MA ENERGY EFFICIENCY ADVISORY COUNCIL

→ CONSULTANT TEAM

ENERGY EFFICIENCY CONSIDERATIONS: GRID MODERNIZATION, TIME VARYING RATES, AND ENERGY AS A SERVICE

▶ **January 18, 2017**

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INTRODUCTION

- **Trends in the electric grid suggest new challenges and opportunities for:**
  - Increased integration of services for end-use customers
  - Price signals to inform customer behavior
  - Integration of distributed generation
- **Some of these trends are being addressed in MA:**
  - Grid Modernization
  - Time Varying Rates
- **Other that may become relevant in the future:**
  - Energy as a Service

GRID MODERNIZATION CONSIDERATIONS FOR THE COUNCIL

- **Parallel Grid Modernization efforts may or may not impact planning for the 2019-2021 Plan**
- **Energy efficiency programs can support Grid Mod**
  - Ex. EE Plans will provide in-home customer load management devices to customers through existing energy efficiency programs
- **Grid Mod may increasingly interact with energy efficiency in the future**
- **Can support demand reduction efforts**

AS TECHNOLOGIES BECOME "MODERNIZED," THEY PROVIDE INCREASING CONNECTIVITY BETWEEN CUSTOMERS AND SERVICES

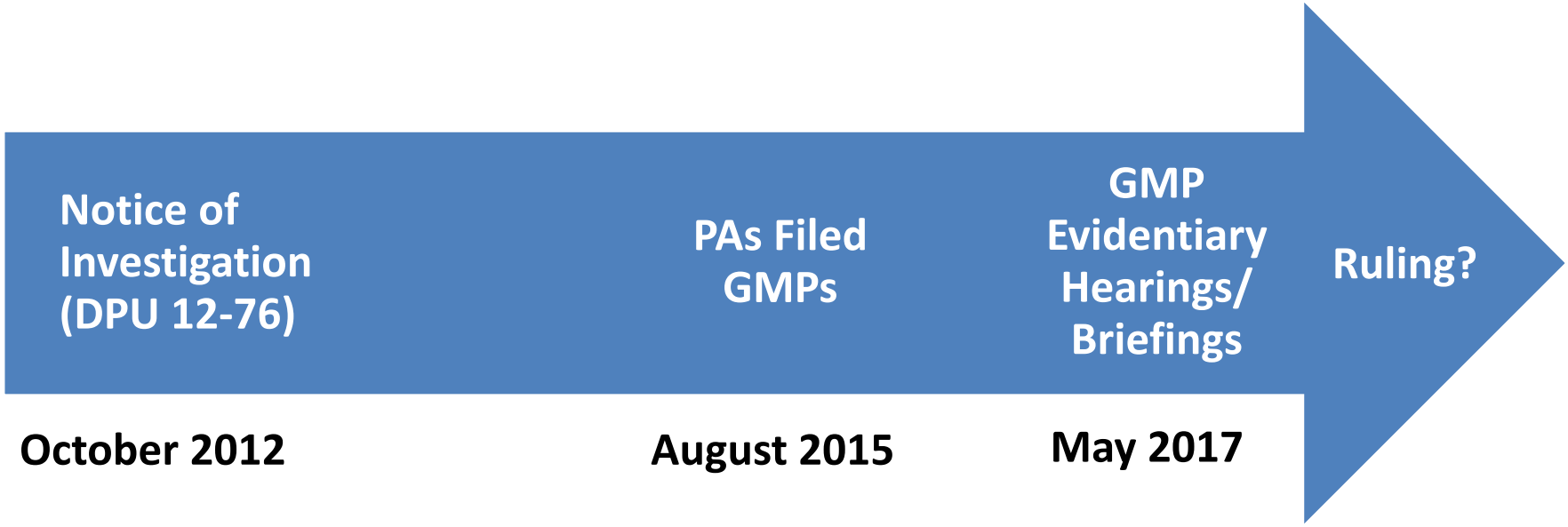
Example: Parking Meters

WHAT IS GRID MODERNIZATION?

- **Meeting demands of the 21st century and beyond by making the grid more:**
  - Reliable
  - Resilient
  - Flexible
  - Affordable
  - Connected

- **Responding to numerous challenges and opportunities**
- **A "smart grid" or "advanced metering infrastructure (AMI)" are key components of Grid Modernization**

TIMELINE OF GRID MODERNIZATION EFFORTS IN MA AT THE DPU



MA DPU GRID MODERNIZATION PLANS

- **Electric distribution companies required to develop and implement ten-year Grid Modernization Plans (GMPs)**
- **GMPs must address four objectives:**
  1. Reducing the effects of outages
  2. Optimizing demand, which includes reducing system and customer costs
  3. Integrating distributed resources
  4. Workforce and asset management
- **Must be updated every five years**
- **First plans were submitted to the DPU on August 19, 2015**

SHORT-TERM INVESTMENT PLANS

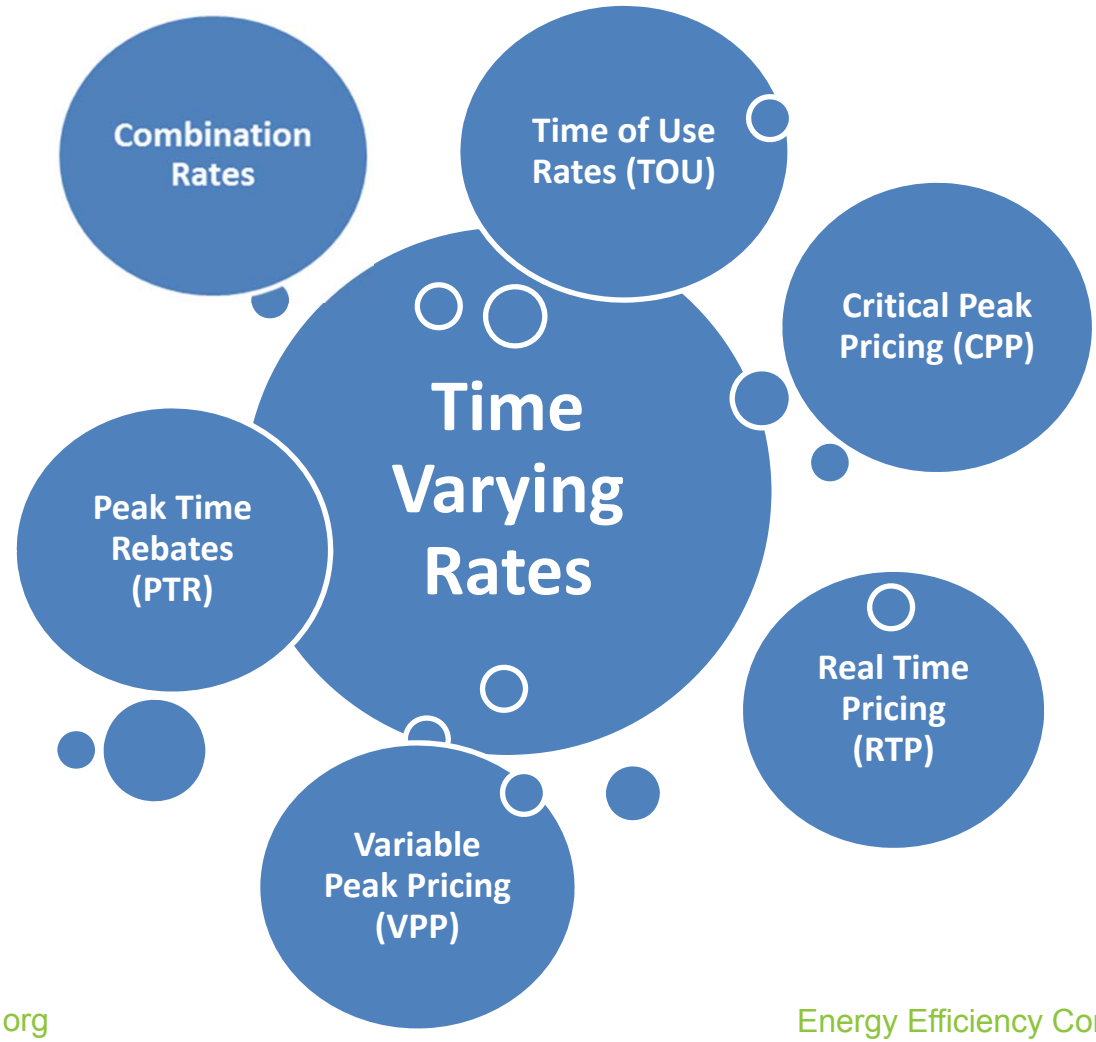
- **First GMP required to include a five-year short-term investment plan (STIP)**
- **Must include an approach to achieve advanced metering functionality within five years of GMP approval (if justified by business case analysis)**

  - Advanced metering functionality is a basic technology platform for grid modernization and includes:
    - Collection of real-time customers' interval usage data, usable for settlement in the ISO-NE energy and ancillary services markets
    - Automated outage and restoration notification
    - Two-way communication between customers and the utility
    - Communication with and control of appliances

TIME VARYING RATES

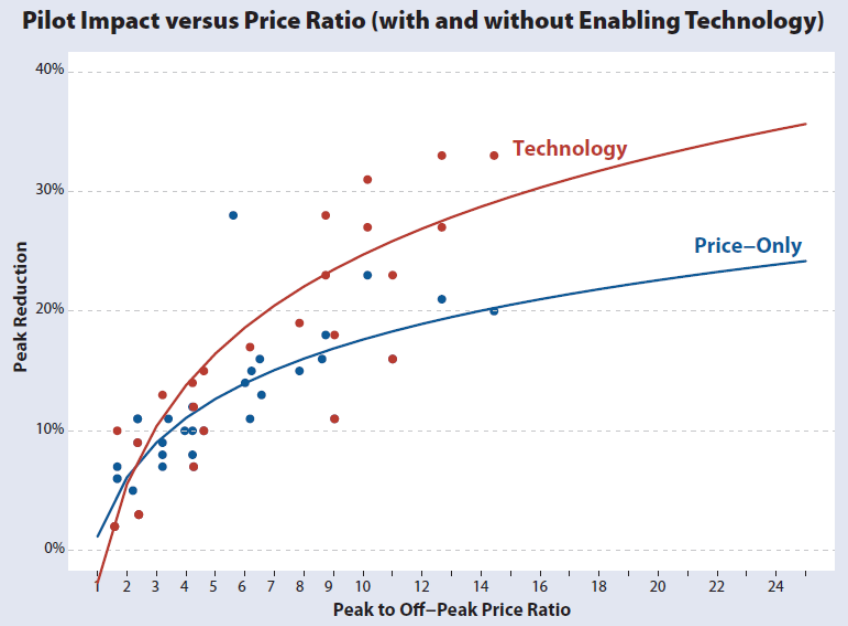
- **What?**
  - Rates that vary over time
- **Why?**
  - Flat or fixed rates don't reflect true system costs and don't send accurate price (cost) signals to customers
- **How?**
  - Rate Design, Pilot, Full-Scale Deployment
- **Time-Varying Rates Are NOT a new concept**
  - Parking meters
  - Airlines, hotels, and car rental companies
  - Public transportation (e.g. D.C. Metro)
  - Bridges and Tolls (e.g. SF Bay Bridge, Congestion charging on major roads in parts of London)
  - Sports

TYPES OF TIME VARYING RATES



TECHNOLOGY CONSIDERATIONS

- **Supporting Technology**
  - Smart Meters
  - Programmable Communicating Thermostats
  - Home Energy Management Systems
  - Smart appliances
  - Wi-Fi
- **Technology Supported**
  - Distributed Resources (e.g. solar, storage, etc.)
  - End-use technologies (e.g. plug-in EVs)



Time-Varying and Dynamic Rate Design, RAP (2012)

OTHER CONSIDERATIONS

- **Low Income considerations**
  - Rate design is critical
  - Cost-effectiveness
  - Vulnerability of low-income customers
- **Other considerations**
  - Regulatory/Market Coordination
  - Advanced Metering Infrastructure
  - Customer Fears of Price Volatility

TVR EXAMPLES

- **PG&E's "SmartRate"**
  - CPP
  - Rates reduced during summer except on SmartDays (peak days)
  - 15 events in 2015
  - Peak load impacts ranged from 12-29%

- **PG&E's TOU Rates**
  - 2-3 periods in summer and 2 periods in winter
    - Summer load reductions were 8-12%, winter 5-11%

- **Other Examples**
  - France – Successful modified CPP with 400,000+ customers
  - Vietnam – TOU for high-consumption C&I customers that saved over $45 million in new capacity requirements

TVR MA EXAMPLES

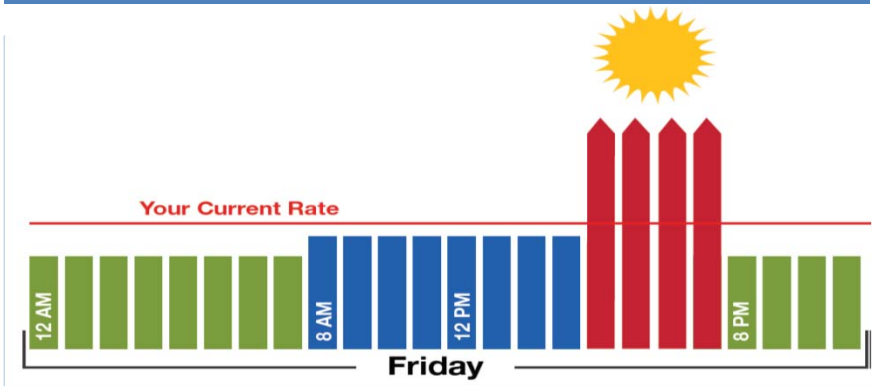
- **Eversource Optional Residential TOU**
  - For residential customers
  - Peak hours: 9am-6pm Mon-Fri (Eastern Daylight Time), 4pm-9pm Mon-Fri (Eastern Standard Time)
- **National Grid C&I TOU**
  - For large C&I customers with demand >200 kW
  - Peak hours: 8am-9 pm Mon-Fri, except holidays
- **Pilots**
  - See NGrid's Smart Energy Solutions Pilot (slides 15-17)
  - Eversource Smart Energy Pilot
  - Marblehead Municipal Light Department, EnergySense Program

NATIONAL GRID'S SMART ENERGY SOLUTIONS PILOT

- 2015-2016 pilot program
- ~15,000 smart meters across Worcester, MA
- 2 pricing plan options
- 4 technology level options
- Opt-out design

SMART ENERGY SOLUTIONS PRICING OPTIONS

Time-of-Use / Critical Peak



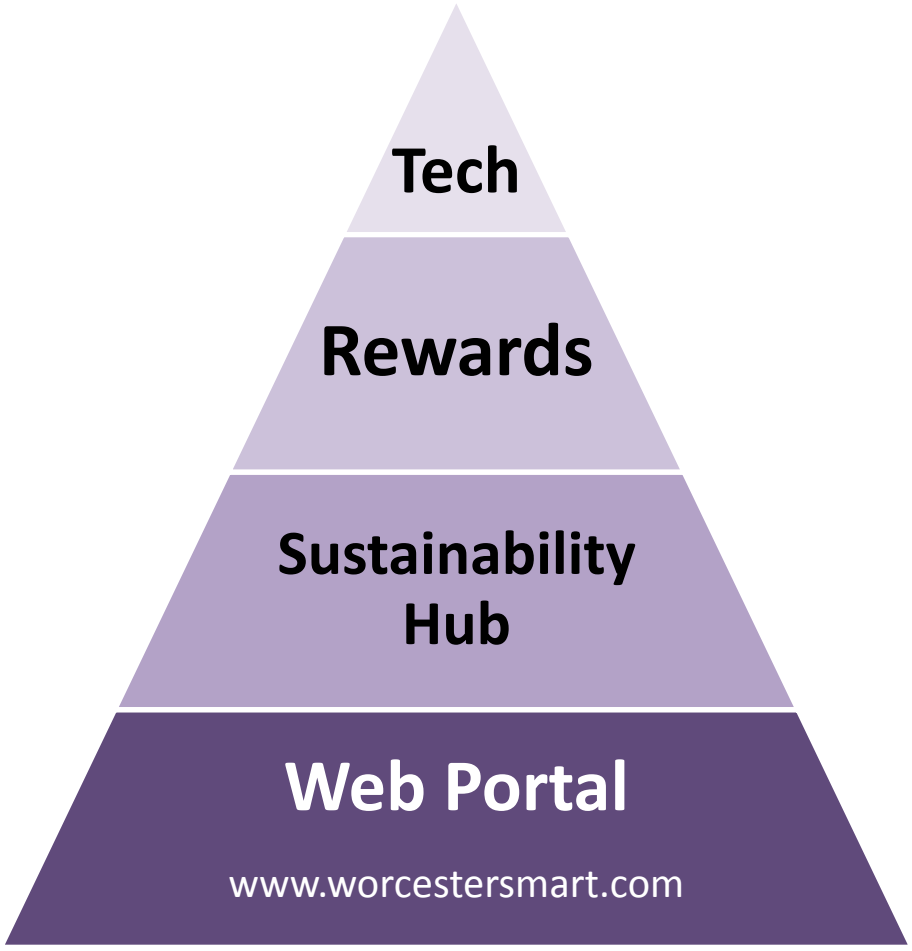
- Offers bill protection
- Default pricing plan
- 95% of participants
- Higher demand & energy savings
- Average bill savings: $100

Peak Time Rebate

- Basic service rate with rebates for saving during Peak Events
- Required active choice
- 5% opted for PTR
- No energy savings in Yr 1
- Average bill savings (2015): $20

3 out of 4 participants believe they understand their pricing plan

SES: CONNECTING WITH CUSTOMERS



- Many opportunities for engagement with customers
- Web portal usage up in Year 2
- Tech offers unique opportunities to connect

Overall satisfaction with the pilot: ~70%

ENERGY AS A SERVICE (EAAS)

"People don't want heating fuel or coolant; people want cold beer and hot showers."

—Amory Lovins

Energy as a Service (EaaS)
A holistic portfolio wide oversight of an organizations overall energy operations

Example:

Lighting as a Service (LaaS)
The third-party management of a lighting system that may include additional technical, maintenance, financial, or other services

WHY NOW?

- **LaaS was originally introduced by Edison in the late 1800s.**
- **It is viable now because:**
  - Industrial Internet of Things (IoT) has matured
  - Prevalence and access to new operational and environmental data
  - Growth of as a service models
    - Software as a Service (e.g. Microsoft Office 365, Citrix GoToMeeting)
    - Media as a Service (e.g. Netflix)
    - Hardware as a Service (e.g. cable, phone, IT equipment)
- **Integrated, customized service**
  - Service provider handles complex energy industry

EXAMPLES

- **GE Current**
  - Large C&I EaaS
  - LED, solar, EV charging, and energy management services(EMS)
  - Emphasis on non-energy benefits from energy technology
- **Tendril Orchestrated Energy (since 2016)**
  - Cloud-based residential demand management software that optimizes system operation and customer comfort
  - Customized schedule for smart thermostats
    - Expanding to water heaters, solar systems, and EV
- **Regency Lighting**
  - Lighting as a Service: installation→maintenance→disposal
  - Monthly fee includes price of upgrades to latest technology

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THANK YOU

Questions?

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APPENDIX

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MA GRID MODERNIZATION RESOURCES

- http://www.mass.gov/eea/energy-utilities-clean-tech/electric-power/grid-mod/grid-modernization.html
- http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=15-120%2fTestimonyandExhibitsBook1Redac.pdf
- http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=15-121%2fUnitil_GMP_Report_81915.pdf
- http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=15-122%2fInitial_Filing_Petition.pdf

PROCEDURAL HISTORY OF DPU GRID MODERNIZATION EFFORTS IN MA

Timeframe	Action
Oct 2012	DPU issued a Notice of Investigation into the modernization of the electric grid (DPU 12-76)
Nov 2012-June 2013	Stakeholders discussed grid-facing and customer-facing issues relating to the modernization of the grid
July 2013	Stakeholders submitted a final report to the DPU with their recommendations.
Dec 2013	DPU issued an order (DPU 12-76-A) containing a straw proposal for modernizing the electric grid
June 2014	DPU issued an order (DPU 12-76-B) requiring each electric distribution company to submit a ten-year Grid Modernization Plan (GMP)
June 2014	A companion order (DPU 14-04-B) set fourth an anticipated policy framework for the implementation of time varying rates for basic service customers
Nov 2014	DPU issued an order (DPU 12-76-C) outlining requirements of the business case analysis that companies should use to evaluate the costs and benefits of GMPs
August 2015	Companies submitted first GMPs to the DPU in separate proceedings

GMP PROCEDURAL SCHEDULE

Date	Action
February 10, 2017	Intervenor Notice of Intent to File Testimony
February 24, 2017	Intervenor Testimony due
April 7, 2017	Deadline for all Discovery Requests
April 21, 2017	Final Discovery Responses due
May 5, 2017	Rebuttal Testimony due (if requested)
May 17-18, 2017	Evidentiary Hearings
May 22-25, 2017	Evidentiary Hearings Briefing Schedule (TBD)

TIME VARYING RATES RESOURCES

- https://www.edf.org/sites/default/files/a_primer_on_time-variant_pricing.pdf
- http://www.raponline.org/wp-content/uploads/2016/05/rap-faruquihledikpalmer-timevaryingdynamicratedesign-2012-jul-23.pdf
- https://www.smartgrid.gov/recovery_act/time_based_rate_programs.html
- https://emp.lbl.gov/sites/all/files/report-lbnl-54238.pdf
- http://www.calmac.org/publications/2._PGE_2015_Res_TVP_Report.pdf
- https://sites.energetics.com/madri/toolbox/pdfs/pricing/eei_2008_quantifying_dynamic_pricing.pdf
- http://brattle.com/system/publications/pdfs/000/004/917/original/Quantifying_Demand_Response_Benefits_in_PJM_Jan_29_2007.pdf?1379343092
- https://www.ferc.gov/legal/staff-reports/2016/DR-AM-Report2016.pdf
- http://web1.env.state.ma.us/DPU/FileRoomAPI/api/Attachments/Get/?path=10-82%2fNGrid_Interim_Report_4116.pdf

TYPES OF TIME VARYING RATES

Type	Description
Time of Use (TOU)	• Day is broken out into 2-3 periods (e.g. peak, off-peak, interim) • Prices vary by period but remain consistent from day-to-day
Critical Peak Pricing (CPP)	• Period of time in the day (i.e. critical peak event) where prices increase dramatically to reflect system costs • Typically occurs up to 15 days per year • Rates are flat or fixed outside of critical peak events
Peak Time Rebates (PTR)	• Analogous to CPP, but instead of paying more during the critical peak event, customers are incentivized to cut back during that period • Customers do not face a penalty if they are unable to reduce consumption during peak events
Real Time Pricing (RTP)	• Prices vary frequently (e.g. hourly or less)
Variable Peak Pricing (VPP)	• Analogous to TOU, but prices for at least one period (typically on-peak) vary day-to-day to reflect system conditions • Prices in other periods do not change from day-to-day
Combination Rates	• Some rate types can be combined to take advantage of the relative advantages of each • TOU with either CPP or PTR

COMPONENTS OF TVRS

Component	Description
Number of Pricing Periods	• Prices may change once per day, hour, or even more frequently • Depends on metering technology
Timing of Pricing Periods	• Applicable hours when each pricing period is in effect
Price Level	• Prices need to reflect system costs AND provide sufficient financial incentive for customers to participate in a meaningful way
Notification	• Timing of when customers are informed of upcoming prices and their applicability • Depends on number of periods
Incentive	• High/Low costs for high/low cost hours OR rebate payments for targeted load reductions • Depends on type of TVR
Combination	• Determine whether rate type will stand alone or be combined with other or existing rates

ENERGY AS A SERVICES RESOURCES

- http://www.edisonenergy.com/news/news-articles/energy-service-charting-path-complexity/
- http://www.currentbyge.com/
- https://insights.regencylighting.com/what-is-lighting-as-a-service-laas-and-how-does-it-work
- http://www.energymanagertoday.com/energy-as-a-service-charting-a-path-through-complexity-0125174/
- https://www.navigantresearch.com/research/lighting-as-a-service
- https://www.tendrilinc.com/newsroom/press-release/tendril-orchestrated-energy-redefines-demand-response
- https://www.lunera.com/lighting-as-a-service/