



FREEMAN, SULLIVAN & CO.
A MEMBER OF THE FSC GROUP

Interim Load Impact Results from SMUD's Smart Pricing Options Pilot

2013 National Town Meeting on Demand Response and Smart Grid

Time-Based Pricing – New Info, but is There New Movement?

Dr. Stephen S. George
Chief Executive Officer
Freeman, Sullivan & Co.

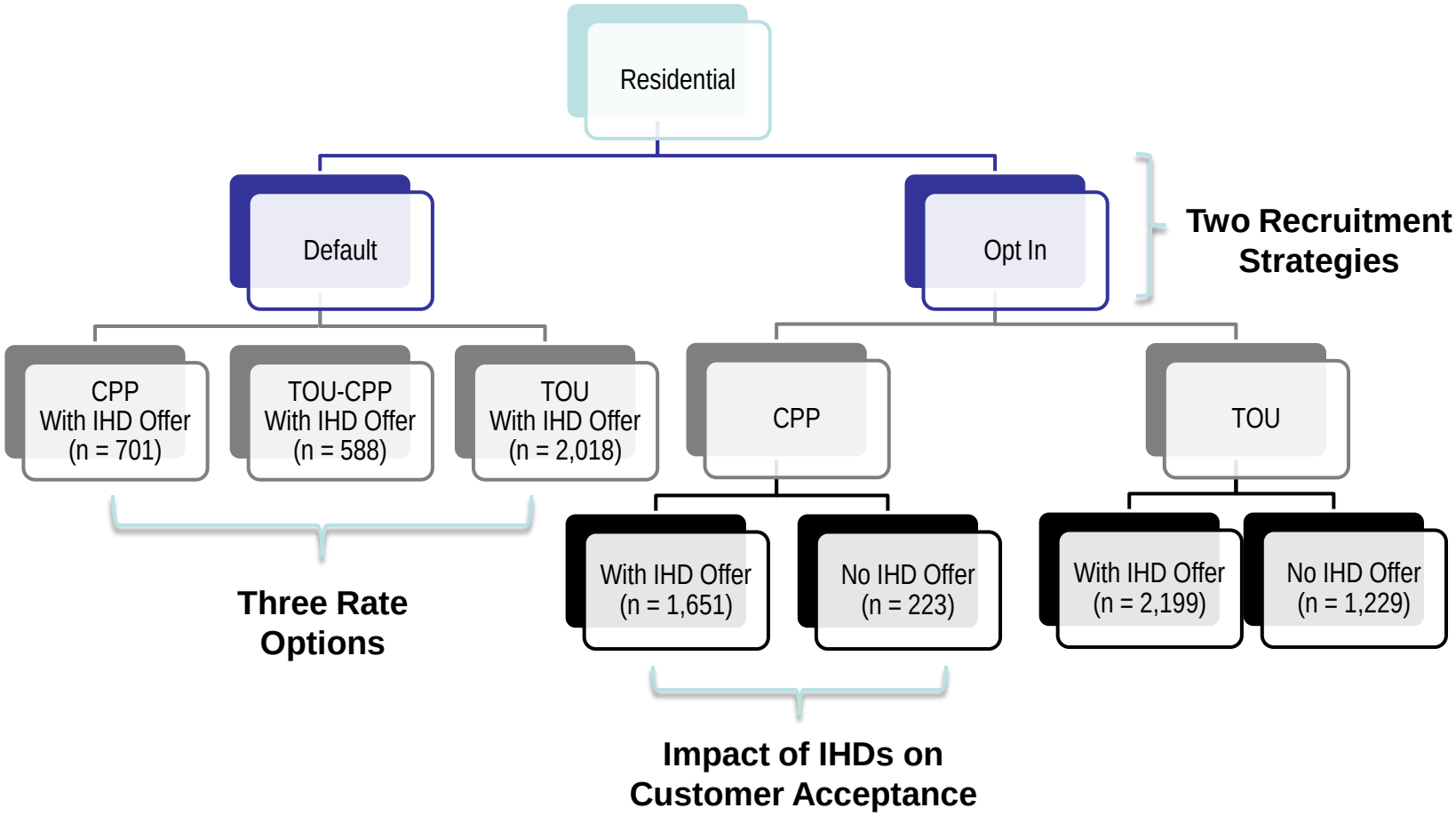
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Presentation Overview

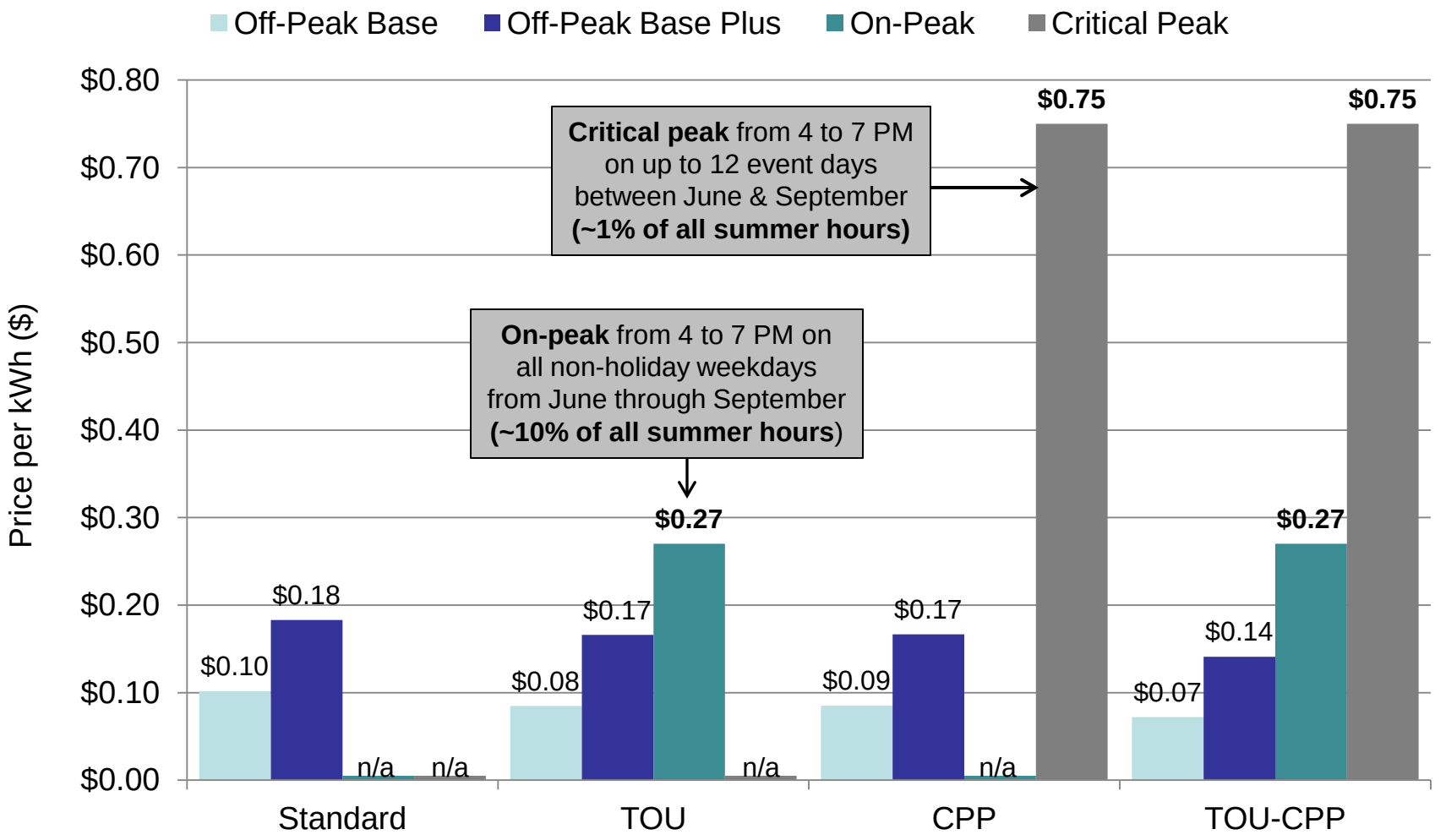
- **Pilot Overview**
  - Already covered by Lupe Jimenez from SMUD but included here for completeness in case someone pulls this off the website
- **Customer Acceptance and Retention**
- **Load Impacts**
- **Appendix: The importance of sound experimental design**
  - Not covered in the presentation but included as evening reading for the researchers in the room

Key features of SPO pilot



n = # of customers enrolled (excluding deferred groups); total enrollment including deferred groups = 12,027;
Total # of customers receiving offers (including deferred groups) = 53,798; total customers in SPO including controls= 99,661

Comparison of pricing plans



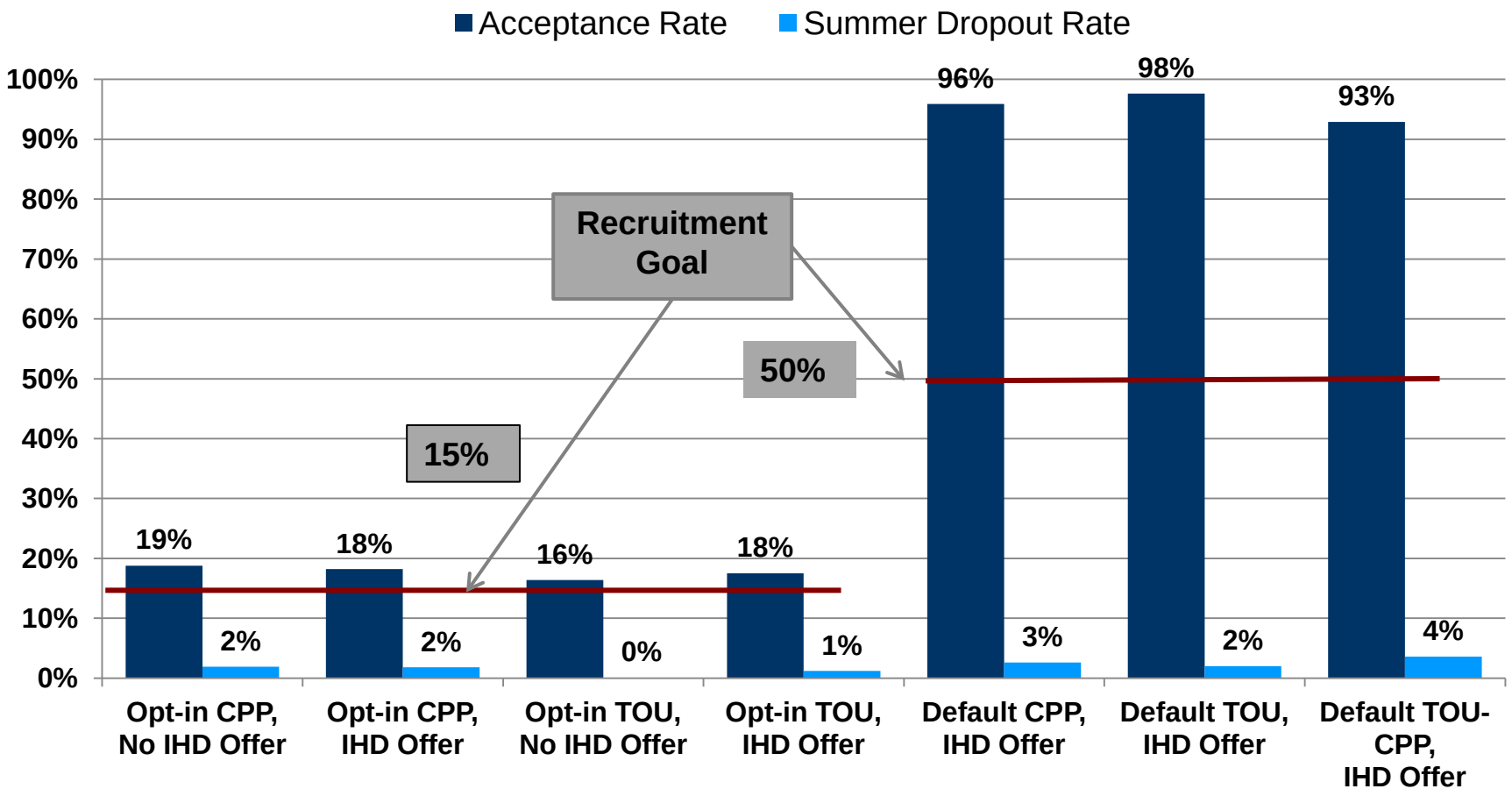
The SPO was well designed & implemented

- **Rigorous adherence to sound experimental design principles**
  - SMUD used the "gold standard" for experimental design, a randomized control trial (recruit and delay) and randomized encouragement design
- **Implementation meets high research standards**
  - Detailed validation analysis shows SMUD did an excellent job adhering to design
  - All marketing materials were identical except for treatment differences
  - Extensive market research as input to development of marketing and educational material
  - Effective tracking of offers, enrollment and attrition
- **Addressed many of the most important policy issues of interest to the industry**
  - Side-by-side comparison of opt-in and default enrollment and load impacts for same rate plans
  - Comparison of customer acceptance rates for different time-varying rate plans
  - Examination of the impact of the offer of information feedback technology on customer acceptance of opt-in rates and load impacts

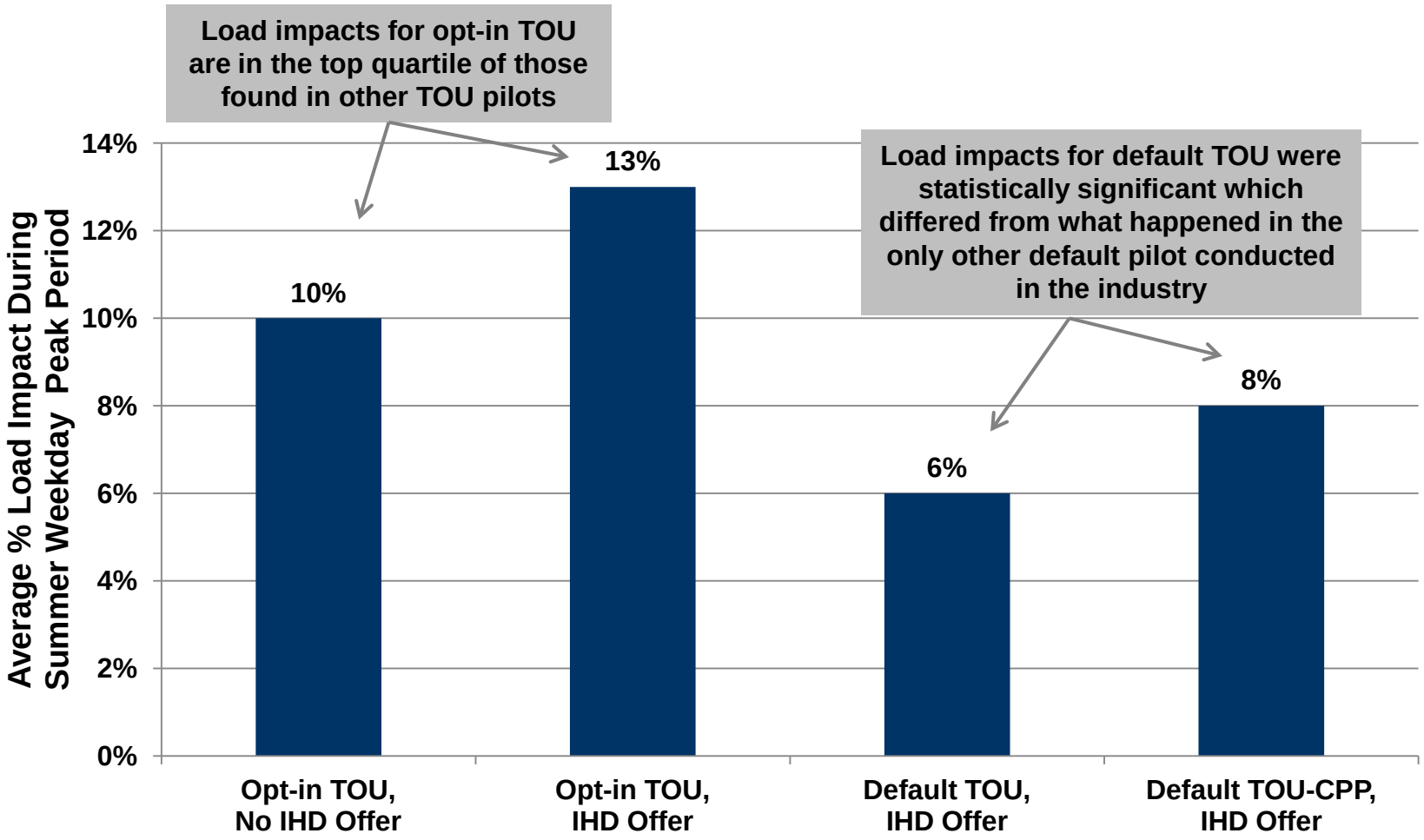
Key findings on customer acceptance

- **SMUD's multi-faceted marketing strategy produced opt-in rates that exceeded the target of 15% and were quite high by industry standards**
  - Acceptance rates ranged from 16.4% to 18.8% across four opt-in treatments
- **Acceptance rates were very similar for CPP and TOU pricing plans**
- **Offer of enabling technology in the form of a free IHD did not materially increase customer acceptance of the opt-in CPP or TOU pricing plans**
- **Default treatment groups displayed extremely high enrollment rates, ranging from roughly 93% to 98% and significantly exceeded 50% target**
- **Once enrolled, less than 2% of opt-in customers and 4% of default customers chose to drop out over the course of the 2012 summer**
  - A greater number of customers left the rate because of account closures due to customer relocation (in actual program, customer could take rate with them)

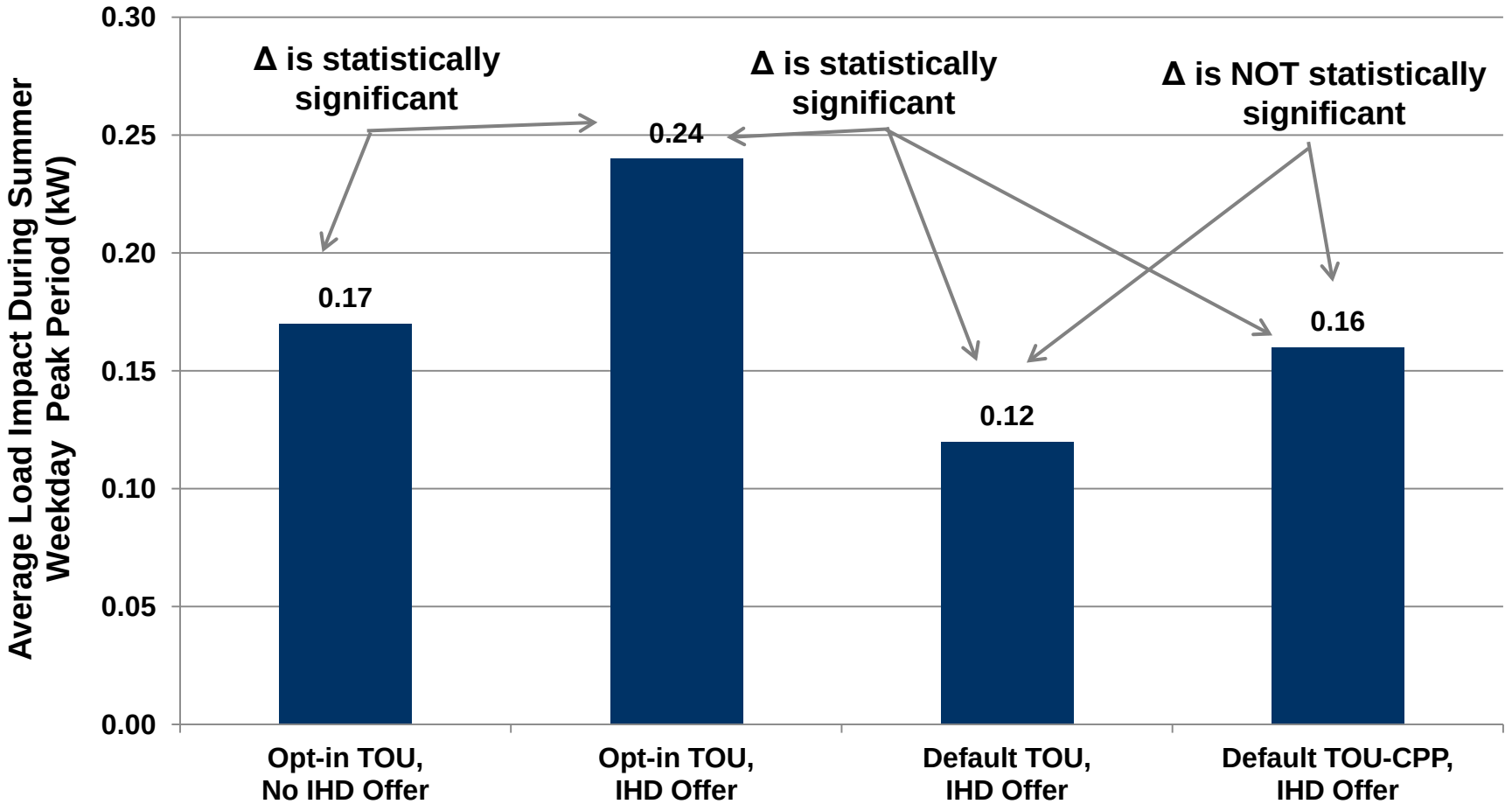
Acceptance rates for different pricing plans were very similar within each recruitment strategy (opt-in vs. default), but very different across strategies



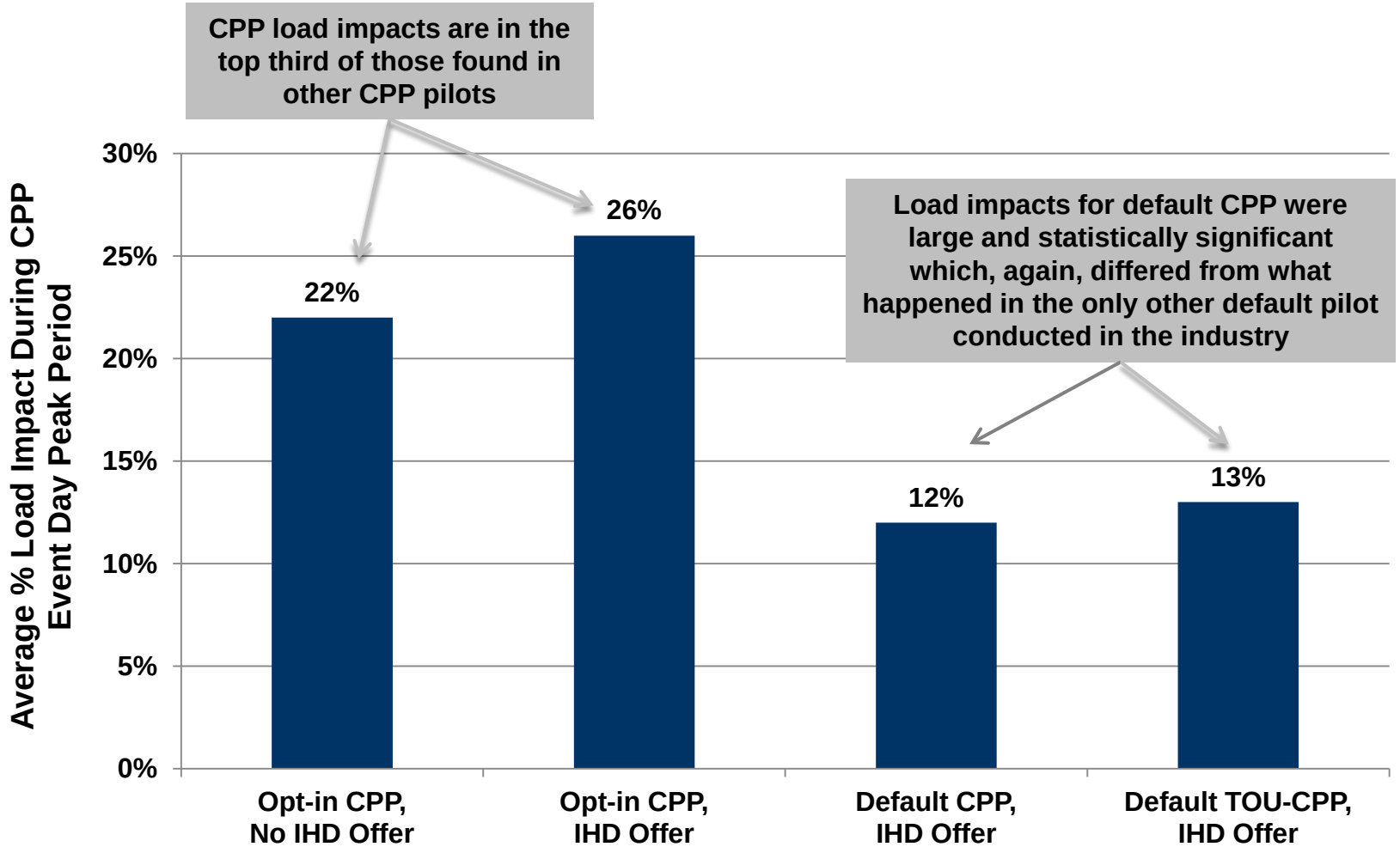
% peak load reductions for TOU pricing plans were significant for both opt-in and default participants



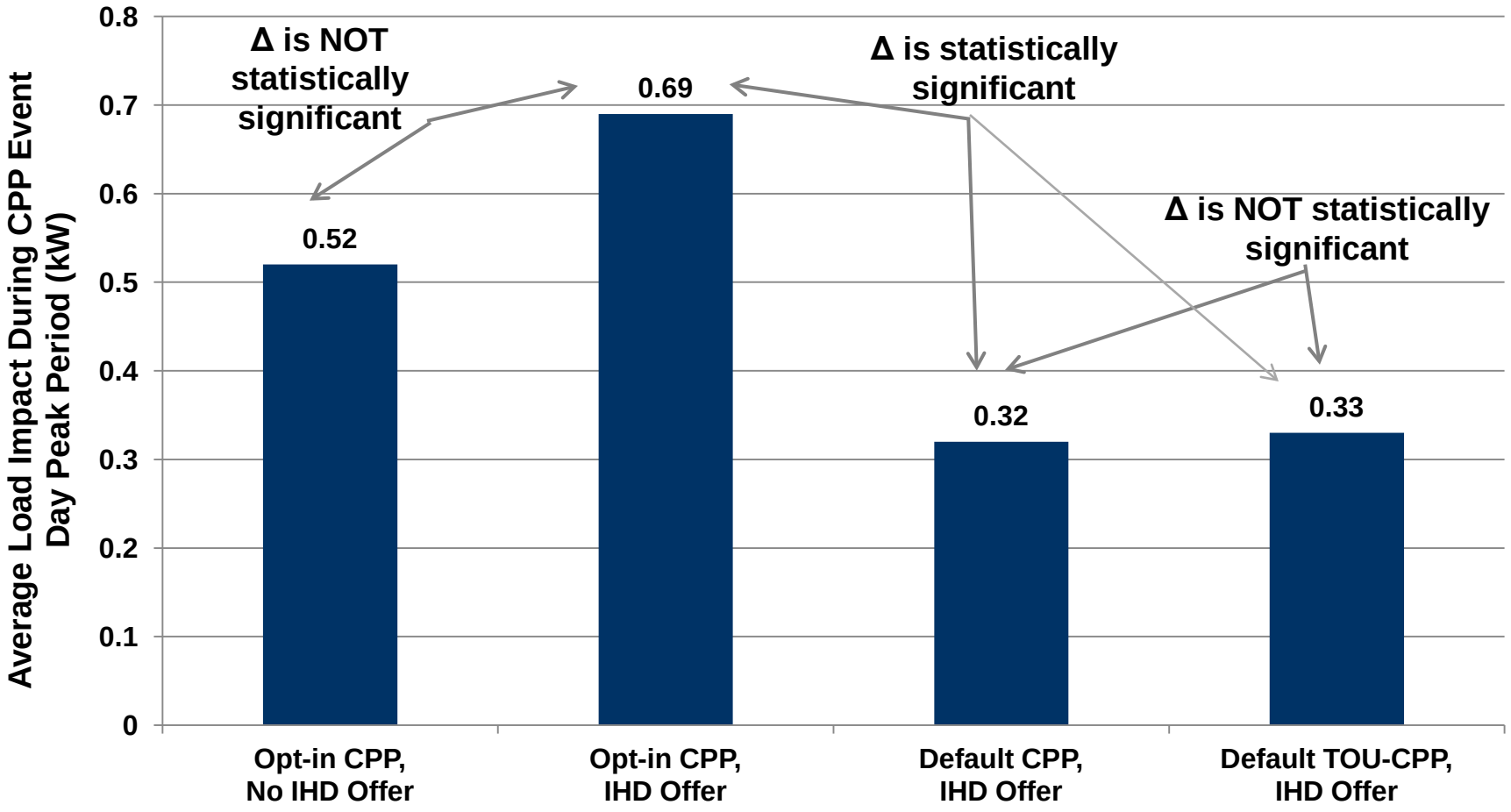
Absolute TOU load impacts differ by recruitment strategy and offer of IHD



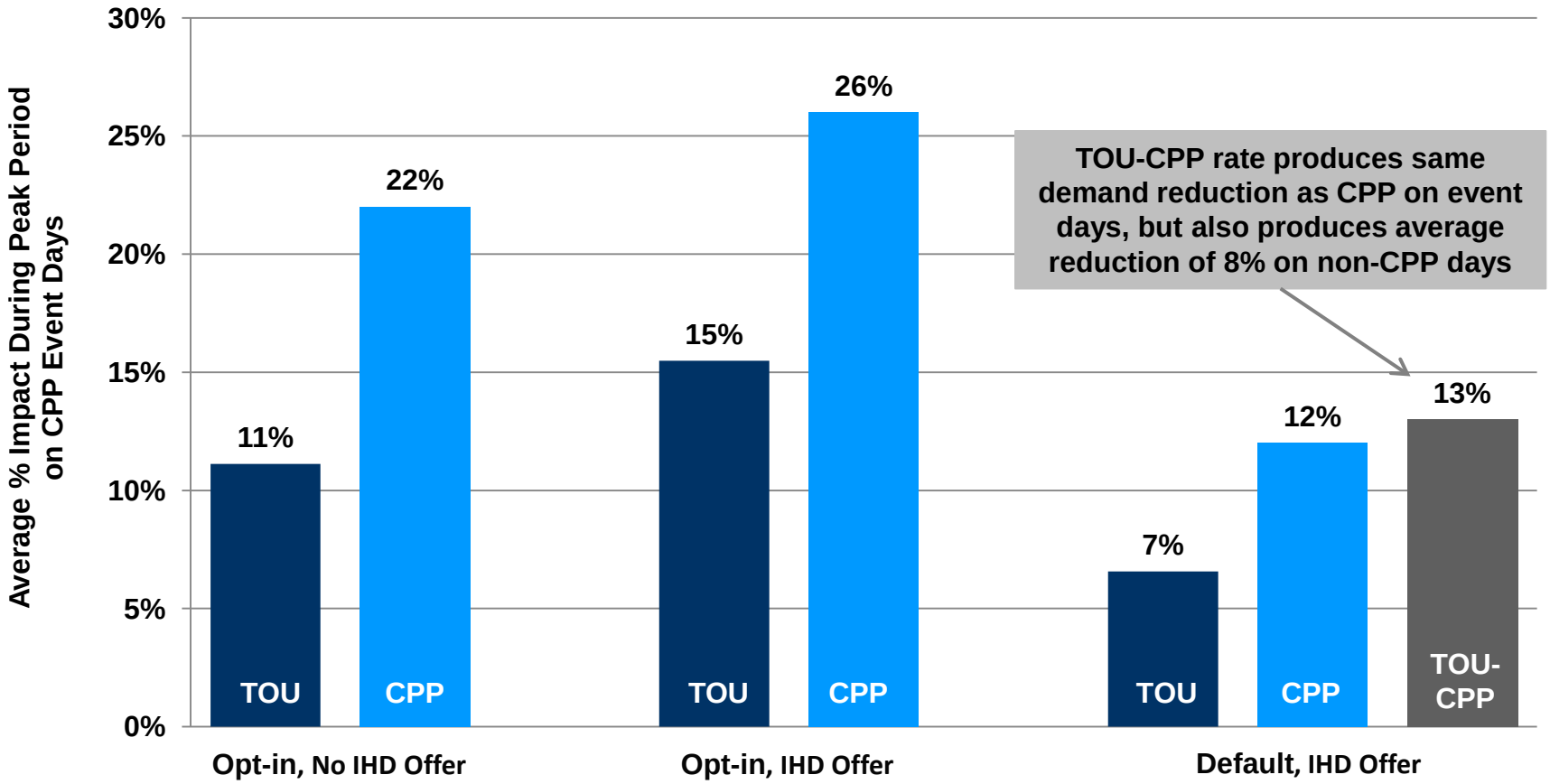
% peak load reductions for CPP pricing plans were significant for both opt-in and default participants



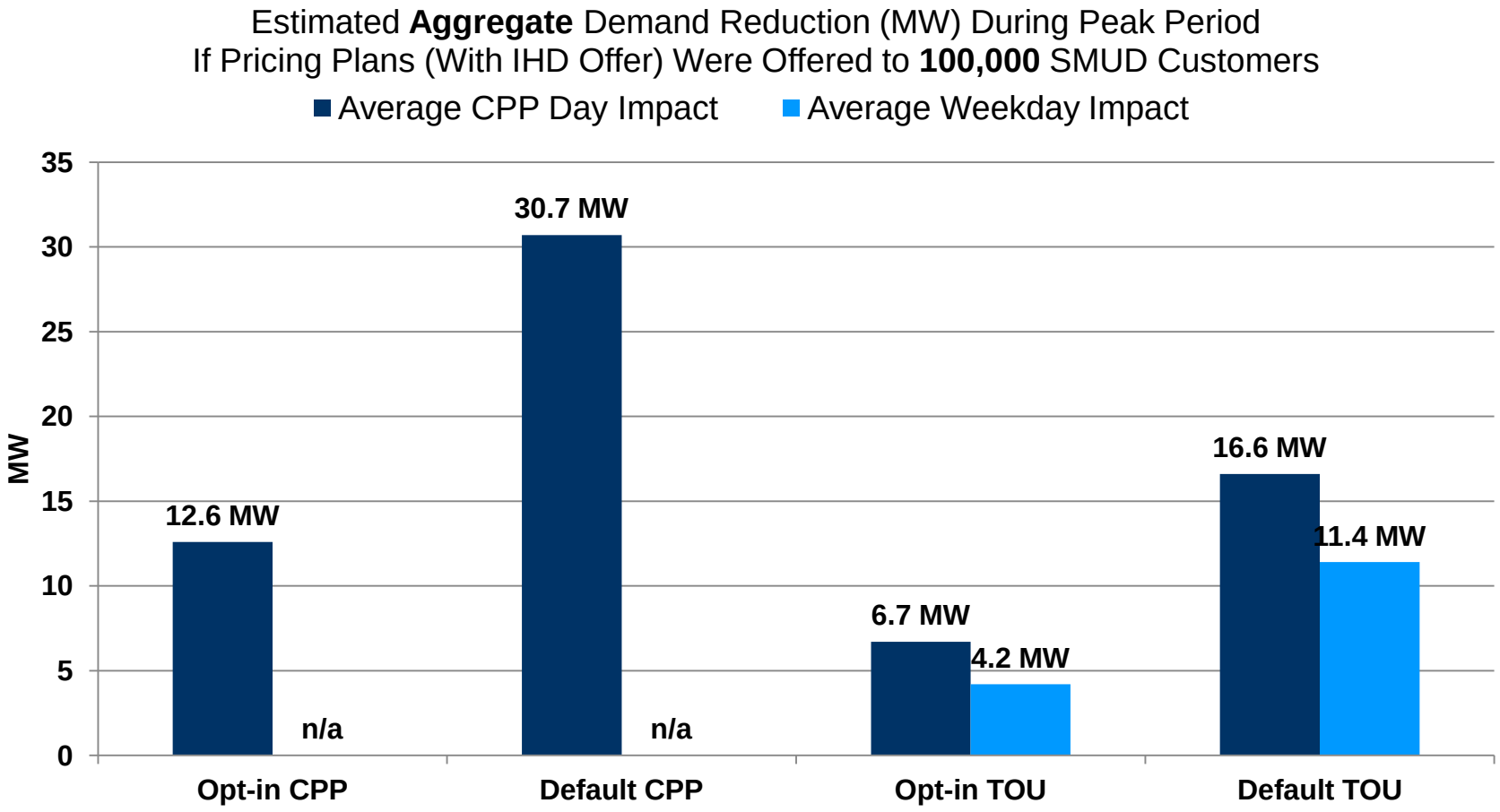
CPP impacts also differ by recruitment strategy



Customers on the CPP rate plan show higher % impacts than TOU customers on CPP days



Based on SPO acceptance rates and average load impacts per customer, aggregate load impacts are much larger for default enrollment than for opt-in enrollment



Key outcomes of SPO

- It is possible to implement a true RCT (recruit and delay) without creating significant dissatisfaction among customers
- It is possible to implement default pricing without creating significant dissatisfaction among customers
- The average default customer on CPP produced demand reductions equal to around 12%, or roughly half that of opt-in customers
- Opt-in enrollment equaled 16% to 19%
- Enrollment under default marketing was between four and five times larger than under opt-in marketing
- Based on the results of the SPO, if SMUD implemented new pricing options using default enrollment, aggregate impacts would be roughly twice as big on high demand days than if SMUD implemented opt-in enrollment in spite of a very high opt-in rate by industry standards

APPENDIX: COMPARATIVE METHODS ANALYSIS

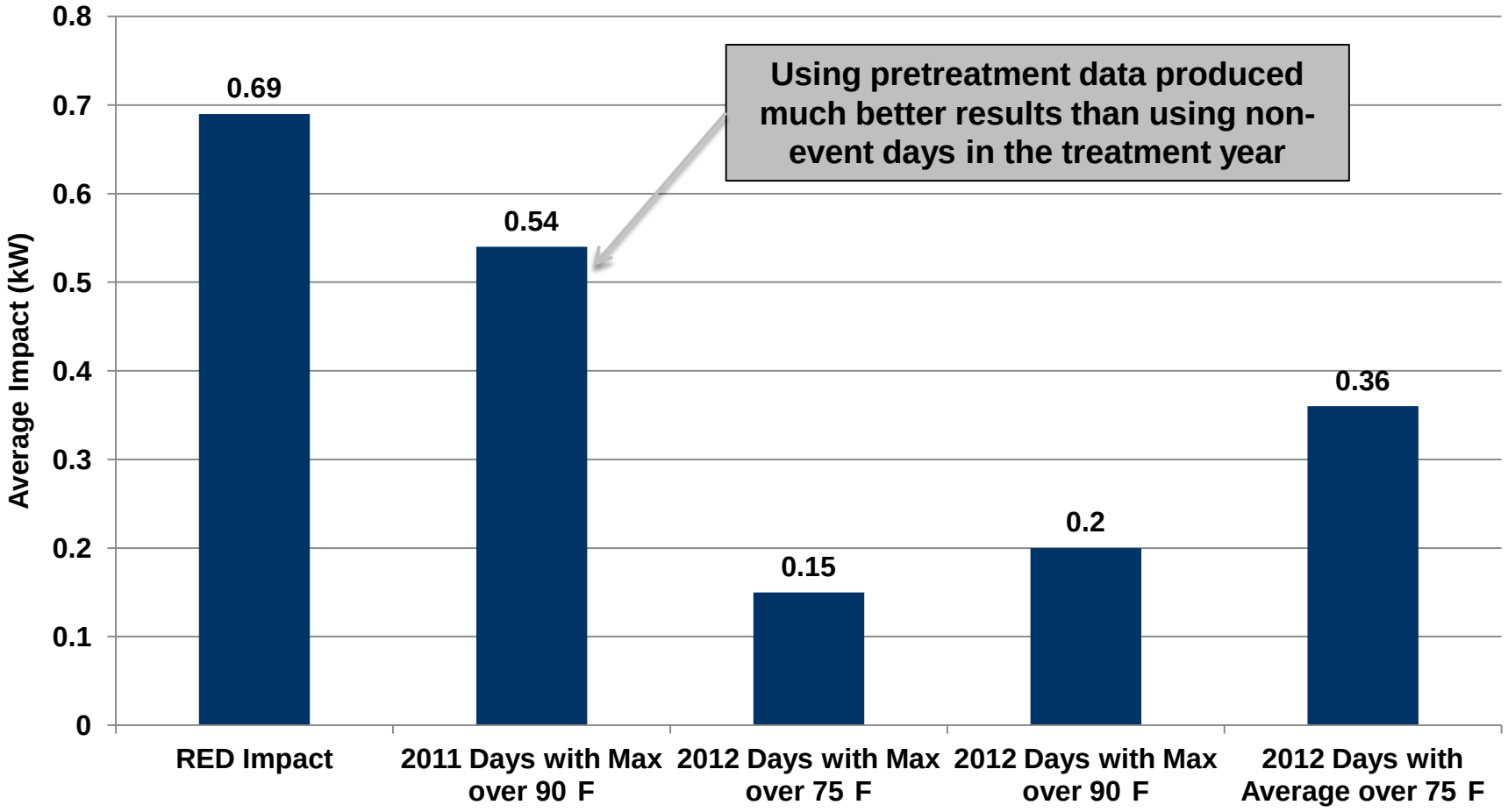
Comparative research methods analysis – the importance of experimental design

- **Many utilities do not implement RCT or RED designs due to time and budget constraints and concerns about customer satisfaction -- in addition, for ex post analysis of existing programs, quasi-experimental methods are typically the only feasible options**
- **Two of the most commonly used alternative methods are within-subjects designs and matched control group methods**
  - **Within-subjects methods** compare usage during treatment and non-treatment periods for each customer
  - **Matched control group methods** select a comparable control group for the treatment group based on observable variables, including similar usage during pre-treatment periods
- **The SPO allowed for a comparison of impact estimates based on three different research designs—an RED, propensity matching, and within-subjects analysis—using the same set of customers and data for the analysis**

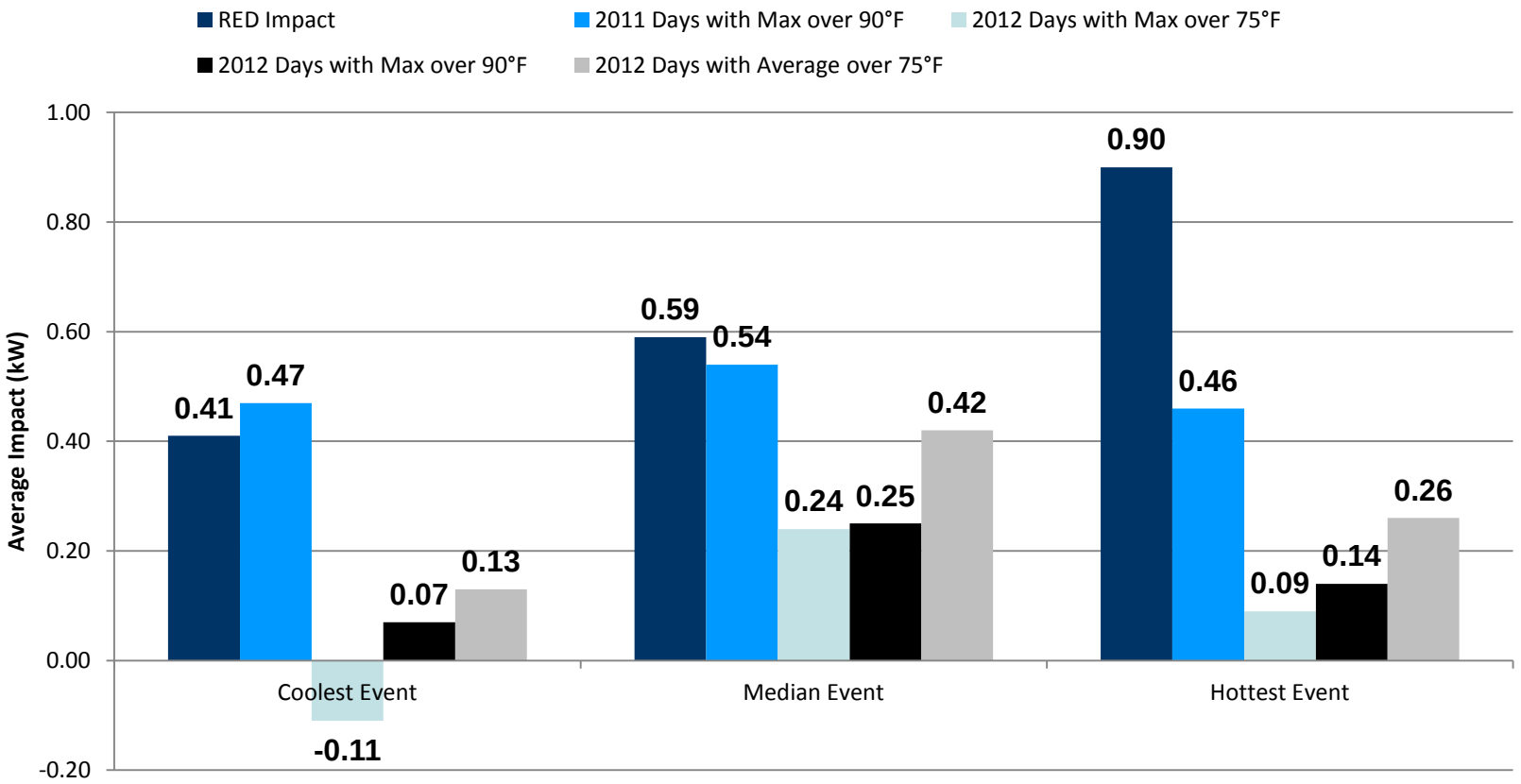
The comparative analysis was performed for two SPO pricing plans

- **Opt-in CPP with IHD Offer and opt-in TOU without IHD offer**
  - The CPP rate was chosen because the design of CPP rates lends itself well to within-subjects designs
  - The TOU rate was chosen because the absence of the IHD offer removes the confounding influence of the IHD – **See Appendix**
- **For CPP pricing plan, Individual customer regressions were tested using all 11 CPP event days from the summer of 2012 and weekdays between June and September chosen as follows:**
  - Days in 2011 (pretreatment period) with daily max temp over 90°F (53 days);
  - Non-event days in 2012 with daily maximum temperature over 75°F (67 days);
  - Non-event days in 2012 with daily maximum temperature over 90°F (41 days); and
  - Non-event days in 2012 with average daily temperature over 75°F (10 days).
- **Four regression models were tested on each set of days and the best model was used for final impact calculation**

Within subject regressions underestimated CPP RED impacts for all four sets of days



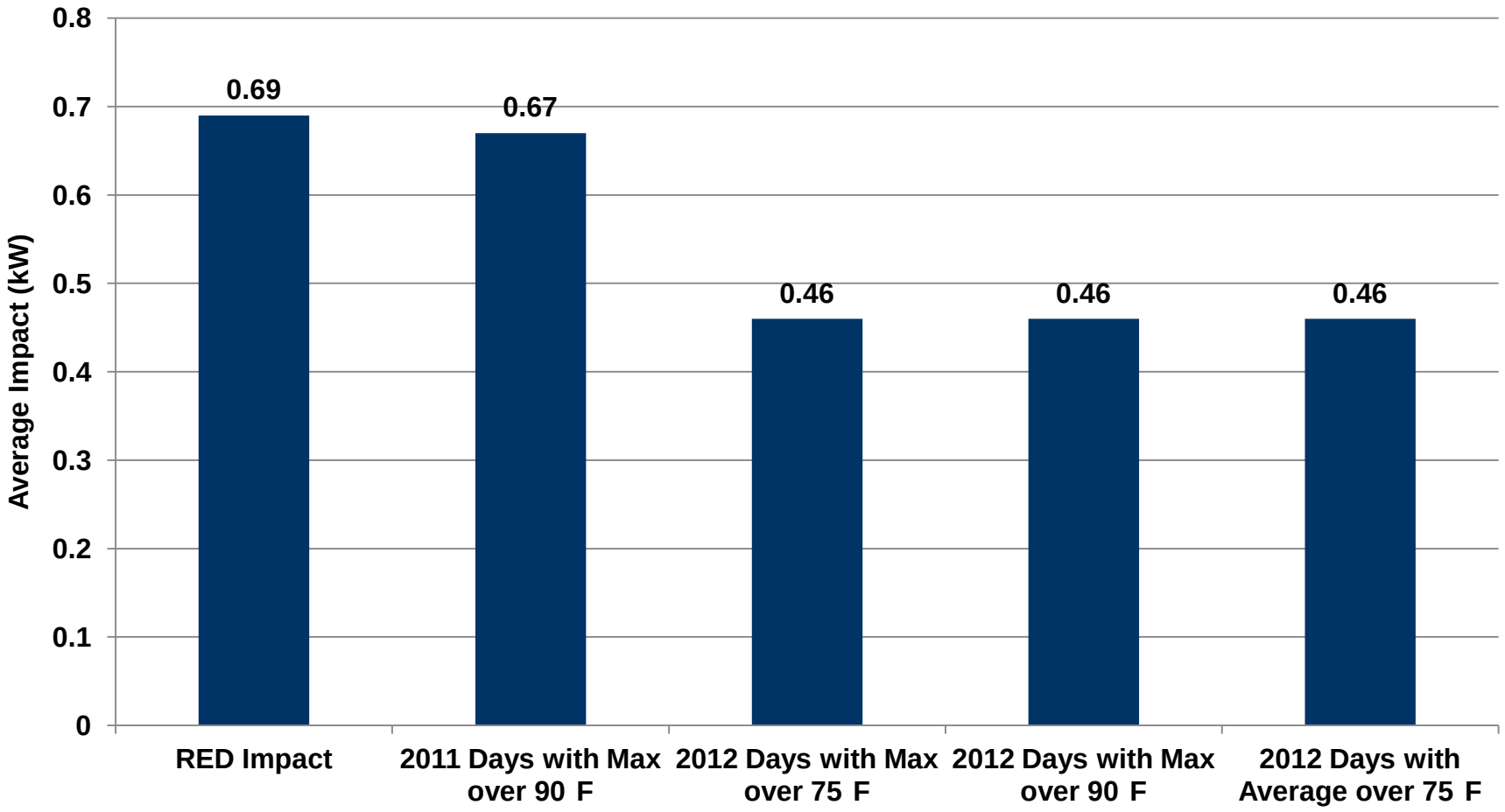
Impacts on individual CPP event days based on within-subjects analysis differed greatly depending on which dataset was used



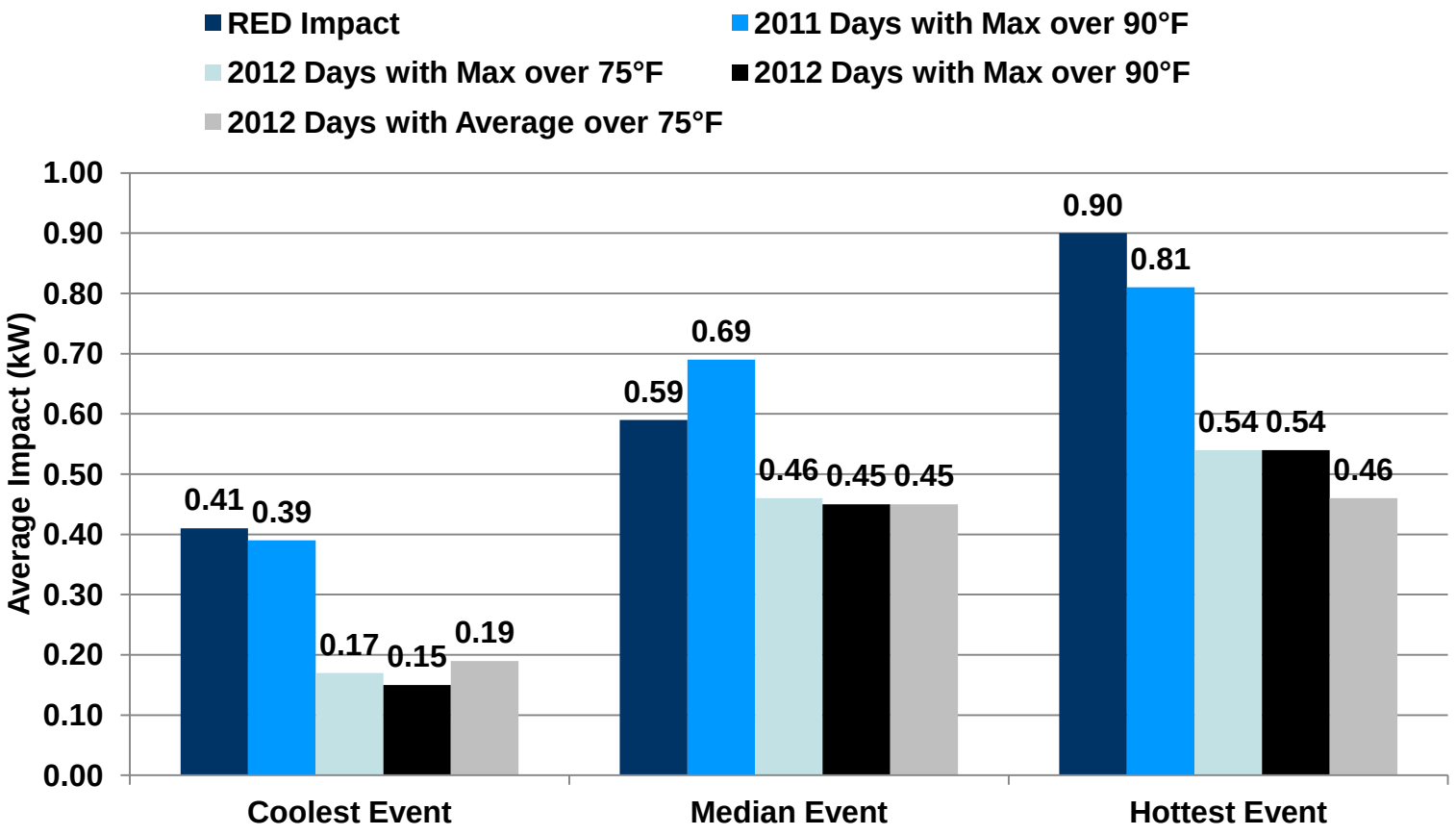
Matched control group methodology for opt-in CPP with IHD offer

- **Four different matched control groups were selected based on usage on:**
  - Days in 2011 (pretreatment period) with daily maximum temperature over 90°F;
  - Non-event days in 2012 with daily maximum temperature over 75°F;
  - Non-event days in 2012 with daily maximum temperature over 90°F;
  - Non-event days in 2012 with average daily temperature over 75°F.
- **Matching was based on a probit model using average usage during peak hours on each set of days and EAPR (low income rate) status as explanatory variables**

Matched control groups using pre-treatment data resulted in load impacts very similar to the CPP RED analysis but impacts using same-year data were biased downward



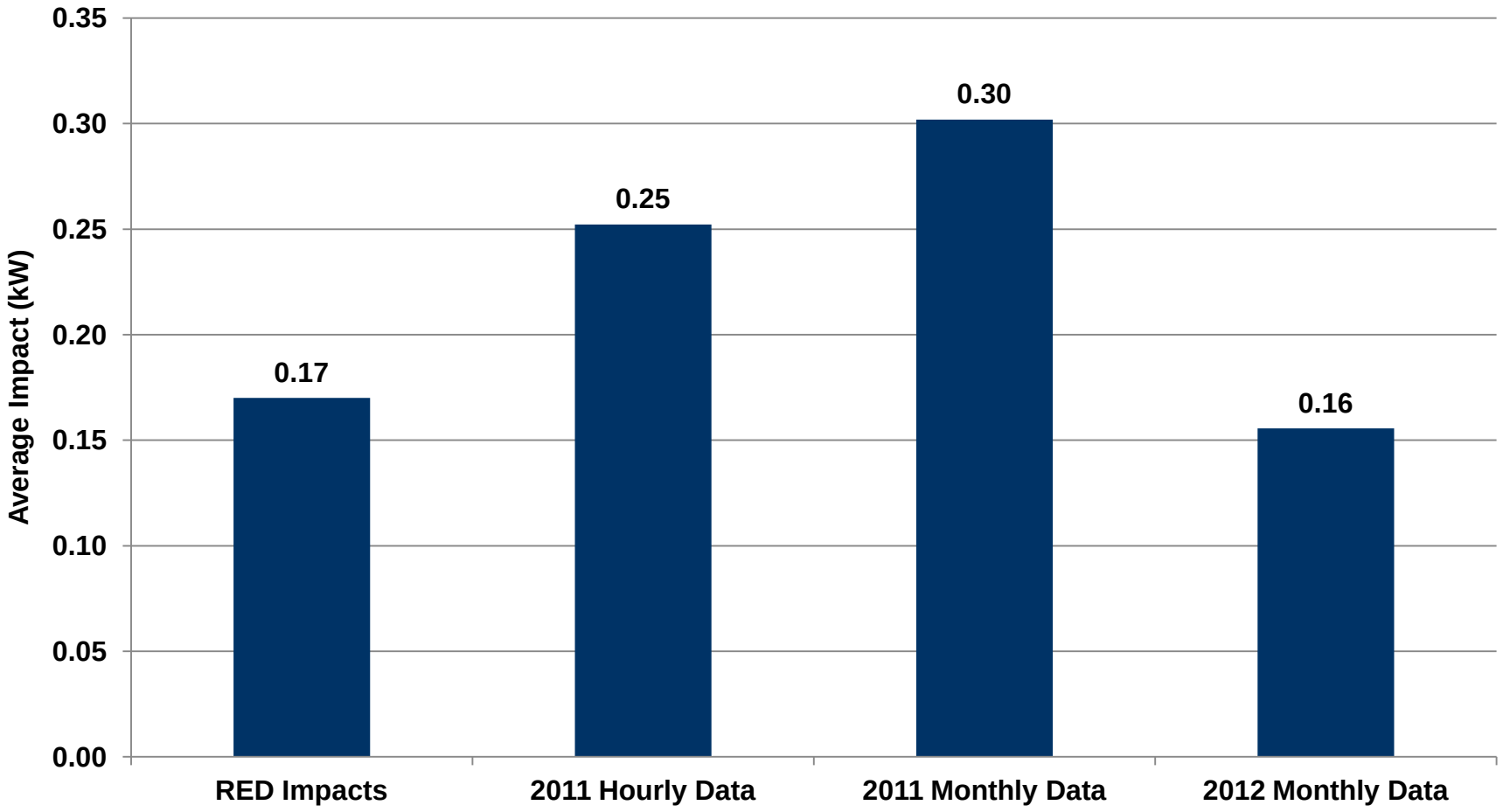
Impacts on individual events using propensity score matching were highly correlated with CPP RED impacts, especially when pretreatment data is available



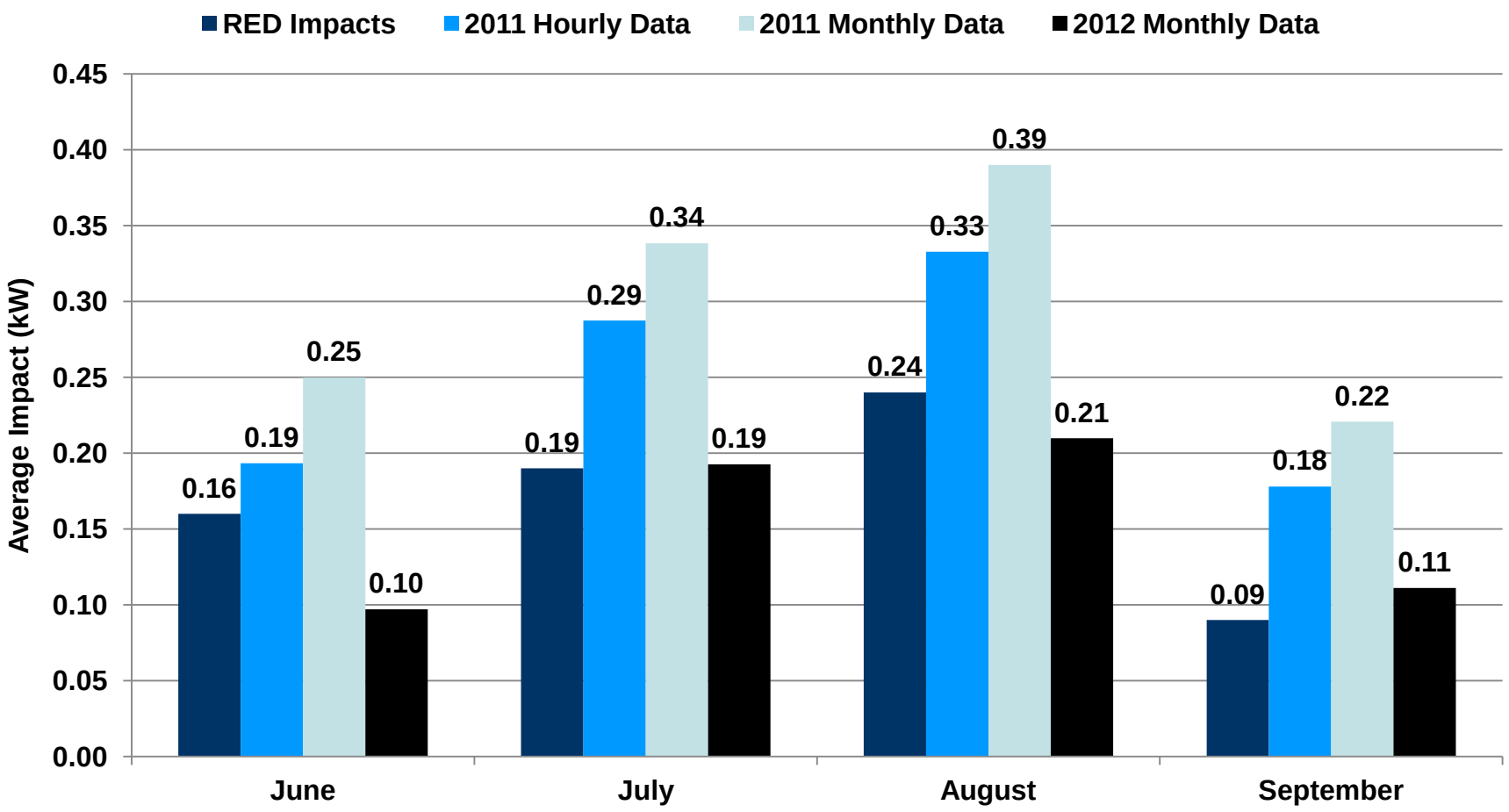
Matched control group methodology for opt-in TOU without IHD offer

- **A similar methodology was used for the TOU analysis as for the CPP analysis described above**
- **Three different matched control groups were selected based on:**
  - 2011 hourly usage data
    - *Optimal situation where hourly, pretreatment is available*
  - 2011 monthly usage data
    - *When hourly pretreatment data isn't available, monthly pretreatment data is the next best option*
  - 2012 monthly usage data
    - *When pretreatment data is not available, match can be made using monthly data from the treatment months*
- **Matching based on probit model using average usage during peak hours on each set of days and EAPR status as explanatory variables**

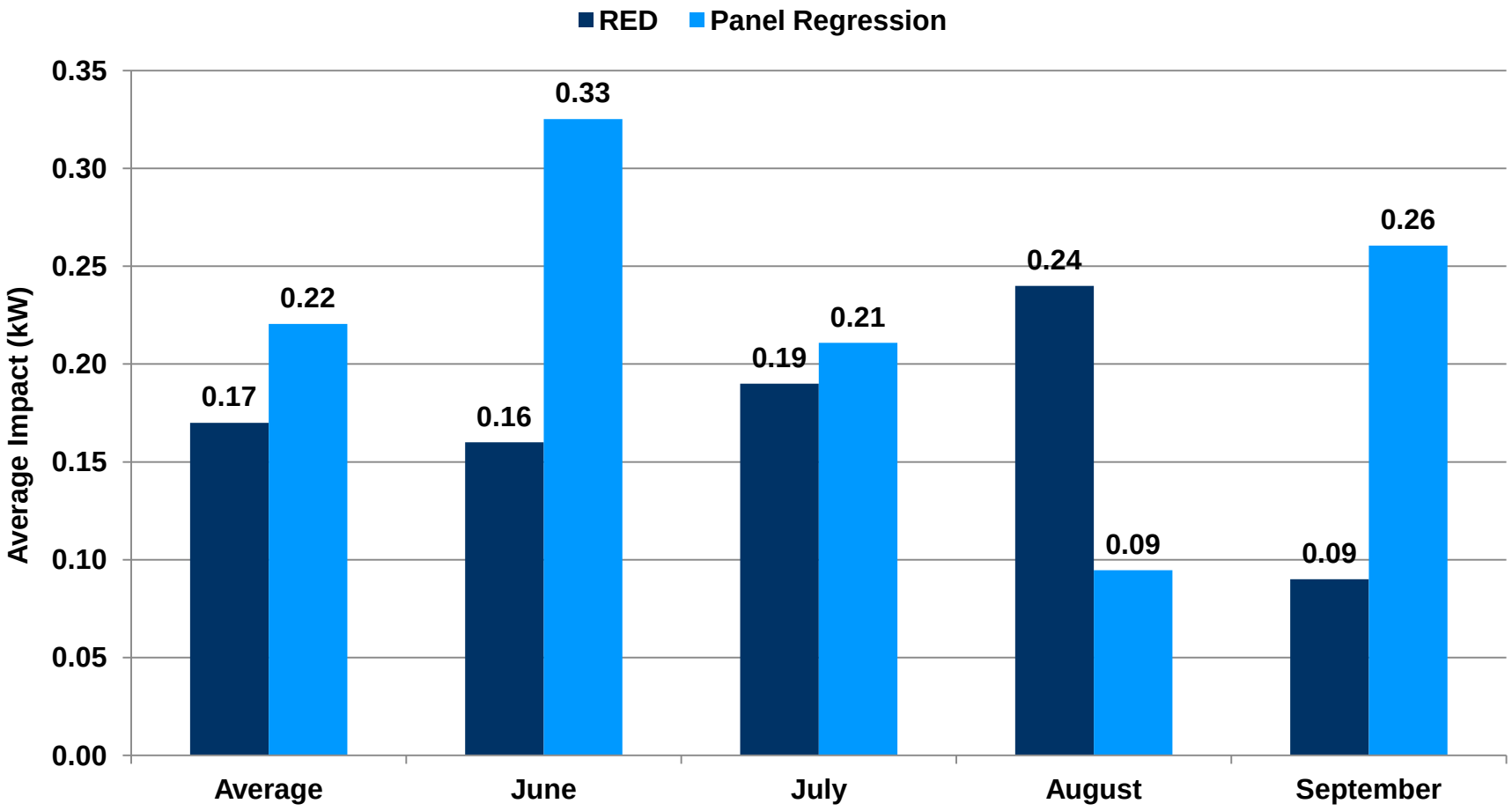
TOU impacts calculated using matched control groups vary depending on what set of data is used



TOU impacts by month based on match control group analysis differed greatly depending on which data set was used



Panel regression* overestimated TOU RED impacts on average and in three of the four summer months



*A panel regression was used rather than individual customer regressions to save computing time. In the comparative methods analysis for CPP, we compared results based on individual and panel regressions and found little difference

Conclusions from comparative methods analysis

- **For the CPP rate, the matched control group method was more accurate at estimating impacts than within subjects regressions**
- **For the TOU rate, neither non-experimental method consistently worked well**
- **The results demonstrate that estimates based on non-experimental methods are heavily dependent on the quasi-experimental method chosen, availability of pre-treatment data, assumptions about day types to use as reference loads, model specification and other factors, while experimental estimates are not**