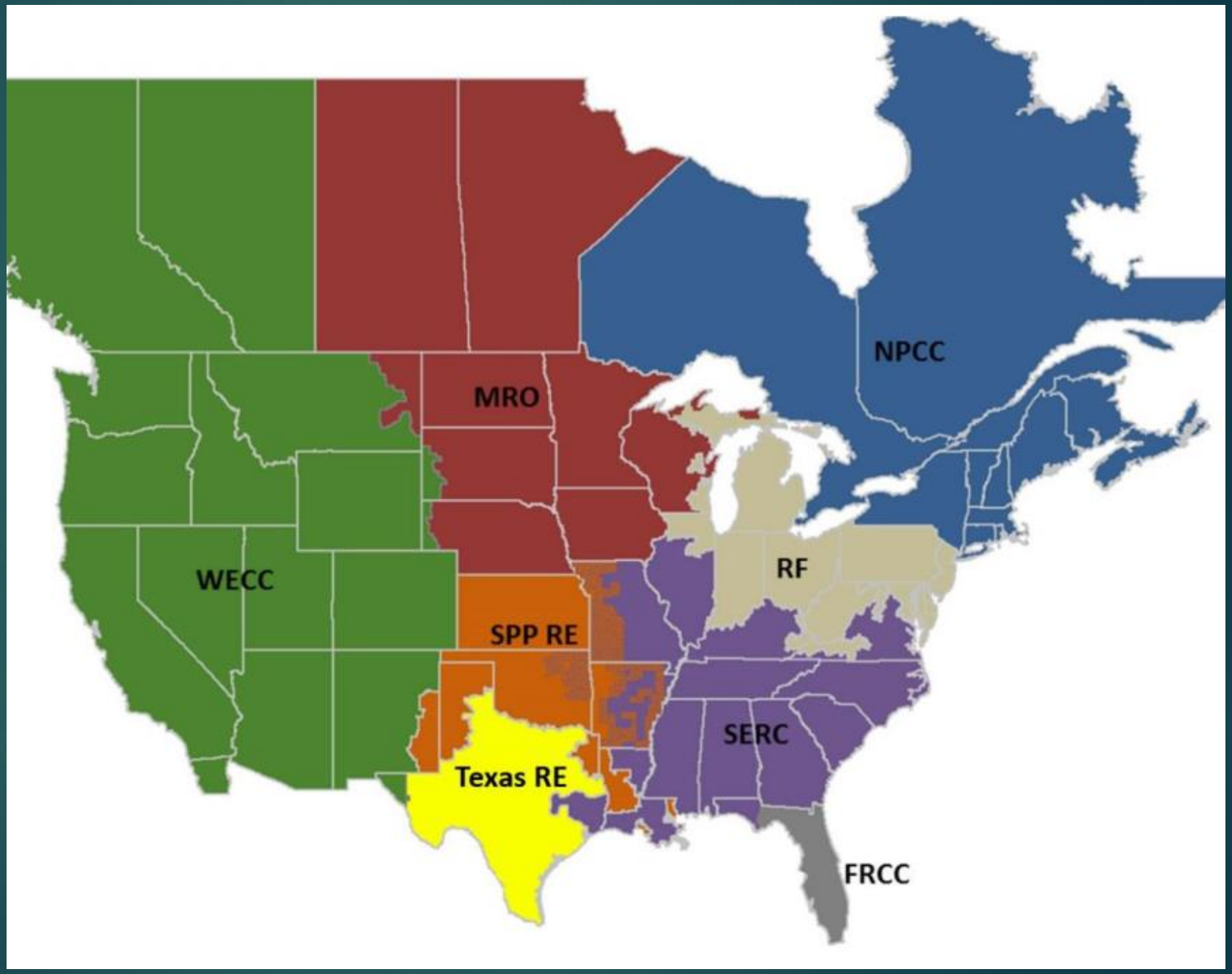
- 1963 North American Power Systems Interconnection Committee (NAPSIC) formed
- 1968 National Electric Reliability Council (NERC) founded
- 1980 NAPSIC merges into NERC
- 1981 name changed to include Canada – North American
- 2007 reorganizes and becomes a Corporation
- 2007 Compliance with approved NERC Reliability Standards became **mandatory and enforceable** in the United States
- 2011 headquarters moved from Princeton, N.J., to Atlanta

North American Electric Reliability Corporation (NERC)

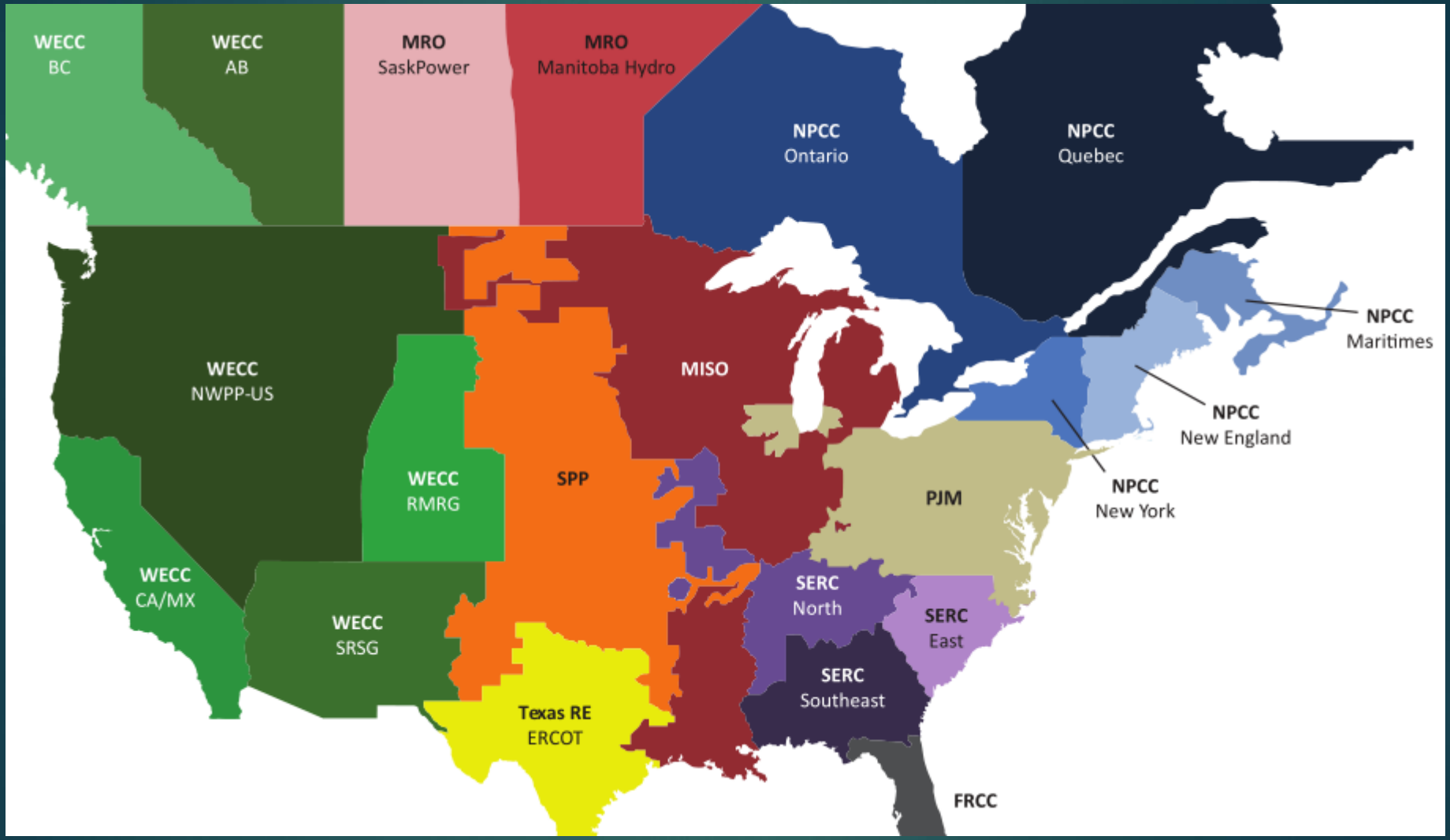
- A not-for-profit international regulatory authority whose mission is to assure the reliability and security of the bulk power system in North America
- Develops and enforces Reliability Standards
- Annually assesses seasonal and long-term reliability
- Subject to oversight by the Federal Energy Regulatory Commission (FERC)

NERC's 8 Regional Entities

Western Electricity Coordinating Council

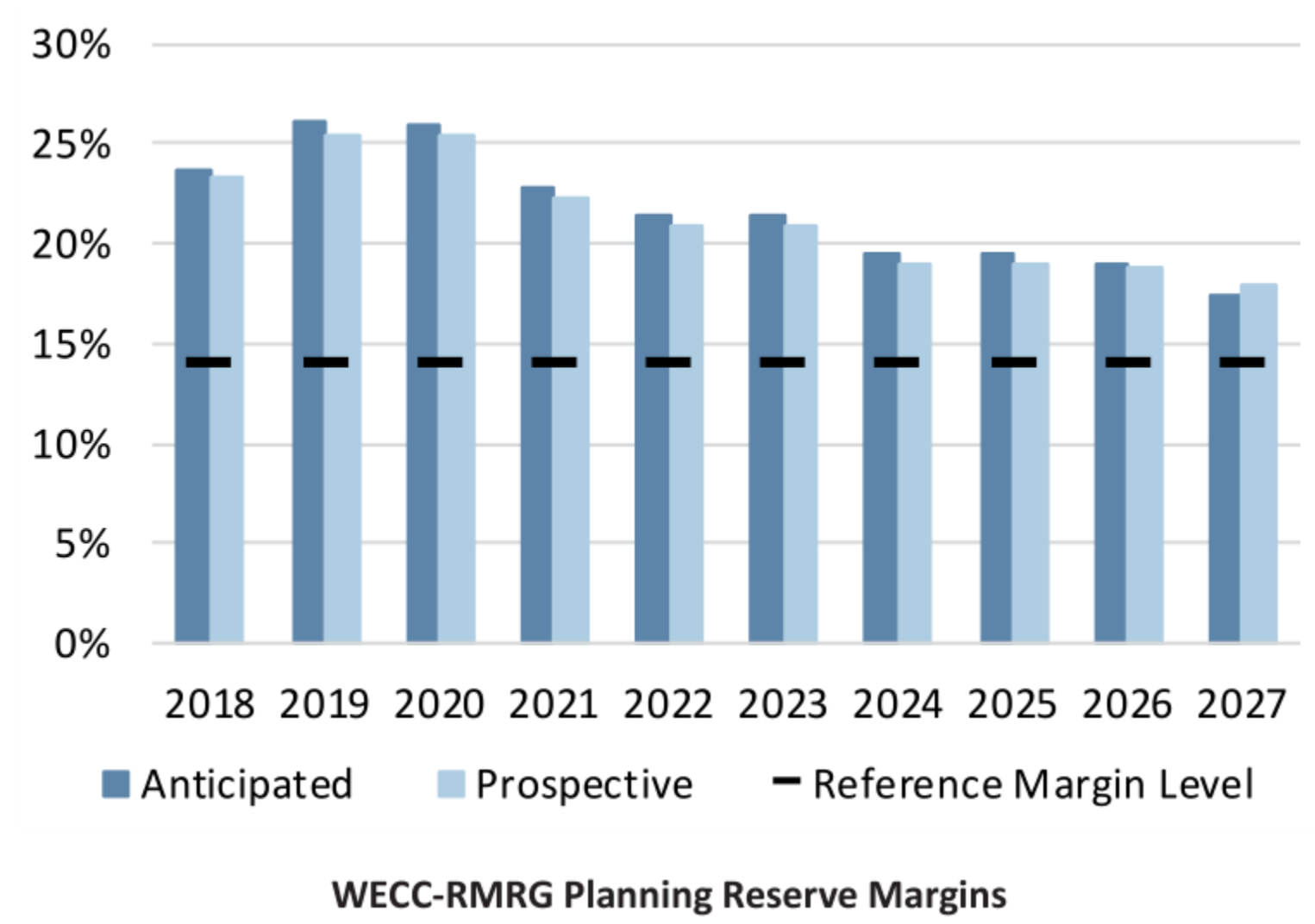


NERC Assessment Areas



We are in the Western Energy Coordination Council (WECC) Rocky Mountain Reserve Group (RMRG)

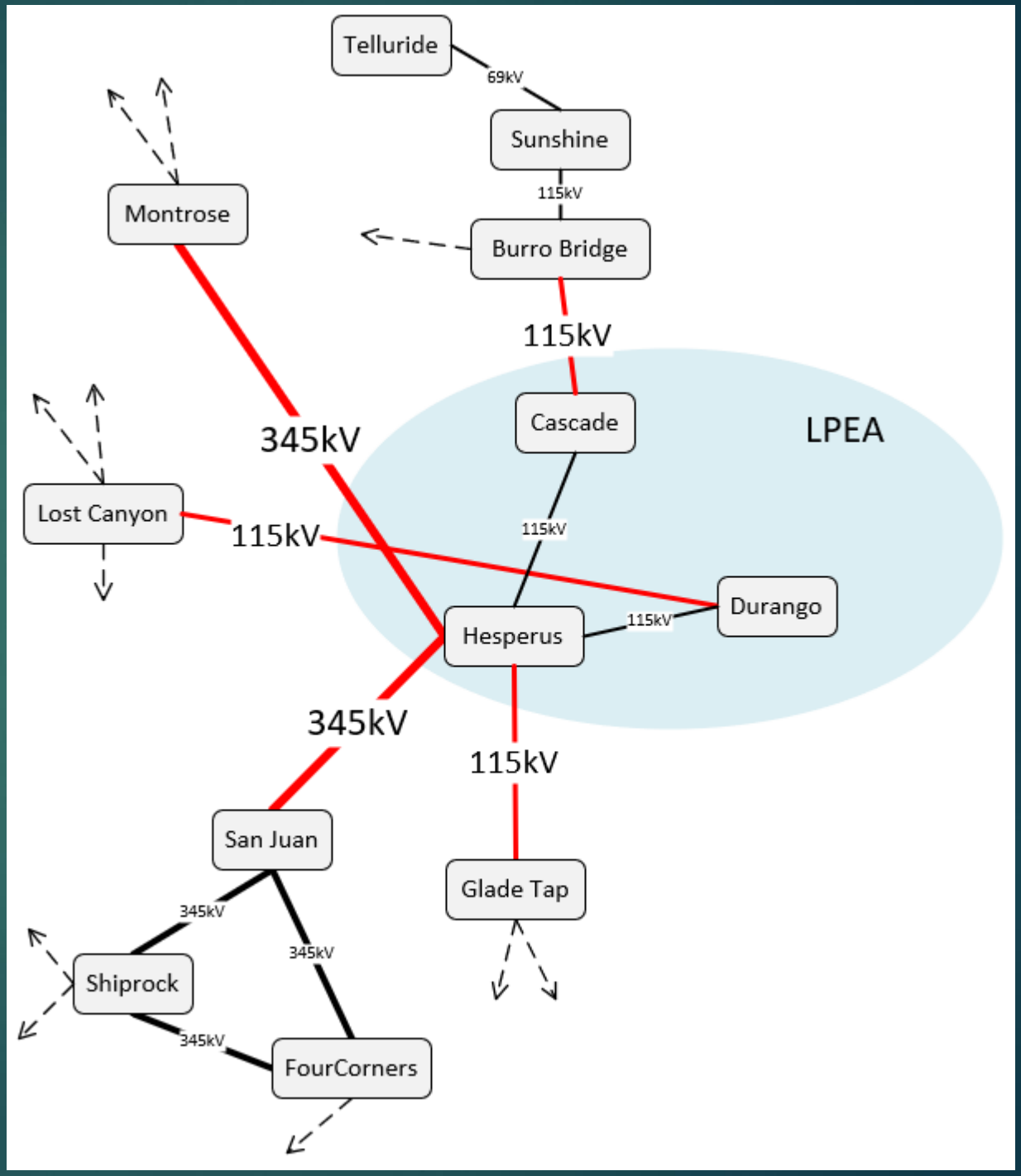
RMRG Reference Margin Level



Source: NERC 2017 Long-Term Reliability Assessment

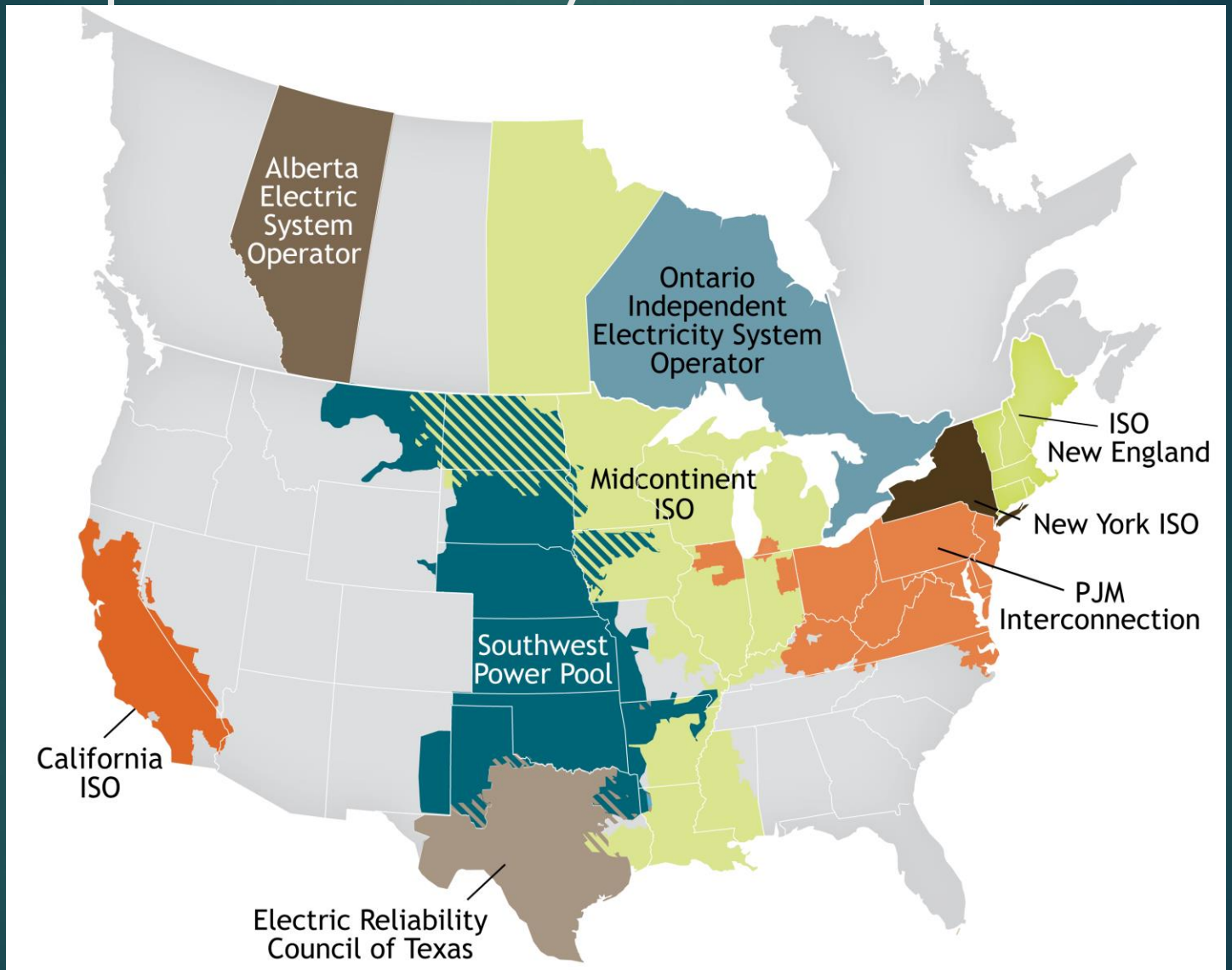
LPEA's External Transmission Connections

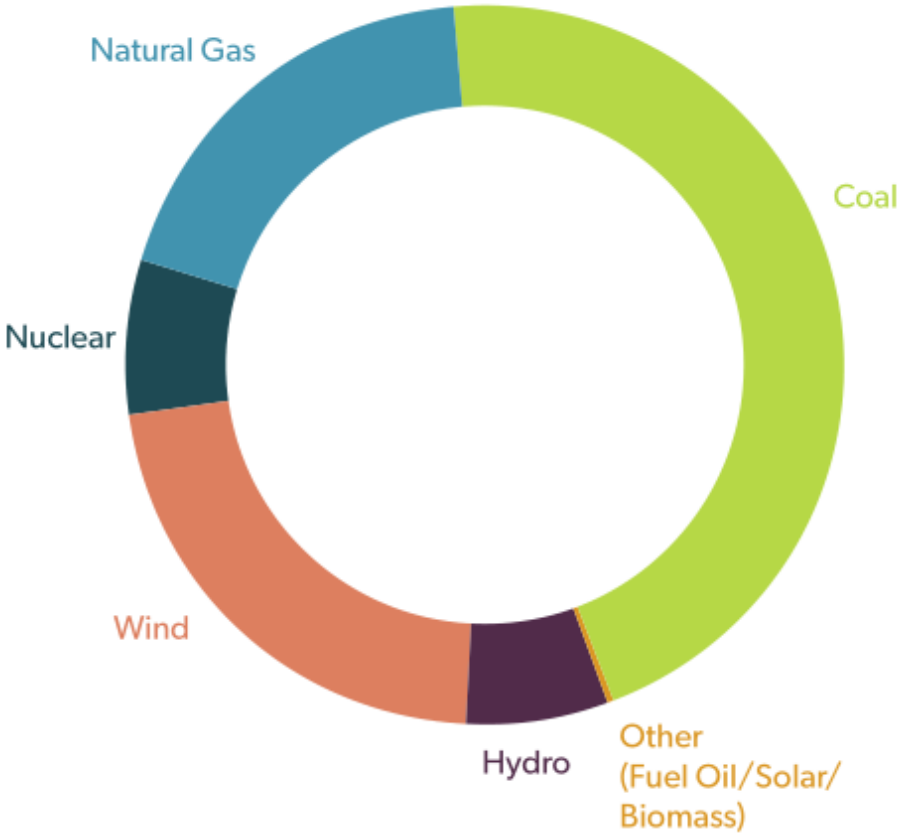
1. 345kV N
2. 345kV S
3. 115kV W
4. 115kV N
5. 115kV S



La Plata Electric Association, Inc. provides its members safe, reliable electricity at the lowest reasonable cost while being environmentally responsible.

Independent System Operators





45.3%	Coal
22.1%	Wind
19.1%	Natural gas
6.7%	Nuclear
6.4%	Hydro
0.2%	Other (fuel oil, solar, biomass)

SPP 2017

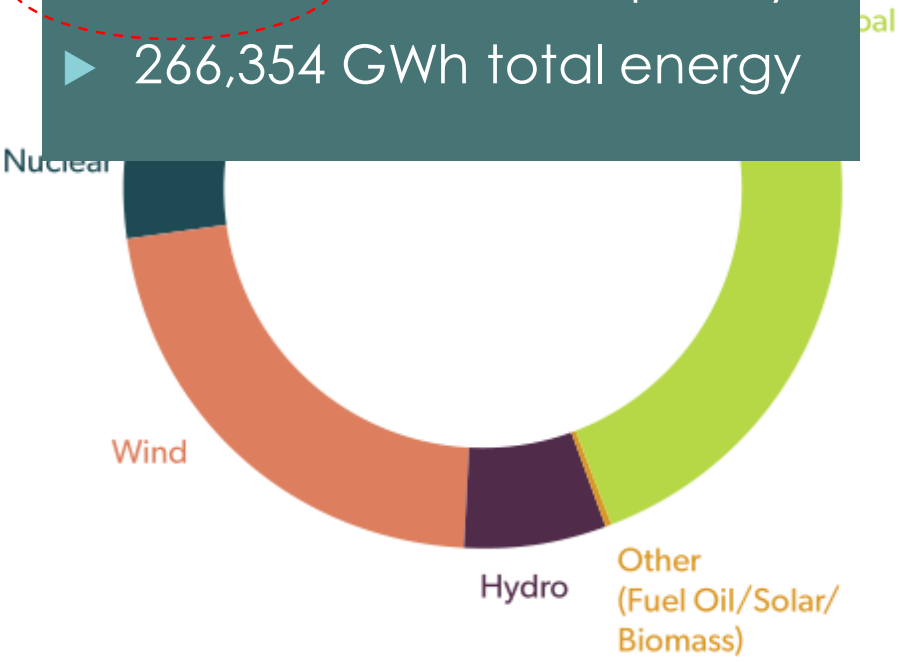
- 87,086 MW total capacity
- 266,354 GWh total energy

- LPEA
  - 149 MW
  - 973 GWh/yr
- TS
  - 2,850 MW (30x smaller)
  - 15,900 GWh/yr

Source: SPP 2017 Annual Report

SPP 2017

- 87,086 MW total capacity
- 266,354 GWh total energy



45.3%	Coal
22.1%	Wind
19.1%	Natural gas
6.7%	Nuclear
6.4%	Hydro
0.2%	Other (fuel oil, solar, biomass)

Pending Interconnection Requests

Wind	50,107 MW
Solar	16,572 MW
CT	1,583 MW
Battery	841 MW
Thermal	488 MW
Diesel	4 MW

Source: SPP 2017 Annual Report

SPP has 95 Members

2017 Average Energy Price

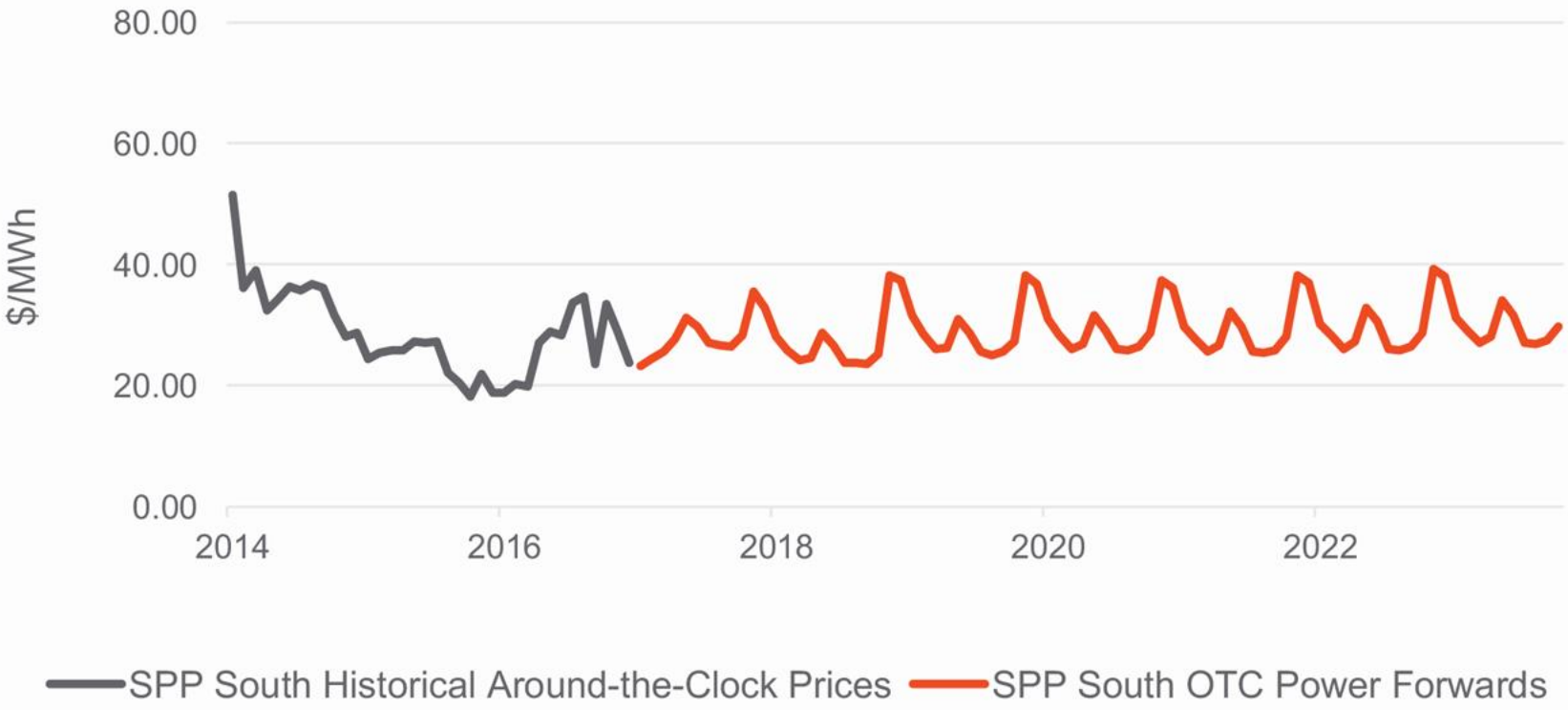
2.7 cents / kWh

Required Capacity Reserve Margin: 12%
Available Capacity Reserve Margin: 32.4%

Source: NERC 2017 Long-Term Reliability Assessment

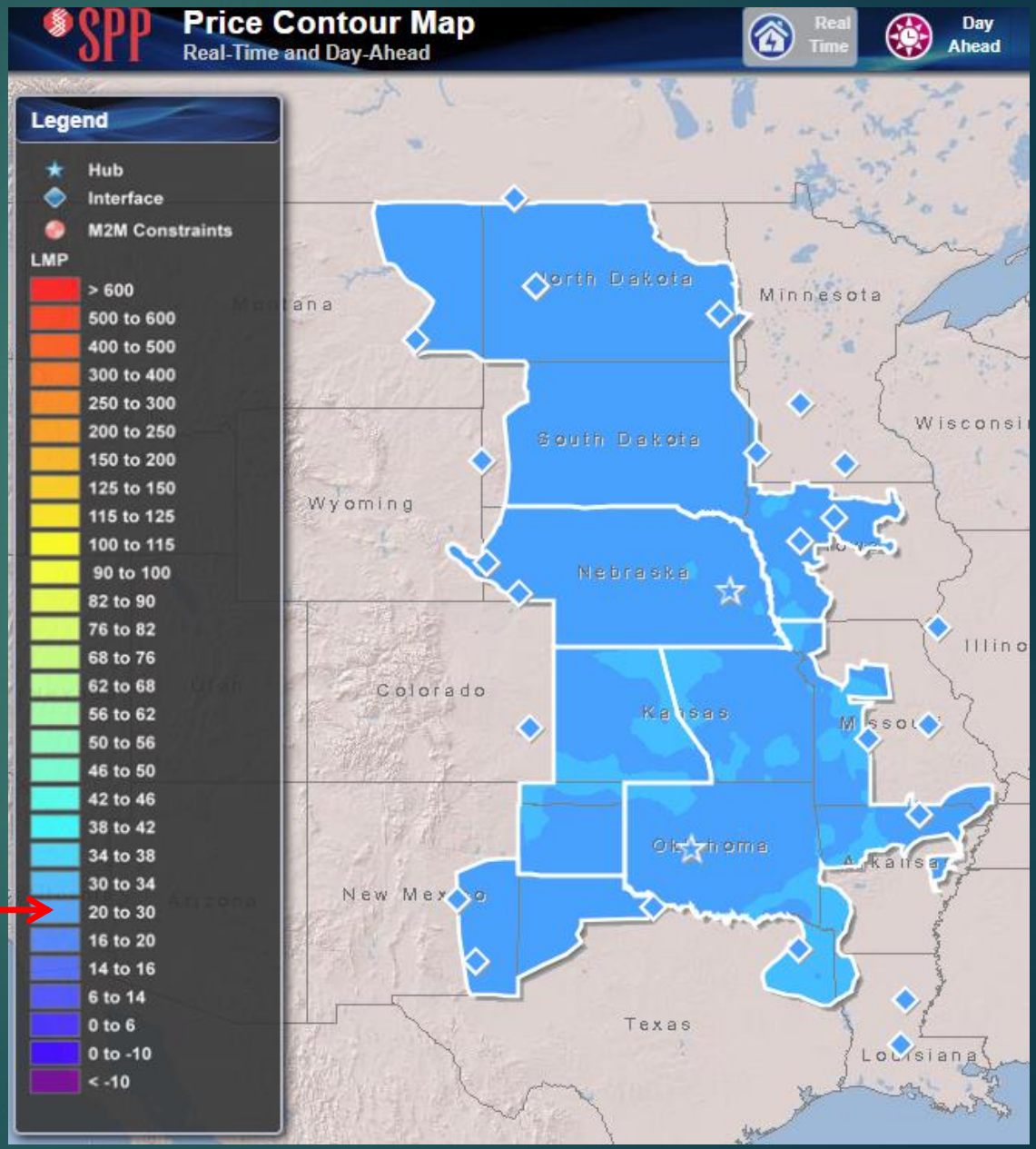
Source: SPP 2017 Annual Report

Historical and Futures Pricing at SPP South Hub



Source: Edison Energy 2017 Altenex Market Report

http://pricecontourmap.spp.org/pricecontourmap/

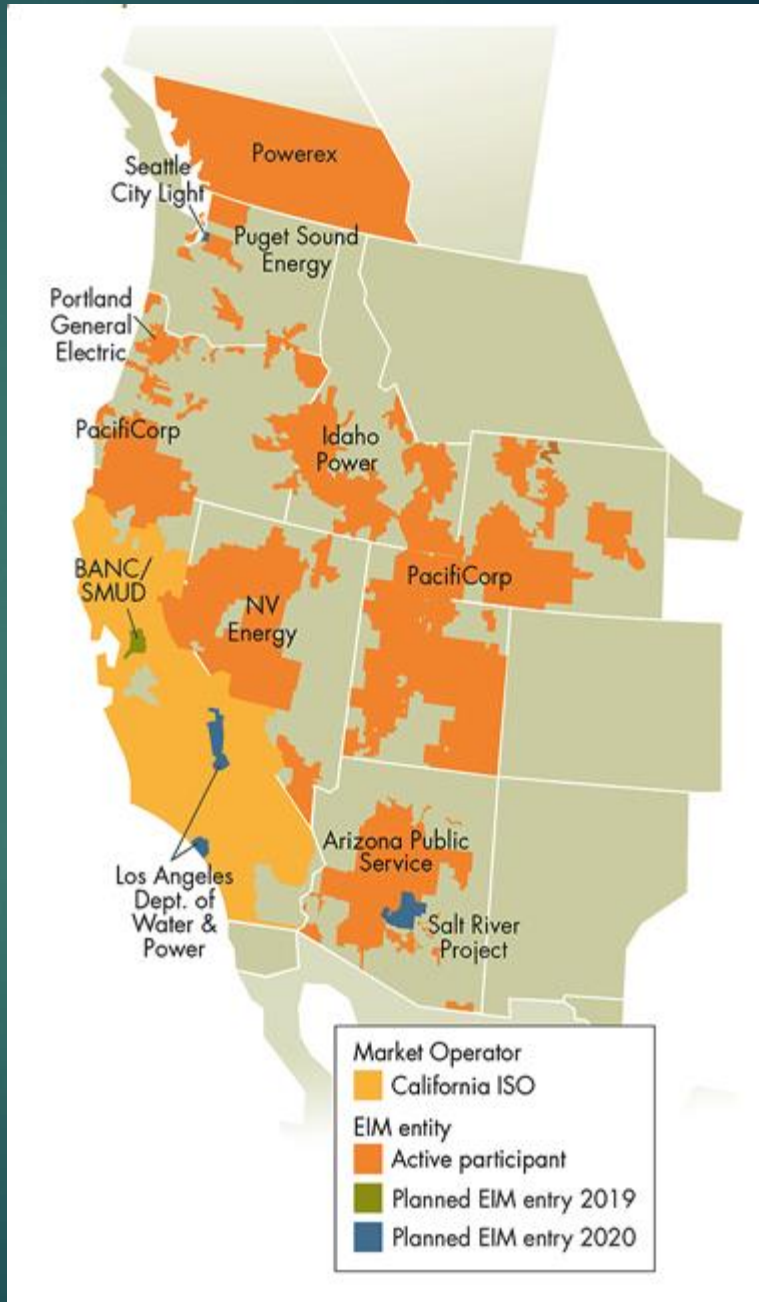


20 to 30 $/MWh

2-3 ¢/kWh

Western Energy Imbalance Market

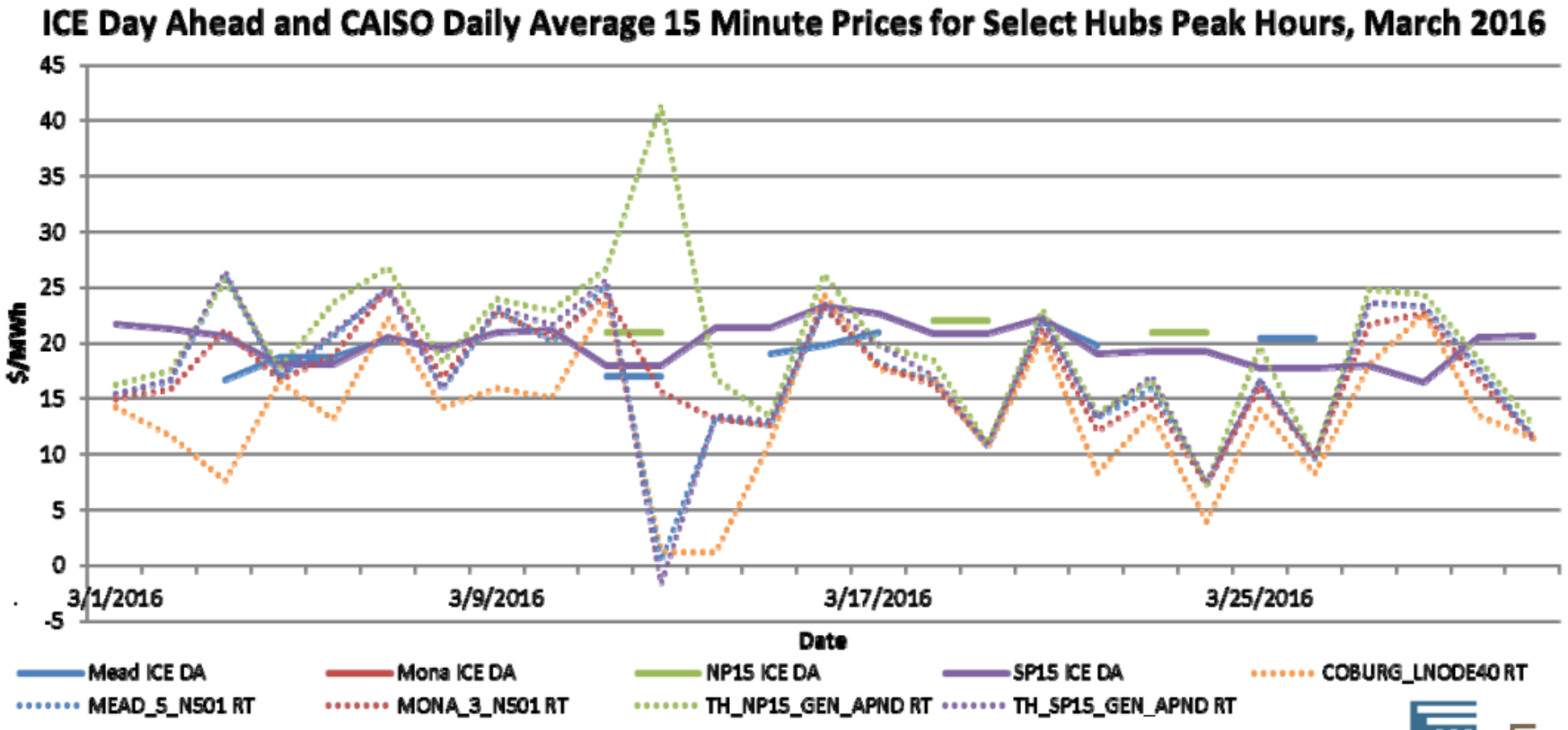
- Started in 2014
- A real-time bulk power trading market
- Utilities maintain control over their assets
- Enhances grid reliability and generates cost savings in the millions for its participants
- Improves the integration of renewable energy
- Initiatives underway to include energy storage



PRICE TRANSPARENCY

The operation of the Western EIM also provides price visibility for all utilities and generators in the WECC, without regard to whether they are EIM participants.

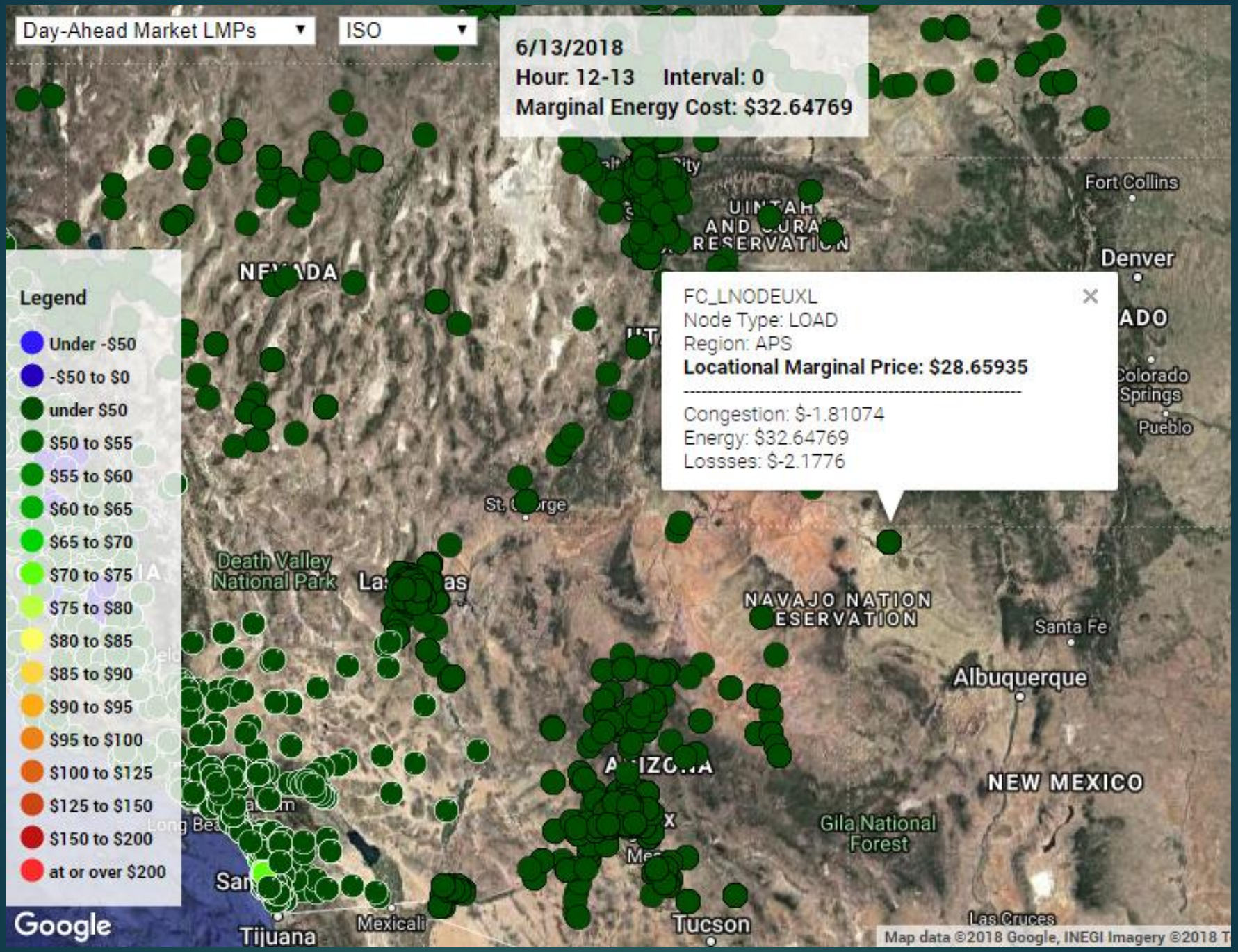
- Unlike bilateral trading platforms, the EIM posts prices every day, every 15 minutes, at every location.



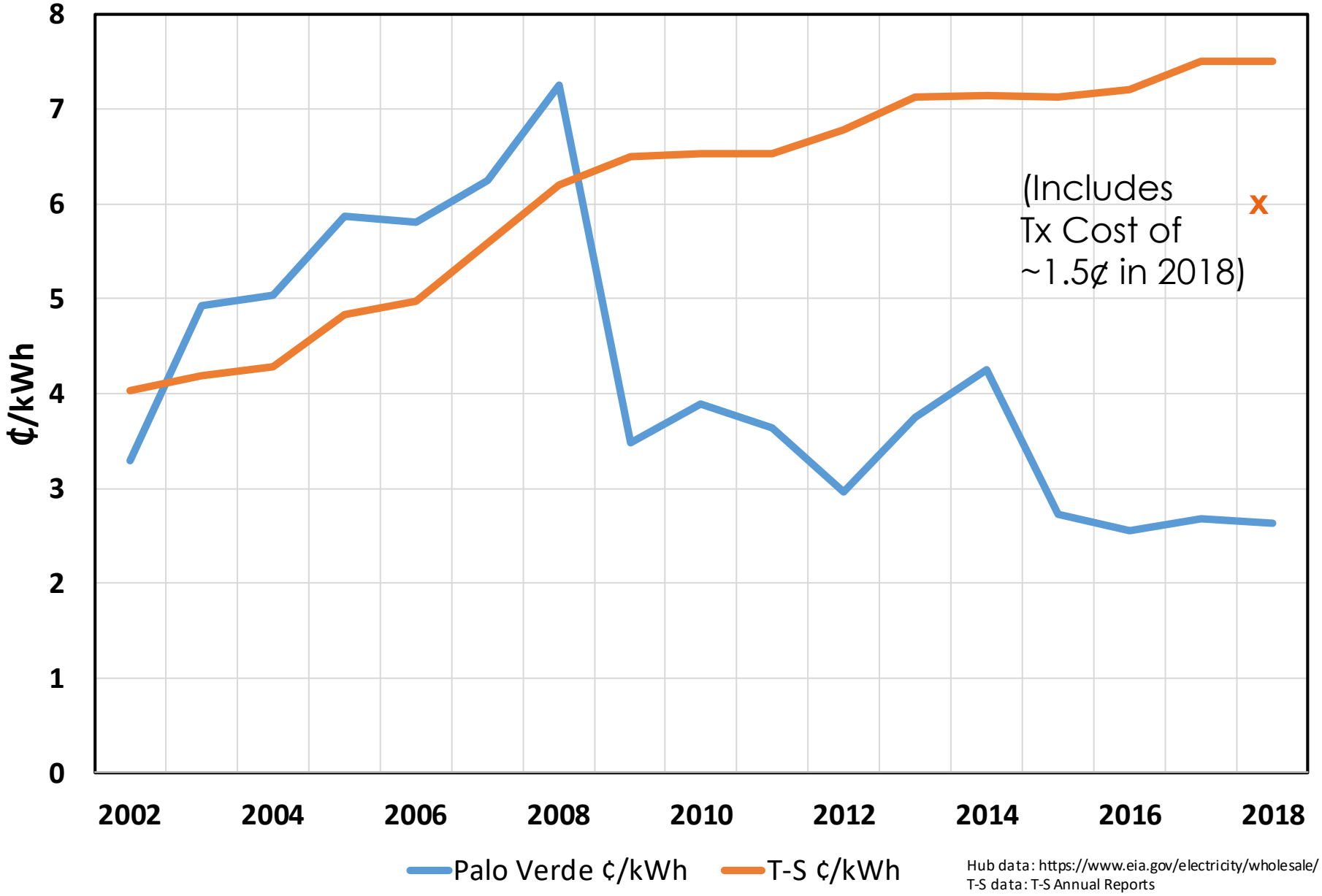
Wholesale Market Nodes

- The ISO wholesale power market prices electricity based on the cost of generating and delivering it from particular grid locations called nodes. One energy market runs the day before the energy is needed (day ahead market), while another one runs in real-time to balance last minute demand needs.

- http://www.caiso.com/PriceMap


Day-Ahead Market LMPs
ISO
6/13/2018
Hour: 12-13 Interval: 0
Marginal Energy Cost: $32.64769
Legend
Under -$50
-$50 to $0
under $50
$50 to $55
$55 to $60
$60 to $65
$65 to $70
$70 to $75
$75 to $80
$80 to $85
$85 to $90
$90 to $95
$95 to $100
$100 to $125
$125 to $150
$150 to $200
at or over $200
FC_LNODEUXL
Node Type: LOAD
Region: APS
Locational Marginal Price: $28.65935
Congestion: $-1.81074
Energy: $32.64769
Lossses: $-2.1776
Fort Collins
Denver
Colorado Springs
Pueblo
Death Valley National Park
NAVAJO NATION RESERVATION
Santa Fe
Albuquerque
NEW MEXICO
Gila National Forest
Las Cruces
Tucson
Tijuana
Mexicali
Google
Map data ©2018 Google, INEGI Imagery ©2018

Palo Verde Hub and Tri-State Average Annual Wholesale Rates



Hub data: https://www.eia.gov/electricity/wholesale/
T-S data: T-S Annual Reports

Beartooth Electric Cooperative

- South central Montana, NE of Yellowstone
- Exited from bankrupt Southern Montana Electric G&T in 2015

- Wholesale Provider: Morgan Stanley Power: 3.425 ¢/kWh
- WAPA: Demand: .065 ¢/kWh-mo, Energy: 1.618 ¢/kWh
- Transmission: varies monthly with demand from 0.58 to 0.92 ¢/kWh

- Combined Average Annual Rate forecast for 2018:
  - **4.144 ¢/kWh**

- Have been able to reduce rate to customers several times

Aztec

- Left PNM in 2016 with wholesale rate ~ 8 ¢/kWh
- Contracted with Guzman Energy for 7 years
- Rate of 4.95 ¢/kWh includes cost of 1.2 MW PV Array
- Rate includes all transmission and ancillary services to point of delivery at Shiprock Substation
- Rate offered without cost of PV array was 4.42 ¢/kWh

- Aztec was able to lower customer rates

Wholesale Power Conclusion

- Cooperative Principle #4 is Autonomy and Independence
- Currently we do not have independence in our power supply
- If we did, we could better address the 4th part of our Mission Statement: being environmentally responsible

- Reliability is high
  - So reliable that TS now relies on the Power Pools rather than keeping spinning reserves.
- Costs are lower
  - Every month we delay independence costs our members at least $1.3 million.*

*($74/MWh – ($42+15)/MWh) * 973,000 MWh / 12

3.6 Electric Vehicles

BOB LYNCH

Future Trends

I. Electric Vehicles
II. Charging Stations
III. Battery Storage

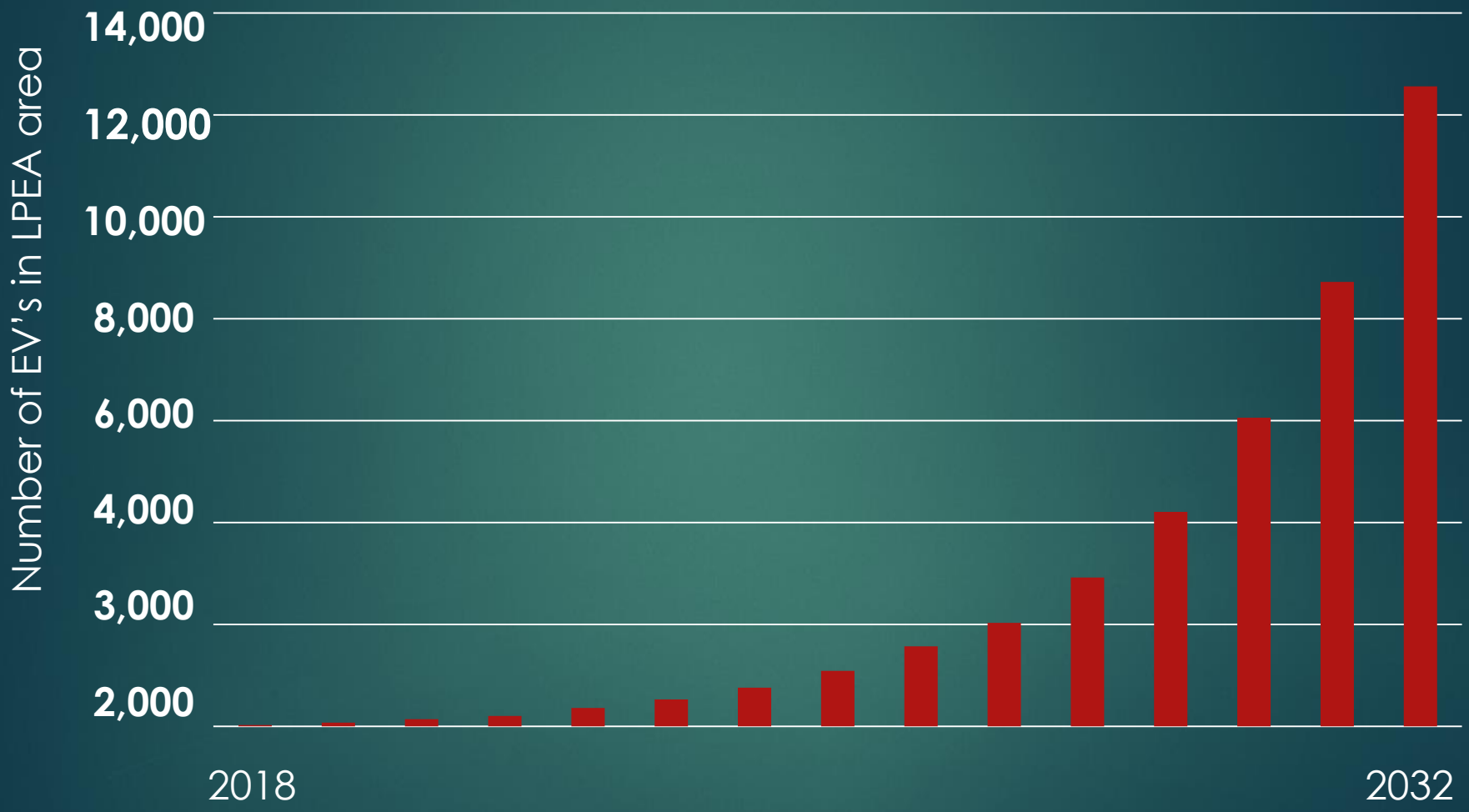
Electric Vehicle Adoption

- Vehicle Sticker Price
  - Early EV's were very costly. TESLA Model S = $75,000
  - Chevrolet Bolt = $35,000
- Costs to Drive
  - It is cheaper, and will be increasingly so, to drive an EV than a gas or diesel vehicle
  - 3-4 miles per kwh at .12 per kwh costs 4 cents per mile
  - $3 per gallon fuel at 25 mpg costs 12 cents per mile
- Charging Availability
  - While this has been a major constraint, charging stations are being installed at a very rapid rate and states are driving plans to facilitate installations.
- Model Availability
  - Selection from local dealers is extremely limited but will expand dramatically starting in 2020
- Environmental Benefits
  - Little or no fossil fuel consumption

LPEA Sales Impact

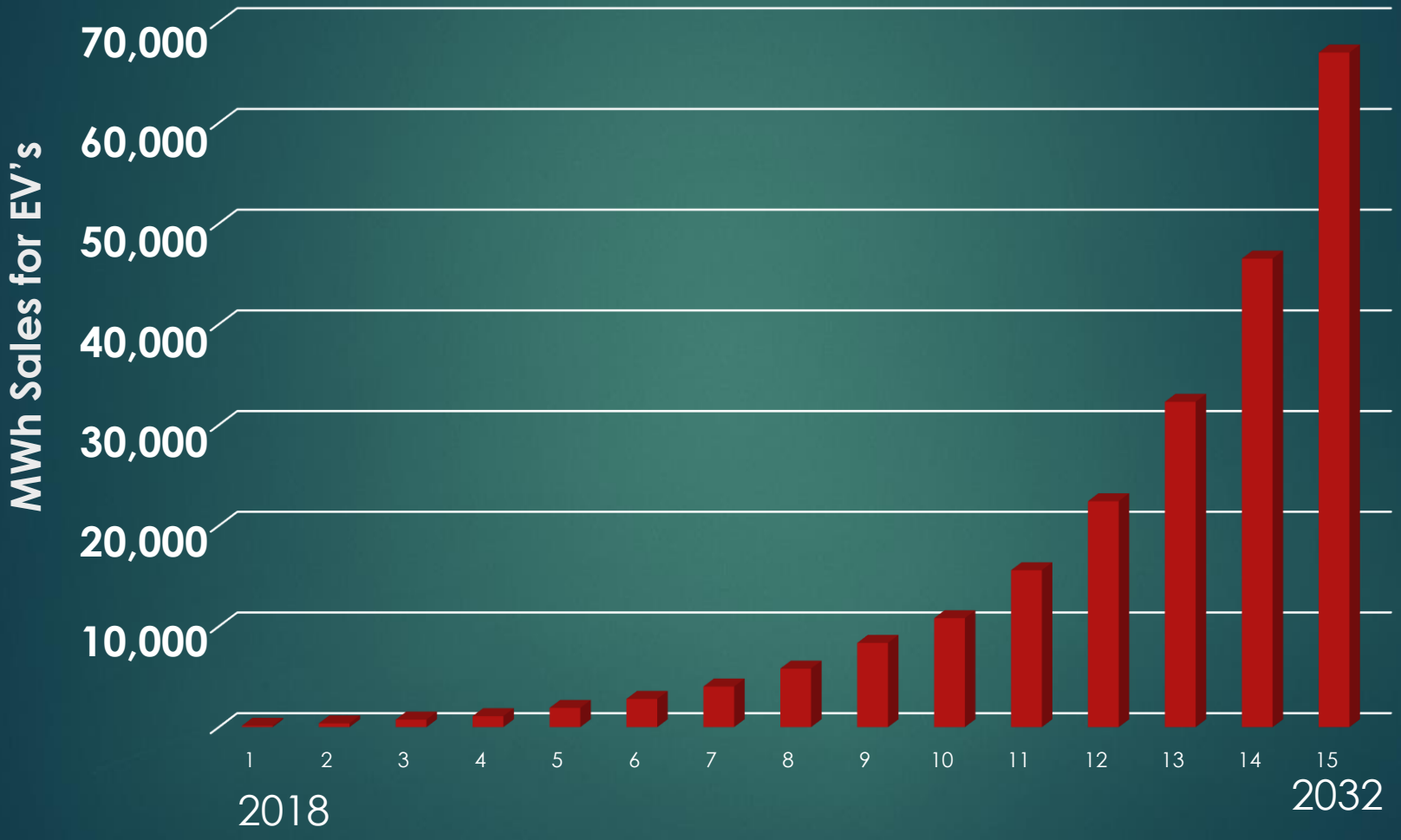
- Electricity sales impacts are very small today
- Electric Vehicles are expected to be 15% of all vehicles by 2030.
- When EV's reach this level, annual kWh sales of about 12MM per year will occur.

EV Growth in LPEA Area



Based on projections from Colorado Energy Office

EV MWh Sales



Based on projections from Colorado Energy Office

Implications of EV Growth

- An important source of new sales will come from growth of EV's.
- Strategically working to enable level 3 charging along the 160 Corridor including Durango and Pagosa Springs will be in the interest of members and LPEA.
- The tourist economy be hurt without Level 3 charging as EV penetration grows.

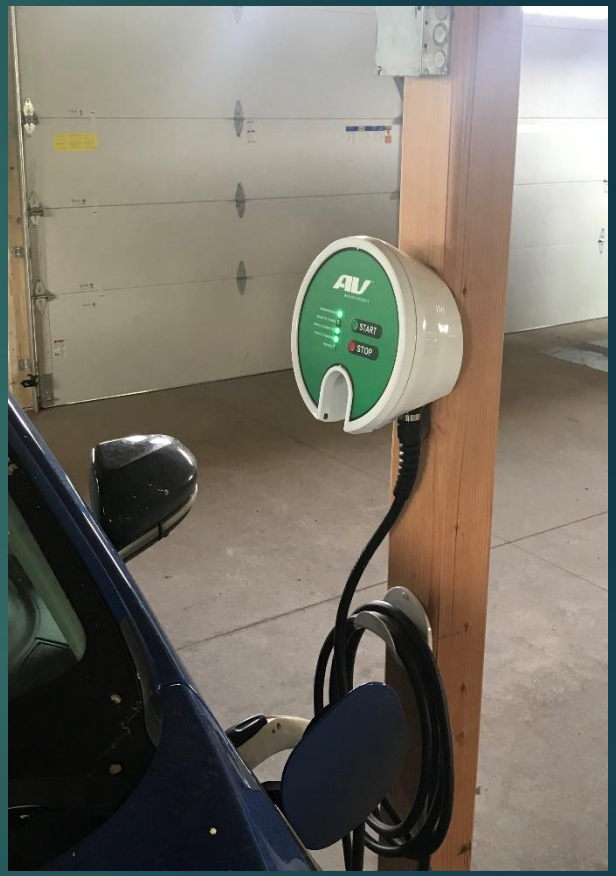
EV Strategic Choices

- Passive Accommodation

- Active Encouragement
  - Ensure level 3 infrastructure is available at ideal locations within our service territory
  - Help corridor developers
  - Partner with local employers/partners e.g. FLC
- Drive Adoption
  - Rate structures and TOU applications
  - Actively pursue and partner with others to obtain grants—work more closely with 4Core on grants and ownership incentives

EV Charging

- Three Levels of Charging
  - Level 1: Standard home outlet
  - Level 2: Home or public locations with 220V
  - Level 3: Commercial Only, 480V 3 Phase
- Most daily driving by LPEA members can be addressed with Level 1 at home, and Level 2 at home or work-place/public locations.
- Tourist travel, and wide-spread adoption, will require strategically located Level 3 charging stations, approximately every 50 miles.



Level 3 Charging Plans

- "Electric highway" concept first used to describe the planned placement of charging stations on the I-5 corridor from Baja CA to Pacific NW.
- Level 3 Charging stations every 50 miles allow for easy flow of EV traffic up and down the west coast.
- The Colorado Energy Office has a plan for developing similar electric highways for I-25, I-70 and I-76
- Colorado has Tier 1 and Tier 2 designated highways and each will receive priority for Level 3 locations
- Hwy 160 is a Tier 2 Corridor and is in the state's plans for development. LPEA can actively participate
- LPEA can serve our members by being an active partner in the planning and implementation of Level 3 Charging in our area.
- Estimates suggest that Level 3 charging stations can cost between $60 and $100 thousand to install.

Colorado Energy Office: EV Market Study, 2015

3.7 Energy Storage

BOB LYNCH

Battery Storage

- Bloomberg New Energy Finance Group "lithium-ion battery price index shows a fall from $1,000 per kWh in 2010 to $209 per kWh in 2017.
- Charging EVs flexibly, when renewables are generating and wholesale prices are low, will help the system adapt to intermittent solar and wind. The growth of EVs pushes the cost of lithium-ion batteries down 73% by 2030.
- Small-scale batteries installed by households and businesses alongside PV systems accounts for 57% of installed storage capacity worldwide by 2040."

Executive Summary from Bloomberg New Energy Finance

Are we reaching the Tipping Point for Storage?

- Massive investment in lithium ion battery manufacturing has caused the cost of the technology to plummet over the last two years
  - Installed costs less than $500/kWh reported for 2016
  - EPRI estimates have been $350 - $500/kWh by 2020
- Prices have reached a very interesting level
  - Still too high for “classical” storage applications such as load leveling
  - But applicable in niche applications such as peak shaving for asset deferral, and peaker replacement

Storage

- Applications of storage employ "value stacking" today in order to make storage applications cost-effective. This value stack usually includes peak shaving combined with other value adders like frequency management.
- Storage makes solar a manageable resource when stored solar generation is shifted a few hours for consumption during peak periods.

Implications of Storage Advances

- Storage has two main tracks for exploration for LPEA
  - GRID applications
  - Home applications
- LPEA should consider storage learning opportunities over the next year that offer opportunities to:
  - Reduce cost of wholesale power through Peak Shaving
  - Provide cost-effective alternatives to line/system upgrades
  - Allow for shifting solar to peak periods
  - Deploy an actively managed resources for system
- Storage should be a stand-alone element of our Strategic Plan

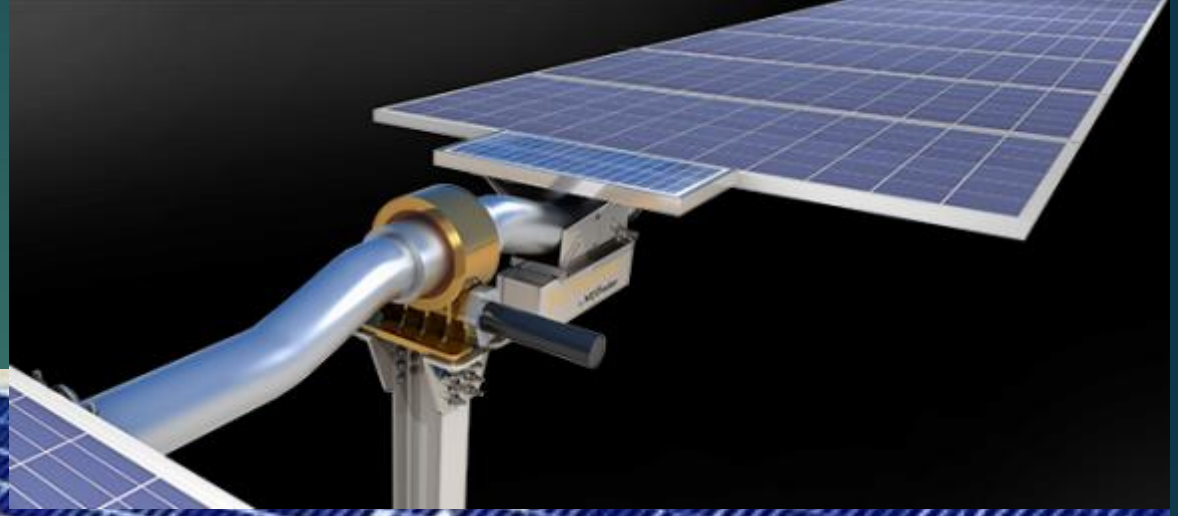
Proactive Storage Plan

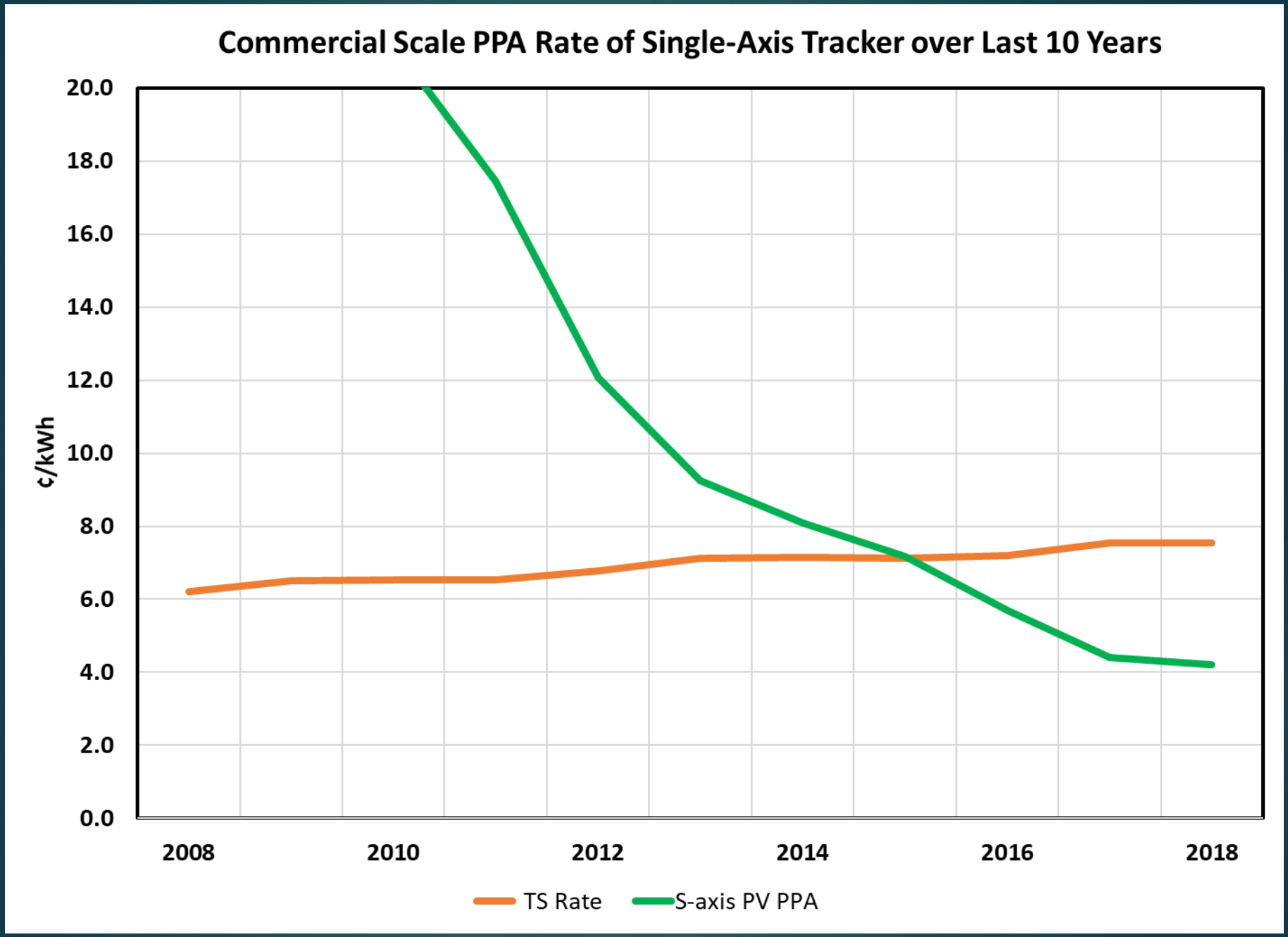
- Storage shouldn't be left to the market for early adopters and wealthy who gain an advantage themselves.
- LPEA should proactively encourage adoption in applications that have benefits for all of the membership.
- We should build a business case like ETS and Marathon Heaters, under the control of LPEA, for peak shaving, solar capture and shifting solar generation a few hours.
- With EV's, a passive role has no negative effect for our Coop… If we are passive with storage we risk exit/advantage only for early adopters…we need to be ahead of this curve to ensure benefits to all members. E.g. Green Mountain Power VT offers Powerwall Installation at $15/month
- Net metering rate changes and law changes that Utilities are advocating will push solar users to add batteries to the mix. Rate fixes in the short run may push members off the grid as economics improve dramatically.

3.8 Distributed Generation

GUINN UNGER

Single-Axis Tracker




Commercial Scale PPA Rate of Single-Axis Tracker over Last 10 Years
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
¢/kWh
2008
2010
2012
2014
2016
2018
TS Rate
S-axis PV PPA

Distributed Generation

- **QFs based on FERC rulings**
- **Transmission effects**
- **Local economic development impacts**

Distributed Generation

QFs based on FERC rulings

Qualified Facilities – This is very much up in the air awaiting FERC ruling on TS appeal and possible changes to PURPA law.

Distributed Generation

Transmission Effects

Transmission costs can be much lower for distributed generation facilities if they are located appropriately. However, this may require substantial storage to reduce Tri-State demand charges.

Distributed Generation

Local Economic Development Impact

Depending on the ownership of local generation facilities, the impact on local economic development will vary.

- LPEA ownership would keep money in our area
- Ownership by LPEA-territory entities might keep most money in our area
- Ownership by others might not have much local economic impact

3.10 Vision of the Future Grid

DAN HUNTINGTON

Disruptors

1903

1913

Disruptors

2007

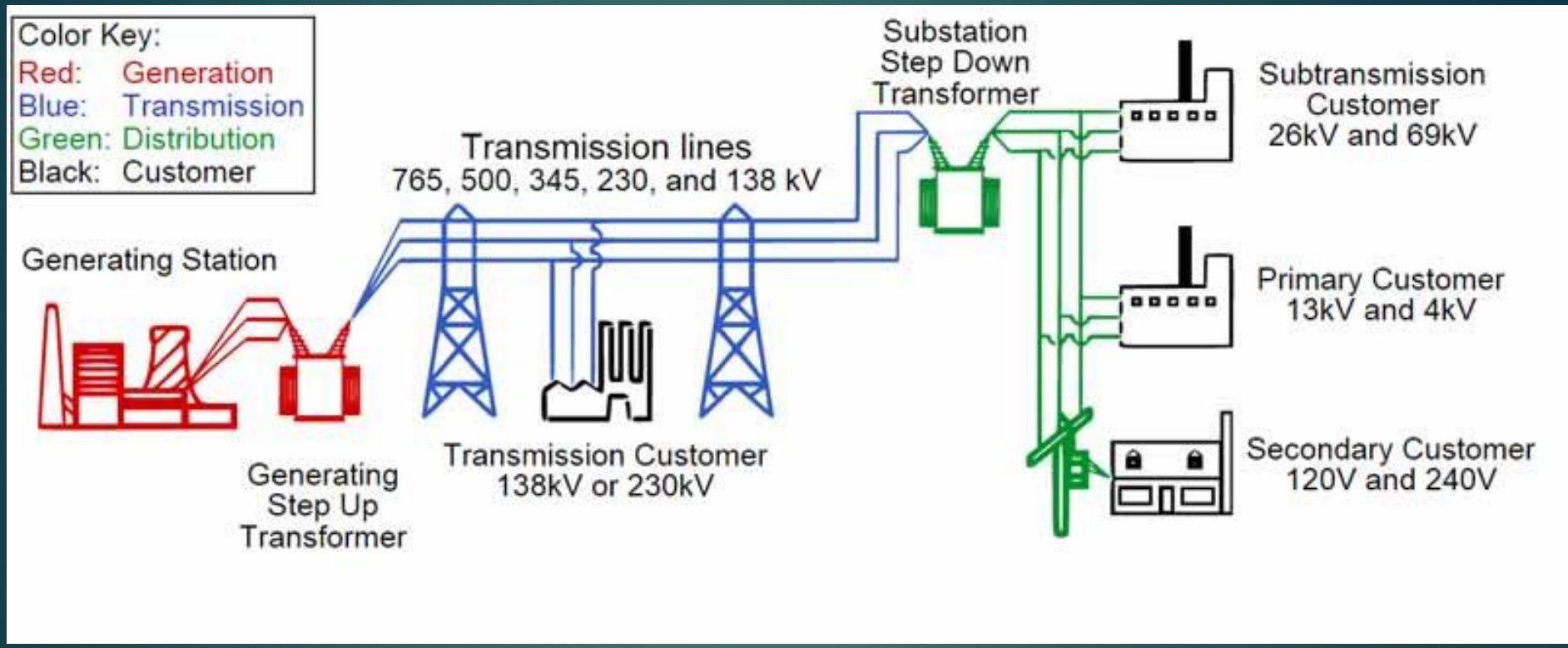
2017

Disruptors?

2018

20??

The Grid



Thing have been pretty stable in the world of electrical generation, transmission, and distribution.

https://www.electricaleasy.com/2016/01/electrical-power-grid-structure-working.html

The Future Grid

https://www.ecnmag.com/article/2011/04/smart-grid-and-beyond