2018
Transactive
Energy
Systems
CONFERENCE & WORKSHOP

June 12-14, 2018
MIT, Cambridge, MA

Lebanon Community Power's Transactive Energy Municipal Aggregation Pilot

Clifton Below

City Councilor & Chair of the Lebanon Electric Aggregation Committee, a.k.a. Lebanon Energy Advisory Committee (LEAC)

City of Lebanon, New Hampshire

Lebanon Community Power (LCP)

What is it?

- A developing municipal load aggregation plan using real-time electricity pricing (RTP), and possibly other TOU rates (for transmission & distribution) as an exchange medium for net metering and other energy transactions with a sharing (TE) platform for local renewable energy.
- A Time-of-Use (TOU) pilot under NH Public Utilities Commission (NHPUC) proceeding to develop new net metering tariffs endorsed in 6/23/17 order (DE 16-576).
- To provide data collection to support NHPUC Value of Distributed Energy Resources (DERs) study to inform future tariffs for net metering and DERs.

Lebanon Community Power: Purpose

- Primary purpose is to accelerate development & cost-effective integration of local renewable energy and other DERs, including storage, demand response or D.R. & targeted energy efficiency.
- Help our community accelerate carbon reduction, innovate, & rely "upon as much local renewable energy as possible" (City of Lebanon policy per Master Plan).
- Generate savings & revenue for the City over long-run.
- Support beneficial or strategic electrification (e.g. vehicles)
- Create a persistent & replicable model for other NH & NE communities, like Community Choice Aggregation (CCA).

LCP Background – Legal Framework

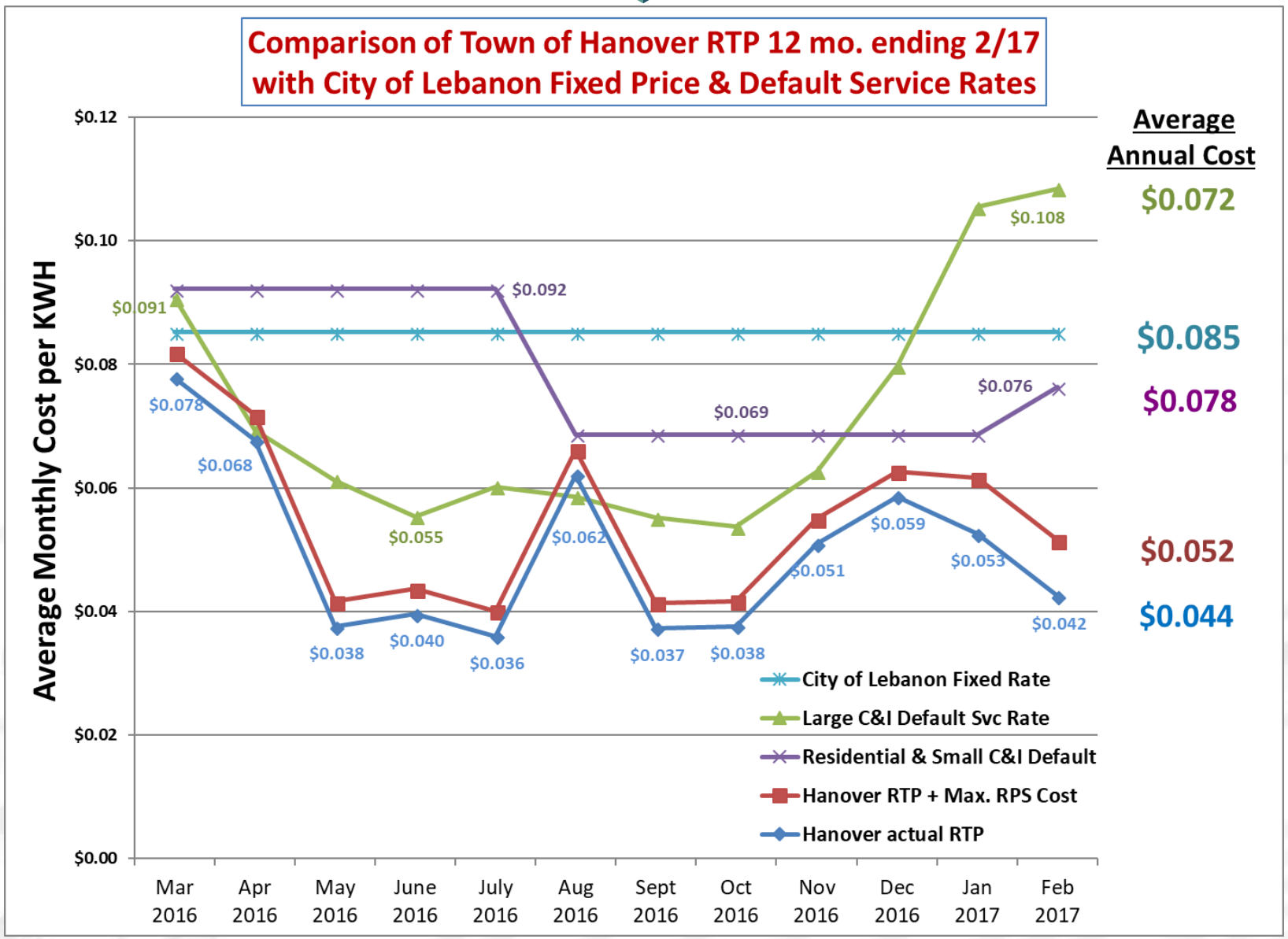
- NH Electric Utility Restructuring Statute (RSA 374-F) from 1996 sets forth the policy framework which calls for:
- Harness the power of competitive markets to reduce costs
- Key: increase customer choice and **develop competitive markets for** wholesale and **retail electricity services**
- Appropriate price signals for buyers & sellers of electricity
- Allowing customers to choose electricity suppliers will help ensure fully competitive and **innovative markets** - should be able to choose among options such as levels of service reliability, **real time pricing**, and generation sources, including interconnected self generation.

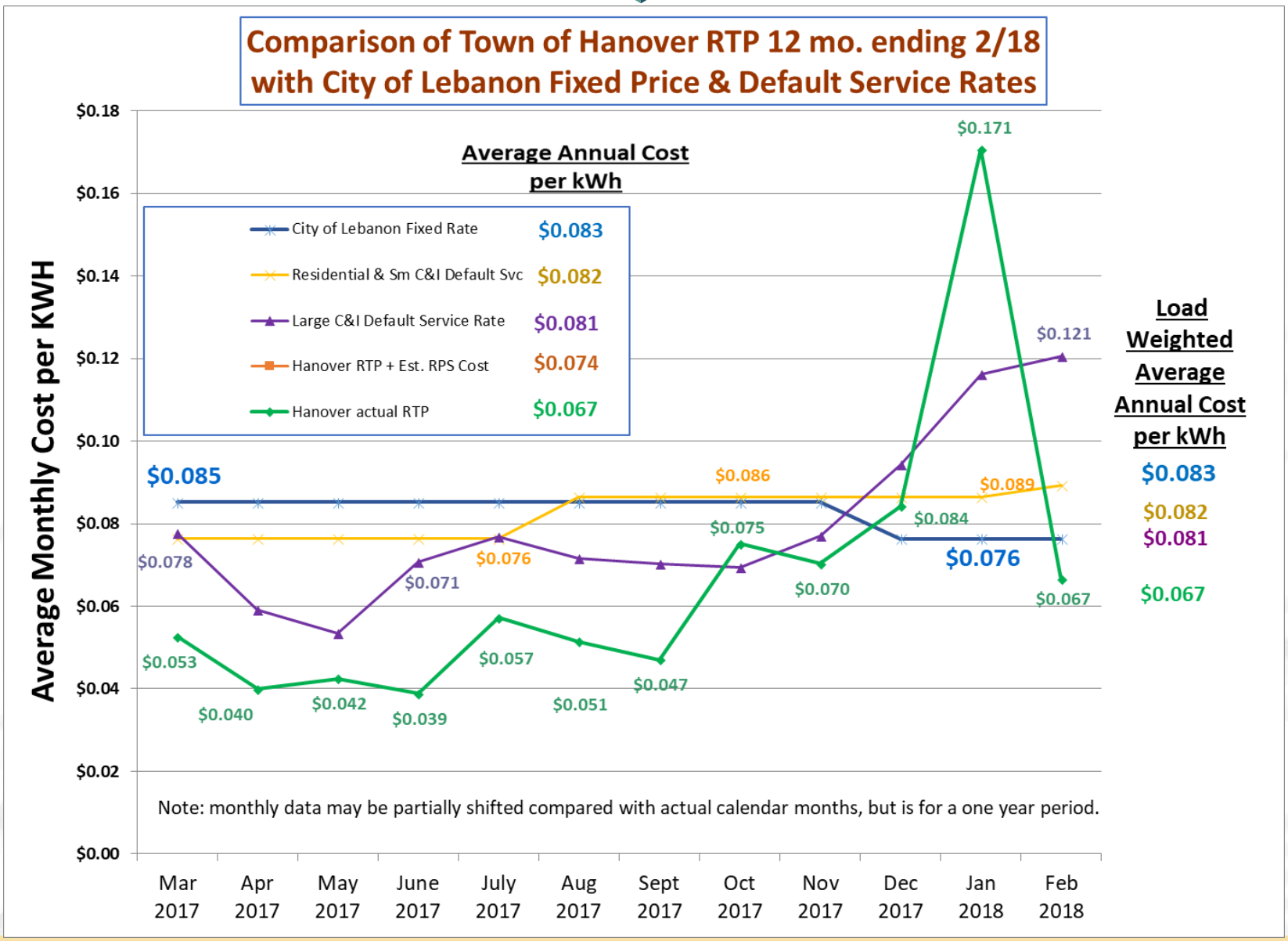
LCP Background – Legal Frame II

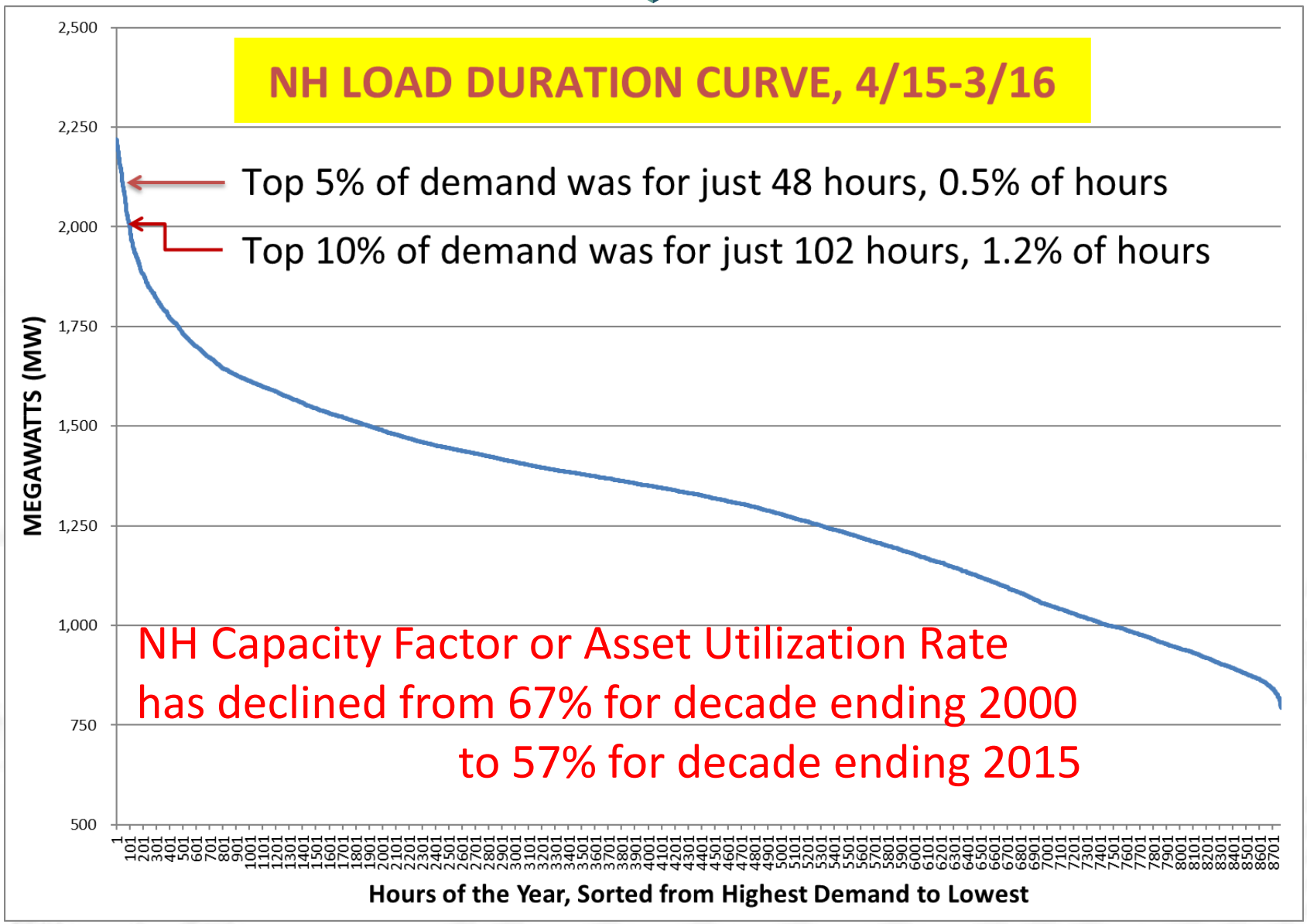
- "The market framework for competitive electric service should, to the extent possible, reduce reliance on administrative process. ***New Hampshire should move deliberately to replace traditional planning mechanisms with market driven choice as the means of supplying resource needs.***" RSA 374-F:3, XIV
- RSA 53-E enables municipal aggregation of load including for supply, meter reading, demand response, energy efficiency & other electricity services.
- Opt-in, can't use tax revenue, but can use revenue bonds.
- Municipalities can operate jointly – Hanover may join.

LCP: Value Proposition to RTP

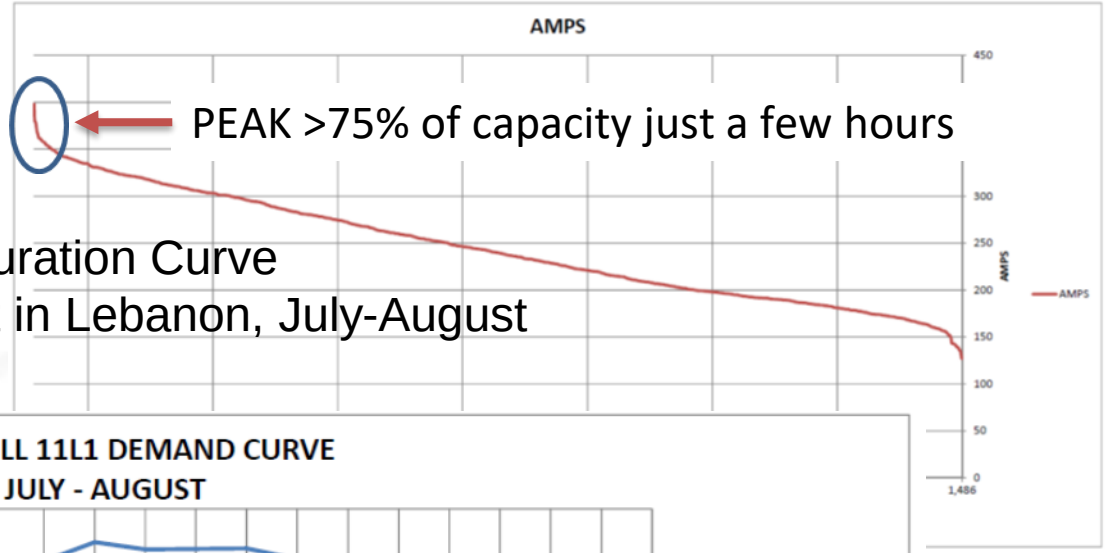
- RTP, based on the hourly Locational Marginal Price (LMP) for NH, has been and likely will continue to be, the lowest cost price for energy – so greatest savings (~7% < DA price)
- Gets rid of hedging cost or risk premium in forward fixed rates – TE platform for local R.E. enables physical hedge
- Time Varying Rates (TVR): unlock temporal value of solar, storage, and flexible demand (e.g. elec. cars, DHW)
- "The Costs and Benefits of Real-Time Pricing" by EDF & CUB found 97% of res. customers would benefit w/o DR
- White Paper on Developing Competitive [retail] Electricity Markets and Pricing Structures, for the NY Rev-RTP value


Comparison of Town of Hanover RTP 12 mo. ending 2/17
with City of Lebanon Fixed Price & Default Service Rates
Average Monthly Cost per KWH
$0.12
$0.10
$0.08
$0.06
$0.04
$0.02
$0.00
Mar 2016
Apr 2016
May 2016
June 2016
July 2016
Aug 2016
Sept 2016
Oct 2016
Nov 2016
Dec 2016
Jan 2017
Feb 2017
$0.091
$0.092
$0.108
$0.078
$0.068
$0.055
$0.062
$0.069
$0.076
$0.059
$0.051
$0.053
$0.042
$0.038
$0.040
$0.036
$0.037
$0.038
City of Lebanon Fixed Rate
Large C&I Default Svc Rate
Residential & Small C&I Default
Hanover RTP + Max. RPS Cost
Hanover actual RTP
Average Annual Cost
$0.072
$0.085
$0.078
$0.052
$0.044

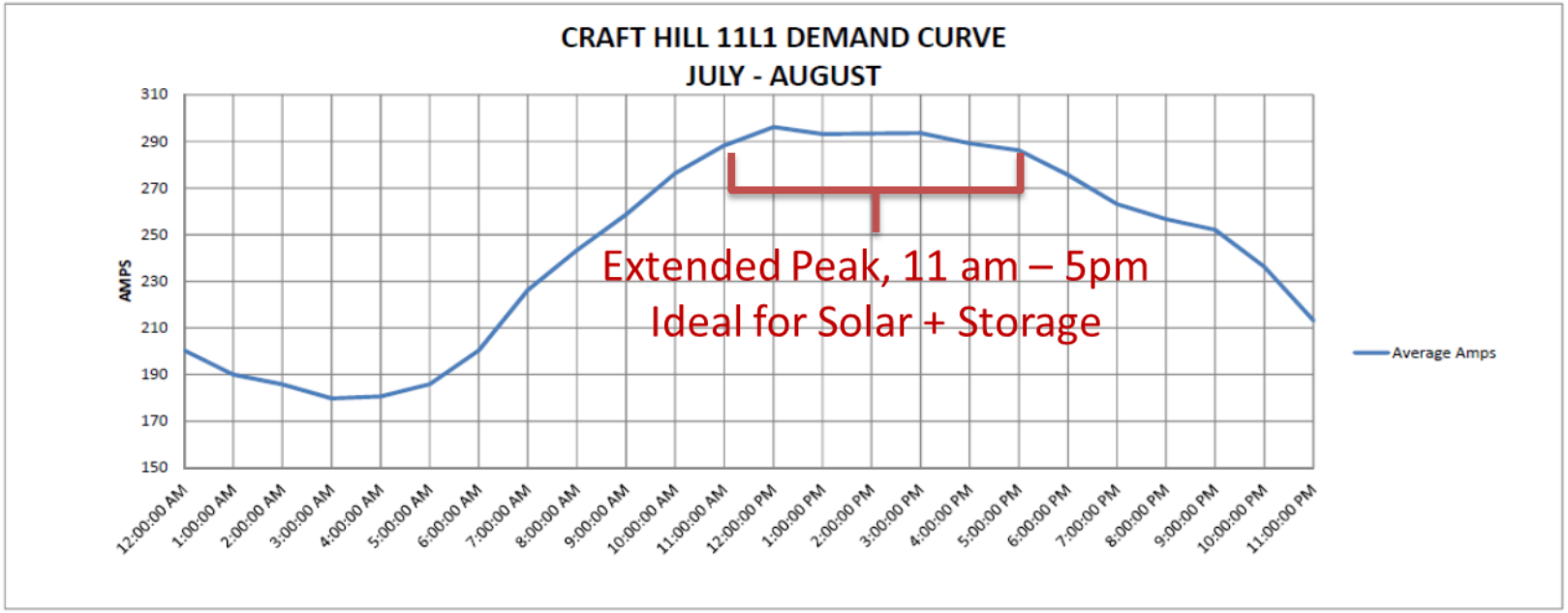

Comparison of Town of Hanover RTP 12 mo. ending 2/18 with City of Lebanon Fixed Price & Default Service Rates
Average Monthly Cost per KWH
$0.18
$0.16
$0.14
$0.12
$0.10
$0.08
$0.06
$0.04
$0.02
$0.00
Average Annual Cost per kWh
City of Lebanon Fixed Rate $0.083
Residential & Sm C&I Default Svc $0.082
Large C&I Default Service Rate $0.081
Hanover RTP + Est. RPS Cost $0.074
Hanover actual RTP $0.067
$0.085
$0.078
$0.053
$0.040
$0.042
$0.039
$0.071
$0.076
$0.057
$0.051
$0.047
$0.075
$0.086
$0.070
$0.084
$0.171
$0.076
$0.067
$0.121
$0.089
Load Weighted Average Annual Cost per kWh
$0.083
$0.082
$0.081
$0.067
Note: monthly data may be partially shifted compared with actual calendar months, but is for a one year period.
Mar 2017
Apr 2017
May 2017
June 2017
July 2017
Aug 2017
Sept 2017
Oct 2017
Nov 2017
Dec 2017
Jan 2018
Feb 2018

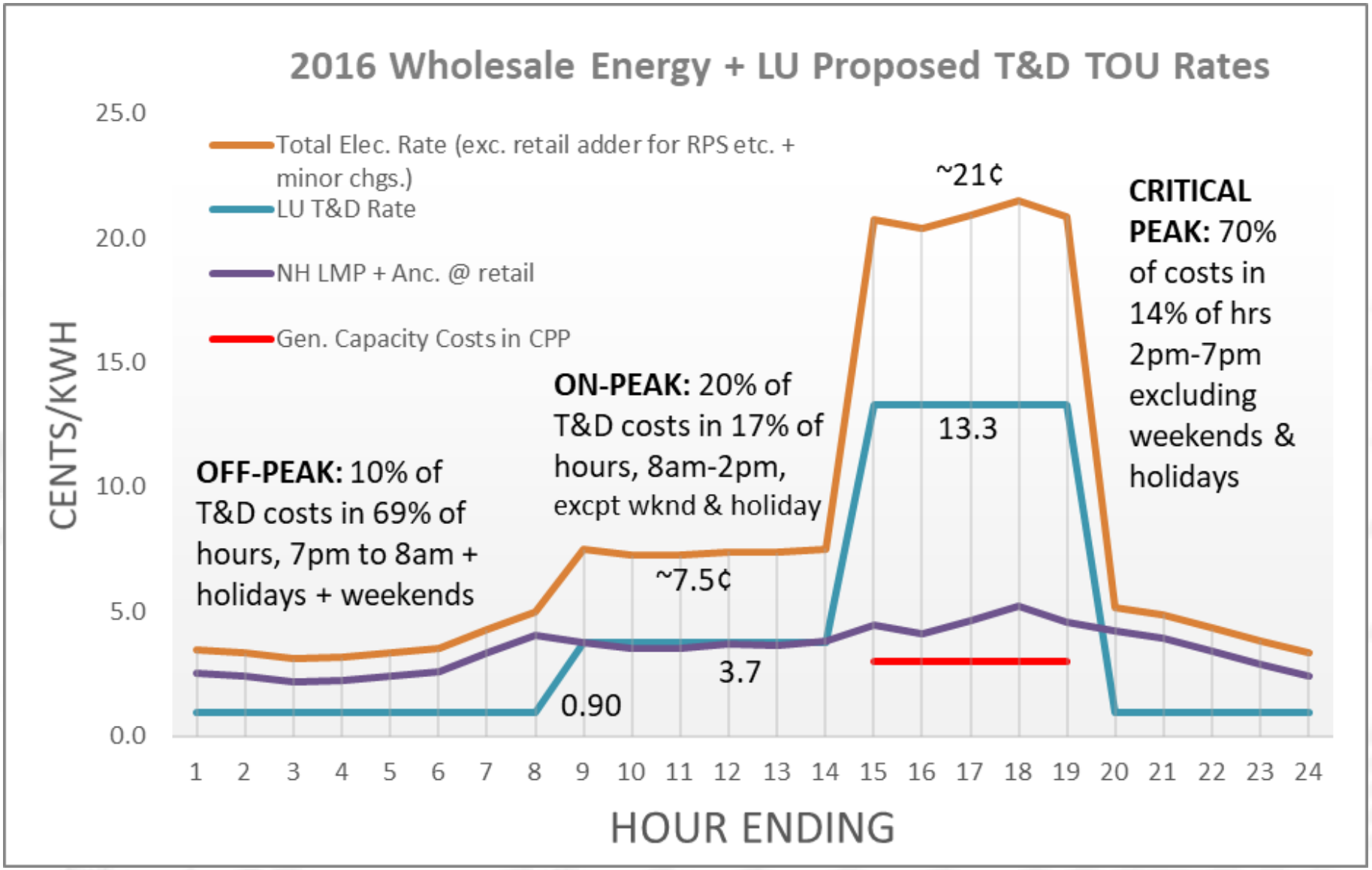

NH LOAD DURATION CURVE, 4/15-3/16
Top 5% of demand was for just 48 hours, 0.5% of hours
Top 10% of demand was for just 102 hours, 1.2% of hours
NH Capacity Factor or Asset Utilization Rate
has declined from 67% for decade ending 2000
to 57% for decade ending 2015
MEGAWATTS (MW)
2,500
2,250
2,000
1,750
1,500
1,250
1,000
750
500
Hours of the Year, Sorted from Highest Demand to Lowest

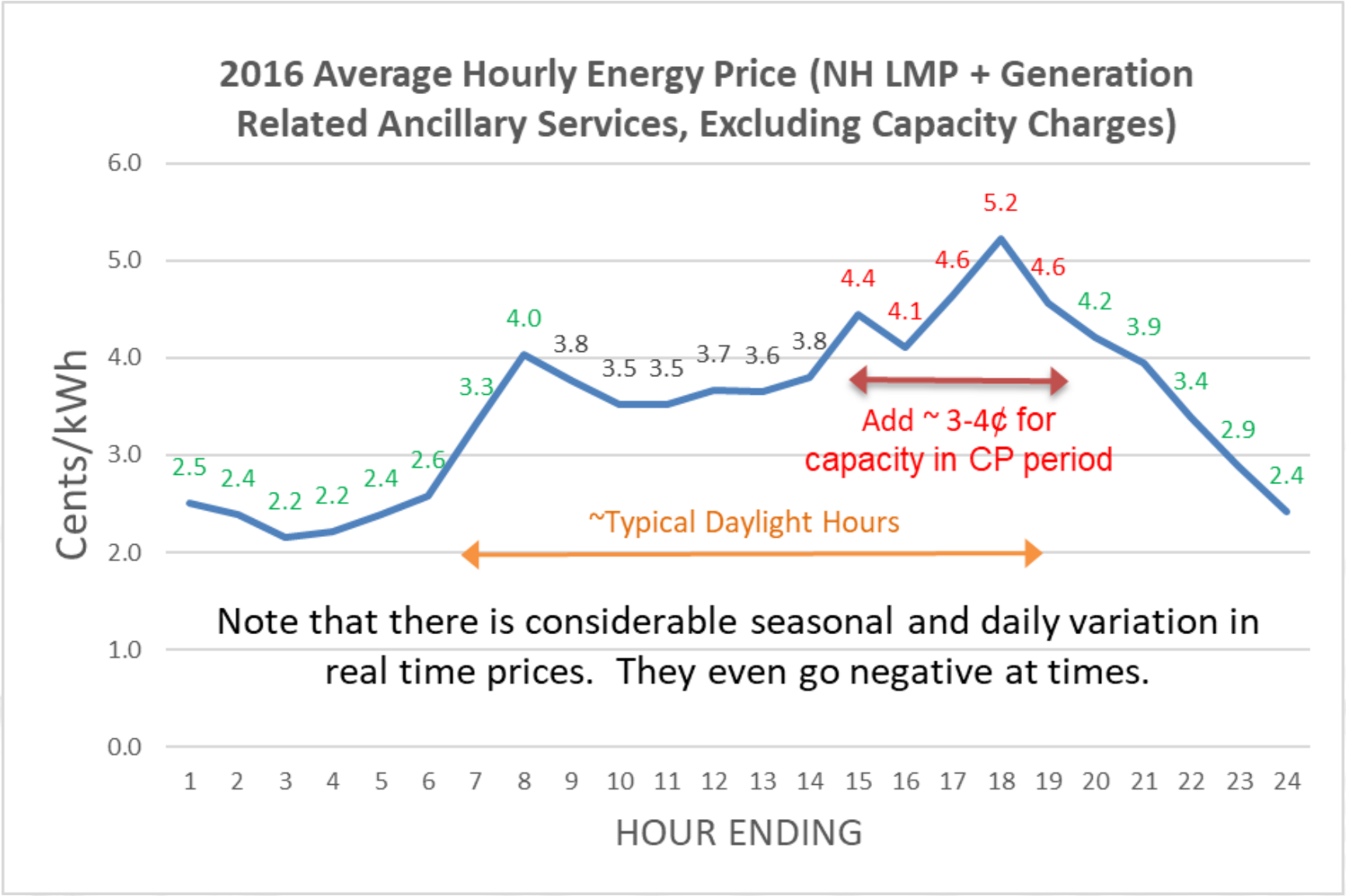
Need for TVR: Liberty Utilities' NWA Proposed Battery Pilot



Load Duration Curve
1 circuit in Lebanon, July-August

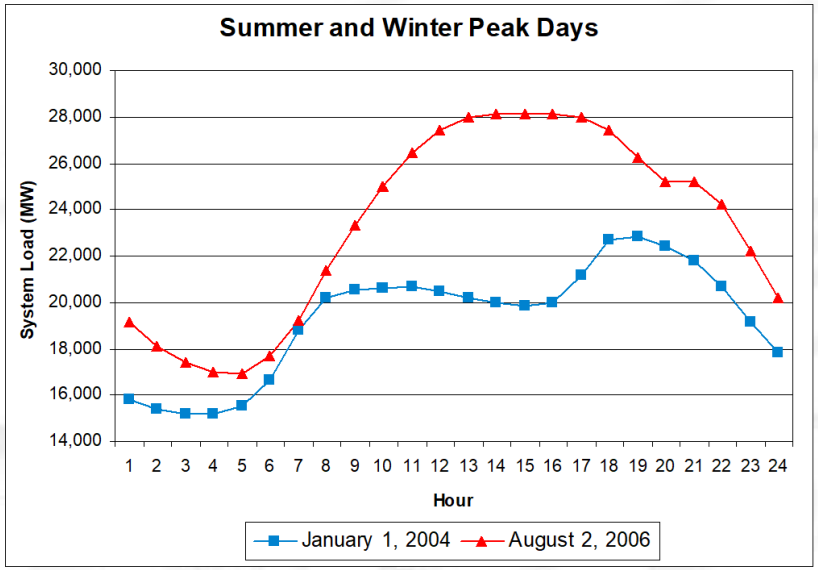



2016 Wholesale Energy + LU Proposed T&D TOU Rates
Total Elec. Rate (exc. retail adder for RPS etc. + minor chgs.)
LU T&D Rate
NH LMP + Anc. @ retail
Gen. Capacity Costs in CPP
CENTS/KWH
25.0
20.0
15.0
10.0
5.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
HOUR ENDING
~21¢
13.3
~7.5¢
3.7
0.90
OFF-PEAK: 10% of T&D costs in 69% of hours, 7pm to 8am + holidays + weekends
ON-PEAK: 20% of T&D costs in 17% of hours, 8am-2pm, excpt wknd & holiday
CRITICAL PEAK: 70% of costs in 14% of hrs 2pm-7pm excluding weekends & holidays

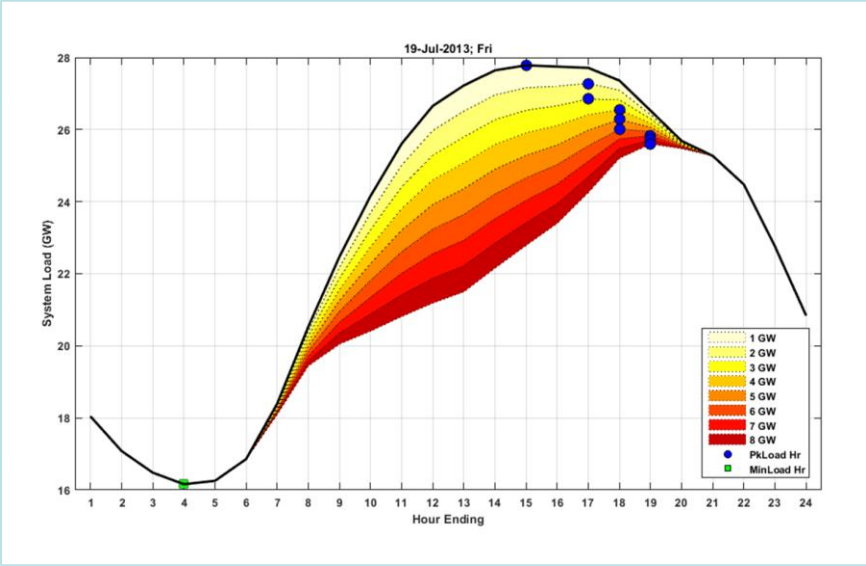

2016 Average Hourly Energy Price (NH LMP + Generation Related Ancillary Services, Excluding Capacity Charges)
Cents/kWh
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2.5 2.4 2.2 2.2 2.4 2.6 3.3 4.0 3.8 3.5 3.5 3.7 3.6 3.8 4.4 4.1 4.6 5.2 4.6 4.2 3.9 3.4 2.9 2.4
Add ~ 3-4¢ for capacity in CP period
~Typical Daylight Hours
Note that there is considerable seasonal and daily variation in real time prices. They even go negative at times.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
HOUR ENDING

New England's changing load shape

Historic N.E. peak load shape: summer vs. winter



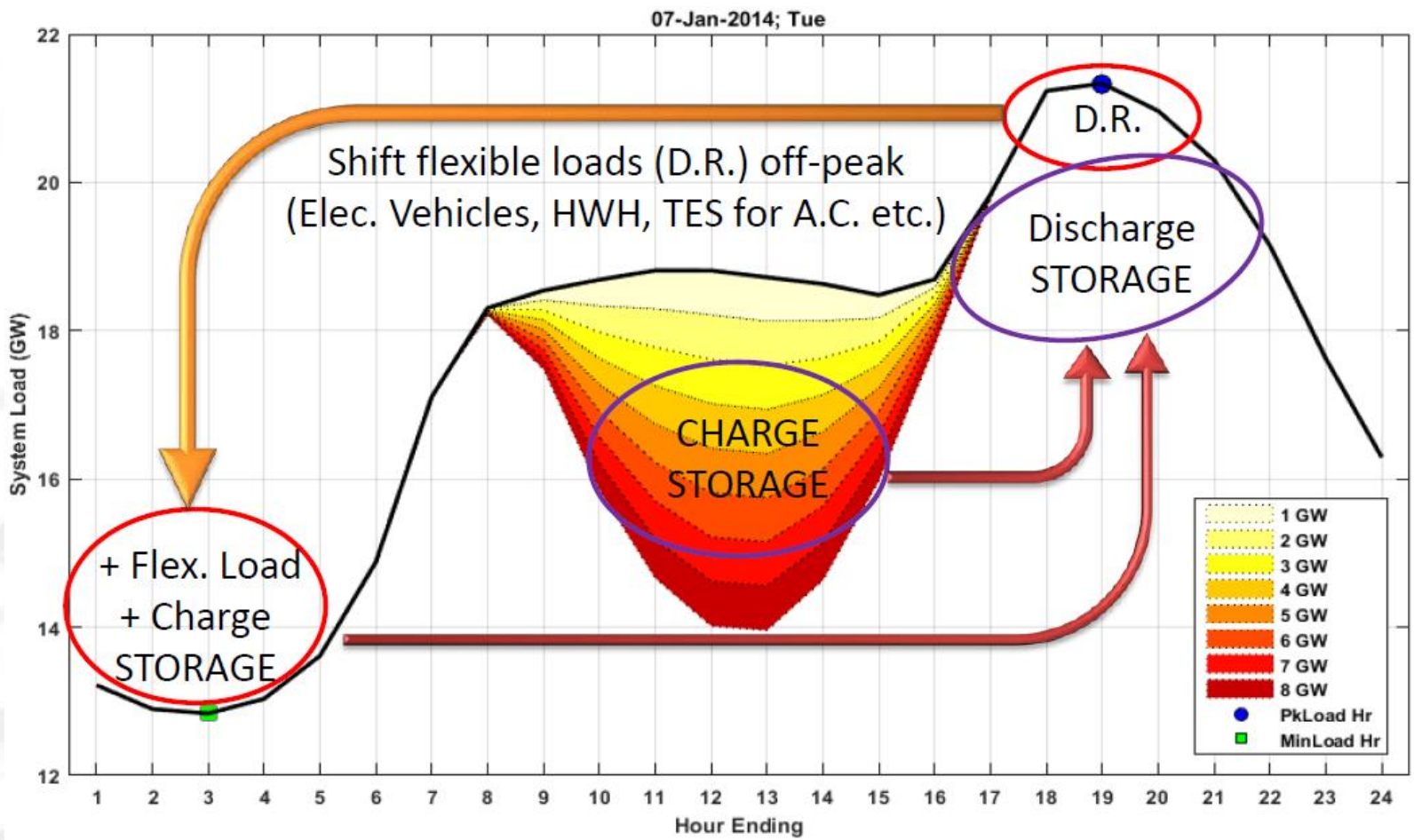
Summer impact of solar as more is installed



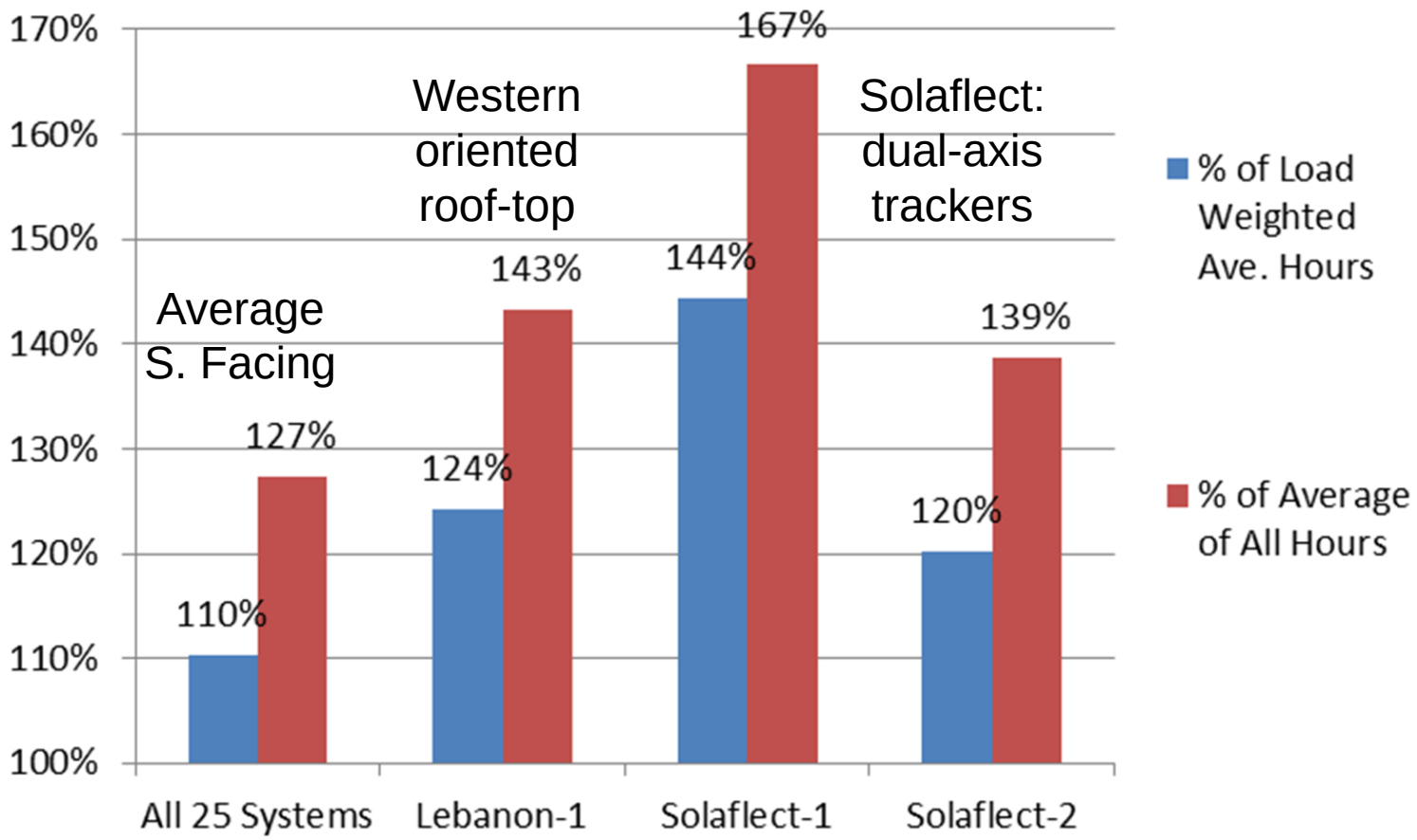
L: ISO-NE provided to C Below, R: www.iso-ne.com/about/what-we-do/in-depth/solar-power-in-new-england-locations-and-impact

N.E.'s Duck Curve & Need for TVR

Base curve and graph from ISO-NE previous citation p.13, mark-up graphics & text from C. Below



Energy Value of Solar PV Production, 4/15-3/16, City of Leb. Testimony in DE 16-576



Treating DERs as Retail Load Reducers Instead of Wholesale Market Participants

- Within ISO-NE generators up to 5 MW in size do not have to register as bulk generators and can be treated as retail load reducers.
- Efforts to enable aggregated DERs to participate in wholesale markets can be seen as a work-around to the lack of retail markets that effectively translate wholesale market price signals to retail load.
- More value as load reducers: avoid not just LMP, but also ancillary service, FCM capacity & transmission charges, all charged to load at wholesale meter point. The later 2 are based on share of annual or monthly peak hour.

LCP: Request for Information (RFI) – Municipal Need for Open Process

- Engage vendors w/interest & provide basis for RFQ/RFP

1) **Smart/Adaptive LED Street Lighting Conversion** (cost savings looks like they may cover communication system)

2) Interval Metering for LCP that can also work with Liberty's battery pilot (w/TOU rates) (in cooperation with Liberty Utilities)

3) **Services to Support LCP**: City to become Load Serving Entity (wholesale market participant), Transaction & Billing System, & other related services (e.g. RPS compliance, payments to participant DG, customer service, wkg. capital)

- RFI open through 6/20: https://lebanonnh.gov/bids.aspx

LCP: Finding an Affordable Bi-Directional Interval Meter (near-AMI)

- Hourly interval data needed by LU for daily load settlement
- 1 min. interval desired for research, Value of DER Study & LCP program development (e.g. power factor improvement)
- Meter Data capabilities desired: bi-directional Wh, VARh, demand (W & VA), volts, amps, power factor & frequency
- Need for near-real time meter data for customer engagement & potential D.R./V.P.P. automation
- How much cyber-security is enough – can we leverage existing internet connections for near RT meter data?
- Municipal-IOU collaboration: Smart City + Smart Grid + IoT

Metering & Leveraging LCP Pilot

- Potential to share Smart Street Lighting R.F. communication system (mesh or point-to-point, lic. or not) for dimmable LEDs, with other IoT apps inc. meter reading, SCADA, etc.
- Operate LCP as a virtual microgrid or virtual power plant (& actual microgrids for resiliency), virtual net-0 non-renewable
- City is considering thermal energy, battery storage, smart inverters in conjunction with building HVAC EE upgrades
- Collaboration possibilities w/ Arthur L. Irving Institute for Energy & Society at Dartmouth College; e.g. Prof. Amro Farid, Thayer School of Engineering, Laboratory for Intelligent Integrated Networks of Engineering Systems (LIINES)
  - advise & plan to collect & anonymize meter data for EM&V

Enabling new forms of Community Solar & other shared renewables

- City has CIP project underway to develop LFGTE (~800 kW to 1 MW capacity) plus potential for at least 10 MW of solar at various City sites, enough to serve City's own load plus another 10-15% of total loads in City
- Avoided transmission credits for >100 kW D.G. ~2¢/kWh
- TE sharing platform can combine fixed price agreements for PPAs, co-ops or buy-in to offsite solar & D.G. with RTP on the margin, such as with "contracts for differences."
- On-bill credits to avoid taxable payments w/residential NM
- May leverage emerging platforms such as www.communitysolarhub.com and www.sharedrenewables.org

LCP: Challenges & the Future

- How to address potential (winter) energy market volatility for residential & small C&I: fixed price Dec.-Feb. sleeve option and/or banking 50% of savings from default service rates in the low-cost spring & fall months for use later.
- Will a partner/competitive supplier invest in developing transaction & billing system with RTP recovered through a mark-up on transactions that is low-enough to attract sufficient volume for this to work? Looks promising so far.
- Strong social media, volunteers & partners for outreach.
- Future: Day Ahead (D.A.) Pricing Option, maybe 5-minute RTP load settlement (as supply is now settled in ISO-NE)