

# Firm Load Dispatch: Keeping Customers Comfortable and Capturing Predictable Demand Response Value

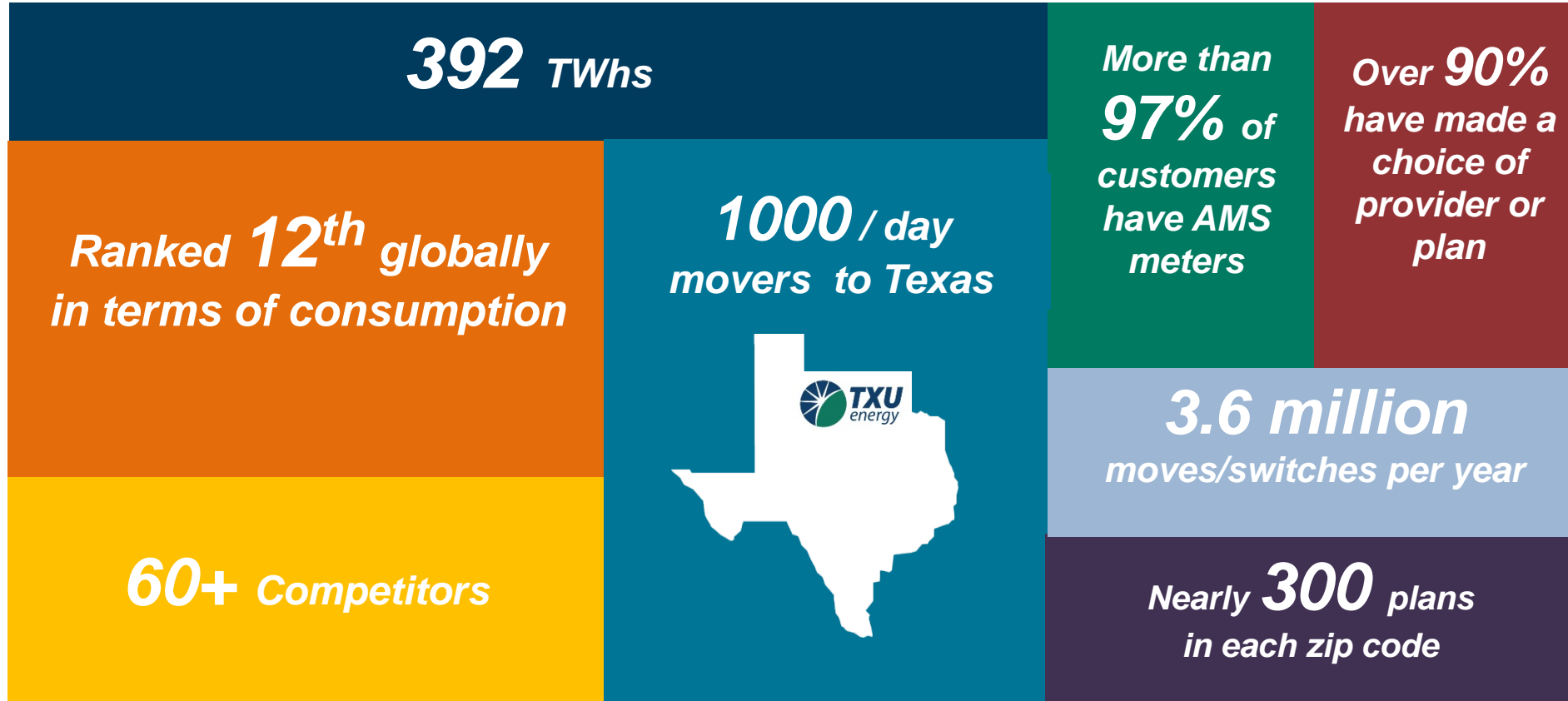


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# Texas is one of the most dynamic markets in the world



# TXU Energy at-a-glance

## Largest Texas-based Retail Electric Provider (REP)

- ~1.7 million customers



## Strong financial position

- 2016 EBITDA: \$839M



## History

- Long industry track record - competitive since 2002



## Products and brand

- Brand promise - *Power Positive Energy Experiences*

# Innovation @TXU Energy – Plans designed to meet customer needs



Our twist on TOU - Free Nights & Solar Days – speaks to key consumer needs

- *Environment – “I need to manage my carbon footprint, but I can’t afford solar panels”*
- *Budget – “I need to manage my household budget, but how do I cut my energy bills”*
- *Rewards – Shift & Save*

# Best in class products that make life easier....

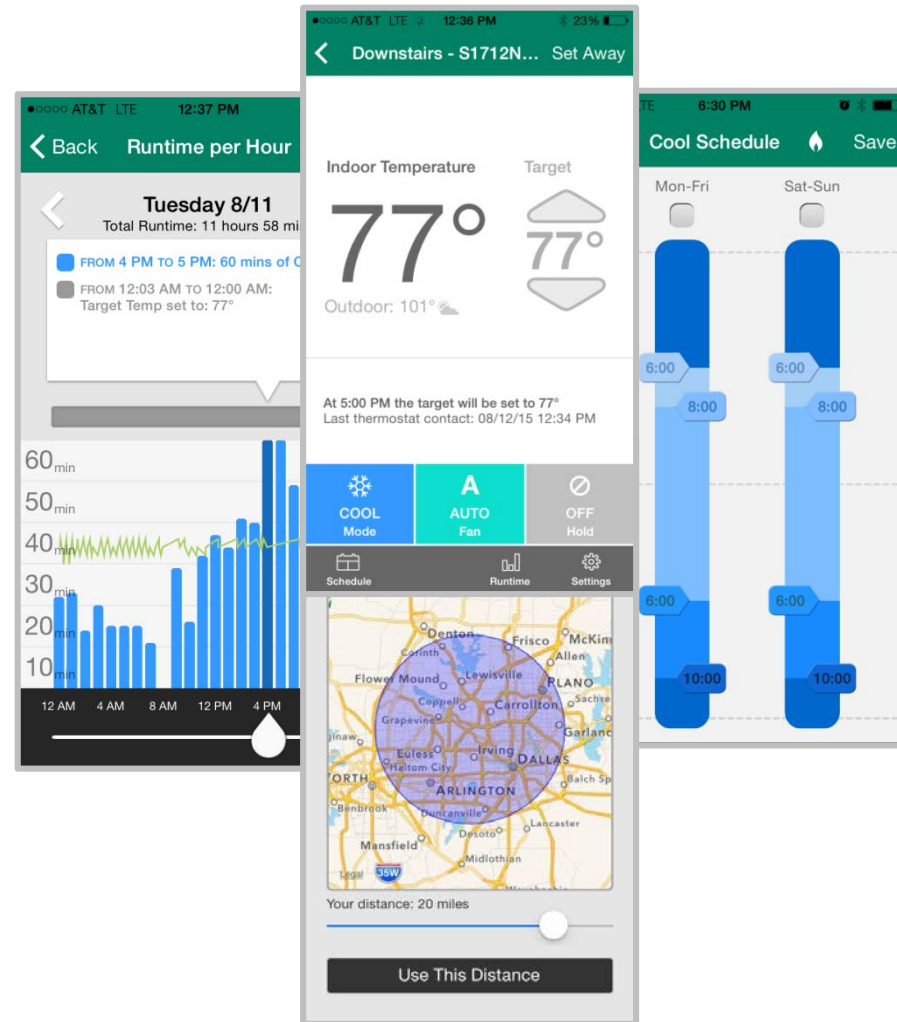
Convenience.

Control.

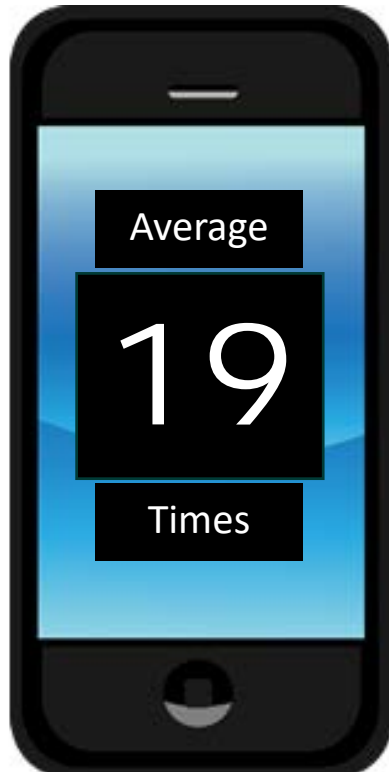
Savings.



TXU iThermostat



# ...and drive customer value and engagement



"I love my new thermostat. So convenient. I was laying in bed the other night and was hot. Grabbed my phone, opened the app, two taps down and the AC turned on. I slept cool and comfortable."

**30%**

Increase in customer satisfaction with new iTherm experience

**Save up to  
\$180 a year**

# However, traditional demand response strategies can lead to bad customer experiences

## TXU iThermostat Benefits

- Convenience
- Control
- Savings



## Traditional demand response impact

- Events last multiple hours
  - Opt outs and customer complaints due to excessive control time
- Undesirable load shape
  - Over-shed, then shed decay
- Reduction highly weather sensitive

Given the risks, we looked to EnergyHub for a new approach

# Motivating questions

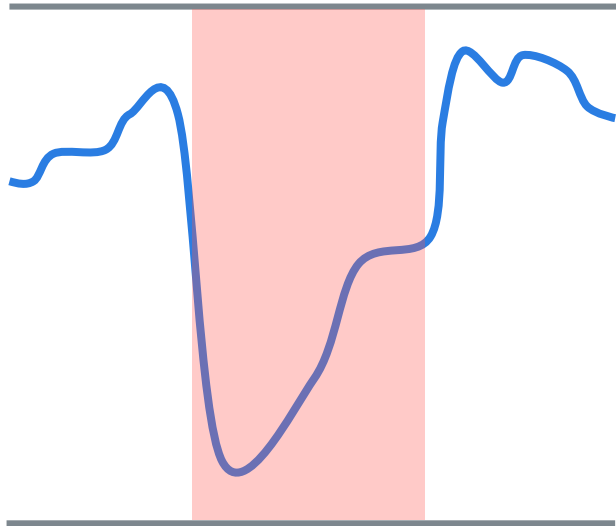
- Can DR reduction be as firm as generation?
- Can aggregation follow an arbitrary target shape?

*While ensuring customer comfort?*

*While reducing impact on the customer?*

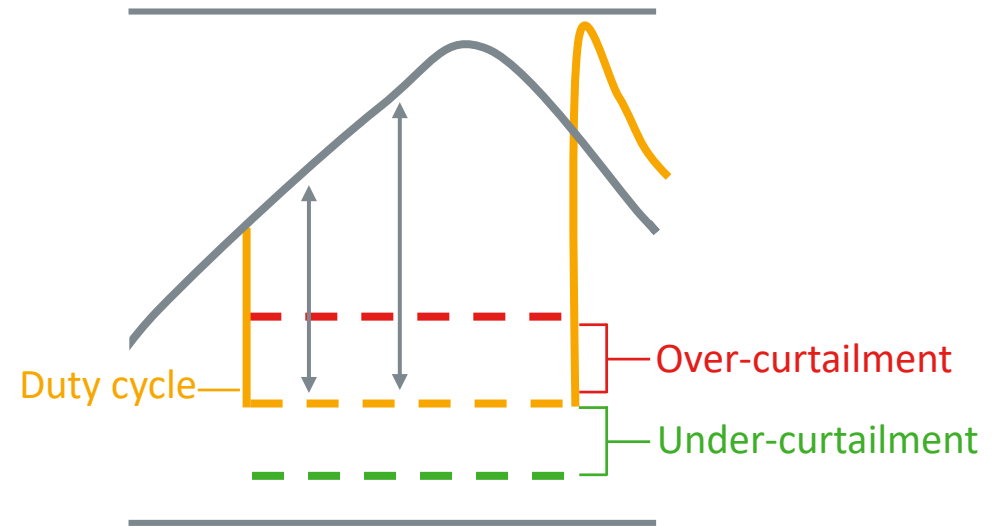


# Limitations of traditional approaches



Comfort protected, but...

- Undesirable load shape
- Over-shed, then decay



Comfort not protected, and...

- Reduction is non-constant
- Guaranteed to either under- or over-curtail customers

# Our goal: Architect for scale

Guarantee customer comfort



Setback controls

Robustness to model and  
forecast error



Stochastic optimization  
(custom Monte Carlo)

Support 100k devices  
(beyond C&I and grid-scale)



Fully distributed architecture

Optimization runtime in minutes



Ultra-fast, custom numerical  
methods

# Firm Load Dispatch: From device modeling to firm load



**Step 3: Execution**  
*Maintain load via real-time corrective control*



**Step 2: Planning**  
*Optimize and dispatch control strategy*



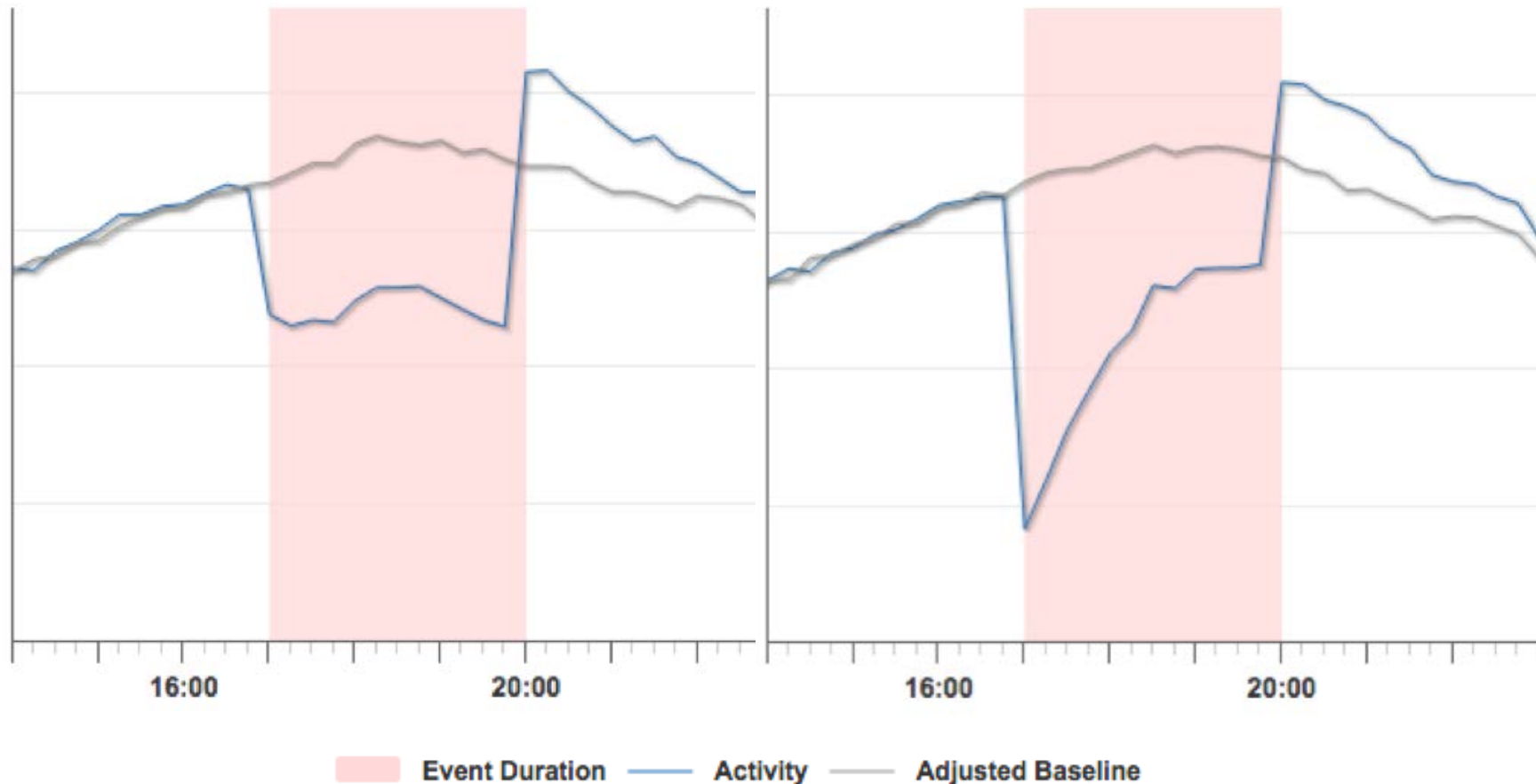
**Step 1: Modeling**  
*Learn individual device models over time*

# Results: 2016 Randomized Controlled Trial

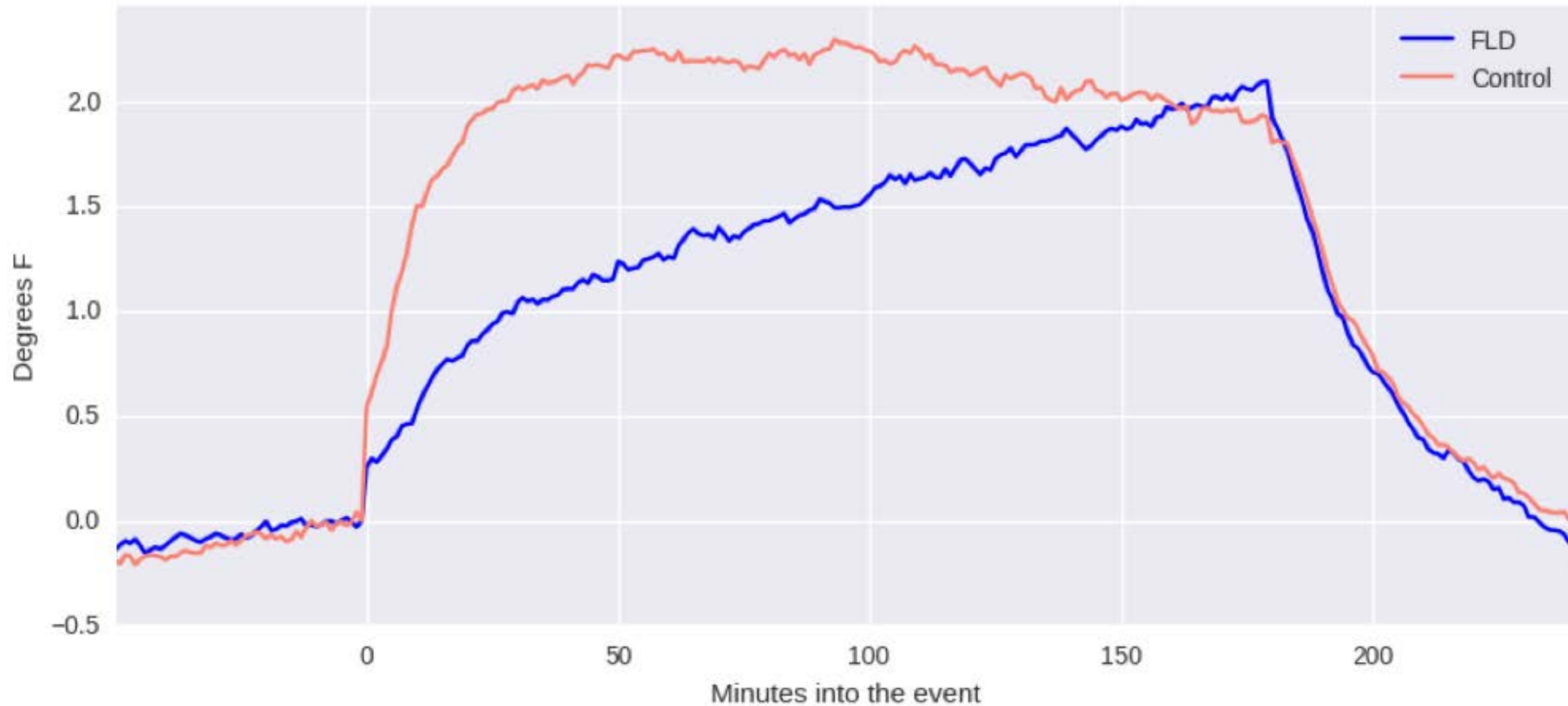
- 700 homes, randomly split into equal-sized treatment and control groups
- Treatment group received FLD-optimized controls
- Control group received traditional setback controls

Results	FLD	Control
Shed decay	-8.8%	63.1%
Load shed standard deviation	4.0%	17.3%
Opt out %	19.8%	25.0%

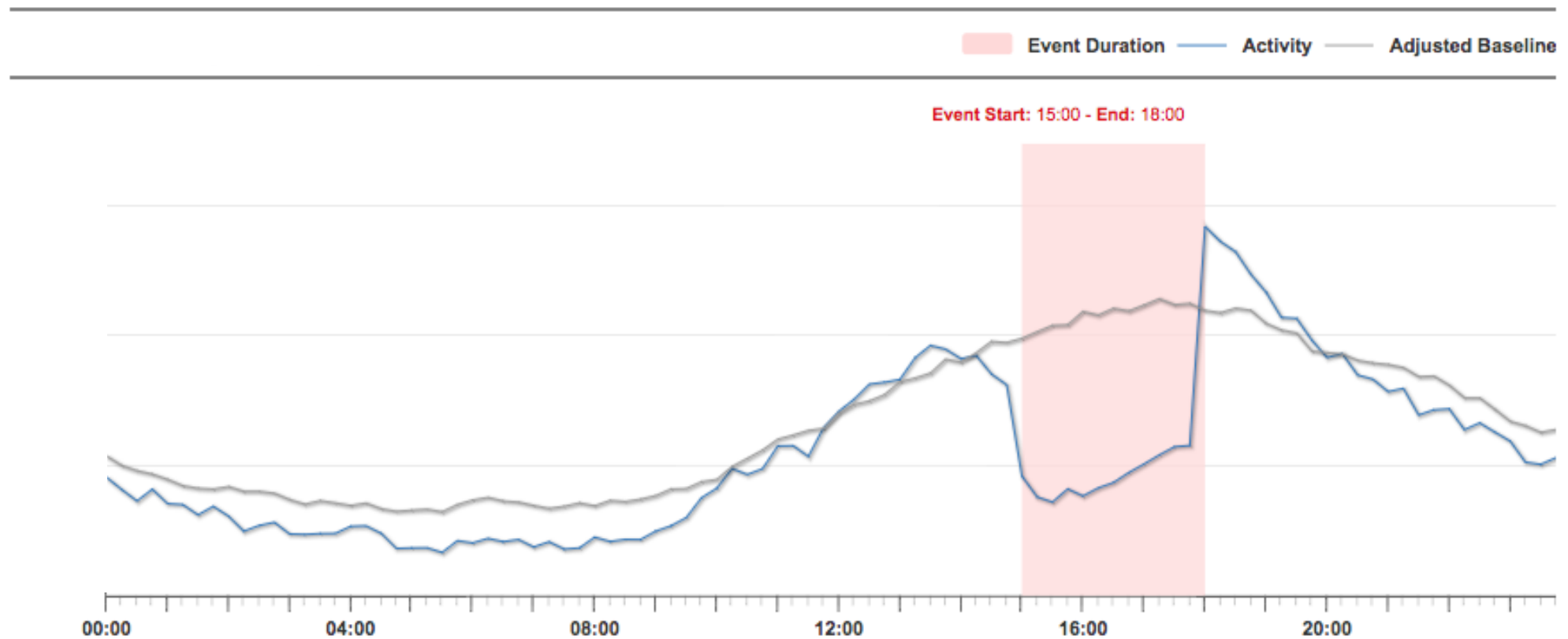
# Example treatment and control event



# Customer comfort analysis

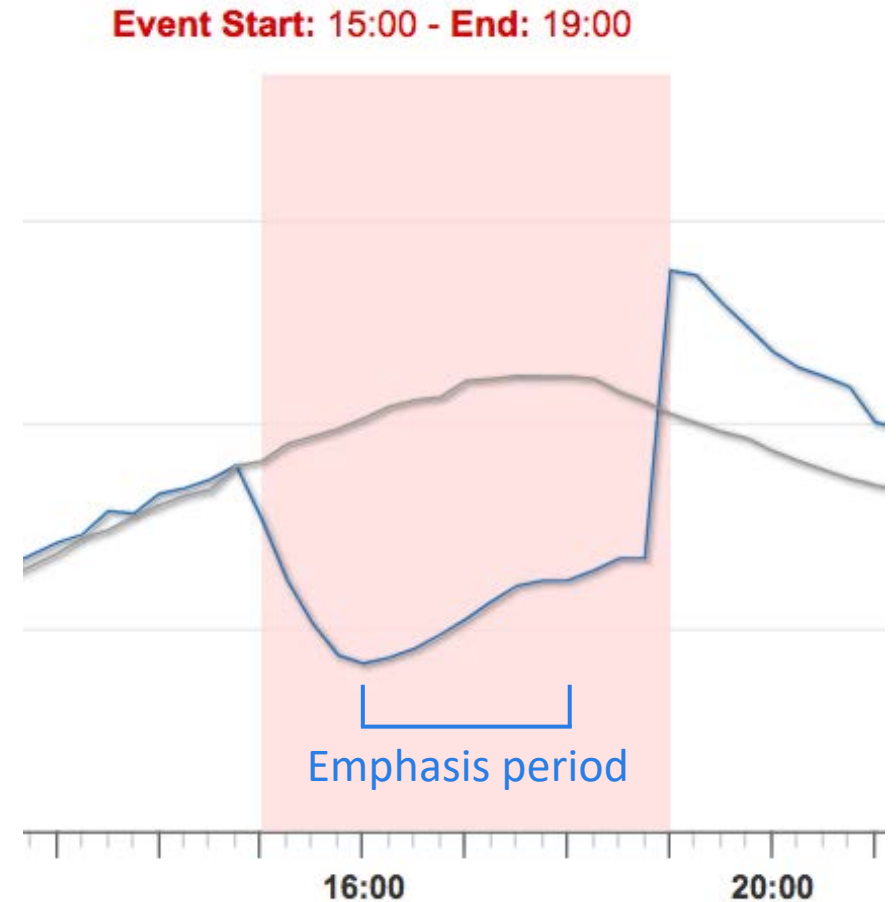


# Example 2017 FLD event



# Advanced load shaping

- Emphasize high-value periods
- Target a coincident peak *within* a DR event
- Support firm load in call-until-cancelled conditions





# Thank you!

- Read more about Firm Load Dispatch here:
  - [www.energyhub.com/firm-load-dispatch-paper](http://www.energyhub.com/firm-load-dispatch-paper)