# Behavior, Energy and Climate Change Conference

## Prepayment, Conservation and Behavior

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**DEFG**

December 8, 2014

# About DEFG

We are a management consulting firm, specializing in energy, and focused on retail energy consumers

Our utility clients participate in our research groups, and we help them improve customer service, increase customer engagement and satisfaction, and improve customer-facing technology and smart grid programs

- Demand & Energy Technology Research Consortium
- Utility Customer Research Consortium
- Low Income Energy Issues Forum
- Prepay Energy Working Group

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## Overview

- *Prepayment for energy service appears to change the way consumers behave. With prepay, consumers have increased control over the household budget. They receive daily usage and cost information which informs them about their behaviors that affect usage.*
- *Statistical analysis of monthly billing data shows energy savings of 10%-15% by adopters.*
- *Prepay is a daily bill-pay transaction. Transactions are significant; modifying a transaction may prove to be a more effective means of changing behavior than creating a program.*
- *Additional study may reveal the specific behaviors and devices that are the most affected, the persistence of their conservation, whether they invest in energy-efficient devices as a result of prepayment and whether any behavior results in loss of essential services.*

## Outline

1. Understanding Prepay—Everyone Prepays for Certain Energy Commodities and for Food
2. Prepay Basics for the Utility Industry—Advanced Meters and the Customer Experience
3. Prepay and Consumer Behavior—Programs, Pricing, Transactions and Behavior
4. Measurement of Prepay Usage Impacts—Methodology
5. Next Steps—Opportunities for Additional Research Through DEFG's Prepay Energy Working Group

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## Everyone Prepays for Certain Energy Commodities and for Food

*Prepay electric service need not be unusual, but it's not yet widespread in North America*

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# Prepay Service May Become Commonplace

## Everyone Prepays for Gasoline

## Everyone Prepays for Groceries

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# Prepay Basics for the Utility Industry

*A decades-old transaction has gotten a boost from advanced metering infrastructure (AMI)*

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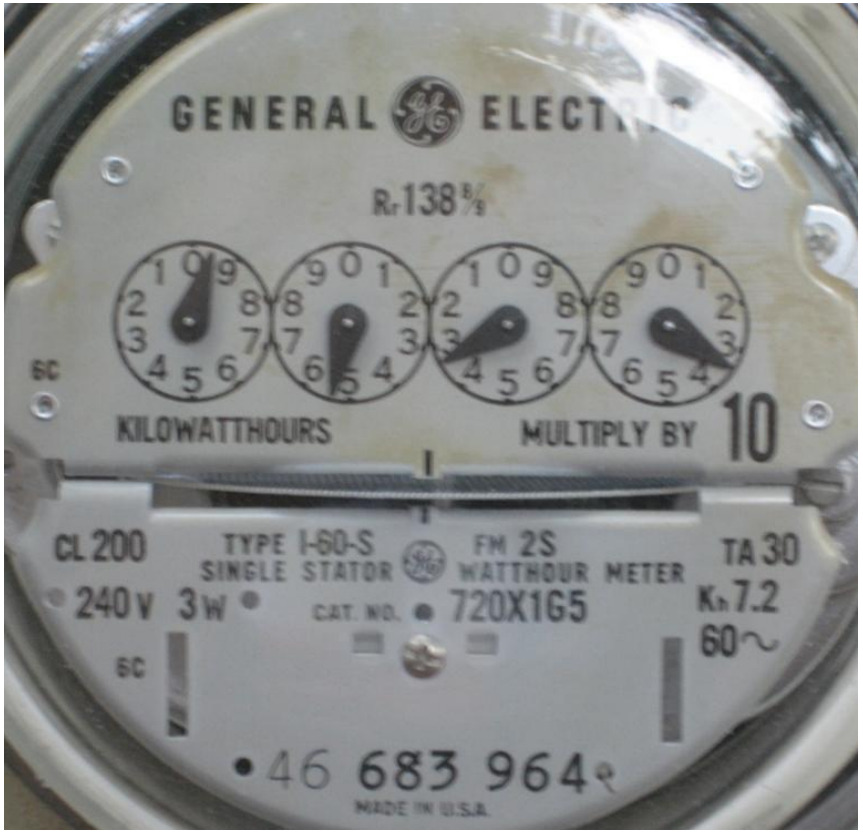
# Advanced Meters

## Watt-hour Meter, Houston, 2001




12 data points per year collected manually

## Digital Meter, Houston, 2011


35040 data points per year collected remotely

***So what? How can we use these data?***

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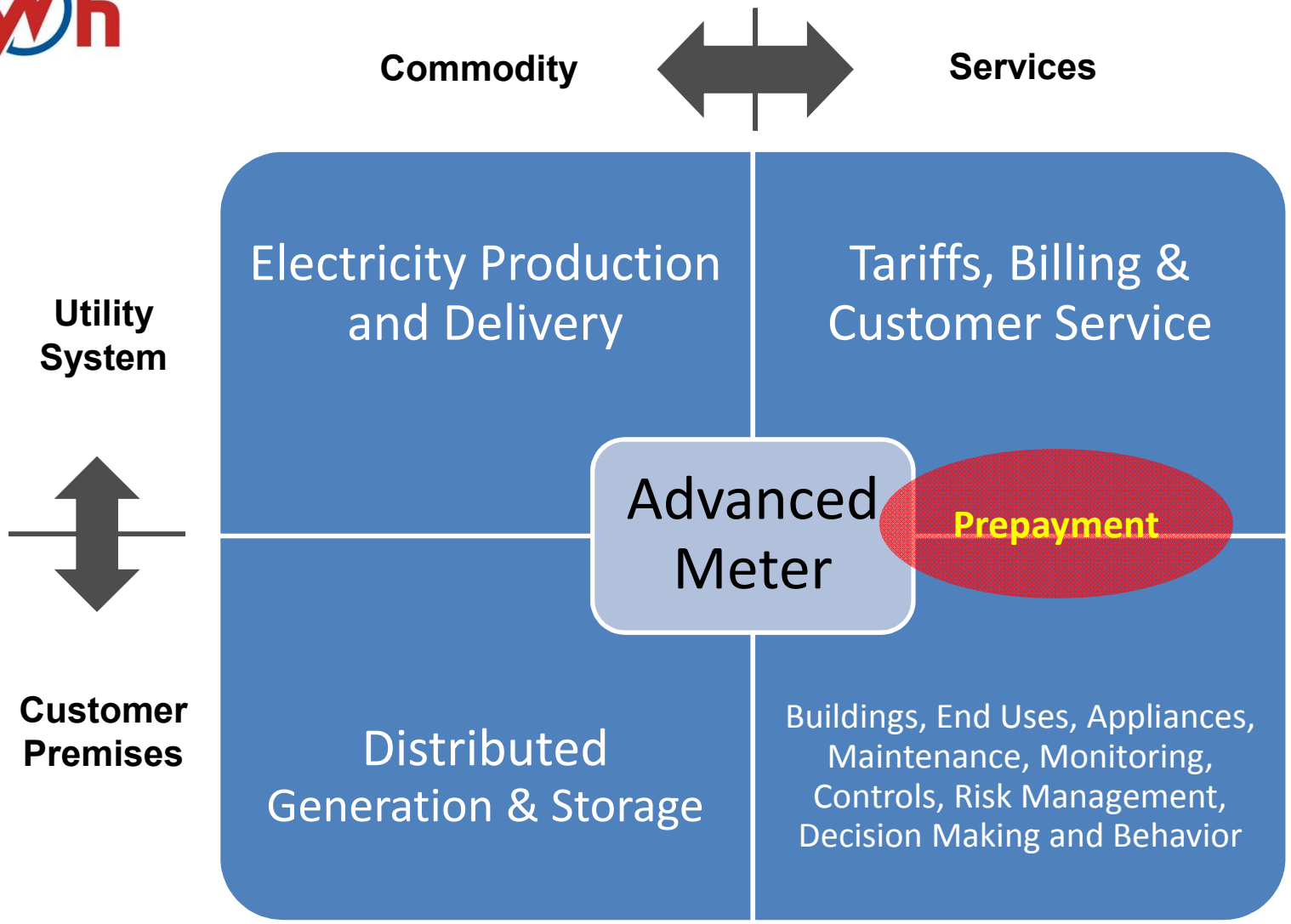
# Advanced Meters Enable Advanced Prepay Service

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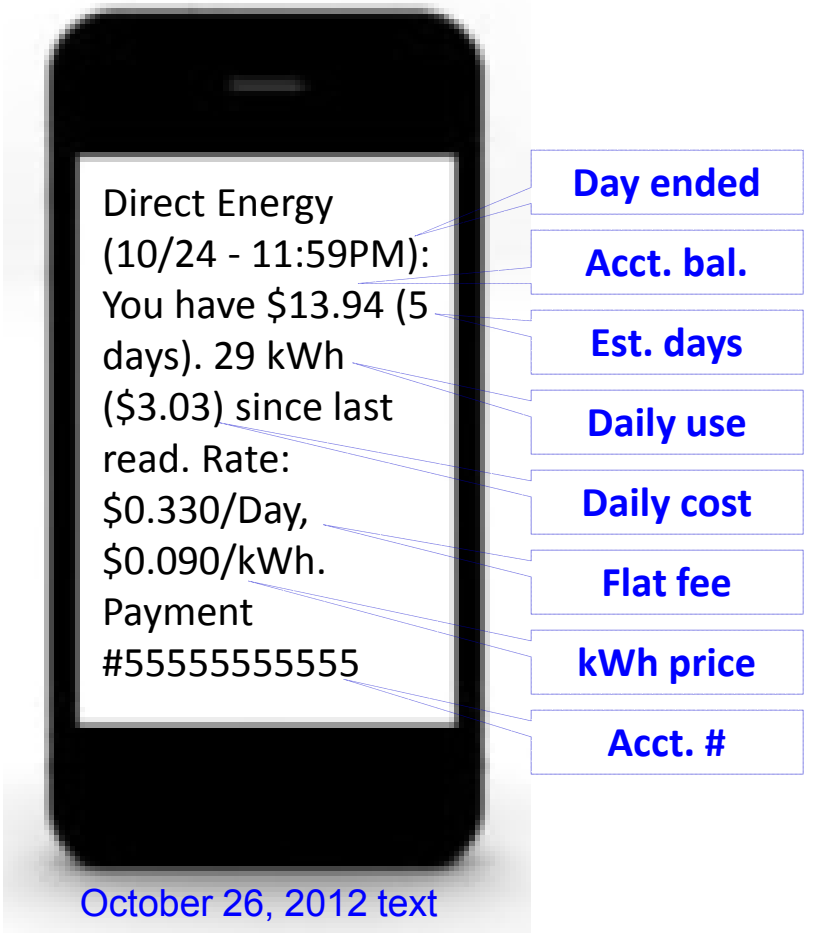
# Customer Experience with Prepaid Electric Service in Houston

- Competitive "retail electric providers" offer service to 62% of Texans; in Houston, 50 "REPs" offer 300 distinct products
  - Month-to-month pricing; fixed price contracts for 3 to 36 months; 100% green; free Saturdays, weekends or nights; EV pricing; 5% back for DR; HVAC checkup; flat monthly bills with no true-up; cash rewards; promotional pricing; etc.
  - Everyone must select a REP and a pricing plan
- A prepayment option is offered by 11 REPs; 17 prepaid electric service products are available to residential consumers
  - Consumer opens an account without a security deposit using cash, check, money order, electronic fund transfer, debit card, credit card, rechargeable prepaid card, etc.
  - Consumer selects a communication channel (text, email, phone) and frequency of communications (daily, weekly)
  - Consumer monitors daily account balance and adds cash as necessary; account balance is adjusted downward daily to buy kWhs
  - Prepay appeals to students, recent immigrants, unbanked and low- to moderate income consumers; month-to-month pricing is typical
  - Consumer in debt can pay off utility debt over time (% of payment)
  - Consumers often think in terms of buying a number of "days" of service; alerts warn of low account balance citing days remaining
  - Signup, service initiation, disconnection/reconnection occur in minutes or hours, nearly seamlessly; a positive account balance restores service after disconnection; no severe weather disconnects
  - REPs focus on customer retention; raising the price may cause a consumer to shop and switch to another REP

***Daily Text for Prepaid Service is Content Rich & Timely—Typical Consumer Saves 10%+ Through Close Usage Monitoring***




October 26, 2012 text

Source: Direct Energy text for residential prepaid electric service in Houston.

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# Moving from a Regulated Tariff to Individual Responsibility

**A customer disconnected for failure to pay past-due amounts**

"You turned my electricity off"

**A customer disconnected for a prepayment balance of zero**

"My electricity ran out"

"a spirit of cooperation instead of blame"
Blue Ridge Electric Membership Corporation

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# Business Case for Utilities

- Conservation—the impact on the environment
  - Usage is reduced, on average, by 10-12% due to careful monitoring of devices
  - Energy savings occurs within months and it is due to behavioral changes
- Customer satisfaction
  - Customer have more control over budgets; customers have more certainty about disconnection
  - Customers claim they are getting: “the deal of the century to keep the lights on for only $25”
  - Customers ask: “I lost my job, but can I keep my prepay account?”
  - Customers say: “I can’t pay $100 a month but I can pay $25 a week”
- Revenue and collections
  - Bad debt (which is generally socialized) is reduced from 1%-2% to “tenths of a percent”
  - Since joining the program, customers have repaid deferred balances of $2,000 over time
  - More rapid move from “meter to cash” using numerous payment channels
- Operational efficiency
  - Increased use of electronic payments; increased use of mobile devices; reduced paper billing
  - Reduced number and complexity of payment arrangements; reduction in call center costs
  - Reduced deal-seeking behavior through the call center by consumers
  - Fewer truck rolls and costs relating to notifications and shut offs

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# Drivers of Consumer Behavior in the Utility Industry

*Programs and Pricing*

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# Current Utility Pricing and Billing Practices

- Scenario for a trip to buy groceries at the grocery store
  - *The basic food basket contains a hundred items. Imagine a weekly shopping trip in which you pick up each item without knowing its price, and then check out without being informed of the total cost. The grocery clerk assures you that you will be send an accurate bill at the end of the month. You receive a bill for one month's groceries with no itemization, and you have a few weeks to pay. If you cannot pay for several months in a row, you are not allowed to shop for groceries.*
- Scenario for paying for traditional electric service
  - *A meter is read monthly and a bill is sent for the total electricity consumed. We are billed for the total kWhs to operate a hundred electricity-consuming devices. We are not told the usage of any device, and we do not receive information about the cost to operate any device. The bill arrives after the energy is consumed. If we cannot pay several bills, service is disconnected.*

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# Base Case for Modeling Behavioral Change—Regulatory Program

- Regulated cost-of-service ratemaking relies on the *aggregation* of costs, a subsequent *allocation* of costs to classes of customers (residential, business, etc.); there is a nearly universal *rate design* that prices the electric commodity at a rate-per-unit
- Regulated cost-of-service ratemaking emphasizes utility revenue stability and cost recovery
- Residential tariffs are designed to be fair: billing is monthly; payment occurs after consumption; the rate design is simple for understandability
- Traditionally, utilities have considered electric customers' diversified uses of electricity a "load" on the system (static); in recent decades, voluntary demand-side management has resulted in limited interactions between demand and supply (dynamic) to correct for poor electricity pricing signals
- The vast majority of residential consumers in North America are part of a centrally-planned and government-administered *program*—the state regulation of electric utilities
- The *regulatory program* has created price signals that have become a part of the fabric of our culture; this has had a profound effect on appliance design and manufacture, building design and construction, and the manner in which we interact with our energy-consumer end-use devices
  - Note: The regulatory program has provided certainty that has resulted in high levels of reliability, investments in infrastructure, and relatively stable prices; these, in turn, have contributed to electrification, economic growth and widespread application of devices that provide comfort, convenience and productivity
- The "base case" or starting point varies from state to state, because the regulatory program is not identical in all those places; all changes from the base case regulatory program can be measured

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# Prepay Service



- Imagine a new approach that results in increased customer satisfaction and engagement. Engaged customers:
  - Feel in control
  - Take better control of an important household expense
  - Better understand the relationship between their actions and the cost of energy
  - Take actions that can reduce energy costs
  - Increase their awareness of their ability to lower costs and interact with utilities
- Prepayment + advanced metering infrastructure creates opportunities
  - Prepayment places payment ahead of consumption and heightens consumer attention
  - Advanced metering data, if properly packaged and presented, can inform consumers
- Prepayment is offered by many different types of providers
  - Electric cooperatives, public power and regulated utilities will generally offer a new payment approach based on the existing residential tariff
  - Retail electric providers in Texas will offer three basic pricing approaches: a) month-to-month pricing with flat daily charge plus a per kWh charge; b) free Saturdays or free Sundays prepay; c) fixed price prepay with a kWh charge that does not change for a specified number of months
- Program designs vary
  - There are many design issues: in-home devices or not; fee structure; debt repayment structure; disconnection policies, etc.

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# Understand the Drivers of Behavior Change with Prepayment



- Transactions
  - Consumers understand dollars and cents more readily than kWh
- Communications
  - A daily “conversation” about the bill can increase customer understanding of daily costs
- Channel
  - A move toward mobile platforms is consistent with other consumer trends and preferences; this could mean offering a mobile phone app for prepayment, or it might simply include the text, email and voice message options that a consumer can receive via mobile phone
- Preferences for channel type and communications form and frequency
  - Customer selection and control of communications is empowering
- Commitment
  - A prepayment account balance increases commitment; a household budget and/or savings goals increases consumer engagement and commitment
- Segmentation
  - Identifiable communities of customers must be studied: students, recent immigrants, unbanked consumers, low- to moderate-income consumers
- Individualization
  - Beyond the identifiable customer segments and targeted markets: with better information, households can discover on their own how to manage usage in a way that suits their unique situation; customization of service can become a reality; individual behaviors drive change

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# Measurement of Prepay Usage Impacts

*Methodology*

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# High Level Findings About the Methodology*

- A regression model can be used to quantify the change in electricity usage resulting from a consumer electing to take prepay electric service
- The model controls for the effects of weather and disconnections by considering a period while the consumer were served under the traditional utility tariff, and the period starting when the consumer switched to the prepay program
- Usage data are analyzed for the set of consumers on the prepay program, including historical data for months when those consumers were served under the traditional utility tariff
- This “fixed effects panel data” approach is often used in energy efficiency program evaluation

* Based on discussion with Jay Zarnikau and based on his forthcoming workshop presentation to the Prepay Energy Working Group: Zarnikau, J. (2014, December). *Further Insights in the Quantification of the Conservation Effect for the Oklahoma Electric Cooperatives and Pacific Northwest Cooperatives*, DEFG.

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# Econometric Approach

- DEFG engaged Michael Ozog, PhD, of Integral Analytics, Inc. in 2011 to prepare a methodology to account for the conservation behavior or efficiency measures that might arise through prepayment. A fixed-effects panel was chosen. Monthly billing data from electric cooperative were analyzed.

  "The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household." Algebraically, the fixed-effect panel data model is described as follows:

$$\ln(kWh_{it}) = \lambda_t + \alpha_i + \beta(\lambda_t \cdot Temp_t) + \delta PP_{it} + \gamma PP_{it} Disc_{it} + \psi Disc_{it} + \varepsilon_{it}$$

where:

| | | |
|---|---|---|
| $kWh_{it}$ | = | energy consumption for home *i* during month *t* |
| $\lambda_t$ | = | binary (1/0) variable denoting each month in the analysis |
| $\alpha_i$ | = | constant term for home *i* |
| $Temp_t$ | = | temperature during month *t* |
| $Pp_{it}$ | = | a binary variable denoting if home *i* was under prepay during month *t* |
| $Disc_{it}$ | = | the number of disconnects for home *i* during month *t* |
| $\beta$ | = | vector of estimated coefficients denoting the effect of temperature on energy consumption during each month |
| $\delta$ | = | the estimated change in energy usage associated with prepay |
| $\Psi$ | = | the estimated change in energy usage associated with disconnection |
| $\gamma$ | = | the estimated change in energy usage associated with disconnection under prepay |
| $\varepsilon_{it}$ | = | error term for home *i* during month *t.* |

Ozog, M. (2011, November). *A Method for Estimating the Conservation Effects of Energy Prepayment.* Series of Regulatory Choices 7. Washington, DC: Distributed Energy Financial Group LLC. http://defgllc.com/publication/method-for-estimating-the-conservation-effects-of-energy-prepayment/
Ozog, M. (2013, March). *The Effect of Prepayment on Energy Use.* Prepay Energy Working Group. Washington, DC: Distributed Energy Financial Group LLC. http://defgllc.com/publication/the-effect-of-prepayment-on-energy-use/

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# Next Steps

*Future modeling opportunities*

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# Next Steps in Modeling

- DEFG engaged Jay Zarnikau, PhD, of Frontier Associates in 2013 to refine the existing approach to
  1. separate weather-related savings from non-weather related savings
  2. develop a deeper understanding of consumer behavior when disconnection is used to change usage
  3. incorporate more detailed end-use data and more detailed usage information (from advanced meters and surveys) into the analysis
- Among his conclusions:
  - Confirmed that prepay results in an average customer savings of 10-15%
  - Changes to the econometric model will be required, depending on whether the analyst is using monthly whole-house data, advanced meter data with smaller time intervals (e.g., 15 minute), or data that is disaggregated by end-uses (space heating and cooling, cooking, etc.)
  - Recommends more prepay impact studies to better understand impacts in different regions
  - A comparative analysis of multiple prepay programs could provide a better understanding of consumer motivations in joining the program and the behavior changes after joining
    - "A formal meta-analysis could be conducted to combine the results from numerous studies and identify patterns and relationships among the results from studies of programs with slightly different features in different regions."

Zarnikau, J. et al. (2014, January). *How Do Prepay Electricity Programs Impact Consumer Behavior?* Prepay Energy Working Group. Washington, DC: Distributed Energy Financial Group LLC. Summary: http://defgllc.com/publication/how-do-prepay-electricity-programs-impact-consumer-behavior/

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# Next Steps in Thinking about Tariffs, Programs and Transactions

- DEFG concluded that if alternative, voluntary tariffs, rate designs or billing approaches result in significant changes in energy usage by consumers, then it is merely a matter of time before they take their place alongside traditional, equipment-based DSM programs in a portfolio of integrated approaches that must be considered to increase economic efficiency in the energy utility industry
- From a consumer perspective, there may be almost no distinction between alternative rate designs, alternative DSM program designs, and alternative billing platforms
- Individual consumer preferences can be expressed in terms of the programs, rates or platforms in which they voluntarily participate
- Because consumers do not understand regulations or utility operations, they have relatively little understanding of *regulatory distinctions* between pricing signals in a rate design, the pricing signals from a DSM program rebate or incentive payment, or the pricing signals from receiving additional valued information or from paying a utility bill in a more convenient manner (reduced transaction costs or increased value)

DEFG. (2014, January). *Assessing the Impact of Tariffs and Programs on Consumer Behavior.* Washington, DC: Distributed Energy Financial Group LLC. http://defgllc.com/publication/how-do-prepay-electricity-programs-impact-consumer-behavior/

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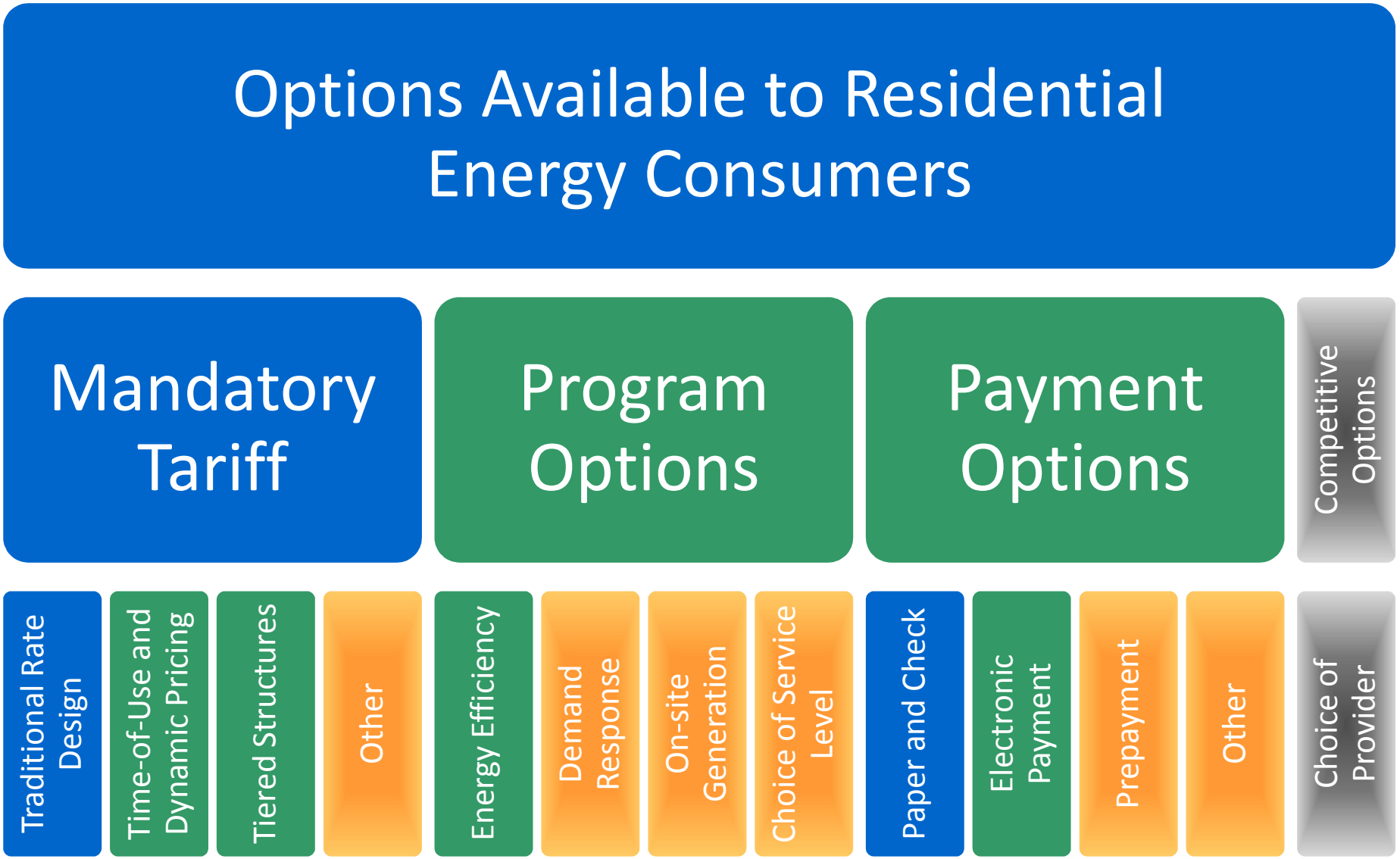
# Conceptual Model for Customer Choices

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# Future Modeling Opportunities

1. Improve the modeling of end uses and technologies that affect conservation savings
   - Once the total change in monthly electricity consumption has been quantified, then the total change can be disaggregated by end-use or appliance; this modeling approach depends greatly on the availability of detailed end-use data and the frequency or periodicity of the available data
2. Model the impact of alternative program designs
   - We can better understand the technologies, channels and program design options
   - Is a specialized in-home device preferable to a smart phone app or email or text?
   - What communication channels should be available and should customers select for themselves?
   - What is the optimum mix of the type and frequency of account balance updates and alerts?
   - What is the impact of different pricing (other than a standard residential tariff)?
   - What fees and charges for payment, reconnection, etc. are appropriate?
3. Model self disconnection behavior as an energy management option
   - There is significant controversy over the ease with which a zero-balance customer can be disconnected
     - Lost of utility service is viewed, by some, as forcing a customer to accept a lower level of electric service
   - Data on frequency and duration of disconnections, and consumer surveys, could increase our understanding of the role of disconnection
     - Is it a means of maintaining control over household budgets? Or does it force customers into deprivation?

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**DEFG believes retail customers are the future of energy. We partner with clients to improve all aspects of the customer relationship. We identify opportunities to create value in a commodity marketplace.**

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