

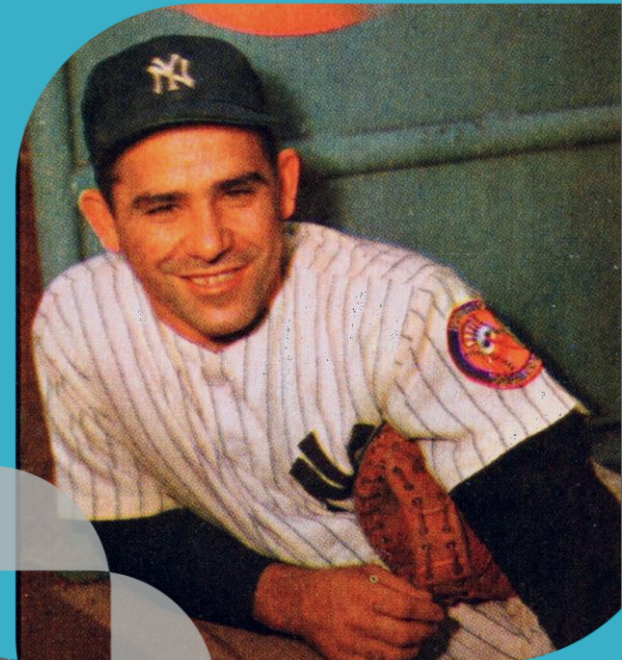


Strategic Implications of Declining Growth in Energy Consumption: As Yogi Berra Might Say...

EEI Strategic Issues Roundtable

April 2017

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Discussion Outline

- What's happening?
- What's causing it?
- What are the implications?
- What can you do about it?



As Yogi might say, “A nickel ain’t worth a dime anymore.”

What's Happening?



What's Happening?

- Declining Demand Growth
- Regional Demand Trends
- Demand Trends

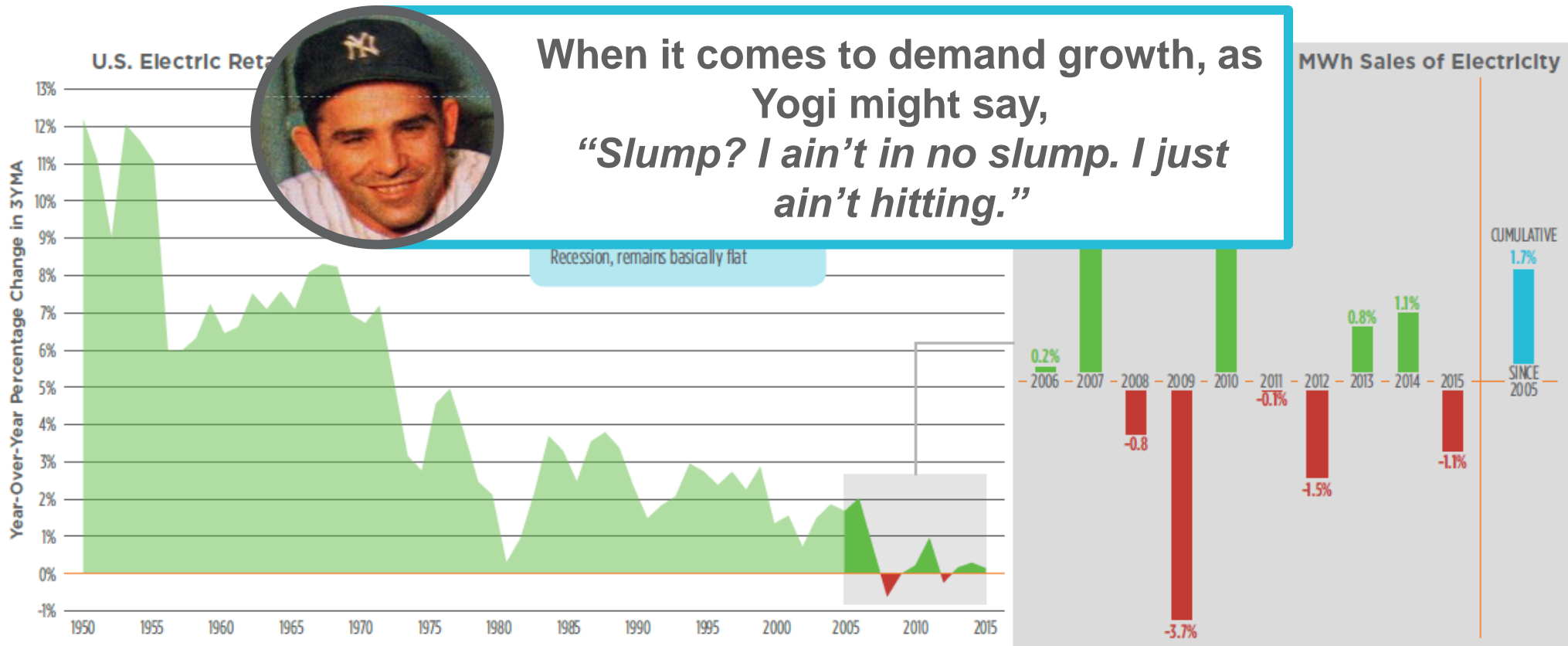


What's Happening?

Declining Demand Growth

Reading the headlines: Where'd the load growth go?

- U.S. MWh sales growth was only 1.7% cumulatively from 2005 to 2015
- Industry consensus forecasts continued sales growth decline
- The good news: revenues per MWh have grown



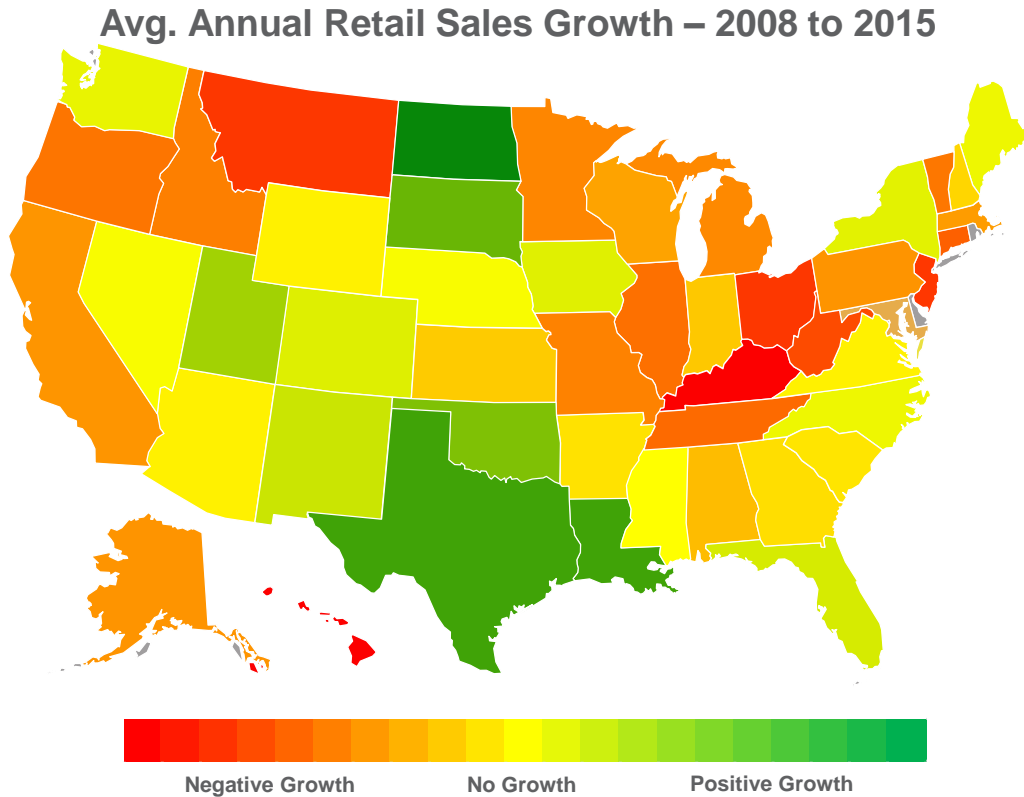
Source: EIA

What's Happening?

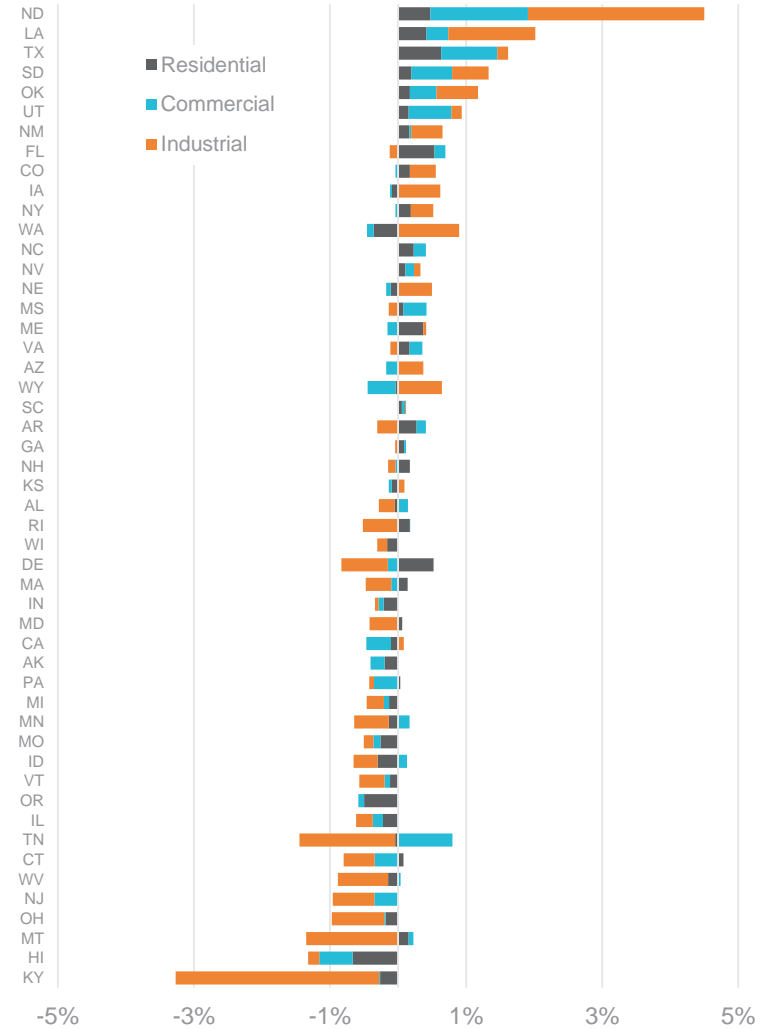
Regional Demand Trends

Growth sightings: All regions are not created equal

- Regions with significant oil and gas resources (e.g., around TX, OK, ND) averaged >0.5% annual sales growth since 2008
- 27 states have averaged negative or no annual sales growth since 2008; 40 states have averaged <0.5%



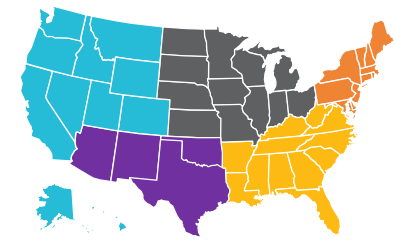
Weighted Avg. Annual Retail Sales Growth 2008 to 2015



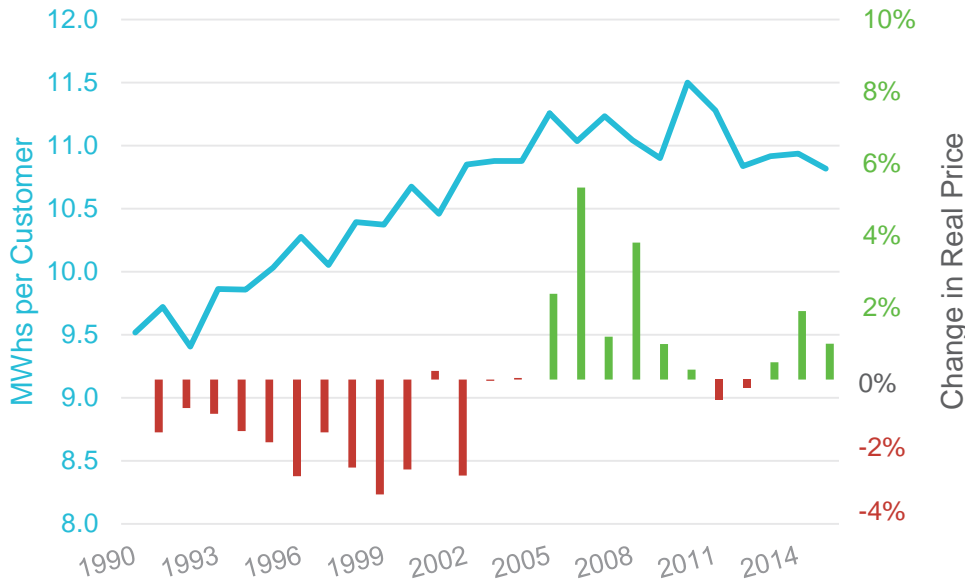
SOURCE: EIA

What's Happening?

Residential Demand Trends



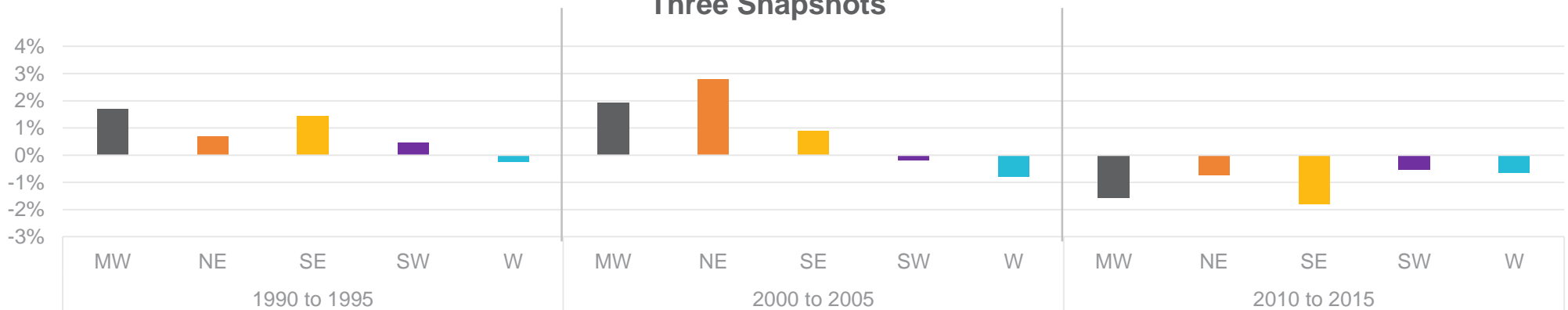
Residential Sales per Customer and Price Change



Residential demand has declined

- Since 2010, total residential sales have declined 3%
- Average sales per residential customer have fallen 6%
- Real prices have increased nearly 3%
- The decline in average consumption has occurred across all regions of the United States
- The West, led by California, has witnessed consistent declines in average consumption, followed by states such as Alaska and Hawaii

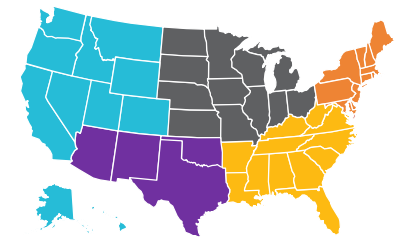
Compounding Annual Growth Rates in Residential Sales per Customer by Region: Three Snapshots



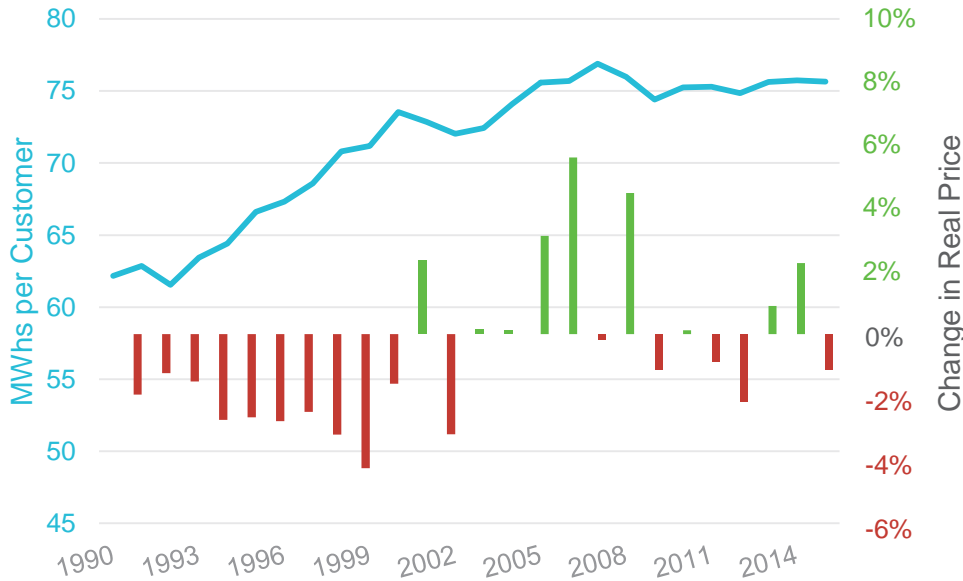
SOURCE: EIA Form 861; RECS

What's Happening?

Commercial Demand Trends



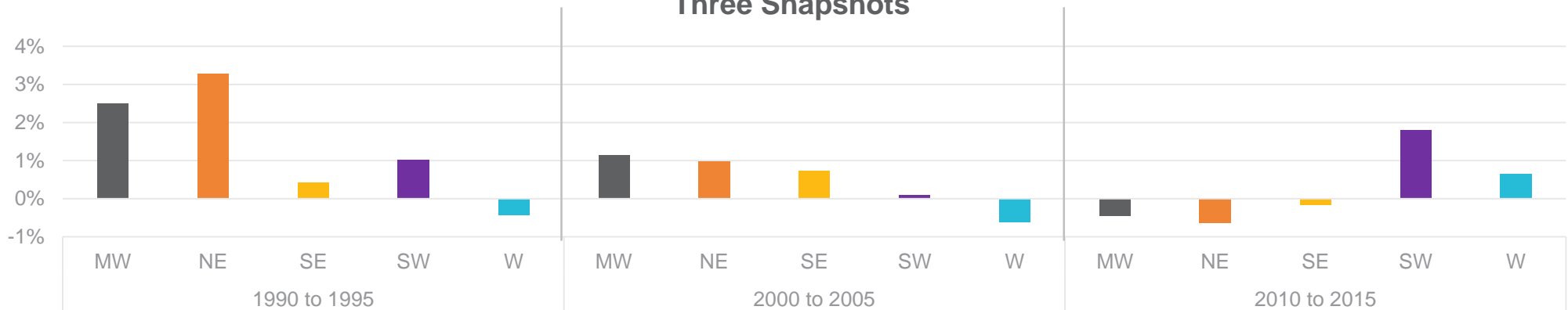
Commercial Sales per Customer and Price Change



Commercial demand has slowed

- Since 2010, total commercial sales have increased 2.3%
- Average sales per commercial customer have increased only 0.5%
- Real prices have decreased by 1%
- The mixed-consumption behaviors across regions have led to a near net-zero effect on U.S. average commercial consumption
- The Southwest has experienced the most consistent growth

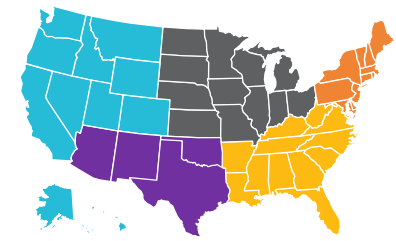
Compounding Annual Growth Rates in Commercial Sales per Customer by Region: Three Snapshots



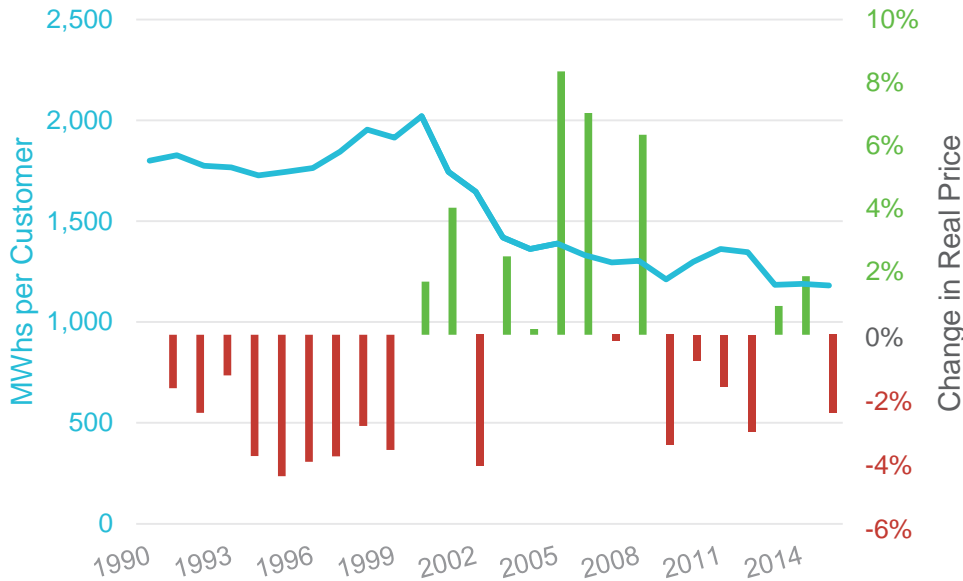
SOURCE: EIA Form 861; CBECS

What's Happening?

Industrial Demand Trends



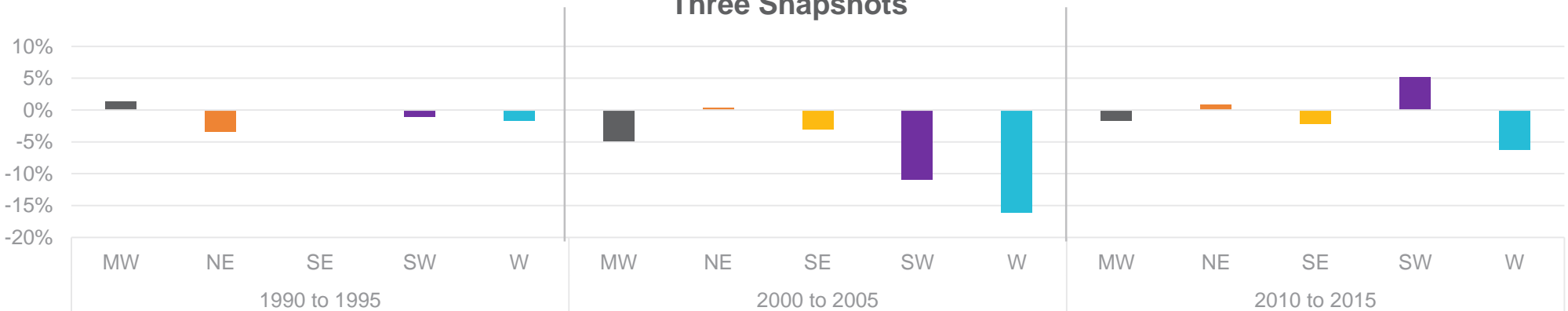
Industrial Sales per Customer and Price Change



Industrial demand has recovered, but remains well below 2000s' levels

- Since 2010, total industrial sales have increased 1.6%
- Average sales per industrial customer have decreased more than 9%
- Real prices have decreased by 4.4%
- Interestingly, regional declines in average consumption have slowed since 2005, though many regions are still negative
- The West has seen the most dramatic declines in average consumption

Compounding Annual Growth Rates in Industrial Sales per Customer by Region: Three Snapshots



SOURCE: EIA Form 861; MECS

What's Causing It?



What's Causing It?

Likely culprits

- Could it be price?
- Energy efficiency?
- Deindustrialization?



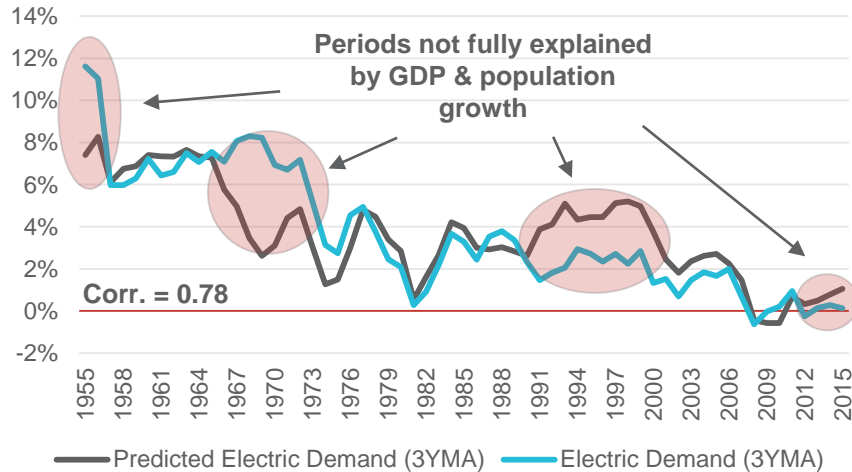
What's Causing It?

Likely Culprits

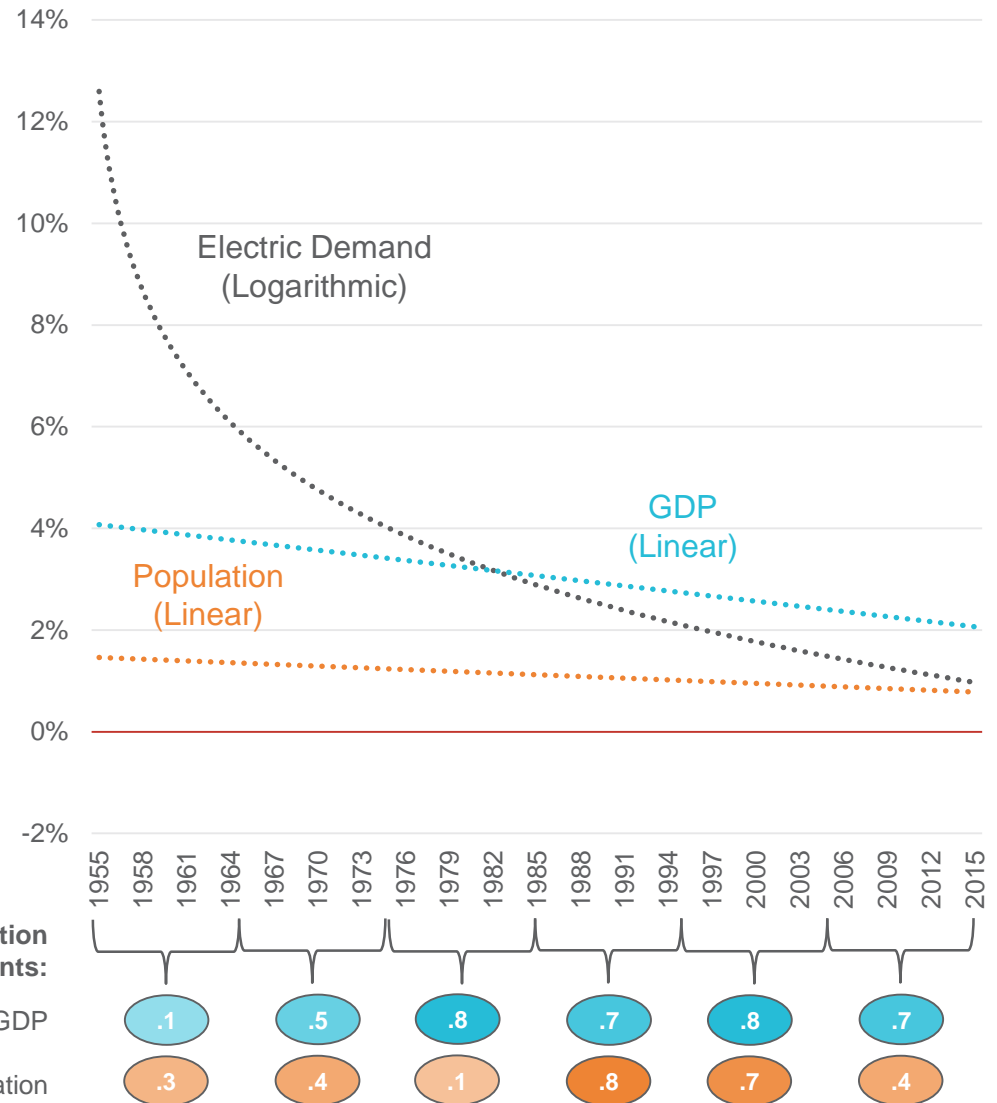
Decoupling of electricity growth from GDP and population is a myth. Slowing GDP and population growth aren't helping, but they're not the only cause

- Slowing economic growth
 - ~2.2% since the recovery in 2011
- Slowing population growth
 - <1% since 2002
- Price
- Energy efficiency
- Deindustrialization

Regression Using GDP and Population



U.S. Growth Trends (3YMA)



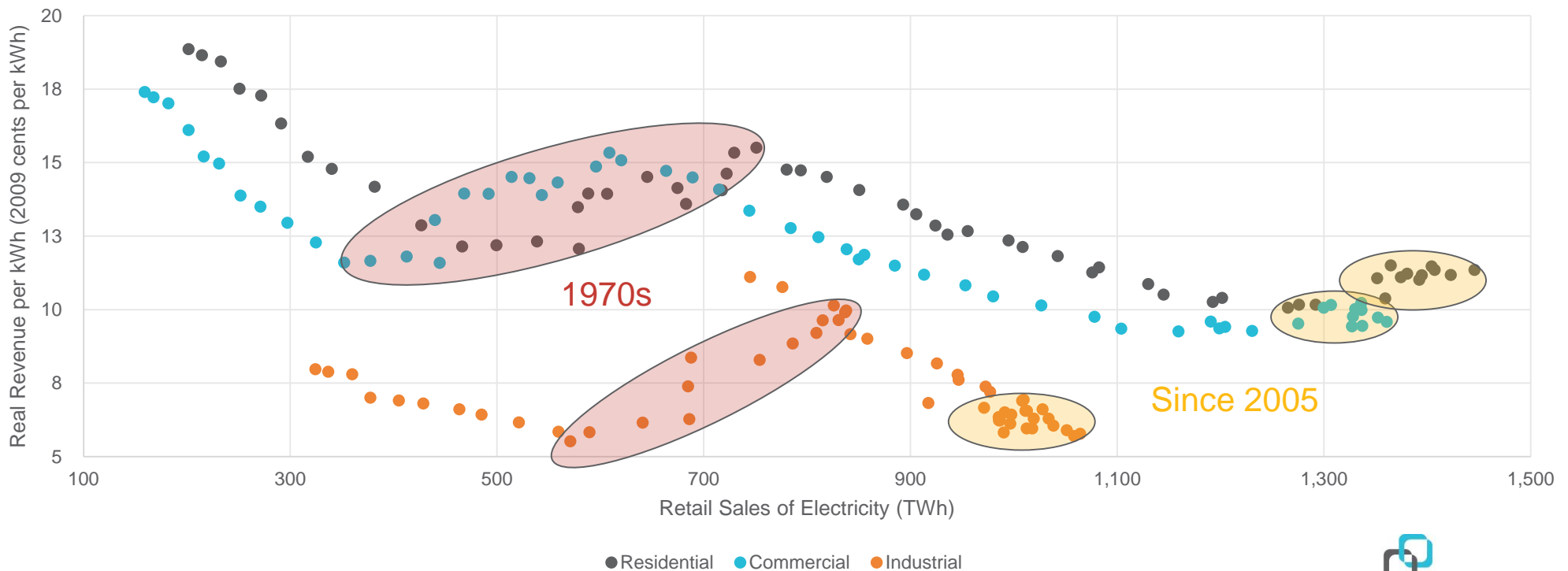
SOURCE: EIA; FRED

What's Causing It?

Could It Be Price?

- Real prices are near their all-time lows, increasing only modestly since 2000
 - Average real prices of electricity have increased 11% since 2000 compared to the core CPI's 34%
- While not “scientific,” the long-term trend line is intriguing and does suggest the possibility of long-term price elasticity punctuated by periods of anomaly
 - The 70s were weird
 - The last decade doesn't seem too normal either

**Retail Sales of Electricity vs. Real Prices of Electricity
(1960 to 2015)**



What's Causing It?

Energy Efficiency?

Buildings are replete with electric end uses, and there's an increasing emphasis on efficiency

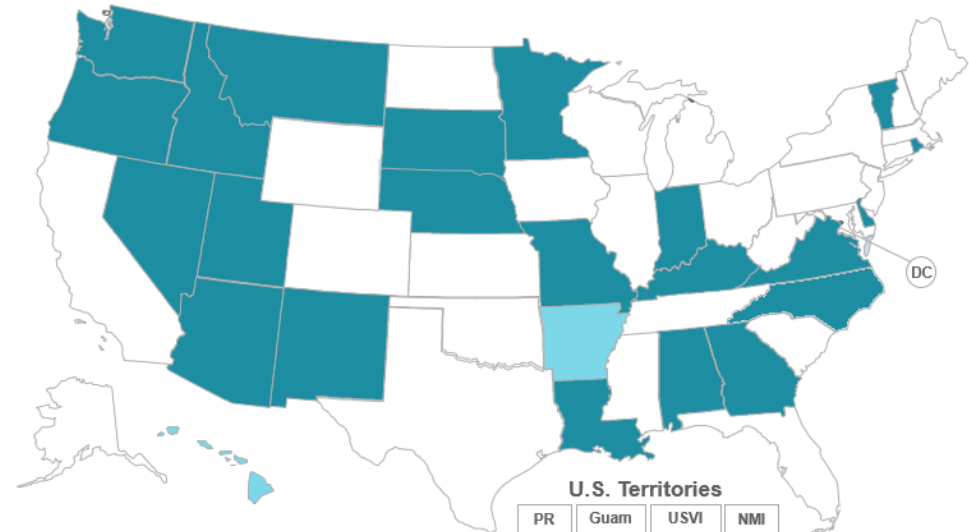
- The penetration levels of household appliances are well above 90%, suggesting their aggregate annual electric consumption is at or very near its peak
- Appliance standards, if continued, will only further increase the efficiency of these end uses
- However, efficiency improvements are being mitigated by the growth rates of miscellaneous electric loads in both the residential and commercial classes

20 States Have Efficiency Standards, While 8 Have Efficiency Goals



- States with an Energy Efficiency Resource Standard
- States with an Energy Efficiency Resource Goal
- No State Standard or Goal

22 States Treat Energy Efficiency as a Resource for Resource Planning and Procurement

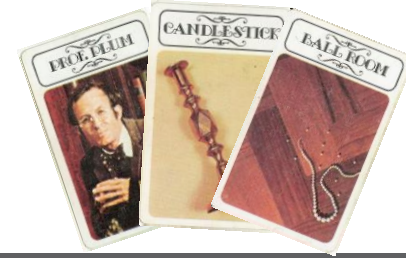


- States with energy efficiency as a resource in their IRPs
- States with IRPs, but where energy efficiency is driven exclusively by EERSs
- States with either no IRP policy or where energy efficiency is not treated as a resource

SOURCE: www.dsireusa.org (Accessed Oct. 2016); <http://database.aceee.org/state/energy-efficiency-resource> (Accessed Jan. 2017)

What's Causing It?

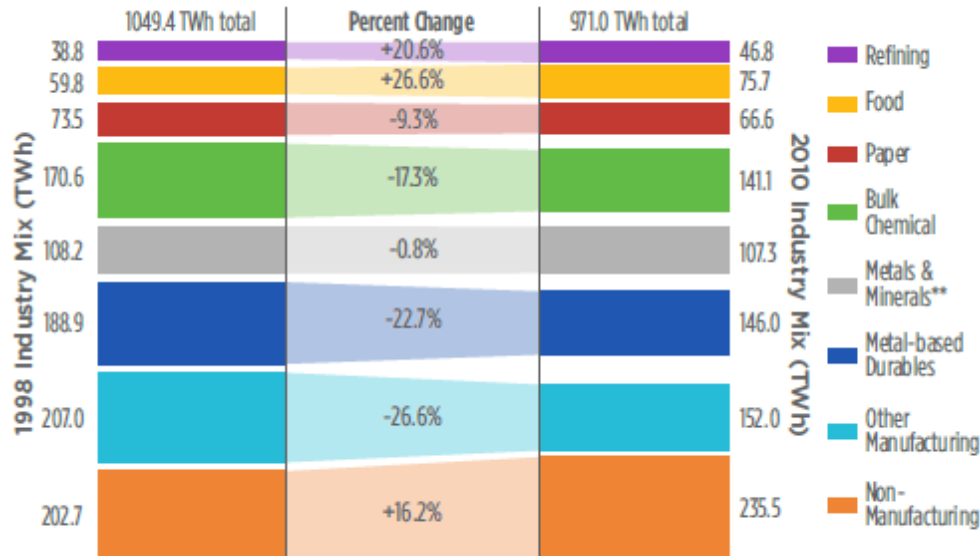
The Industrials Did It...



But not the way people think (i.e., deindustrialization)

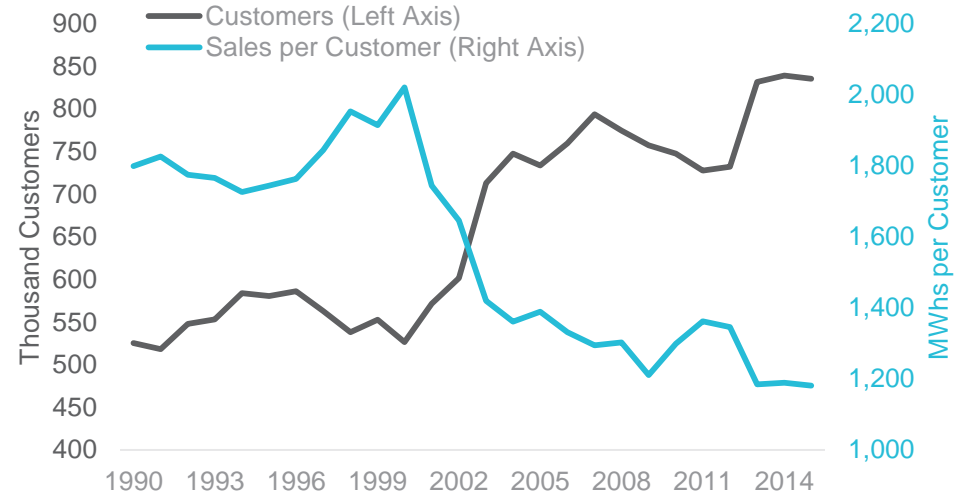
- In fact, industrial customer count has grown...dramatically
- Instead, the industrial mix has changed to less energy-intensive industries
- And we're seeing declining end-use consumption across the board

Change In TWh Sales by Industrial Sector from 1998 to 2010*

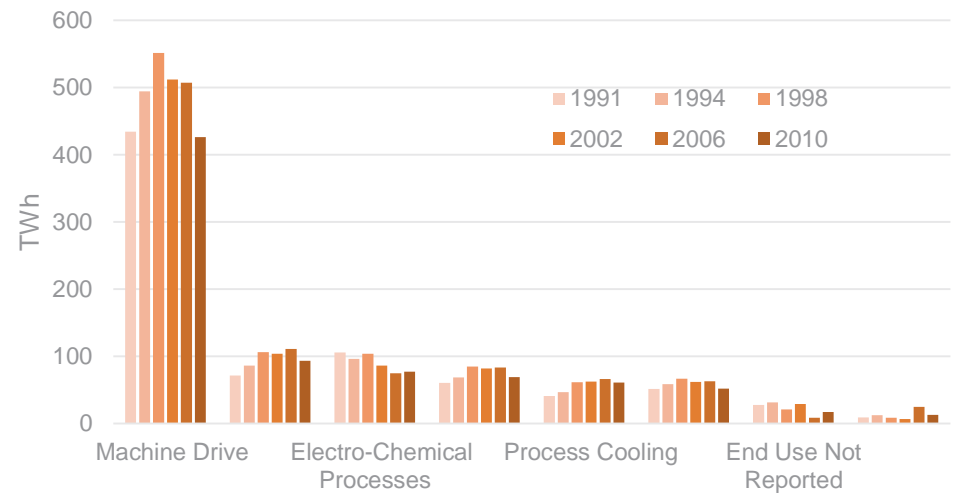


Sources: EIA; ScottMadden analysis

Industrial Sales Decomposition



Net Demand for Industrial Electric End Uses



SOURCE: EIA Form 861; MECS

* 'Net Demand for Electricity' is the sum of purchases, transfers in, and total onsite electricity generation, minus sales and transfers offsite. It is the total amount of electricity used by establishments.

What Are the Implications?



What's Are the Implications?

- Duck Curve
- Pressures on Rates
- Some Observations

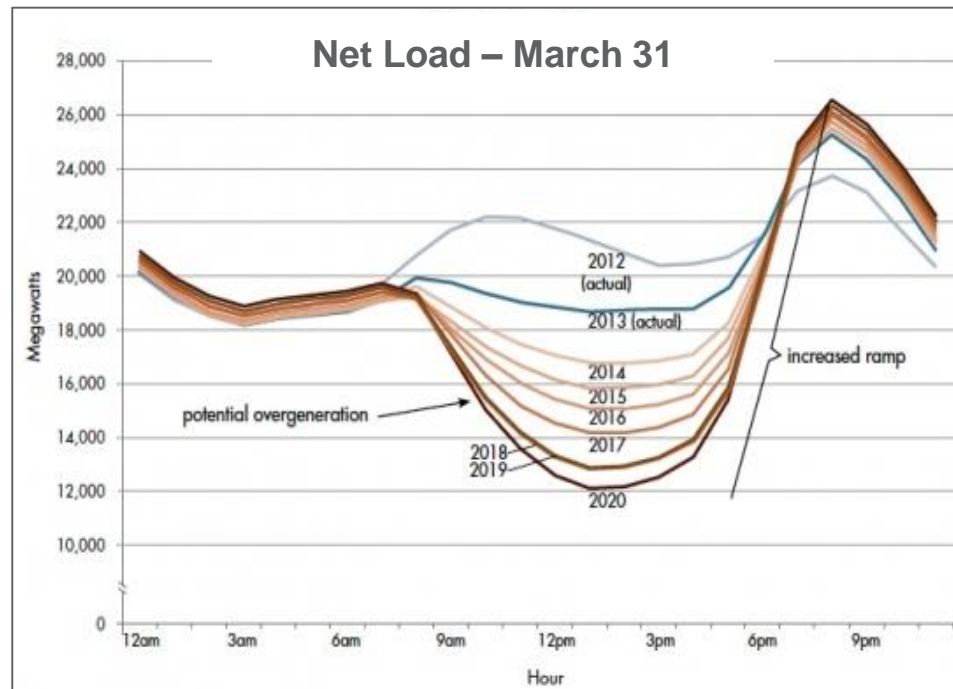


What Are the Implications?

Duck Curve

- 2013 California Independent System Operator (CAISO) analysis predicted that renewable resources would impact grid conditions
- Iconic “duck curve” predicting as variable generation grows, so too will the midday trough of load served by conventional supply
- ScottMadden analyzed average hourly production data from CAISO from January 2011 through June 2016 to understand if actual results align with the original forecast and to see what new insights could be learned from the data behind the curve
- But is it what most people think it is?

The California Duck Curve Chart



SOURCE: CAISO

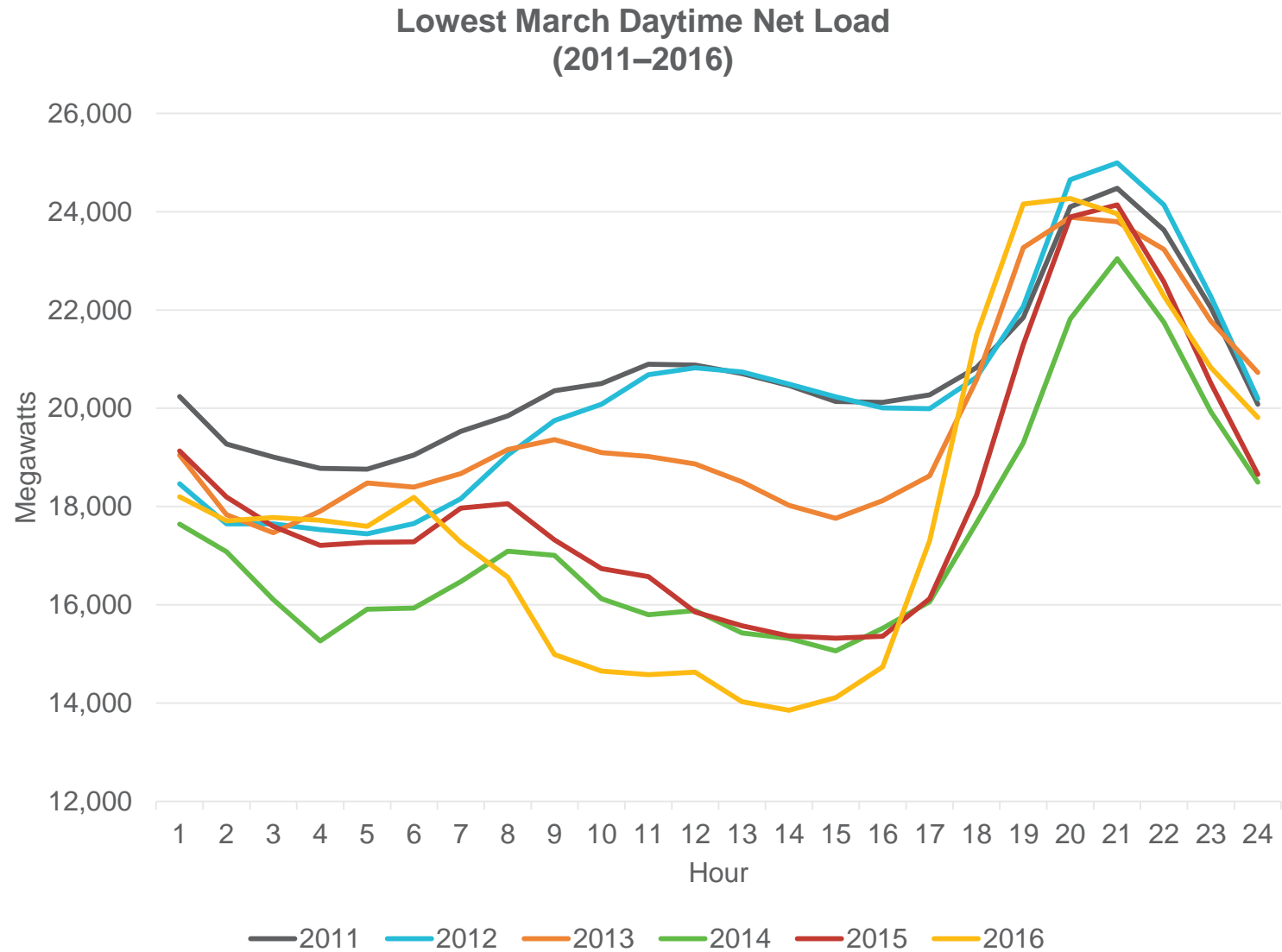


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What Are the Implications?

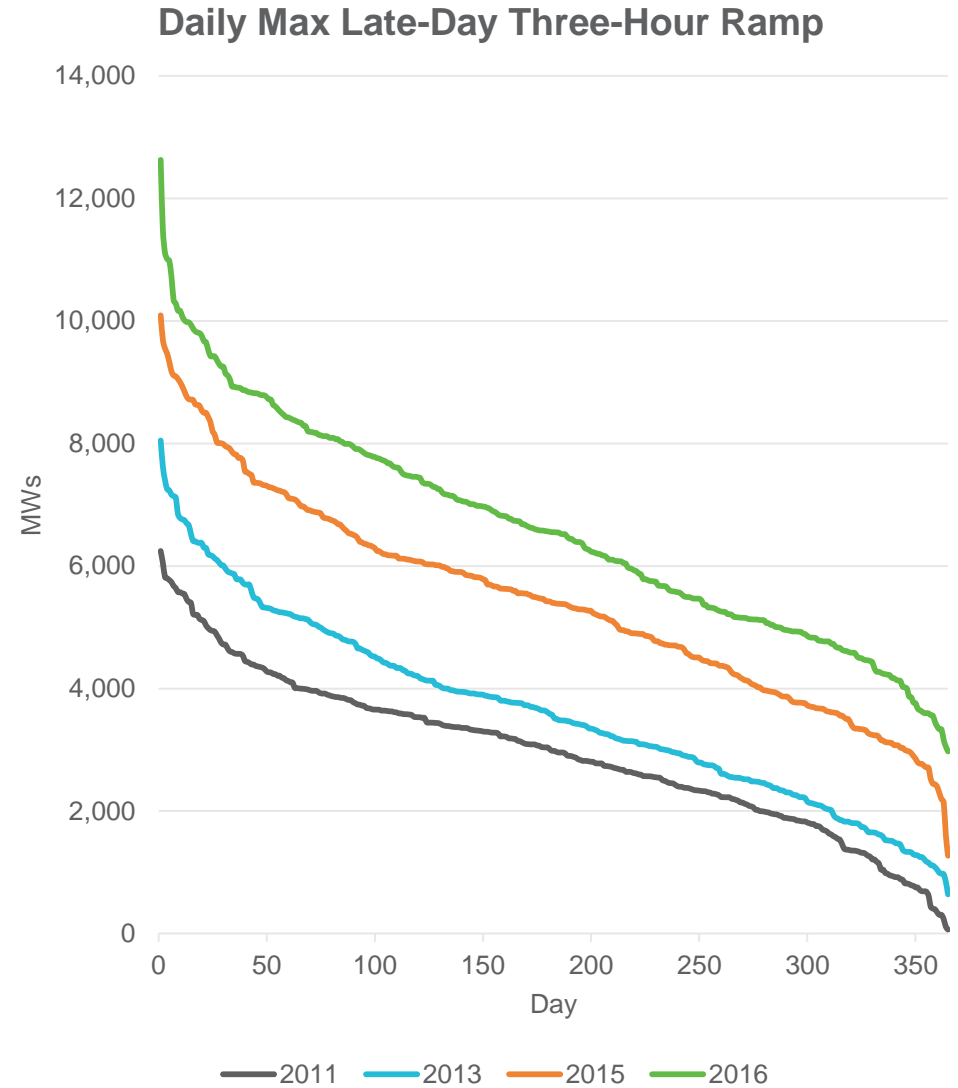
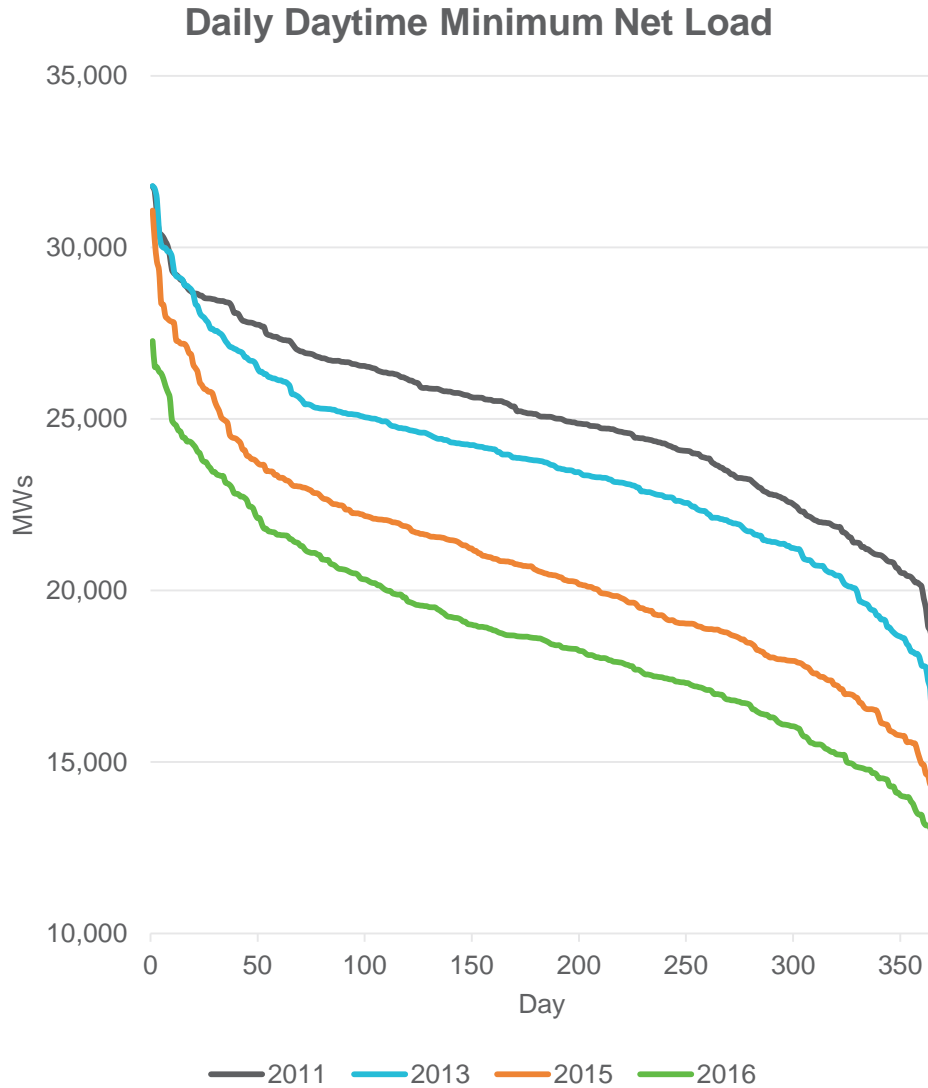
Duck Curve Is Real – and Growing Faster than Expected



SOURCES: CAISO; ScottMadden analysis

What Are the Implications?

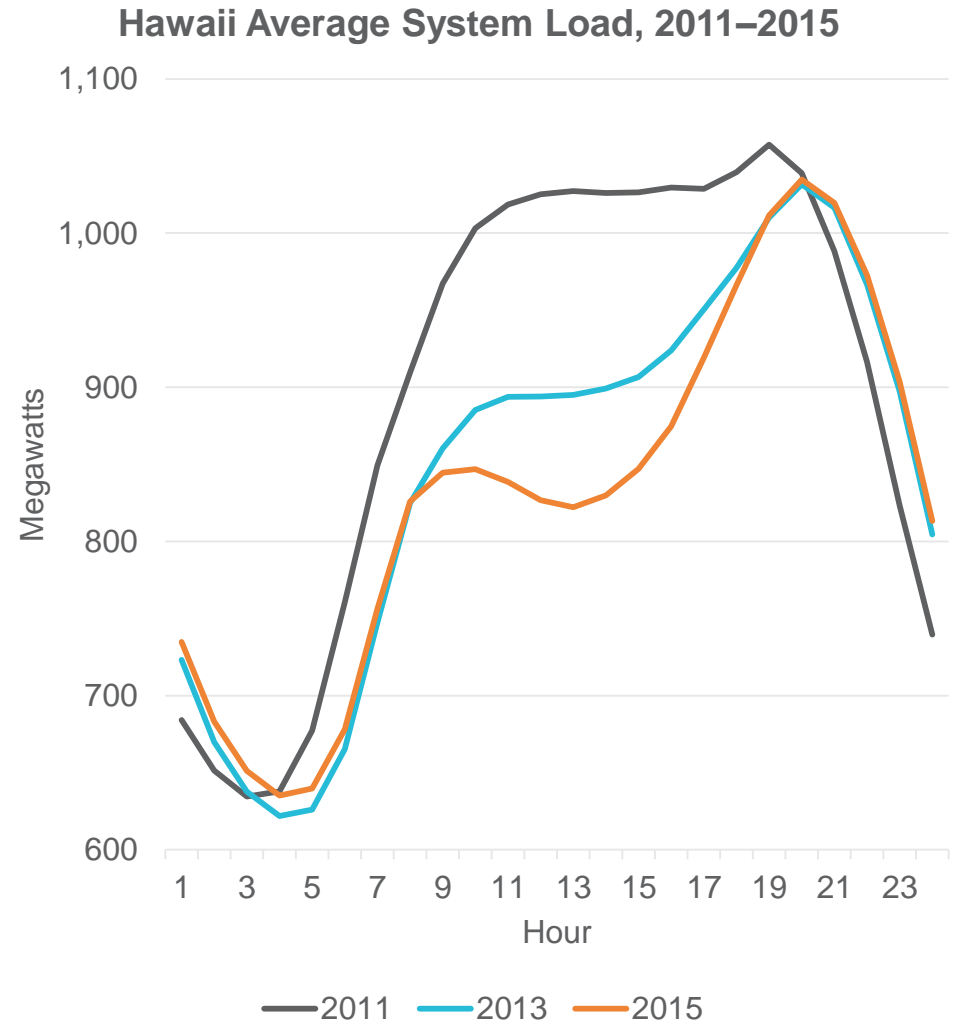
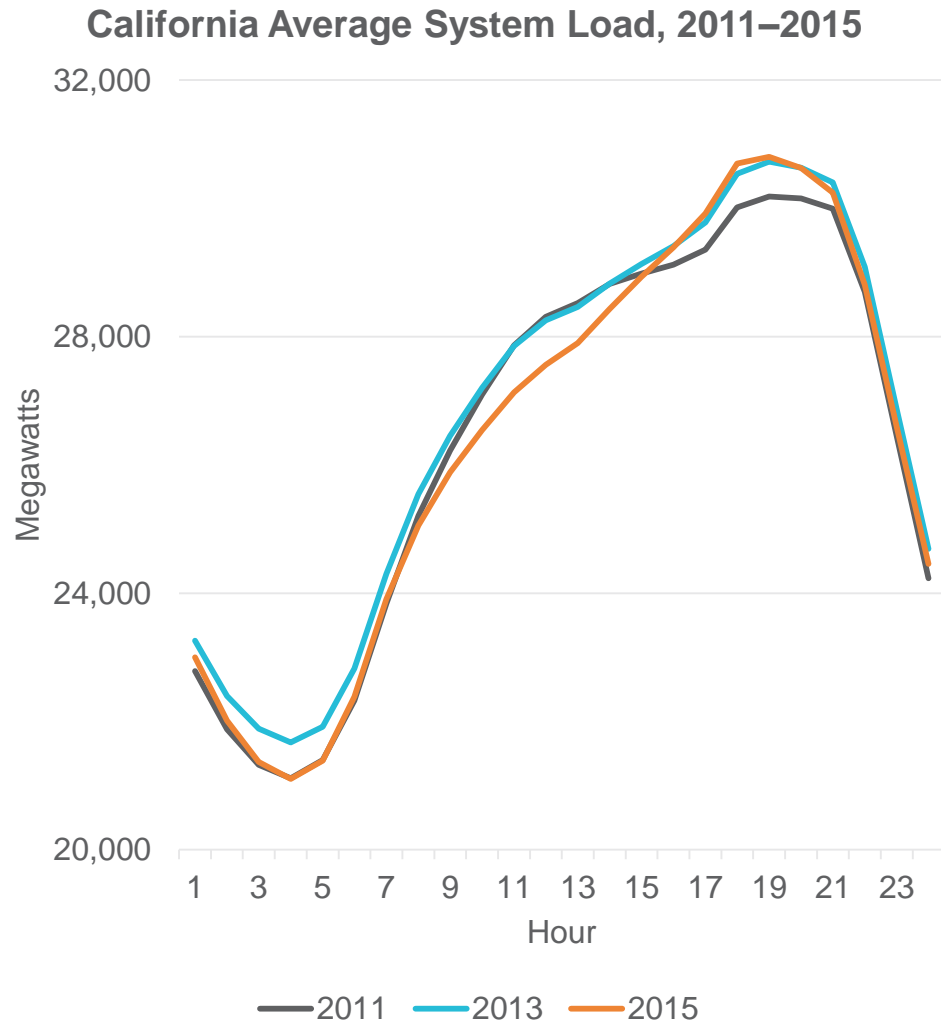
Net Loads Shrinking and Ramps Increasing (2011–2016)



SOURCES: CAISO; ScottMadden analysis

What Are the Implications?

Driven by Utility-Scale Solar, Not Distributed Resources



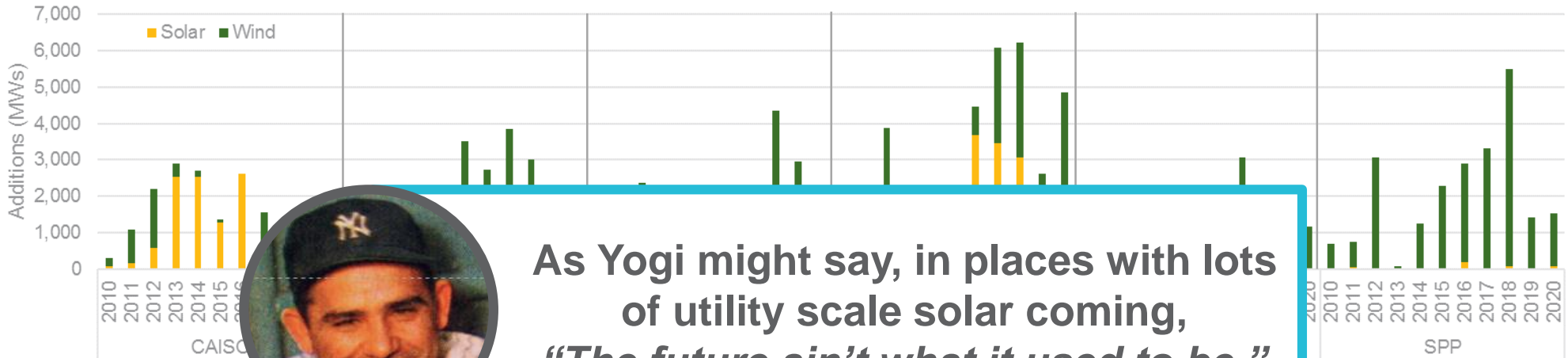
SOURCES: SNL Financial; ScottMadden analysis

What Are the Implications?

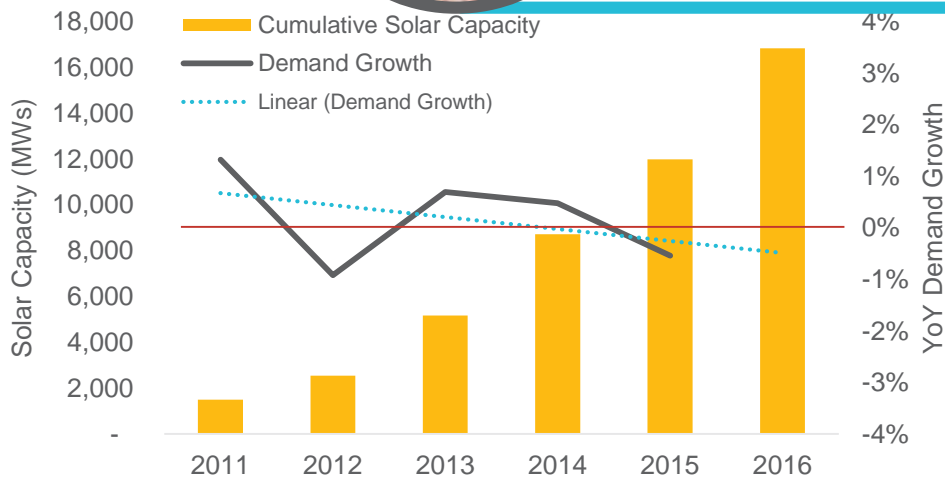
The Duck Curve Can Happen to You

The confluence of increasing intermittent resources and lower demand will lead to duck curves.

Intermittent Capacity Additions* by Select Region – 2010 to 2020



As Yogi might say, in places with lots of utility scale solar coming, *“The future ain’t what it used to be.”*



- The duck could migrate to areas with high penetrations of utility-scale solar
- States forecasted to have more than 3 GWs of utility-scale solar by the end of 2021 include:
 - North Carolina
 - Arizona
 - Georgia
 - Nevada
 - Texas

SOURCE: SNL; GTM; EIA

*Future capacity is based on actual planned/under construction projects and does not include unplanned additions/retirements

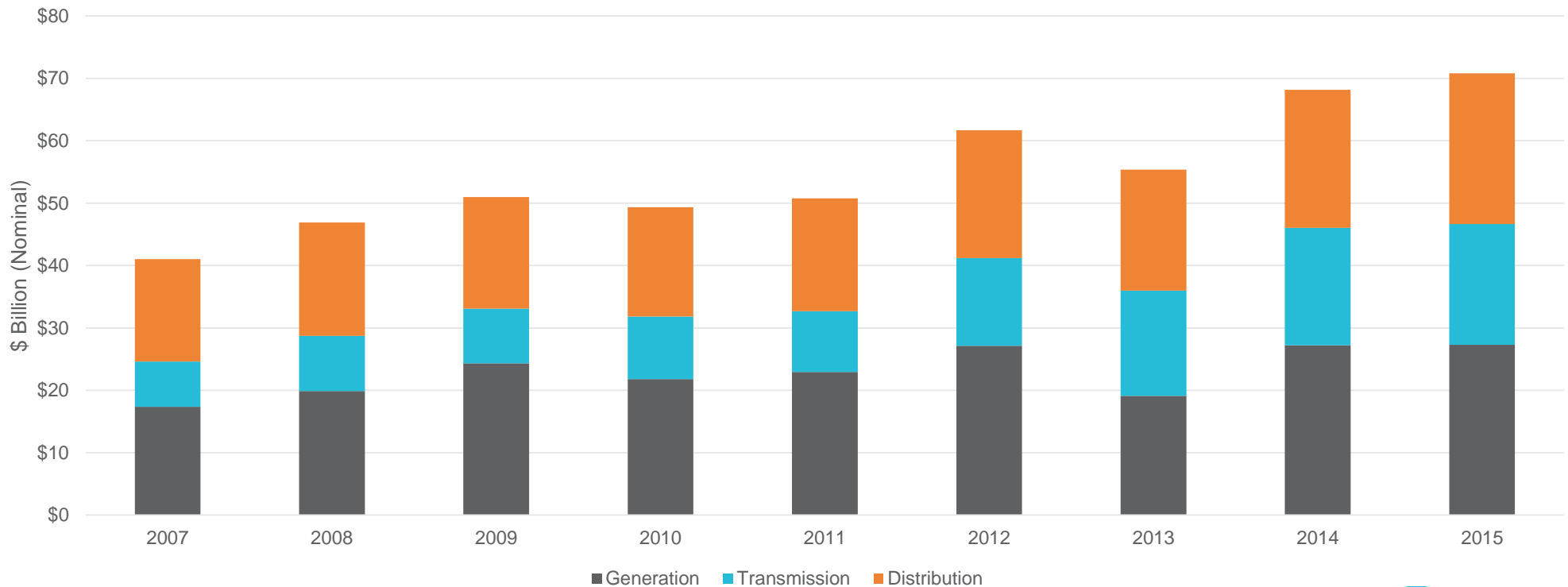
What Are the Implications?

Pressures on Rates

Grid investments are accelerating

- T&D capex is at an all-time high
- And generation investments are at a high point primarily due to renewables
- “If your outgo exceeds your income, your upkeep will be your downfall”

Electric Industry Additions by Year and Type
(In \$ Billions)



SOURCE: SNL; FERC Form 1 Data;



What are the Implications?

Some Observations (from the Best Magazine in the World)

- Public policy is increasing supply when the markets don't want it – we are adding supply when demand growth is stagnant
- The wholesale market is centered around short-run marginal cost, originally designed to determine dispatch order, not to govern entry and exit
- The confluence of these effects is tanking wholesale prices so that the price signal for entry and exit becomes distorted
- As a result, renewables are eating coal and will soon be cannibalizing themselves

The law of unintended consequences is alive and well.

What Can You Do About It?



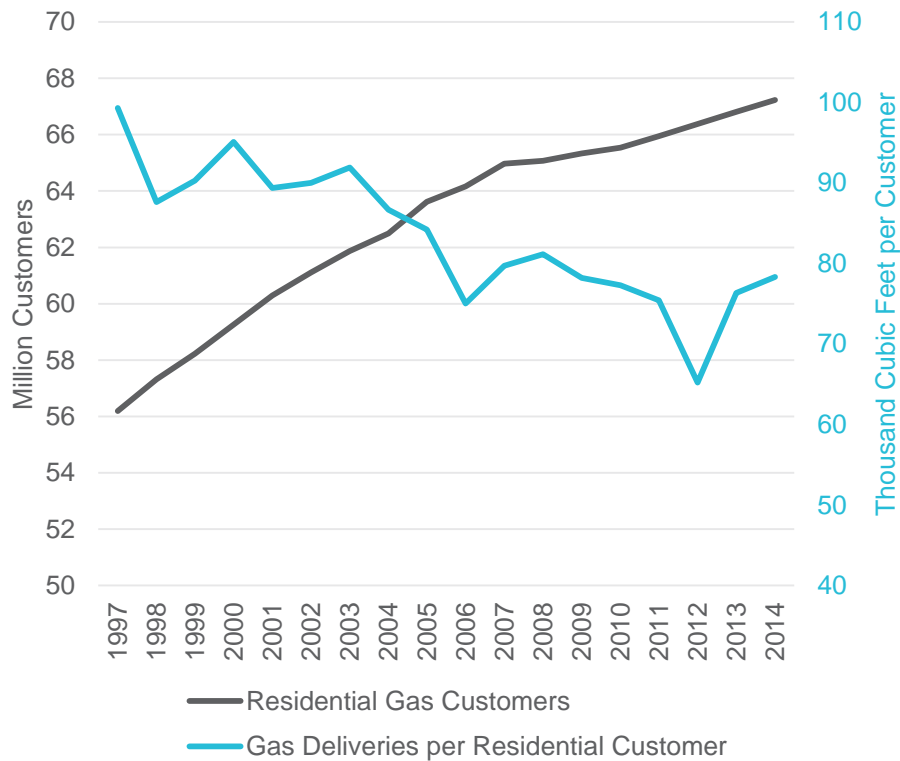
What Can You Do About It?

- Target the Customer Mix
- Rate Structure and Design Alternatives
- Differentiated Pricing
- PPAs Are Ripe for Innovation
- New Services and Strategic Alternatives
- New Markets

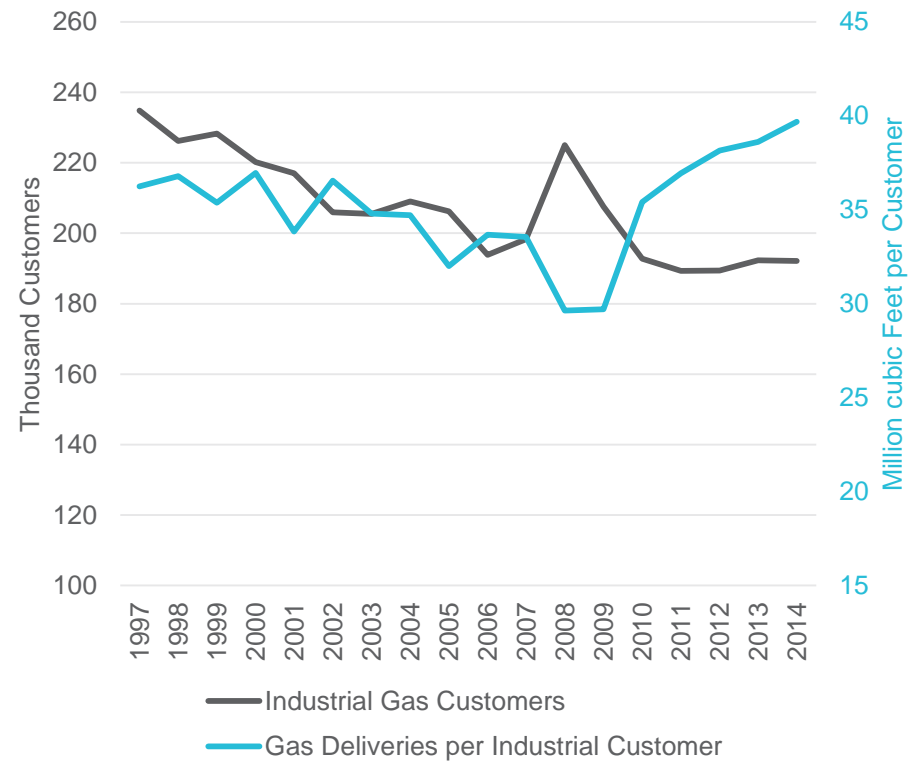
Target the Customer Mix

- Combo utilities look at multi-fuel incentives
 - Growth in residential gas customers, though declining usage
 - Opposite is true for industrial gas customers
- Economic development to bring high-intensity industries back/in

Residential Gas Customers vs. Usage
1997 to 2014



Industrial Gas Customers vs. Usage
1997 to 2014



What Can You Do About It?

Rate Structure and Design Alternatives

In the short run, many costs are fixed; however, in the long run, all costs are variable. Deciding which perspective to take comes with a series of tradeoffs.

	Rate Design	Description	Impact
Power Supply	Power Cost Adjustments	Mechanisms designed to modify rates to reflect supply costs (e.g., fuel and contracted power)	Stabilizes revenue and bond ratings; must be implemented properly to mitigate complaints
	Time of Use Rates	Variable rates based on demand at various time periods	Better reflects the true cost of power production; allows to adjust for system losses
	Economic Development Rates	Declining percentage bill discount, typically over a five-year period	Can often attract new customers and provide cost reductions to existing customers
	Net Metering Rates	Credits full retail rate against production or avoided costs	Can serve as a subsidy to the customer
Distribution	Inverted Block Rate	Increasing fixed rates associated with each additional block or unit of energy	Shifts fixed cost recovery into latter blocks and may adversely impact financial statements
	Revenue Decoupling	Traditional: revenue = fixed price x sales Decoupled: price = fixed revenue/sales	Reduces utility's opposition to energy conservation by ensuring cost recovery
	Demand Charges	Fixed rate based on peak demand rather than consumption	Stabilizes revenue; adversely impacts low use customers
	Customer Charges	Fixed charges designed to recover costs that do not vary with usage such as meter and billing costs	Helps to reduce subsidy between year-round and seasonal customers; adversely impacts low use customers

Rate Structure and Design Alternatives – What Does MIT Say?*

- Ensure that all prices and charges are technology neutral and symmetrical
 - No longer homogenous classes – network utilization patterns more diverse
 - Injections and withdrawals by time, voltage level, and location important, not device (e.g., EV)
- Progressively improve the granularity of price signals with respect to both time and location
 - Efficiency gains with signals based upon time and location
 - But carefully balance against implementation costs and considerations, complexity, and volatility
- Apply forward-looking peak-coincident network capacity charges and scarcity-coincident generation capacity charges
 - Charges should reflect the contribution of network users to the incremental future cost of transmission and distribution network expansion
 - These charges should incentivize flexible demand, DER at right times and locations
- Allocate residual network and policy costs without distorting efficient incentives
 - Volumetric charges don't necessarily induce network savings
 - Fixed charges are better approach, but how to allocate fixed charges in an equitable and acceptable manner

* With *some* poetic license

SOURCE: Adapted from I. Perez-Arriaga, J. Jenkins, and C. Battle, [A Regulatory Framework for an Evolving Electricity Sector: Highlights of the MIT Utility of the Future Study](#), *Economics of Energy & Environmental Policy*, Vol. 6, No. 1 (2017)

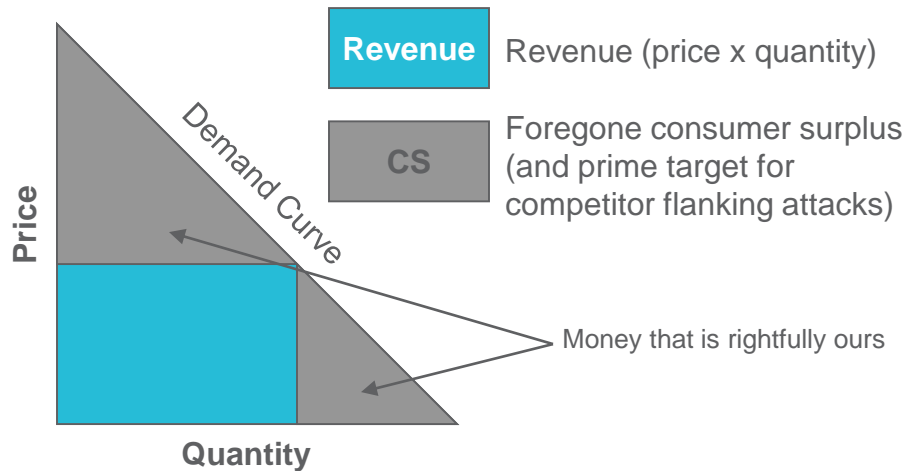


What Can You Do About It?

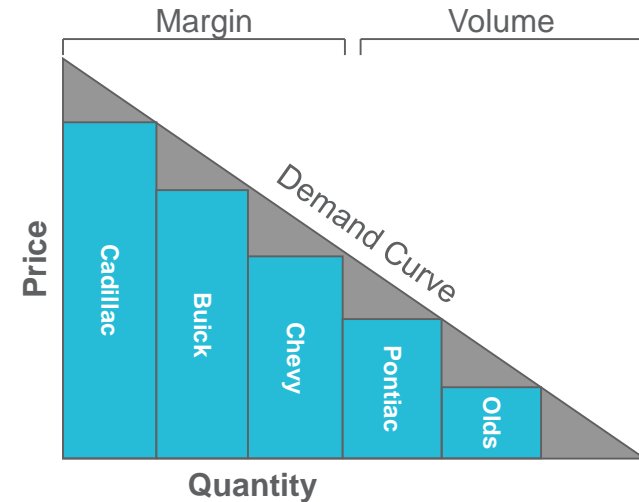
Differentiated Pricing

- Differentiated/segmented pricing can require some differentiation of products, as illustrated by the classic demand curve illustration of General Motors' segmented pricing strategy below:

“One-Size-Fits-All” Pricing Leaves Money on the Table



Segmented Pricing Creates Value and Blocks Competition



- Pricing can be segmented along many lines, such as:
 - Buyer characteristic
 - Time of purchase
 - Purchase location
 - Purchase of quantity
 - Value of end use
 - Product design
 - Product bundling
 - Tie ins
 - Value-based metering

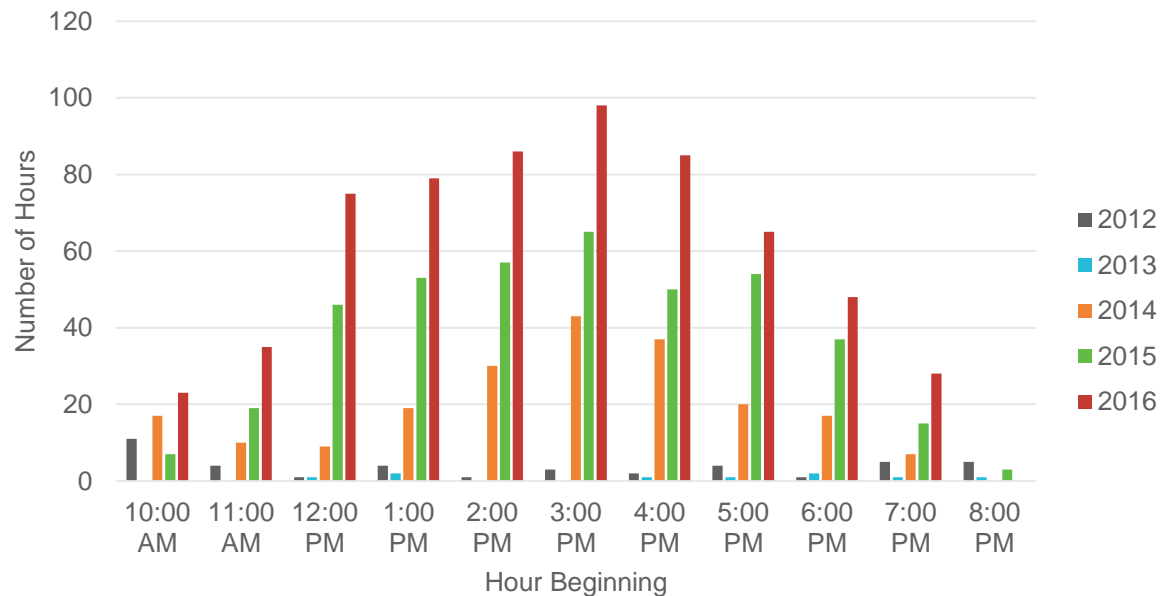
More prices, not fewer. Charge each buyer based on their value vs. “peanut butter spread”

Updating Terms of Solar Power Purchase Agreements

Standard PPAs are quickly becoming inadequate

- Overproduction by solar resources, especially during low-demand periods, is leading to curtailment
- A few states experiencing this effect already are realizing the shortcomings of their solar PPAs
 - Hawaii is exploring how to effectively curtail solar output
 - California is exploring options to address negative midday pricing
 - North Carolina is in the midst of figuring out how to address PURPA's QF model
- These problems may be resolved by pursuing alternative PPA structures
 - Capacity and Energy
 - Time-of-Day Pricing
 - Renewable Dispatch Generation
- Some key questions:
 - Can solar provide ancillary services?
 - Will energy prices be tied to market prices?
 - Are alternative PPAs too complex?

Frequency of Negative Prices in CAISO Trading Hubs



What Can You Do About It?

New Services and Strategic Alternatives

Shifting focus back to the core business, increasing grid investments, and testing expanded customer-centric offerings.

Strategy	Examples
“Build the Platform” Accelerate investments in system digitization and automation	<ul style="list-style-type: none">■ Exelon: \$25 billion in critical infrastructure, smart grid technologies, reliability measures, and customer service programs in regulated utilities■ Southern California Edison: plans to invest \$2.3 billion DER-related upgrades
“Be (a Bit) Unconventional” Expand into energy services	<ul style="list-style-type: none">■ Edison International: launched Edison Energy■ Southern Company: acquired PowerSecure
“Consider Inorganic” Assess growth opportunities through acquisitions and JVs	<ul style="list-style-type: none">■ NextEra Energy: proposed \$18.7 billion acquisition of Oncor■ Dominion Resources, Duke Energy, and Southern Company: recently announced major acquisitions of natural gas utilities and pipelines

NOTE: DER means distributed energy resources

SOURCE: SNL Financial; industry news; investor presentations; company annual reports; EIA; GTM; Rocky Mountain Institute

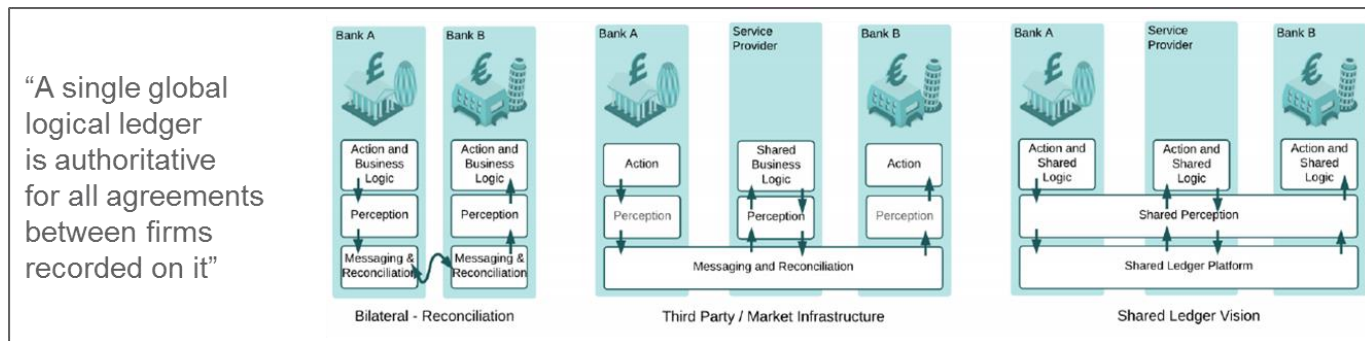
What Can You Do About It?

New Services and Strategic Alternatives

Distributed ledger technology (DLT) provides a single shared system of record that enables unprecedented coordination in competitive environments and the creation of new markets

- Example: Corda – a DLT product made by the R3CEV consortium – allows banks, regulators, and other interested parties to automate the business logic that connects them and their customers

- The platform is **private**, meaning all participants are known and the details of transactions are kept confidential
- The platform is **secure** as a result of well-established cryptographic techniques and its distributed architecture



- The platform is **efficient**, allowing competitors to coordinate without worrying about reconciling disparate ledgers and conflicting interpretations of legal agreements
- The platform **fits within the current regulatory framework** by utilizing existing legal agreements and providing regulators with increased transparency across the network of transactions
- The platform **could enable new revenue streams** for participants that leverage the shared architecture and data to provide value-added services

Should we disintermediate ourselves? Leading banks are exploring this.

Thank You!

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Smart. Focused. Done Right.



And if all this change and uncertainty is making your head hurt – one last Yogi quote, “If the world were perfect, it wouldn’t be.”