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Special thanks to Charlotte Ancel

24/7 Carbon-Free Energy (CFE) Procurement and Goal Setting Landscape

Fall 2023 | Green Strategies, Inc.

Why have a 24/7 CFE Goal?

- Time and location of consumption and generation matter (improving data to understand)
- Moving beyond procurement and initial goals to buy 100% renewable energy and/or RECs to match annual consumption
    - Even w/100% annual matching, periods of time over the course of a year when consumption is not matched by variable RE and reliant on the grid and its portfolio of resources, whether fossil or not
    - Annual "purchase" goals often met by sourcing from broad geographic boundaries and from time periods when CFE generation may be in excess of demand -> 24/7 goals usually involve more narrow time and location-matching, creating incentive for continued progress on all grids where consumption occurs
- Recognition that accelerating grid decarbonization likely relies on deploying a portfolio of both variable and **firm and dispatchable** carbon-free resources

Entities with 24/7 CFE goals or commitments

Major Electricity Buyers

- Google: 24/7 CFE on every grid where Google operates by 2030 (indicates CFE use currently at 64% on an hourly global basis as of 2022)
- Microsoft: 100/100/0 zero-carbon by 2030
- Federal Government: 100% Carbon Pollution-Free Electricity on a Net Annual Basis by 2030, including 50% on a 24/7 Basis
- Iron Mountain: achieve 100% renewable energy use 100% of the time by 2040
- Nucor, Rivian: signed UN 24/7 Compact
- Cities: Iowa – Des Moines, Waterloo, Windsor Heights; California: South Lake Tahoe; New York: Ithaca
- Peninsula Clean Energy: match demand on hourly basis w/RE by 2025

UN 24/7 Carbon-Free Energy Compact

Initiative of buyers, NGOs, project developers, electricity suppliers, data providers, and others committing to support the development of 24/7 objectives

24/7 CFE Transaction Examples

- Iron Mountain/RPD Energy: retail contracts integrating wind and hydro to serve locations across three ISOs, nine states, and 250 accounts
- Federal Government/Entergy Arkansas: executed MOU enabling federal accounts to be served by tariff (will be available to public/private customers) that integrates nuclear along w/regional wind, solar, hydro to meet objective for 100% annual CFE purchase and match 50% of load on hourly basis w/CFE
- Federal Government/Xcel: MOU to serve federal customers in CO and Midwest w/100% CFE by 2030 w/at least 50% CFE every day
- Google/NV Energy: procured 350 MW of solar and 280 MW of energy storage to serve new data center
- Google/AES: procured 500 MW of wind, solar, hydro, energy storage to match around 90% hourly consumption of VA data center
- Microsoft/Constellation: matching 100% of VA data center w/nuclear and RE from previously executed transactions

24/7 CFE Electric Supply Options

- Xcel and Entergy Arkansas: making 24/7 tariffs designed for the Federal Government open to all C&I customers
- Constellation: 24x7x365 solution that matches customer demand from portfolio of w/CFE resources including wind, solar, hydro, nuclear
- Duke Energy: proposed a 24/7 tariff for commercial customers in NC and SC in 2022
- Georgia Power: “Around the Clock” subscription for customers w/new load of >25 MW that provides hourly matching from portfolio of renewables and storage
- Energy Harbor: 24/7 Emissions-Free Energy Product that matches emissions-free energy credits (EFECs) from existing nuclear w/customer demand

Entities helping develop 24/7 CFE marketplace

- EnergyTag: independent non-profit initiative to define and build a marketplace for granular certificates (GCs) that convey environmental and emissions attributes; has developed initial standards for GC creation and use
- Singularity: Open Grid Emissions Initiative offers first publicly available dataset of validated hourly emissions and generation data for the U.S. power sector; can help analyze and predict changes in grid emissions and carbon impact
- Electricity Maps: vendor for historic, in real-time, and as forecast grid emissions and mix data for over 160 regions
- ClearTrace: provides hourly carbon accounting software that can help measure consumption, production, and emissions data
- FlexiDAO: EU-based provider of a SaaS platform to compare hourly consumption and hourly purchase and use of CFE
- Powerledger: tracking and trading platform that matches customer's load profile with electricity supply at a granular level, in near real-time w/blockchain

Considerations in 24/7 CFE Goal Design

- **What counts toward the goal?**
  Options could include:
  - On-site CFE
  - A customer's transactions for off-site CFE
  - A customer's purchases of EACs
  - Grid-supplied CFE
    - Mandatory CFE procured by utility or LSE under RPS or CES
    - Nonbypassable ratebase CFE procured by utility or LSE

- **To what extent will existing and/or new CFE resources be used to meet the goal?**
  - Even if one includes existing CFE in a goal baseline, only rely on new CFE to meet a goal?

- **What are the geographic matching requirements?**
  - Moving from broad geographic matching toward same grid as consumption
  - "Same grid" could be broader RTO or narrow as balancing authority
  - Is CFE delivered to same grid acceptable? Any consideration for transmission constraints?

- **What are potential interim goals?**
  - Continue 100% annual matching, while trying to hit more time-granular milestones
  - Example interim goals: 50% minimum in every hour or high average (80%) but no minimum

Methodologies available from Google, White House CEQ Implementing Instructions

Data Needs

Hourly Electricity Consumption Data

- Deployment of advanced meters may be limited, such data may not be readily shared with customers or digestible by customer
- A lack of actual consumption data may not be the end of the story and potential proxies could serve as substitutes - can potentially find comparable building load profiles
  - May be possible to convert monthly buyer consumption data in hourly estimate based on utility load profile
  - May be able to use public estimated load profile – for example, NREL offers *End-Use Load Profiles for the U.S. Building Stock*

Hourly Generation and Grid Emissions Data

- Development of GCs will help and hope is for hourly-measured generation data
- Similar to consumption, what to do to convert annual or monthly data to hourly estimates
  - May be possible with RTO generation profile data, EIA Hourly Electric Grid Monitor
- Beyond accounting for one's own CFE purchases, many customers want to account for the CFE already included in the grid mix – currently complicated by lack of adequate residual grid emissions factors – which account for CFE already claimed by other customers - for many grids
  - Under a "book and claim" approach, a customer could work to have EACs from existing CFEs retired on its behalf and not claim CFE use until achieved

CFE Score: metric to track progress of hourly consumption of CFE over the course of the year

24/7 CFE under Scope 2 GHG Inventory Accounting

- Current Scope 2 Guidance under GHG Protocol directs reporting entities to use annual inputs (consumption, emissions factors) and permits (under the market-based method) matching of EACs/RECs sourced from broad geographies w/consumption
  - A reporting entity can voluntarily estimate its Scope 2 inventory using hourly inputs and more narrow geographies, but unless guidance to all entities is to prepare hourly inventories, diminished incentive for any one company to do
  - GHG Protocol and Scope 2 Guidance also inform the regulatory and voluntary requirements for climate disclosure and other climate leadership and recognition initiatives including the Science-Based Targets initiative (SBTi), CDP, RE100
- Clean Air Task Force (CATF)/Green Strategies/NorthBridge Group recommendations for updating Scope 2 Guidance to integrate the use of more time and location-granular information in Scope 2 inventory preparation
  - With the use of more granular information, “modified” Scope 2 inventories will better reflect the emissions associated with a reporting entity’s electricity use
  - Enable Scope 2 inventories to better reflect progress on decarbonizing individual grids and recognize strategies that aim to deploy CFE resources and manage electricity use based on time and location elements

Getting involved in advancing 24/7 CFE

- Plenty of stakeholder forums for continued education and sharing of best practice:
  - UN 24/7 Carbon-Free Energy Compact
  - Clean Energy Buyers Institute (CEBI) Beyond the Megawatt Initiative
  - WRI 24-7 Carbon-Free Energy project
  - RAP 24-7 CFE project
  - EnergyTag working groups on GC development
- GHG Protocol's update process for Scope 2 underway – will engage stakeholders from across public and private sectors, academics, NGOs, and other experts over next two years – could result in updated guidance to use time and location-granular inputs in estimating Scope 2 inventories
- Dialogue with electricity suppliers and others (RTOs, REC registries) to access data on consumption and grid generation and emissions that could in help 24/7 goal tracking

October 18, 2023

24/7 Carbon Free Transition Tariffs – A Regulatory Tool for Accelerating Decarbonization

REV 2023 Conference

Strategies for Advancing 24/7 Carbon-Free Energy

Dave Farnsworth, RAP

A Three-Phase Project This Year

24/7 Project Goals

- Establish a constructive national dialogue around 24/7 carbon-free energy (CFE)
- Examine technical challenges to implementing 24/7 CFE
- Create 24/7 CFE transition tariff options

Summary Report

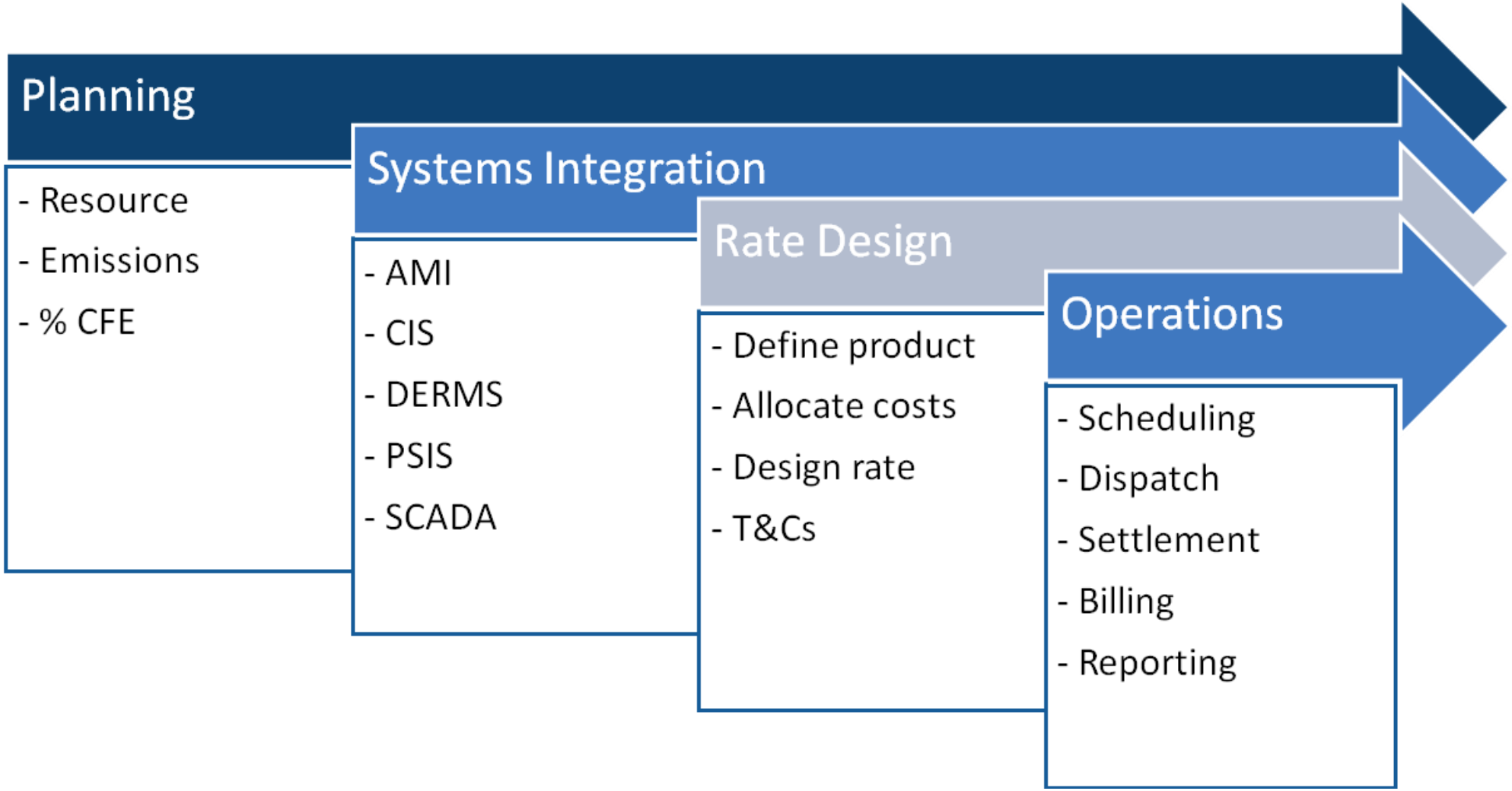
- Addresses key implementation recommendations necessary to support a 24/7 CFE Transition Tariff

- Includes *Resources*, *Emissions* and *Ratemaking* papers, and a *Sample Tariff* as appendices

Designing Tariffs

- Practical 24/7 tariffs for now…
  - requires many interim improvements with an eye toward long run best practice

- Implementing practical tariffs today will…
  - drive planning, operations, emissions tracking and ratemaking changes needed to achieve best practice in the long run


Planning
- Resource
- Emissions
- % CFE
Systems Integration
- AMI
- CIS
- DERMS
- PSIS
- SCADA
Rate Design
- Define product
- Allocate costs
- Design rate
- T&Cs
Operations
- Scheduling
- Dispatch
- Settlement
- Billing
- Reporting

Keeping an Eye on Long Run Best Practice Requires

- Integration of 24/7 CFE portfolios into resource planning and procurement
- Alignment of operational improvements with information technology capabilities
- Use of best hourly emissions data or emissions data proxies to validate emissions impact
- Ratemaking that anticipates costs and benefits of 24/7 investments associated with building grid that meets local, state and federal policy goals

Practical Planning & Procurement Improvements that 24/7 Carbon Free Energy Transition Tariffs Should Support Now

Planning and Procurement -- Recommendation #1

Recognize the Contribution of 24/7 Carbon Free Energy to Local, State, Federal and Utility Policy Goals

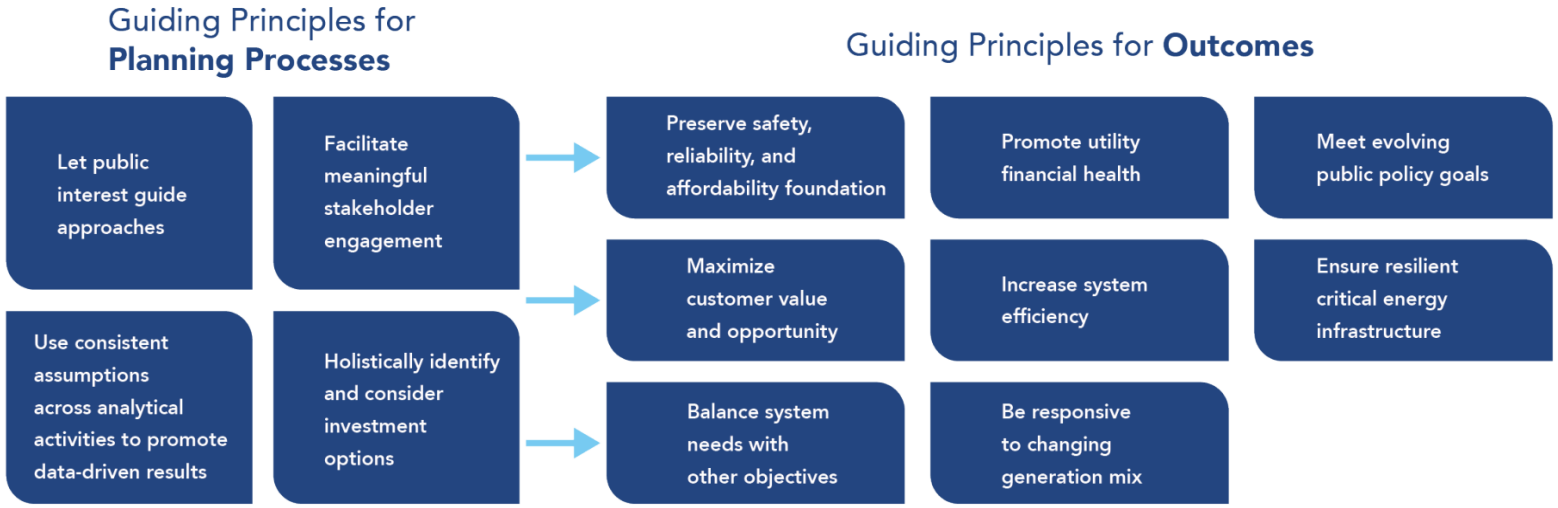
Planning and Procurement -- Recommendation #2

Account for Progress Toward Meeting Local, State, Federal and Utility Emissions Reduction Goals is Essential

Planning and Procurement -- Recommendation #3, *part 1*

Integrate 24/7 Portfolio Planning with Planning According to Context

Figure 4: Guiding Principles Frequently Referenced by Task Force Cohorts

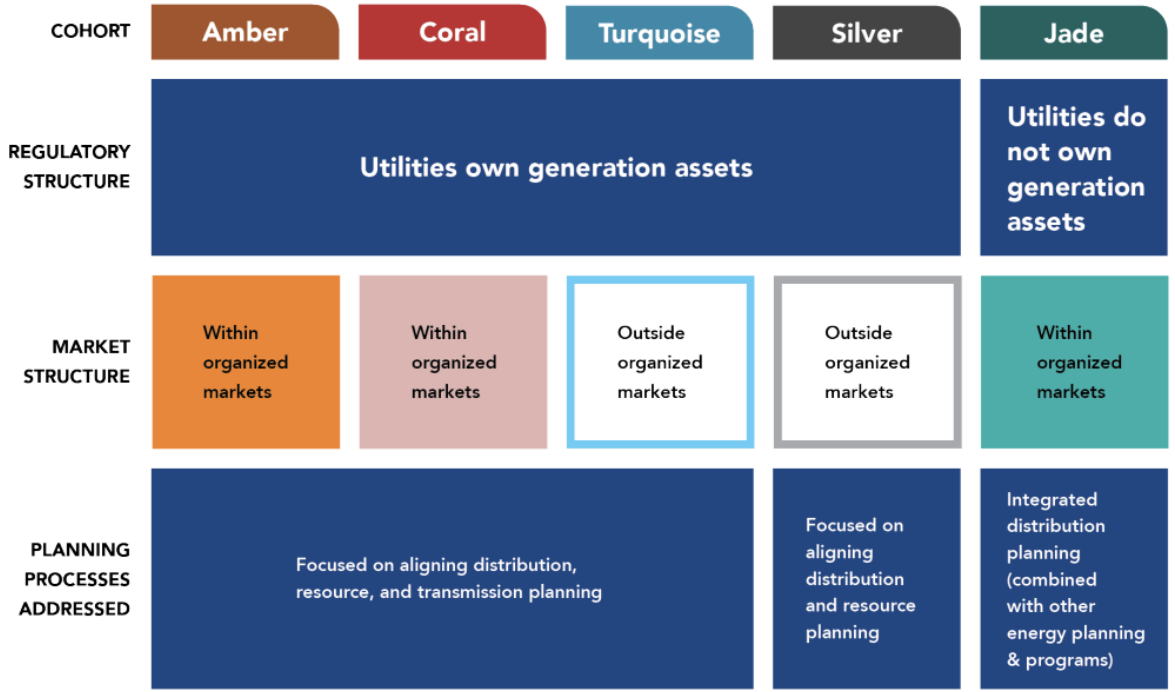


Blueprint for State Action: NARUC-NASEO Comprehensive Electricity Planning Task Force, page 15

Recommendation #3, *part 2*

Follow NARUC Planning Cohort Contexts

Figure 2: Overview of Task Force Cohort Structure



Blueprint for State Action: NARUC-NASEO Comprehensive Electricity Planning Task Force, page 9

Practical Operational Improvements that 24/7 Carbon Free Energy Transition Tariffs Should Support Now

Operational Improvements -- Recommendation #1

Match with Actual Data

- Implement hourly matching using *actual* data
  - Where the best available data could be hourly or monthly profiles
- System Integrations
  - Metering System
  - Market Settlement System
  - Generation/Emissions Tracking System
  - Billing System
- An Essential First Step
  - Matching using actual data is a prerequisite for matching using forecast data

Operational Improvements -- Recommendation #2

Match with Forecast Data

- Implement hourly matching using *forecast* data
- System Integrations Abound
  - Market systems are likely to be starting point
  - Customer & DER systems could come next
  - Operations, GT&D could follow
- Tariff Design Informs System Integration
  - Design of CFE tariff will require some system integrations, and system integration constraints will also constrain tariff design
- Bottom Line
  - Some system integration is necessary
  - Implementing full smart grid vision is not

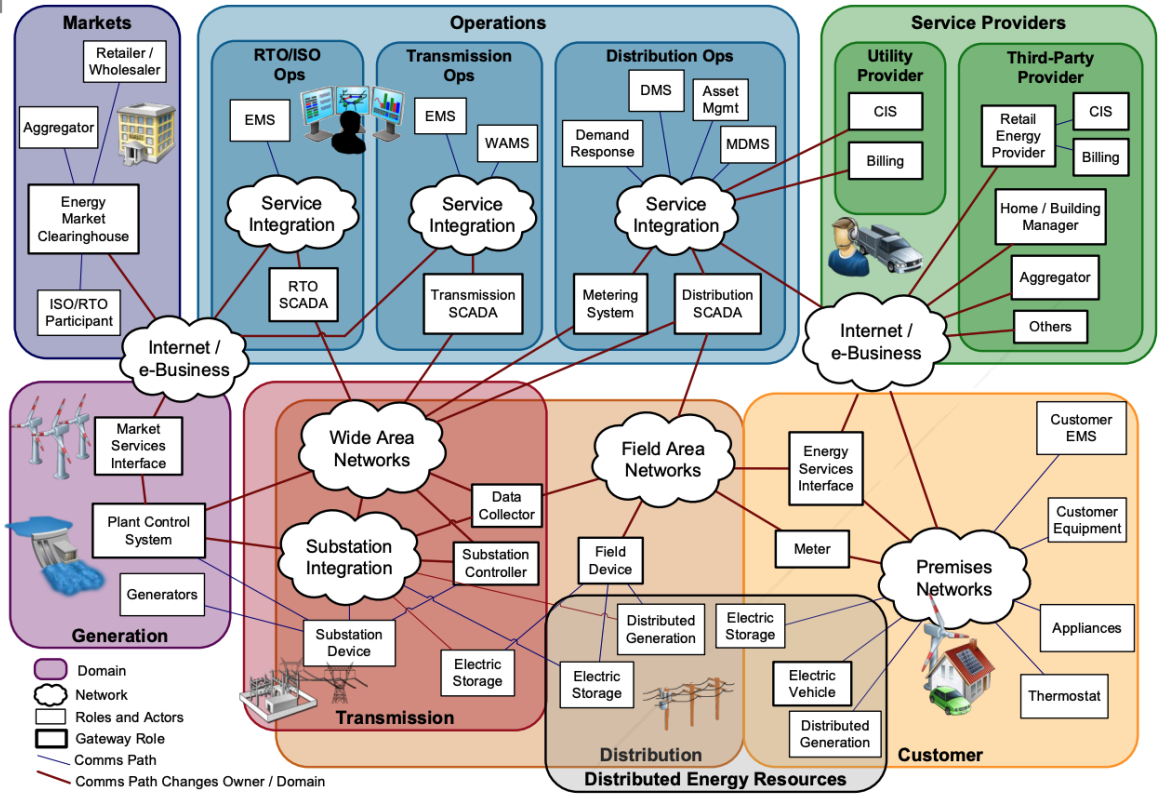


Figure 5-7. Logical Model of Legacy Systems Mapped onto Conceptual Domains for Smart Grid Information Networks

Operational Improvements -- Recommendation #3

Increase Forecast Frequency

- Frequent forecasts are foundational for ex ante matching.
- Focus on forecasting the aggregates, not the individuals.
  - Develop & integrate demand forecast systems for aggregations of CFE customers.
  - Develop & integrate supply forecast systems for the portfolio of CFE resources.
- Frequent, accurate forecasts enable better operational decisions.

Practical Emissions Tracking and Validation Requirements 24/7 Carbon Free Energy Transition Tariffs Should Support Now

Emissions – Recommendation #1

Support the adoption of hourly all-generation tracking systems.

Emissions – Recommendation #2:

Adopt hourly, *attributional, market-based accounting* to support 24/7 CFE procurement, and rely first on *best available* emissions data.

Emissions – Recommendation #3:

Rely on Best Available Customer Load Data

Emissions – Recommendation #4:

When allocating existing CFE, ensure that nonparticipating consumers are not harmed.

Emissions – Recommendation #5:

Tariff design should balance the interest in greater access to CFE resources with the physical realities of the grid.

Practical Ratemaking, Pricing and Resource Compensation Principles 24/7 Carbon Free Energy Transition Tariffs Should Support Now

Key Question from Comments

- To what extent are 24/7 Transition Tariffs an evolution or phase change from previous tariffs and programs?
- Possible answers
  - Expanded set of technologies and resources
  - Higher system value for non-participating customers
  - Better participating customer value proposition
  - Better customer-side structure for load management

Ratemaking, Pricing, and Resource Compensation Recommendations for…

- Utility-Owned 24/7 CFE Offerings in Vertically-Integrated Jurisdictions
- Alternative Supply Choices in Vertically-Integrated Jurisdictions
- Restructured Jurisdictions with Supply Choice
- Recognizing Distributed Energy Resource Options

Next Steps

Report Timeline

- Completing draft Summary Report and Appendices (including sample tariff) – November 2023

- Schedule for release of production quality report planned for February 2024

Buildings as Grid Assets: How Supply Side Investment and Hourly Accounting Can Help

Rachael Straub

Senior EM&V Project Manager

CXassociates LLC

Burlington, VT | Portland, ME | Keene, NH

Engineering a future where buildings are better

Founding

1994

Started with building commissioning.

Today

A suite of services for new and existing buildings and efficiency programs.

In the business of decreasing a building's energy use and carbon footprint to combat climate change.

Services

Commissioning

Retrocommissioning

Energy audits

Decarbonization

Measurement and verification

Energy management (EMIS)

Controls optimization

Program evaluation

LEED facilitation

Markets

Higher education

Museums & historical sites

PK-12 education

Healthcare

Multifamily

State & municipal

Utilities

Industrial

Large residential

Buildings are More of an Asset than We Think

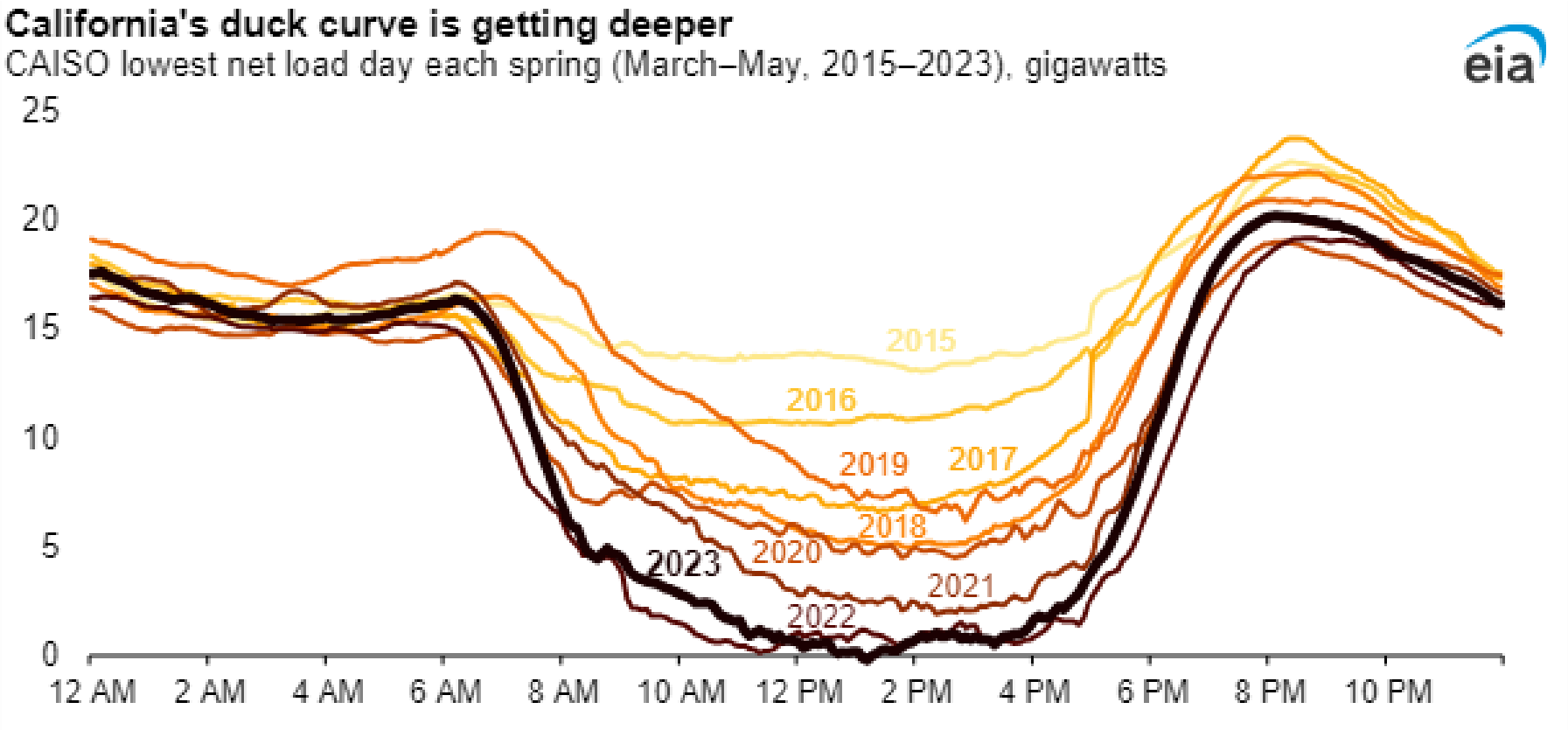
100% net-zero emissions economy by 2050[1]

Decarbonizing the grid is essential to meet U.S. climate mitigation goals.

Wind, solar, and biomass account for just 13% of electricity generation in the U.S. (5% a decade ago).[2]

1. U.S. Biden Administration National Climate Task Force
2. U.S. Environmental Protection Agency Electric Power Sector Basics

"The problem with investing in more solar panels in California is that the output often will not cause fossil fuel based generators to turn off, because they are already idle at the time of day the solar panels will produce power." - Chalendar and Benson



Source: U.S. Energy Information Administration

Buildings account for:

75% of electricity generation[3]

40% of annual global CO_2 emissions[4]

3. U.S. Department of Energy

4. International Energy Agency 2022

New study[5] says massive investment in building energy efficiency could…

Reduce building emissions up to 91% below 2005 levels,

Represent nearly half of sectoral CO_2 emissions by 2050,

And avoid more than one-third of the cost of decarbonizing the power supply.

Efficient, grid-responsive buildings would make a zero-carbon grid $100B cheaper per year

5. Langevin, J., et. al. 2023. *Demand-side solutions in the US building sector could achieve deep emissions reductions and avoid over $100 billion in power sector costs.* One Earth. Volume 6, Issue 8, 1005-1031.

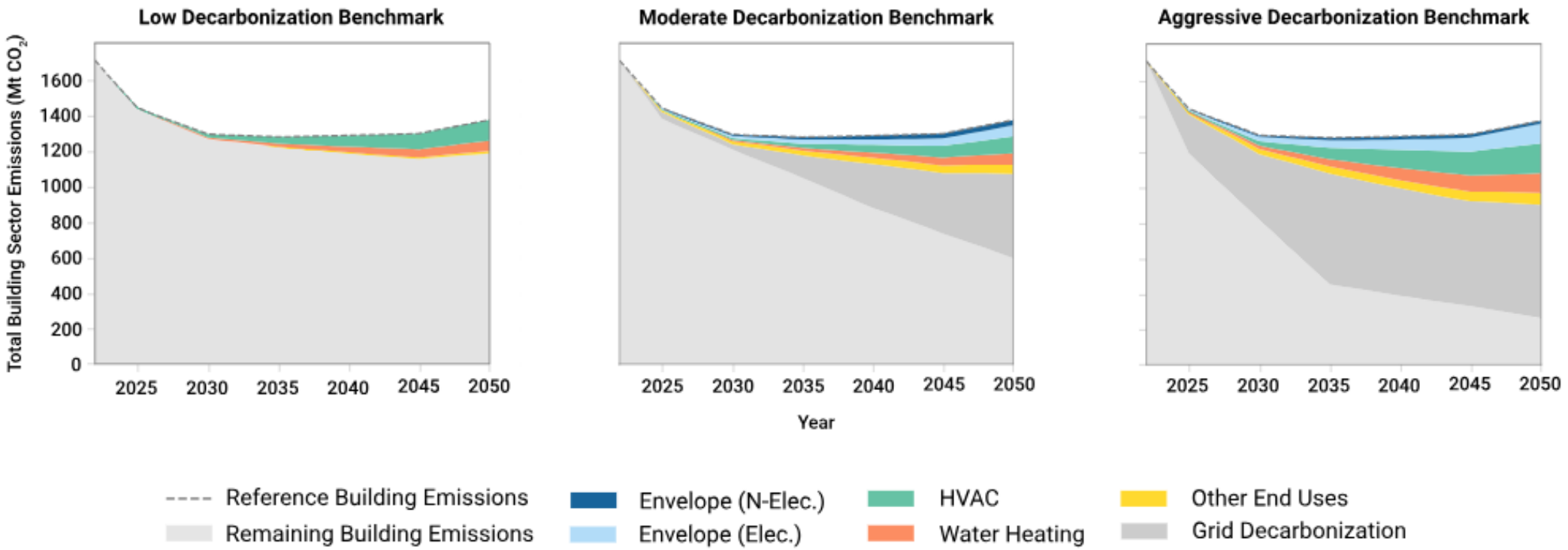


Figure Caption: The figure shows emissions reduction wedges relative to AEO 2021 Reference Case building sector emissions for the low, moderate, and aggressive benchmark scenarios. Reductions from electrifying and improving the efficiency and flexibility of building end uses (demand-side measures) are indicated with colored wedges for each affected end use. Power supply decarbonization, which further reduces the emissions from any reference case building electricity that remains after accounting for deployment of efficiency and flexibility measures, is indicated with a dark gray wedge in the figure, and remaining building sector emissions are represented by the lighter gray wedge.

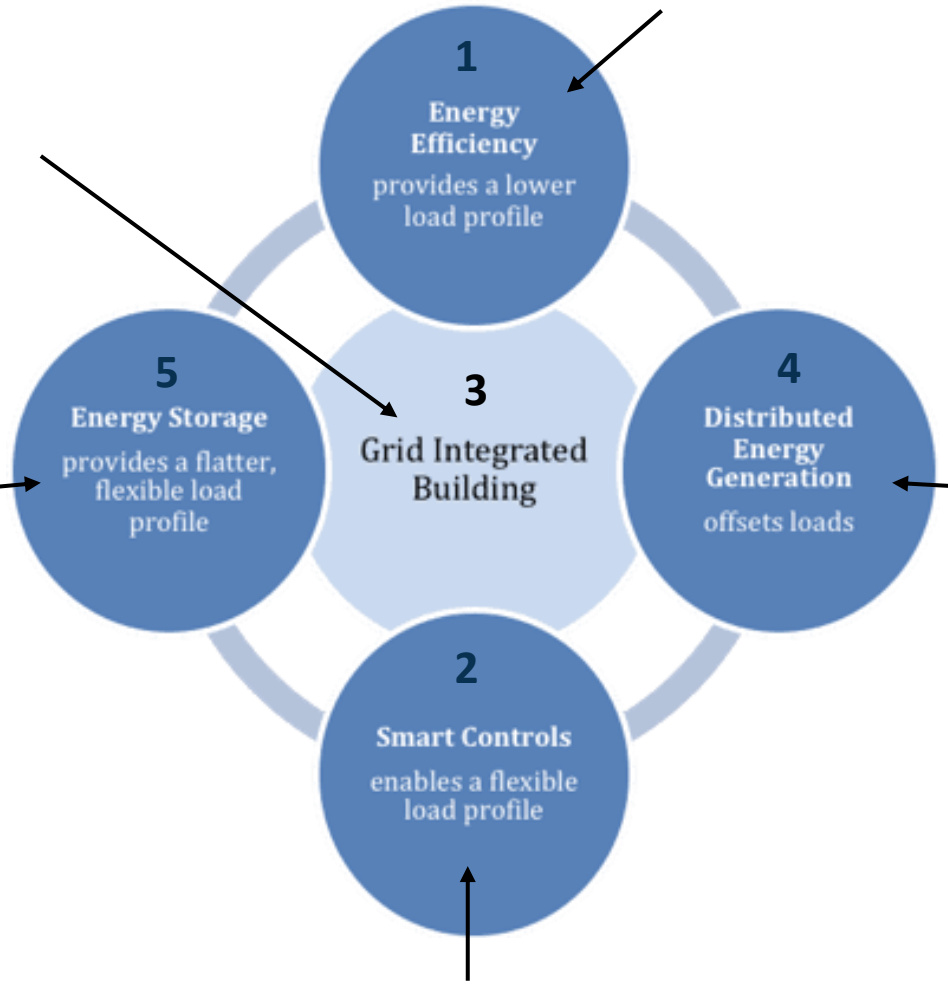
Grid-interactive Efficient Buildings (GEBs)

What a building-based grid asset could look like

Technology: Connected to the grid through two-way communication.

Behavior: high incentive program utilization and consumer learning.

Energy efficiency provides foundation for electrification. Lowest hanging fruit.



Batteries, thermal storage.

Solar panels, wind turbines, geothermal, etc.

Sensors, controls, and analytics. Also relatively inexpensive.

Graphic Source: Rocky Mountain Institute, https://rmi.org/our-work/buildings/pathways-to-zero/grid-interactive-energy-efficient-buildings/

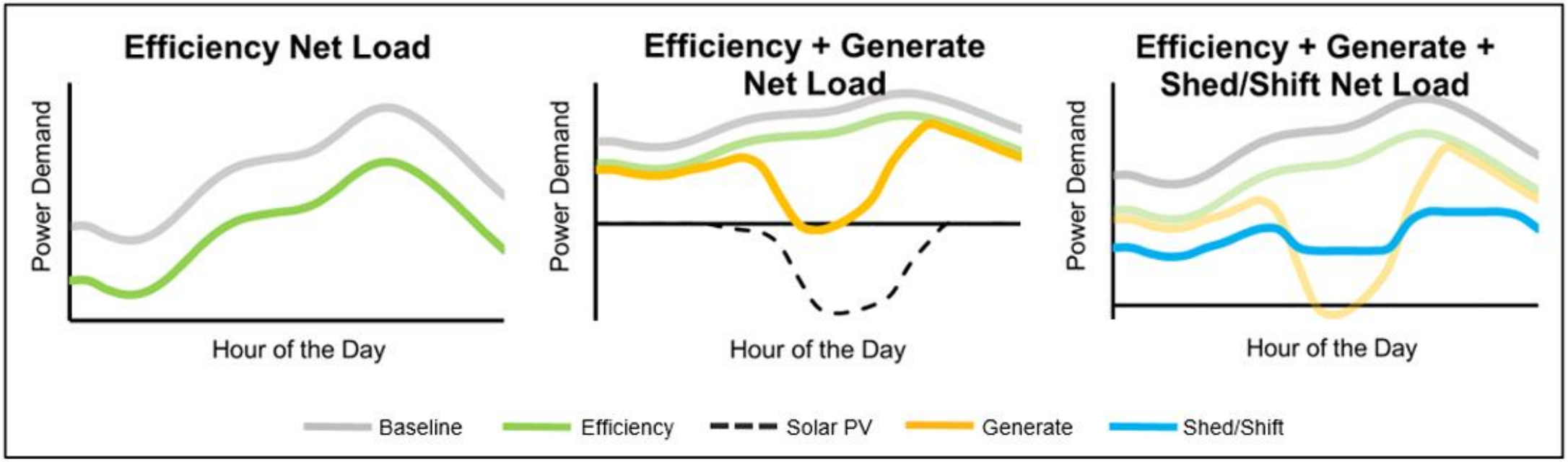


Figure 3. GEB load curves

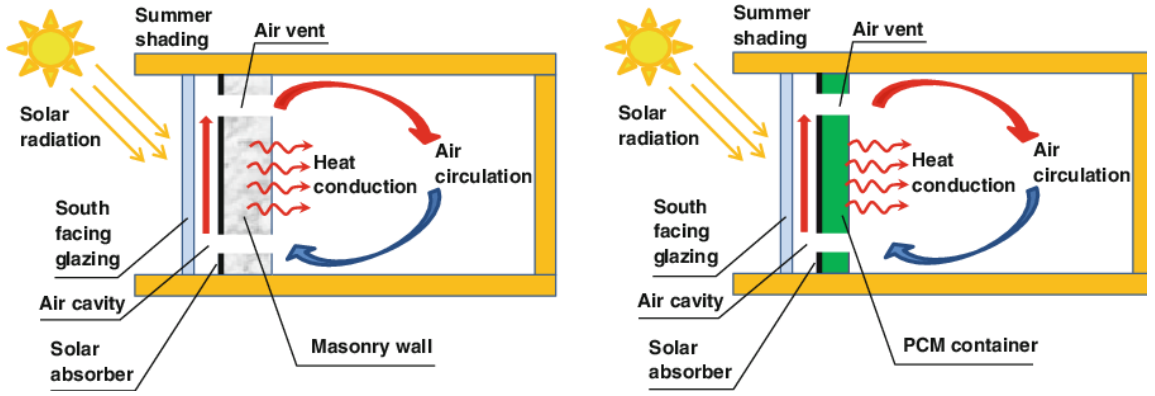
In these graphs, the gray curve represents an example baseline residential building load curve generated using the Scout time-sensitive efficiency valuation framework, as in Figure 2. All resulting building load curves (green, yellow, and blue) were estimated for illustrative purposes and are meant to show the additive effects of efficiency, solar PV, and flexibility in a single building.

6. Neukomann, M., et.al. *U.S. Grid-interactive Efficient Buildings Technical Report Series*. Department of Energy Office of Energy Efficiency & Renewable Energy. Dec 2019.

Overcoming Barriers

Investing in Buildings

Pushing the Envelope



Deep enclosure retrofits extend occupant comfort to **days rather than hours**.[7]

Passive thermal storage needs **active thermal** to meet long-term demand response.[8]

Thermal storage may not have a favorable ROI for building owners **but could for utilities**.[9]

7. Erba, S. and Barbieri, A. (2022) Retrofitting Buildings into Thermal Batteries for Demand-Side Flexibility and Thermal Safety during Power Outages in Winter. Energies 15(12):4405.

8. Chen, Y.; Xu, P.; Chen, Z.; Wang, H.; Sha, H.; Ji, Y.; Zhang, Y.; Dou, Q.; Wang, S. Experimental investigation of demand response potential of buildings: Combined passive thermal mass and active storage. Appl. Energy 2020, 280, 115956.

9. Li, Zhenning, et. al. (2021) Cost Targets to Achieve Commercially Viable Thermal Storage in Buildings. Oak Ridge National Laboratory for the U.S. DOE.

Image source: Kośny, J. (2015). Short History of PCM Applications in Building Envelopes. In: PCM-Enhanced Building Components. Engineering Materials and Processes. Springer, Cham. https://doi.org/10.1007/978-3-319-14286-9_2

Include the True Costs

ROI for thermal storage includes costs related to demand management and peaker plants that could avoided.

Green Mountain Power - giving customers Tesla home batteries cheaper than building new lines and power plants.[10]

Demand flexibility is better for the climate than natural gas[11], but the price of natural gas doesn't include cost of GHG.

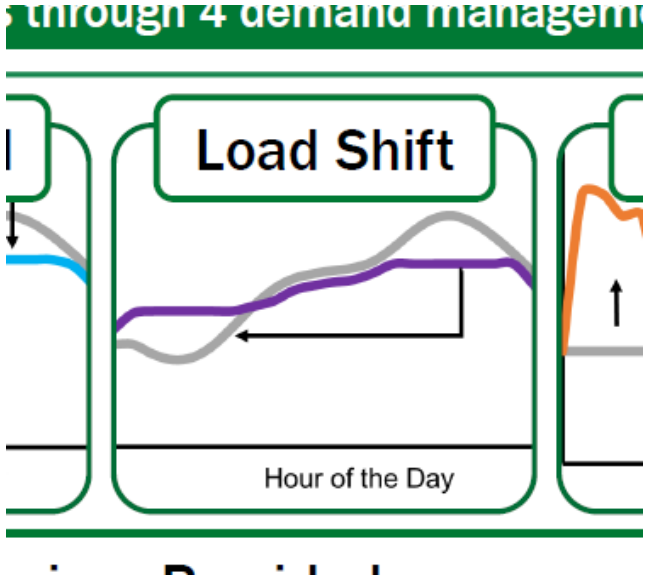
10. "Vermont Utility Plans to End Outages by Giving Customers Batteries" https://www.nytimes.com

11. Goldenberg, C., M. Dyson, and H. Masters. 2018. Demand Flexibility: The Key to Enabling a Low-Cost, Low-Carbon Grid. Basalt, CO: RMI. rmi.org/wpcontent/uploads/2018/02/Insight_Brief_Demand_Flexibility_2018.pdf.

Overcoming Barriers

Annual Accounting

It’s not just about peak. It’s also about carbon.



Carbon Intensity (of electricity)

The amount of carbon emissions for which one unit of electricity is responsible. Expressed as:

- **lbs CO_2e / kWh**
- **tons CO_2e / MWh**

Carbon Footprint (of a building)

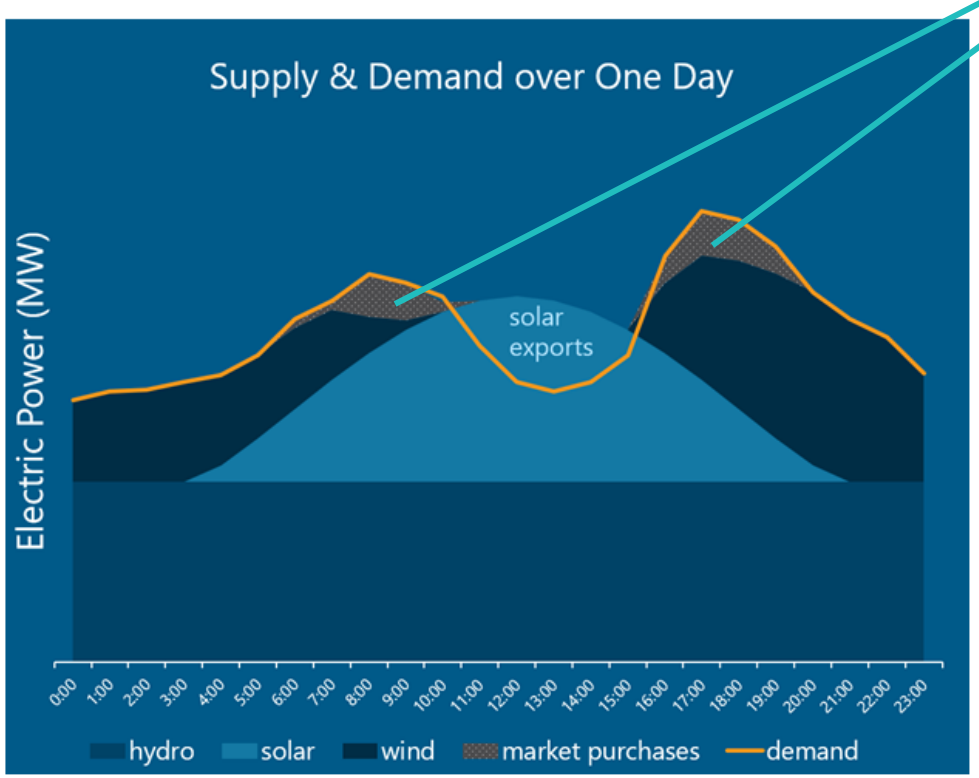
The carbon intensity of the grid multiplied by how much energy the building uses.

- **(lbs CO_2e / kWh) x kWh**

Expressed as:

- **lbs CO_2e**

Annual Accounting



CARBON FREE? CURRENT LEGISLATION ALLOWS UTILITIES TO USE RENEWABLE EXPORTS (KEEPING UNBUNDLED RECS) TO MASK THE CARBON IMPACTS OF WHOLESALE POWER PURCHASES. ANNUALLY RESOLVED REC ACCOUNTING MAKES THIS POSSIBLE.

Renewable Energy Credits (RECs)

Reconciled **annually** to meet quotas Renewable Portfolios Standards for those states that have one

Unbundled - detached from the time and location from which it was originally generated

Annual accounting overstates emissions reductions

By 50% when solar energy reaches 25%[12]

PCE MATCH model demonstrates 40x increase in carbon intensity between annual and hourly accounting[13]

Hides the carbon intensity of the grid when fluctuations in renewables is large.

Relying on Hydro Quebec

Massive number of inexpensive RECs created decades ago.

Hampers the development of new renewables in neighboring states

12. Chalendar, J.A., Benson, S.M. *Why 100% Renewable Energy Is Not Enough.* Joule. Volume 3, Issue 6, 1389-1393. June 2019.

13. Pepper, J., Miller, G., Maatta, S., Shahriari, M. *Achieving 24/7 Renewable Energy by 2025*. Peninsula Clean Energy white paper. January 2023.

Impact on Demand Side

Sending the Wrong Message to Building Owners

GHG Protocol's "Location-based" (ISONE carbon intensity) and "Market-based" (includes RECs) emissions numbers give mixed signals.

"We've got this, your electricity is already carbon free", when it isn't.

Lack of Granularity

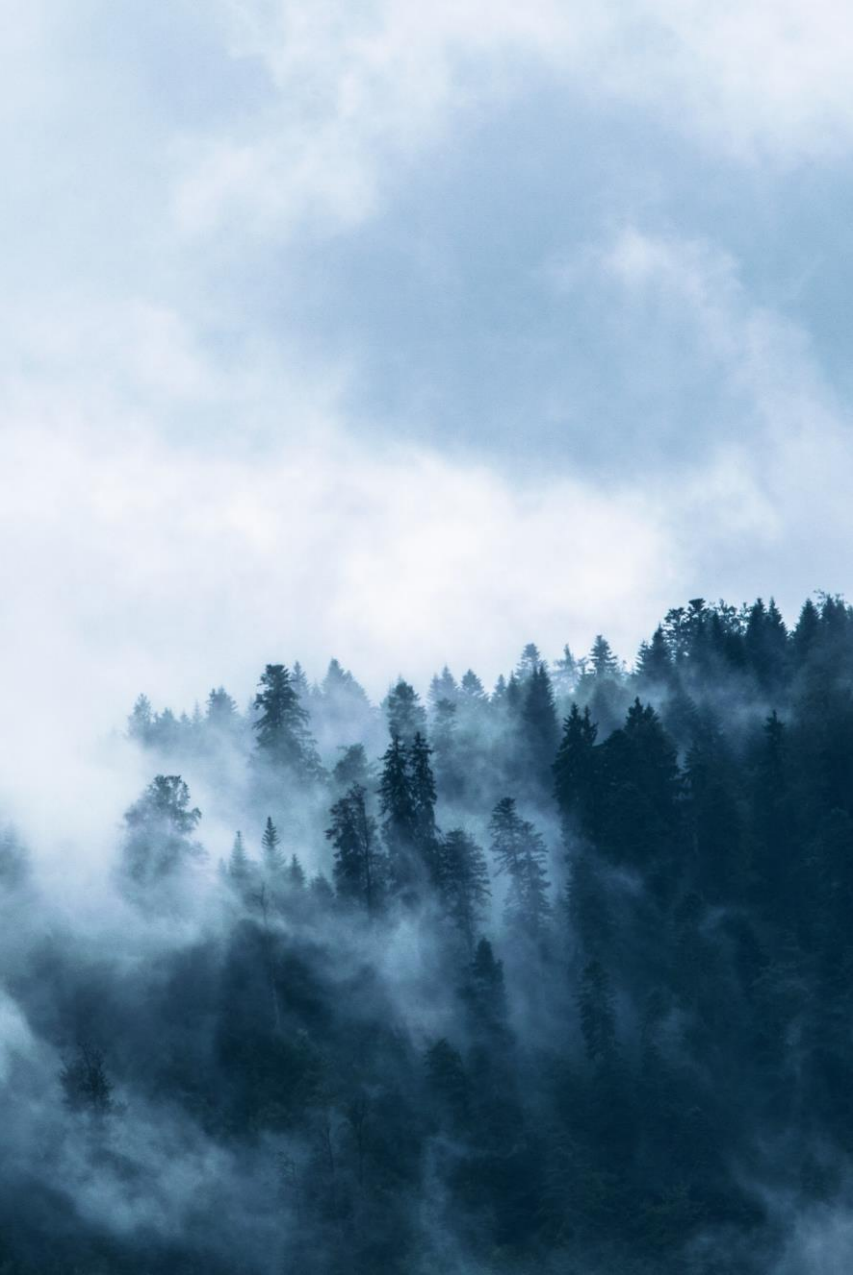
Hides the time-of-use with respect to carbon.

Undervalues the program we already have.

Undermines the potential of a GEB to respond to the grid.

What Are We Missing?

Solution can be unlocked by the right signaling.



What Do We Need?

- ✓ Actions by building owners based on hourly carbon signaling.

AND

- ✓ Actions by utilities based on peak or price signaling.

(And when do we need it? NOW!)

Thank you!

Contact:

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THANK YOU REV2023 SPONSORS & EXHIBITORS!

Special thanks to Charlotte Ancel