Lovejoy Office Building | Portland, OR *Credit: Opsis Architecture*

MWCOG: Getting to Zero Carbon

June 18, 2020

California Lottery Santa Fe Springs | Santa Fe Springs, CA *Credit: LPAS Architecture + Design*

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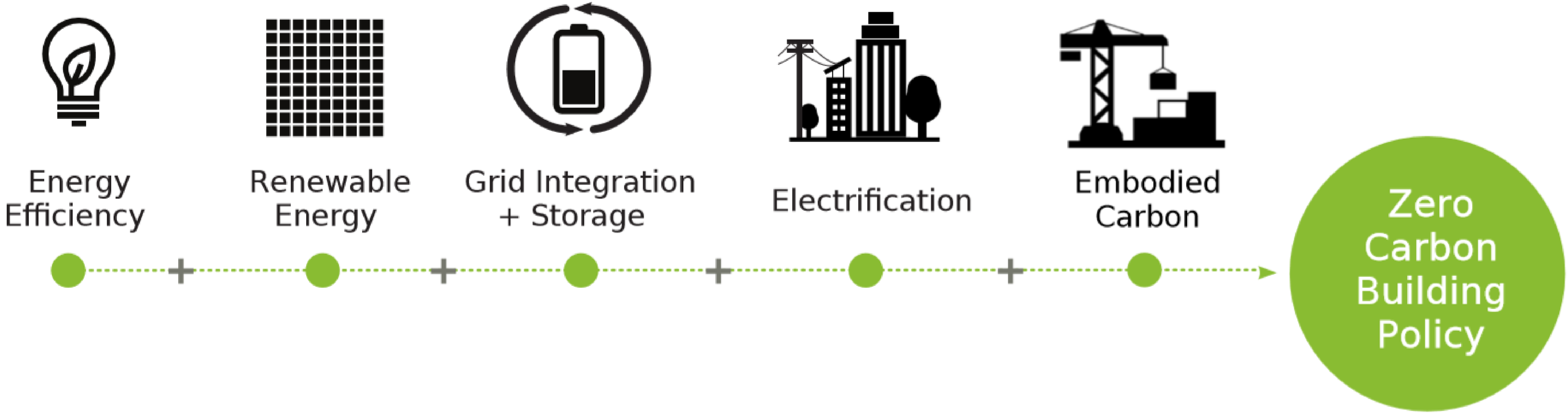
Mission

To achieve better buildings that are zero energy, zero carbon, and beyond – through research, policy, guidance and market transformation – to protect people and the planet.

Five Foundations of Zero Carbon Building Policies



Definitions/Lexicon

Zero Energy

(aka Net Zero Energy, Zero Net Energy)

A zero energy building combines energy efficiency and renewable energy generation to consume only as much energy as can be produced onsite through renewable resources over a specified time period. (Source: U.S. Department of Energy)

Zero Carbon

(aka Net Zero Carbon, Zero Net Carbon)

A zero carbon building is defined as one that is highly energy-efficient and produces onsite, or procures, carbon-free renewable energy in an amount sufficient to offset the annual carbon emissions associated with operations. (Source: Zero Carbon Building Standard Canada Green Building Council)

Electrification

Electrification refers to replacing direct fossil fuel use (e.g., propane, heating oil, gasoline) with electricity [use] in a way that reduces overall emissions and potentially energy costs while lowering other air pollutants.
(Source: Environmental and Energy Study Institute)

Building-Grid Integration

(aka Grid-Enabled Buildings, Grid Harmonization)

Building-grid integration refers to the integration and optimization of homes and commercial buildings with the nation's energy grid. (Source: [Department of Energy])

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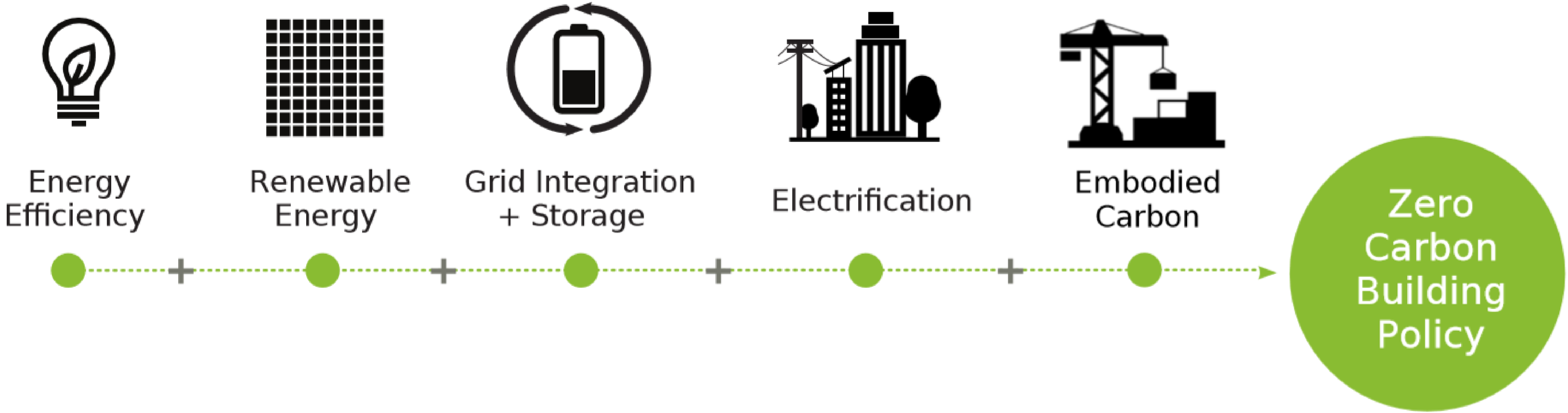

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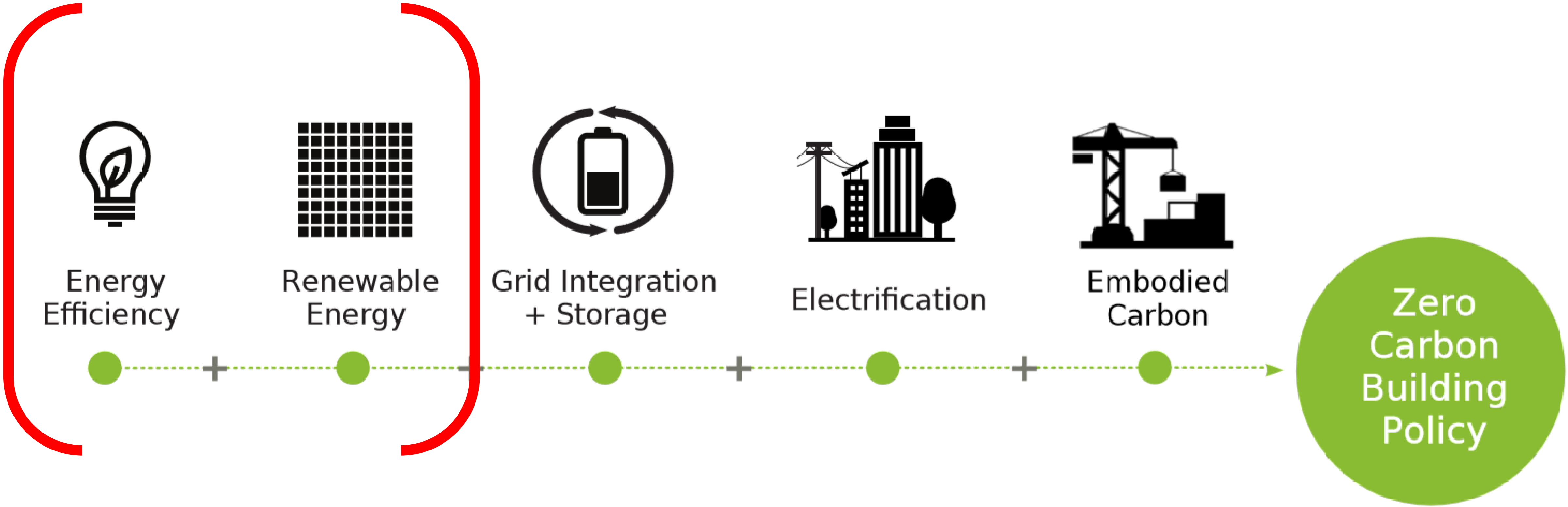
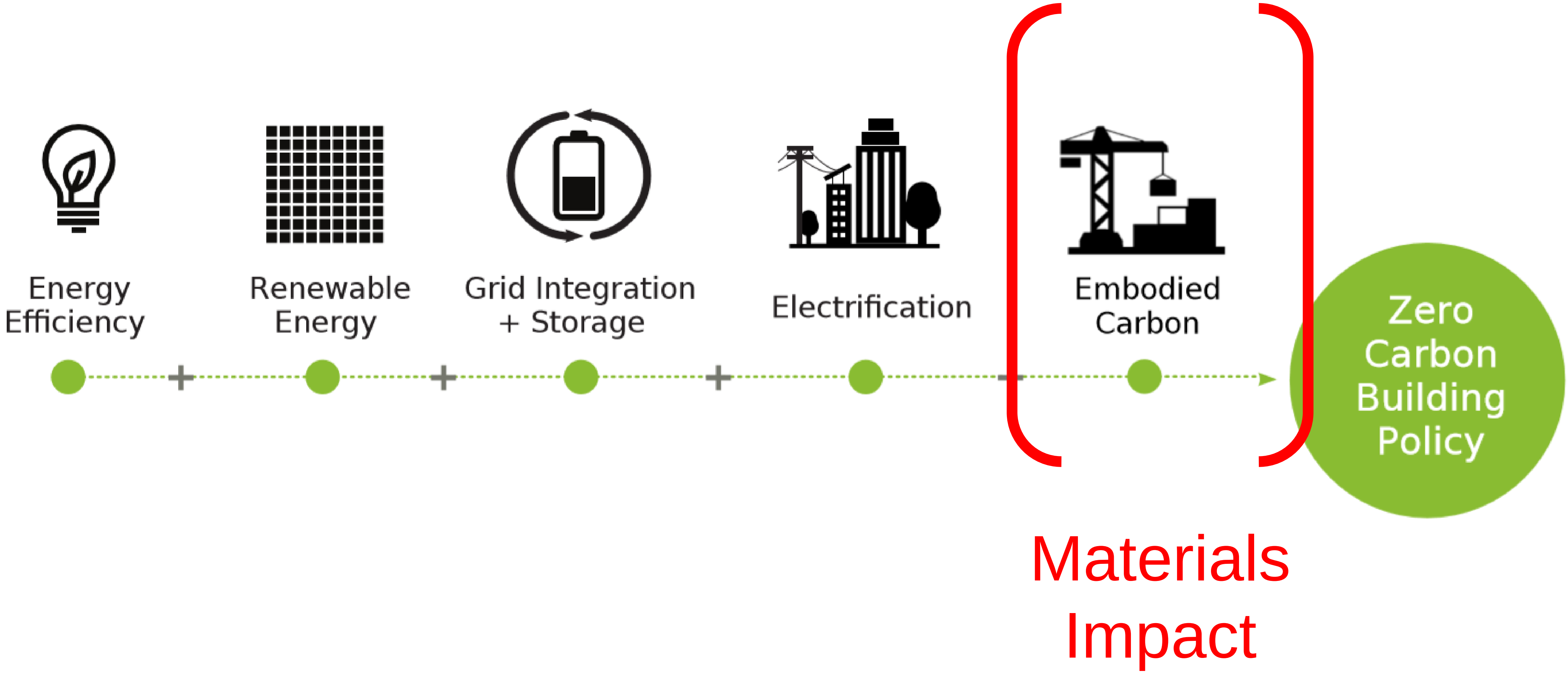


The basis of ZNE

Five Foundations of Zero Carbon Building Policies



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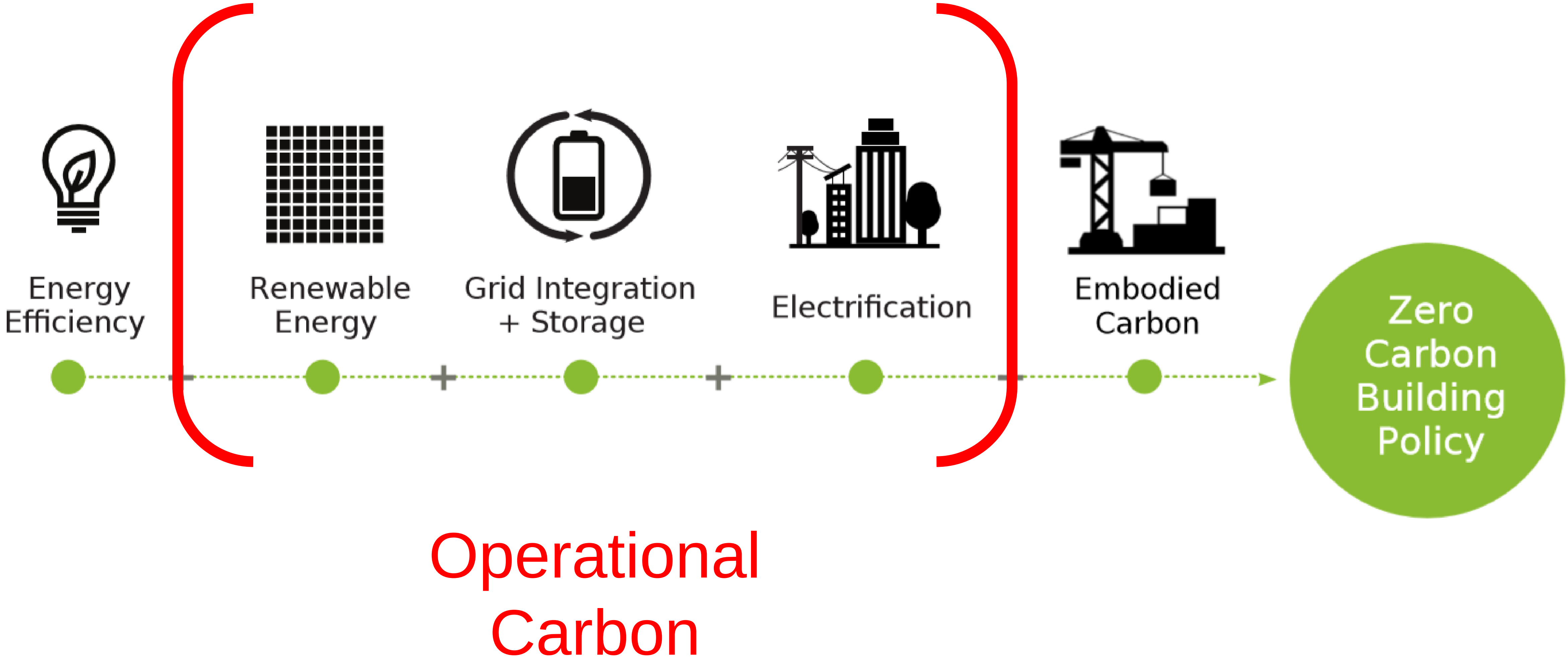
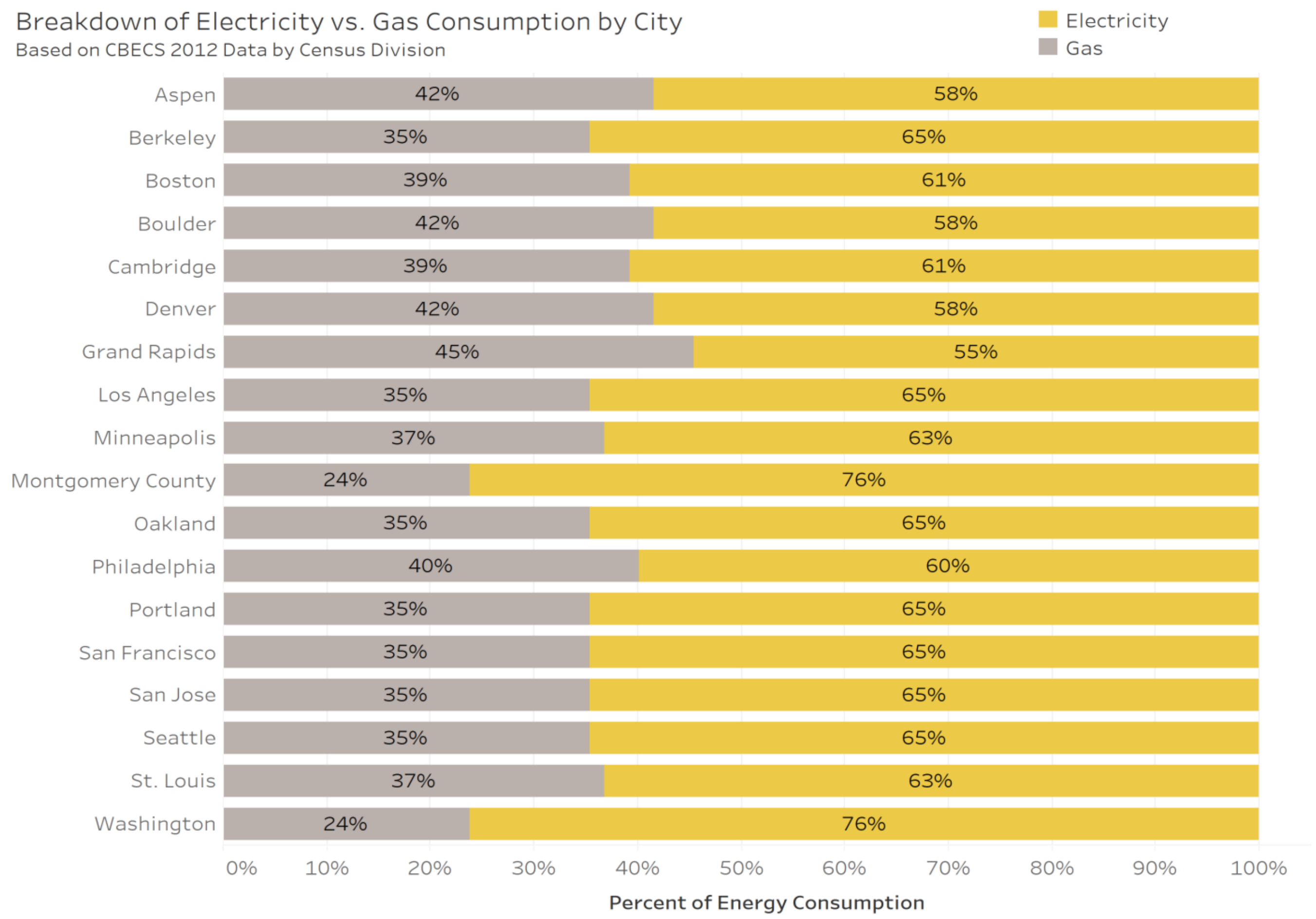


Operational Carbon

Gas v. Electric Commercial Bldgs (Site BTUs)



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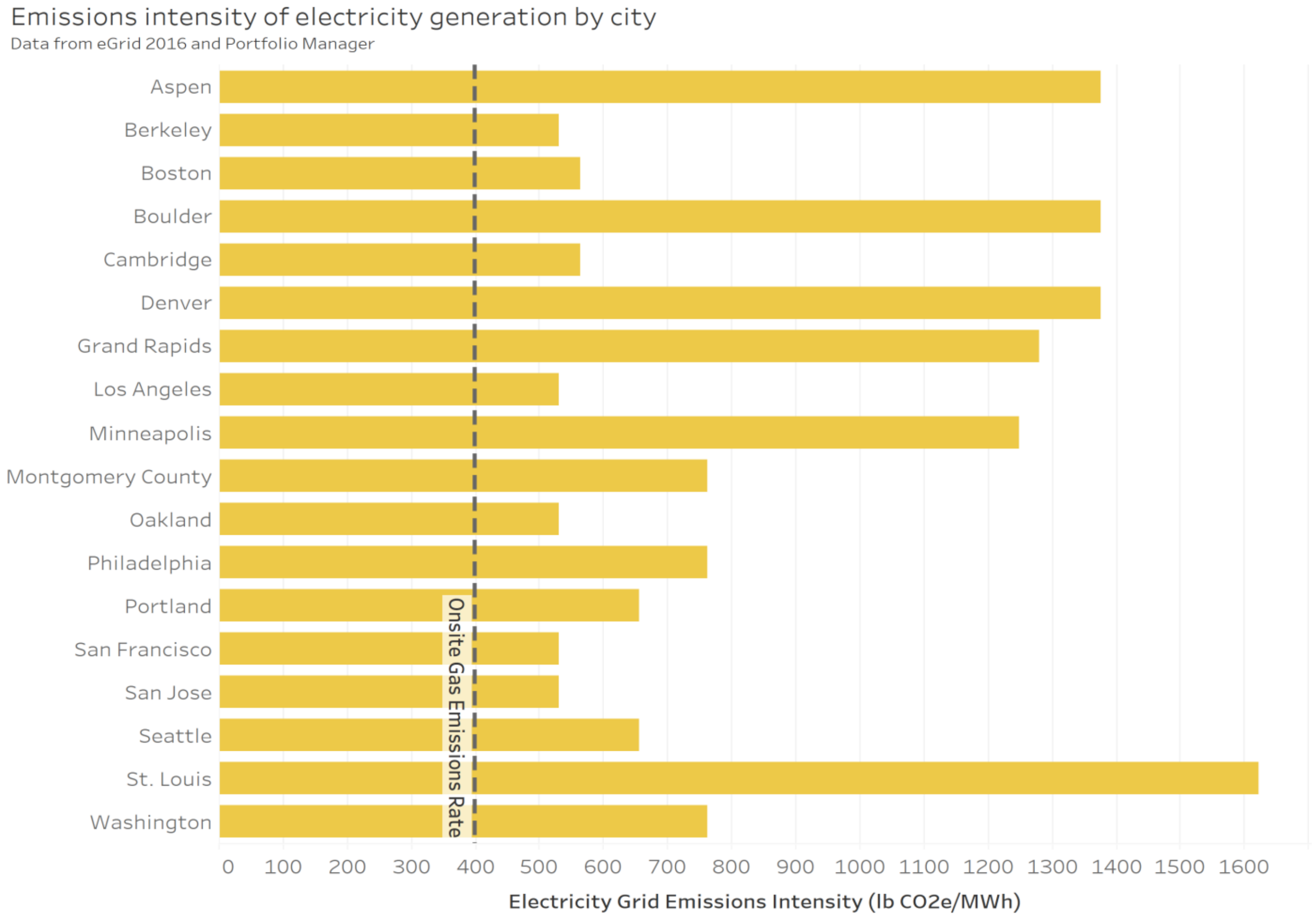
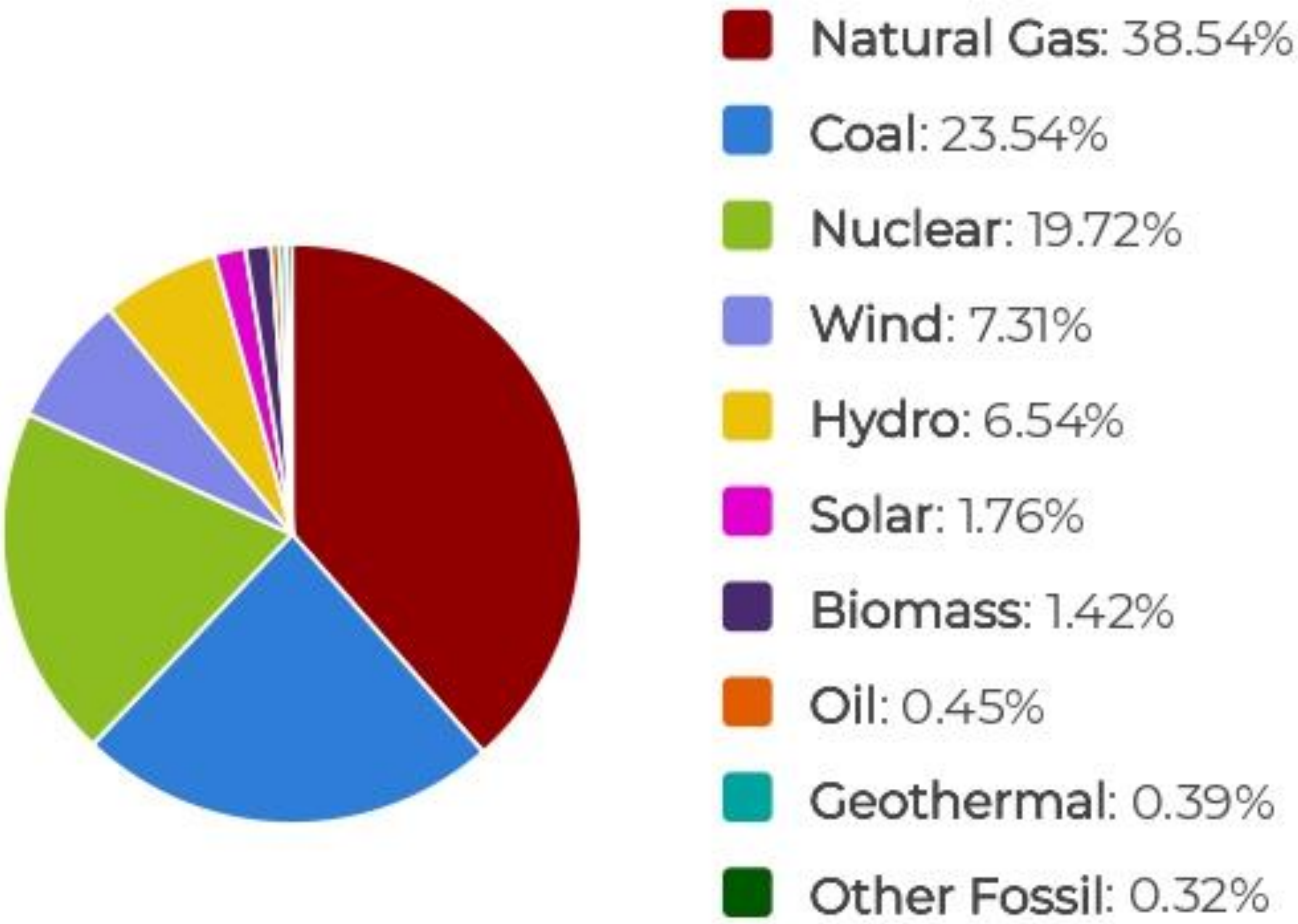


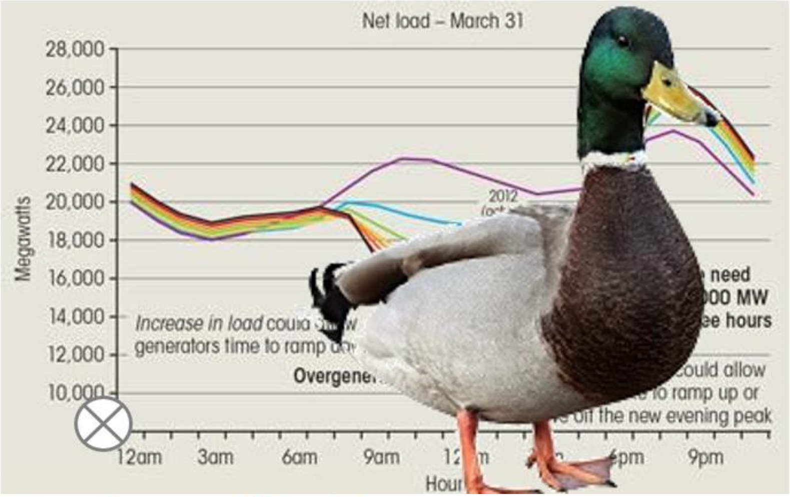
Electric Grid Sources - National



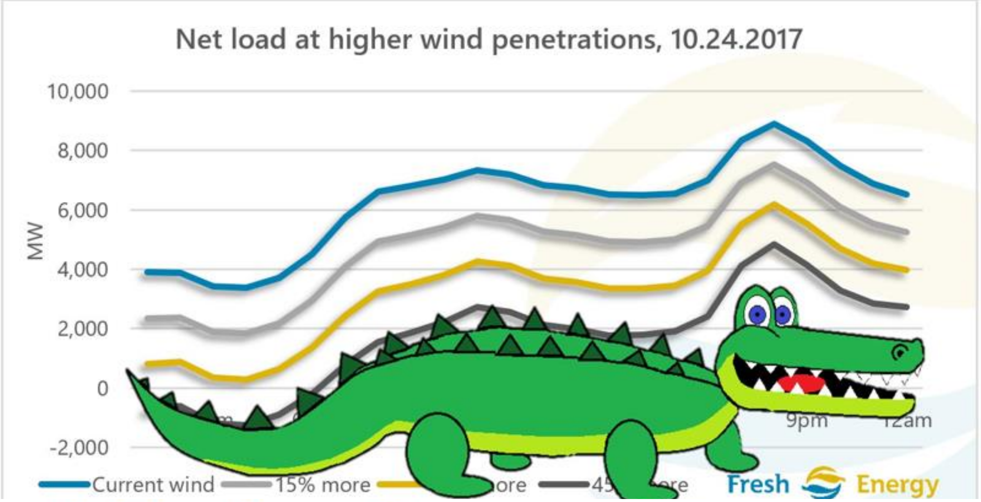
U.S. Energy Information Administration's Open Data API for Electricity Net Generation.

Time of Use

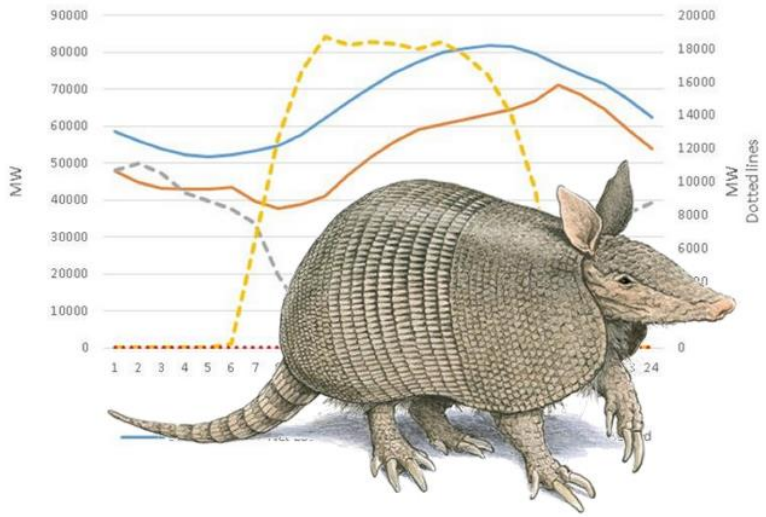
California: The Duck Curve



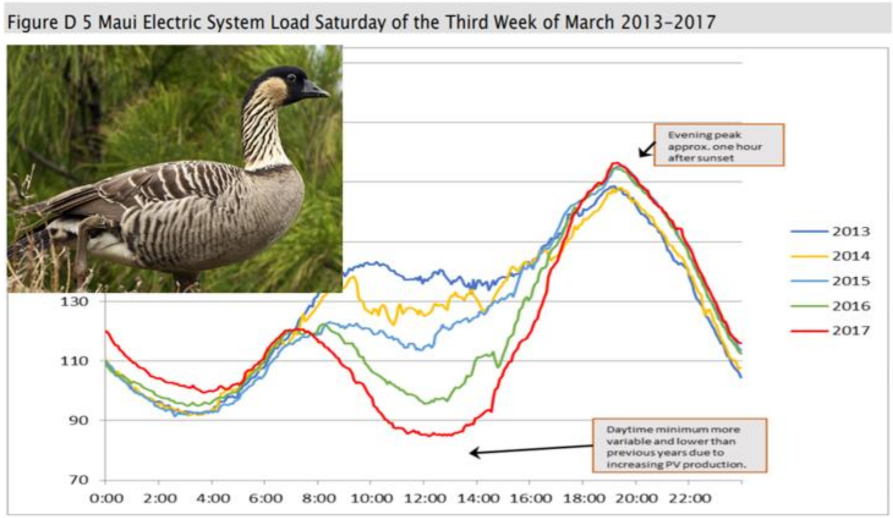
Midwest: The Gator Curve



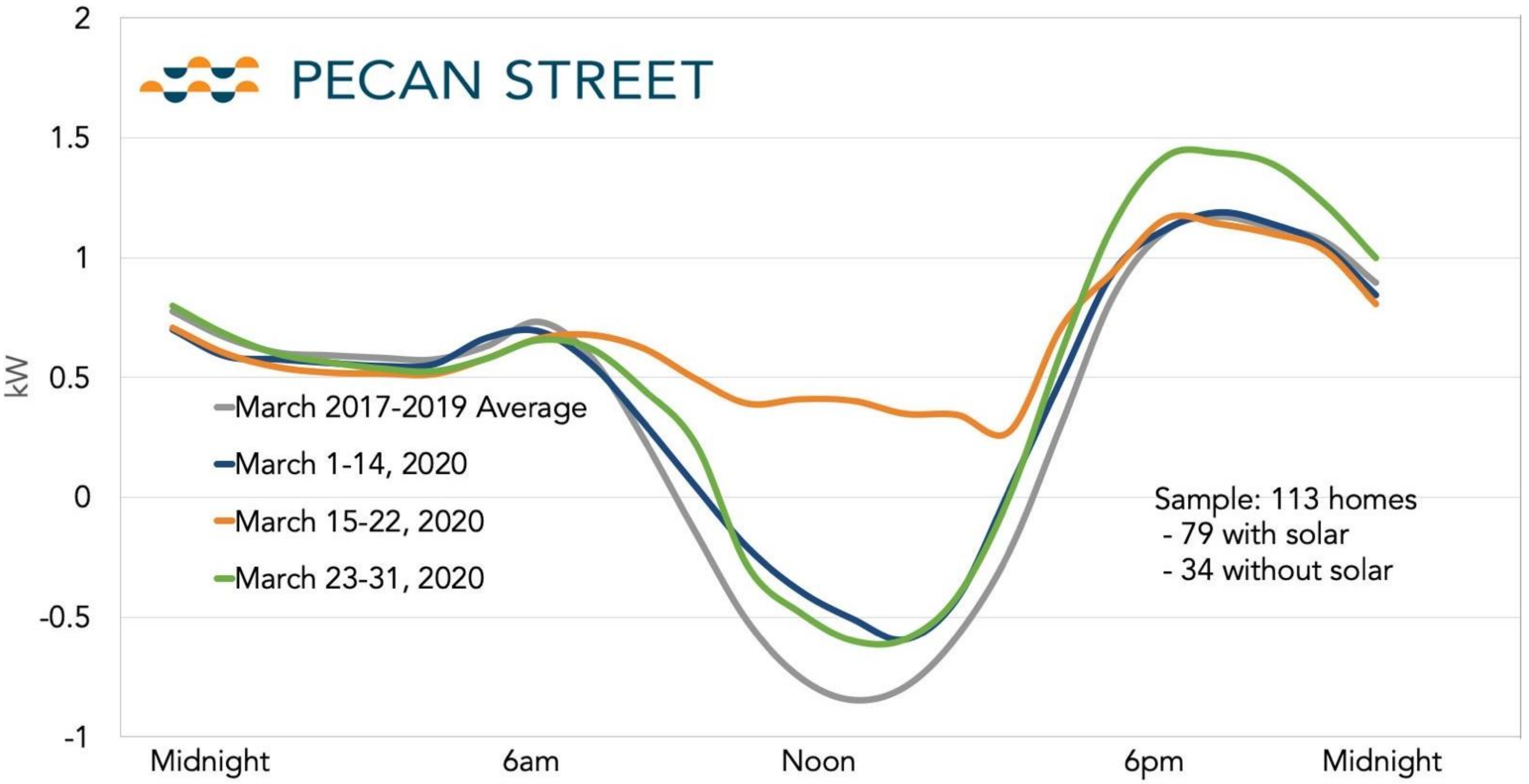
Texas: The Armadillo Curve



Hawaii: The Nene Curve



COVID-19 Impacts



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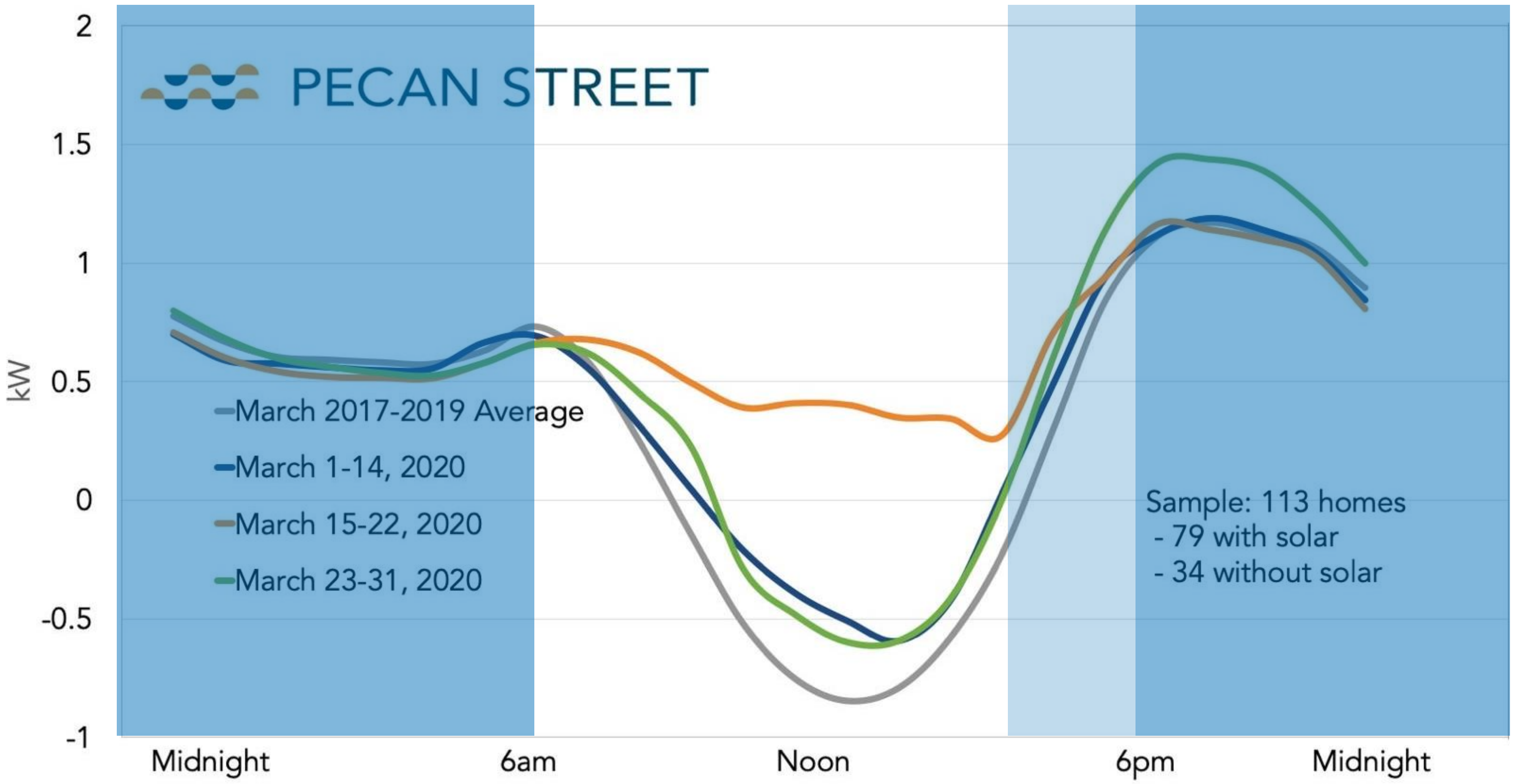


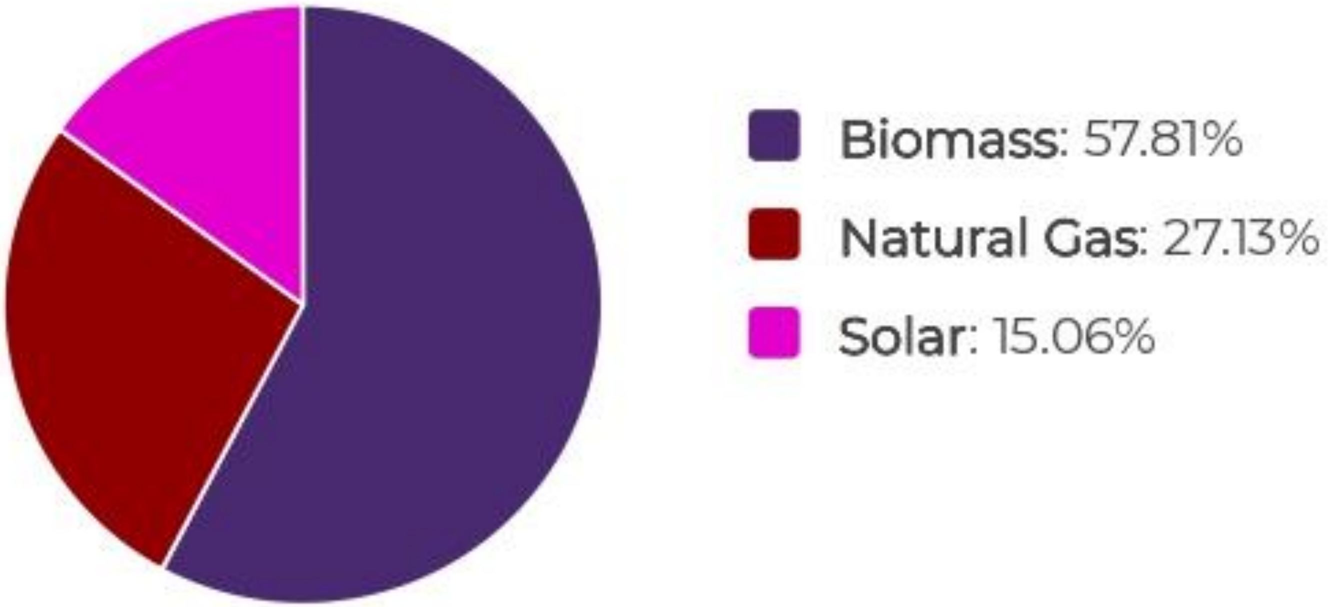
MWCOG Context

- Climate Energy Environment Policy Committee
  - Regional GHG reduction 40% by 2030
  - 80% by 2050
  - Targeted goals for sectors for local governments

MWCOG Context

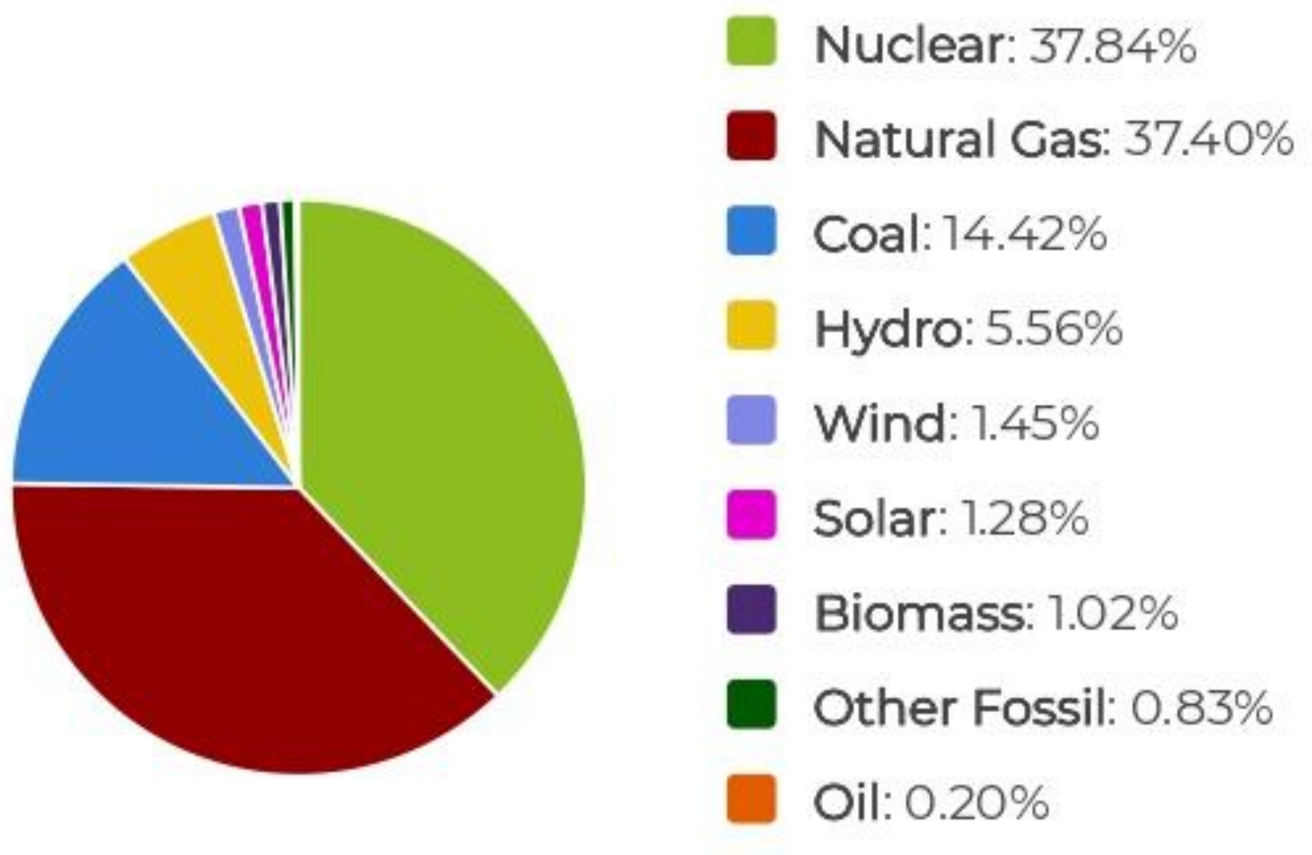
- Maryland 50% RPS by 2030; 100% by 2040
  - MoCo, MD exploring BPS
- Washington, DC 100% RPS by 2032
  - 2017 Energy Code increase
  - BEPS
- Virginia 100% RPS by 2050
  - Energy code updating

Electric Grid Sources - DC



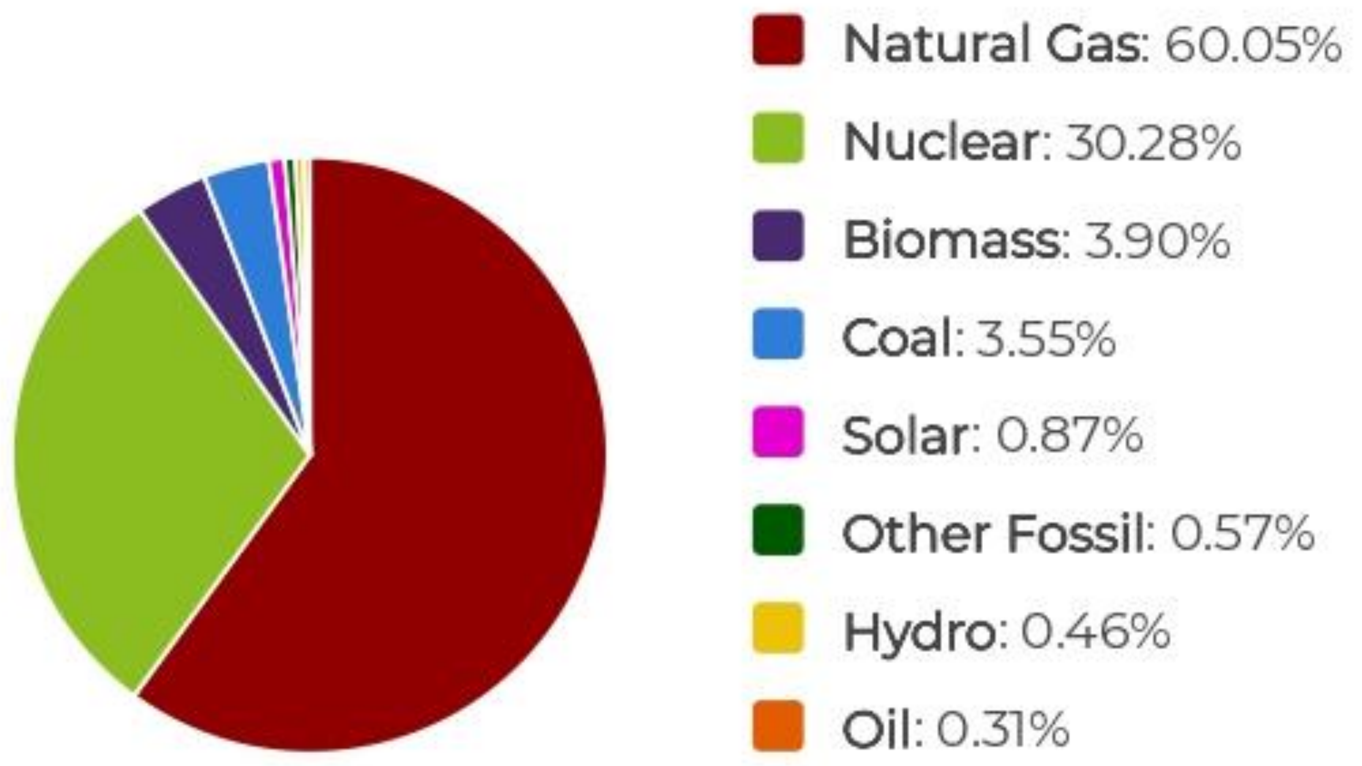
U.S. Energy Information Administration's Open Data API for Electricity Net Generation.

Electric Grid Sources - Maryland



U.S. Energy Information Administration's Open Data API for Electricity Net Generation.

Electric Grid Sources - Virginia



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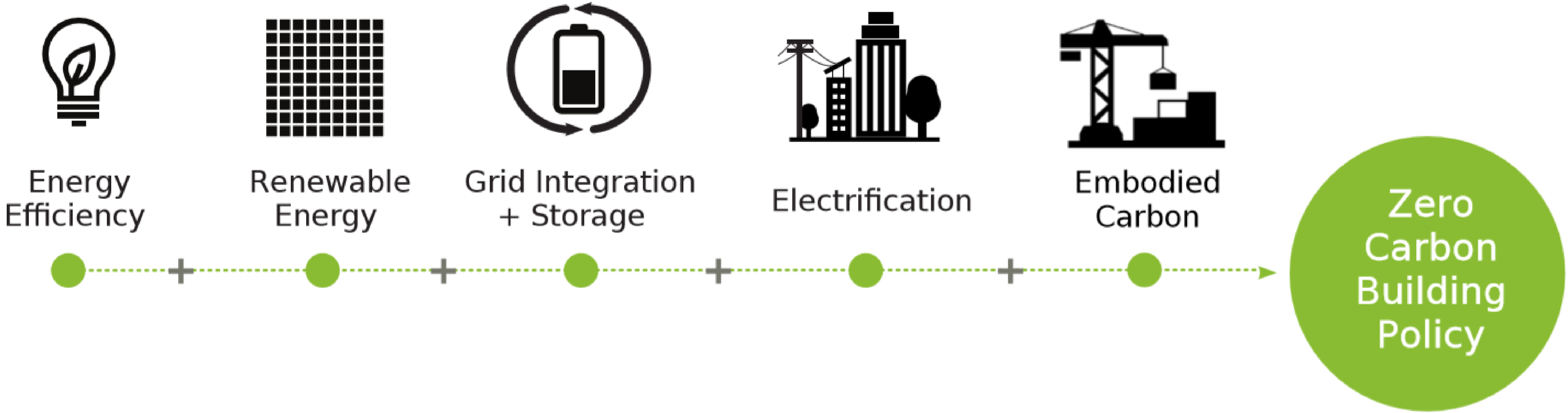
Five Foundations of Zero Carbon Building Policies



Grid Integration + Storage

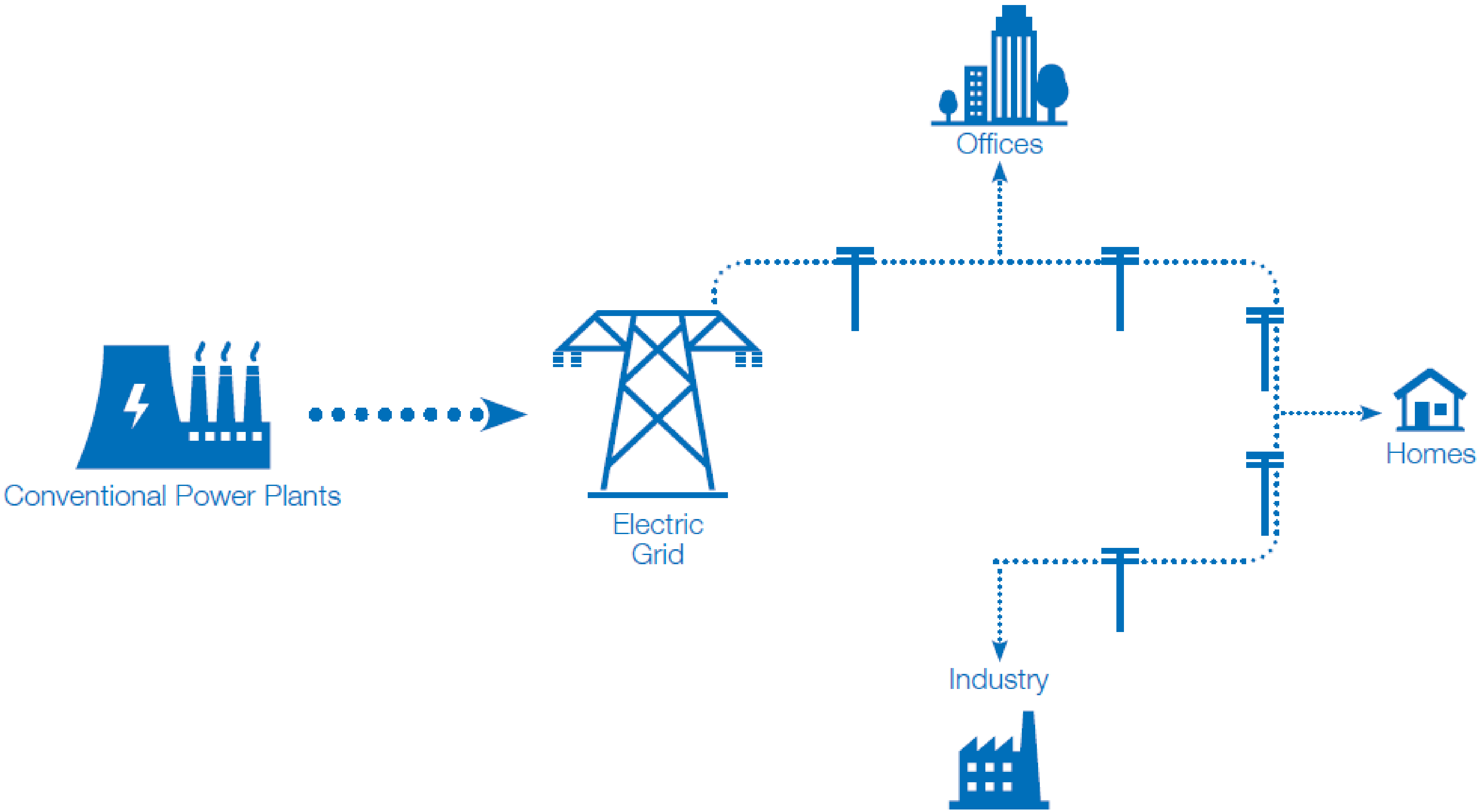
The GridOptimal Buildings Initiative

New Metrics for Building-Grid Integration

The GridOptimal Buildings Initiative - Key Themes

- The way **buildings interact with the electric grid** is evolving rapidly.
- Buildings will face increasing **regulatory and economic pressure** to be able to respond to **changing utility rate and delivery structures**.
- Designers will need to **understand and incorporate strategies** that allow buildings to directly interact with the utility grid.
- Adapting to the ***interactive grid*** will be critical to maintaining **building services and comfort** and to **grid dependability**.
- Efforts to **decarbonize the electrical grid** will require **better integration** of distributed energy resources.

One-Way Grid



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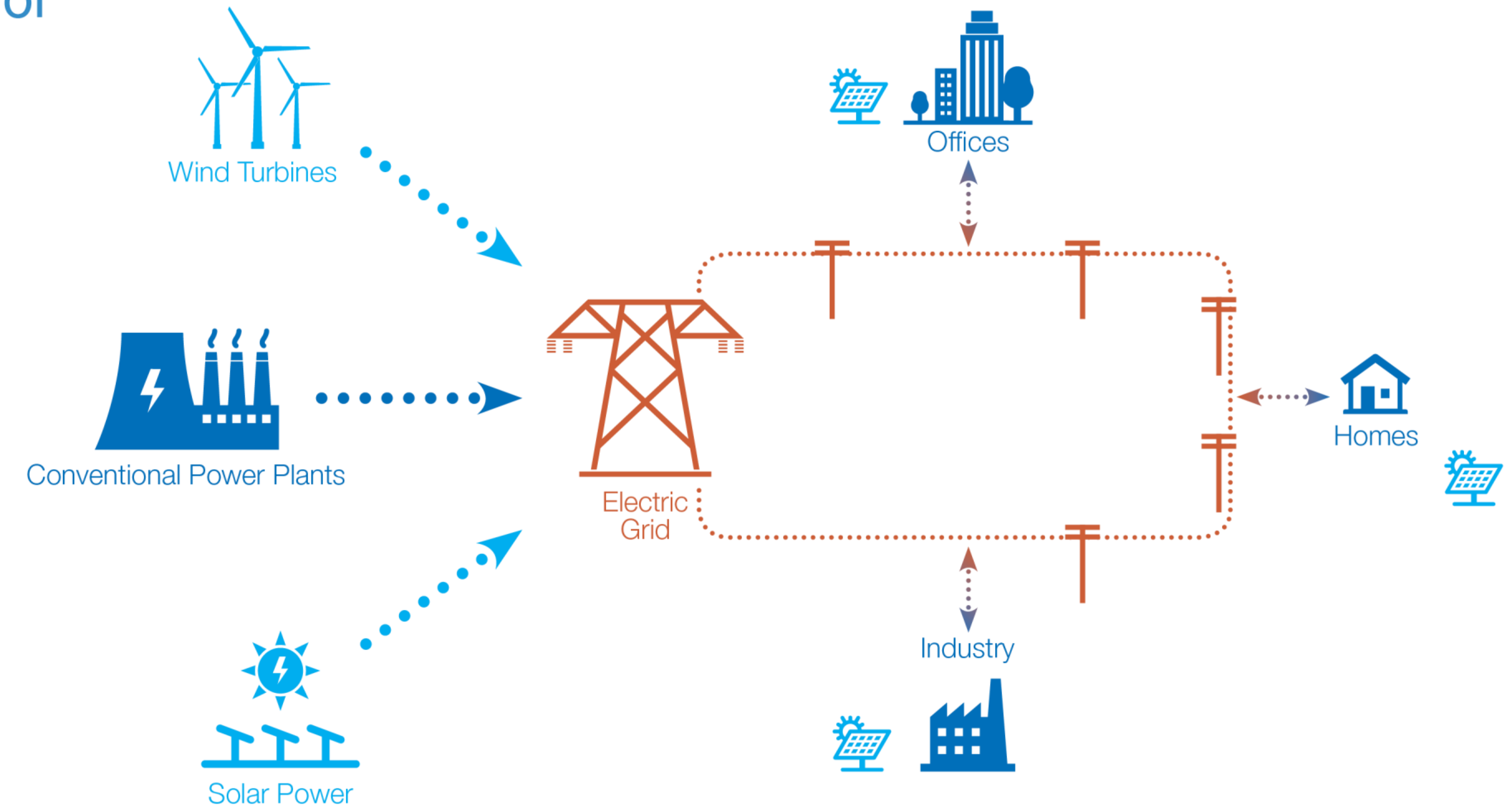
The proliferation of distributed generation creates a need for more active grid management

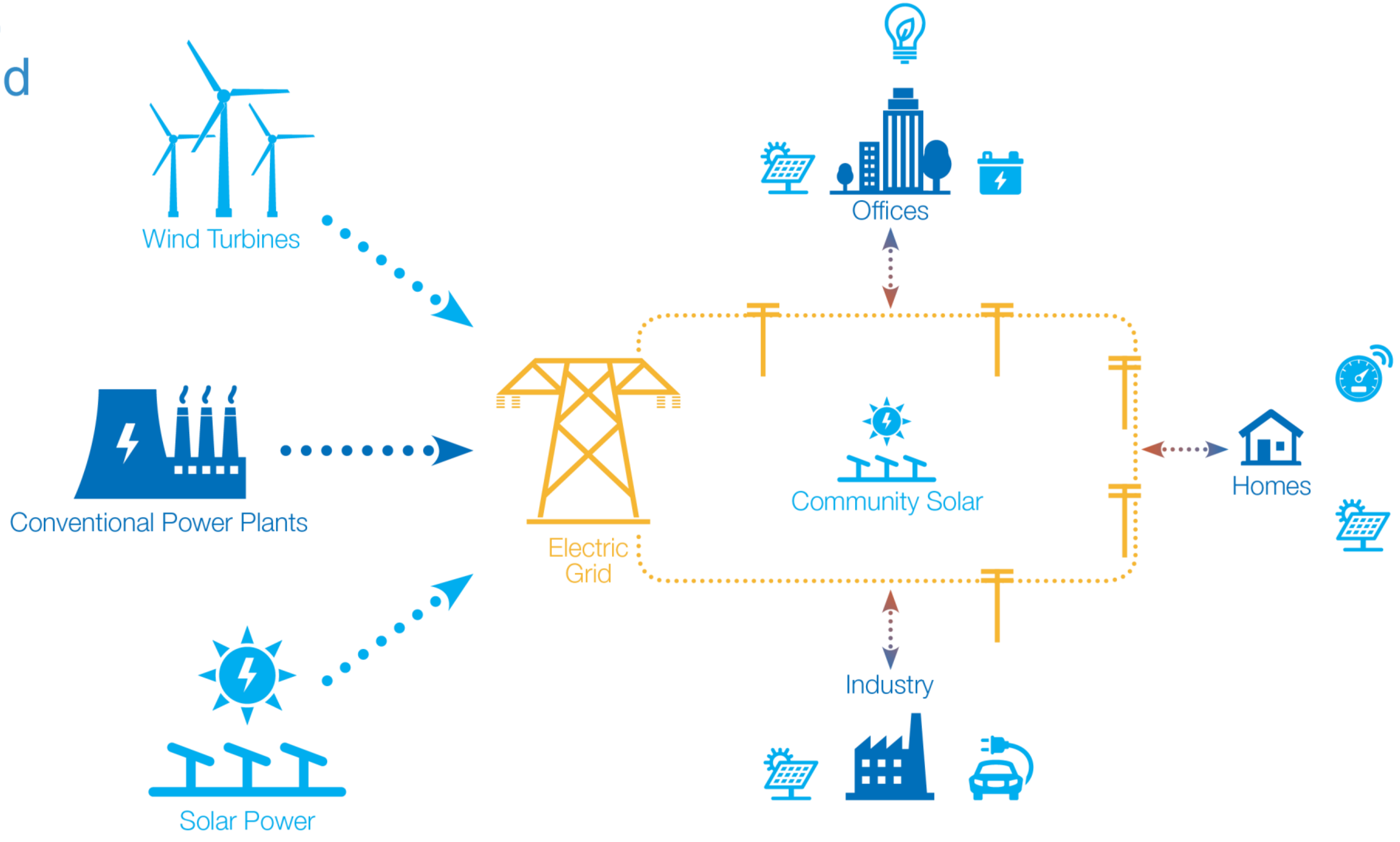


GridOptimal Technologies and Strategies:

renewable energy

GRIDOPTIMAL BUILDINGS INITIATIVE

Storage and smart devices can help support clean grid operations

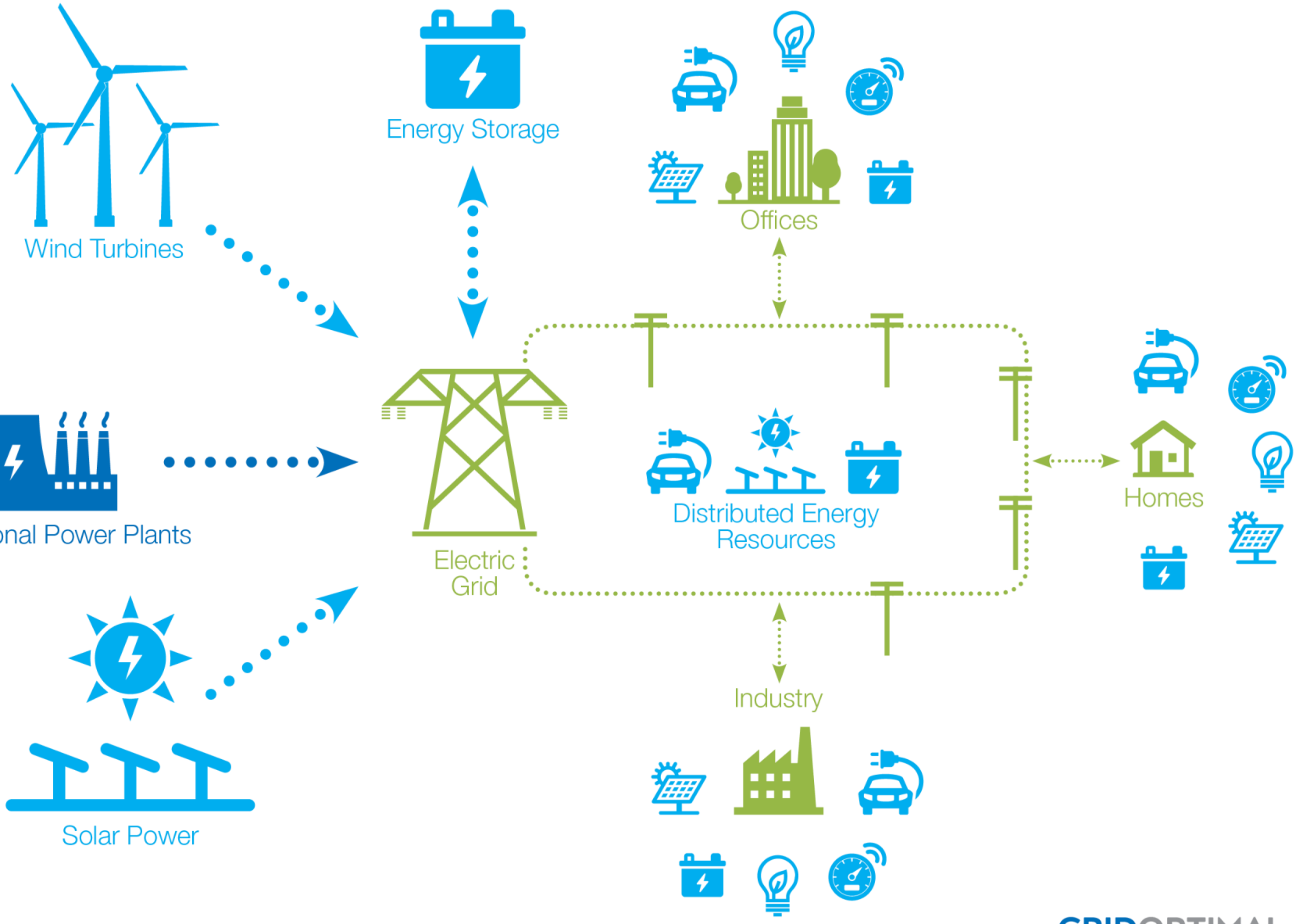


GridOptimal Technologies and Strategies:

- renewable energy
- energy efficiency
- electric vehicle
- energy storage
- smart connected controls

GRIDOPTIMAL BUILDINGS INITIATIVE

GridOptimal empowers players on both sides of the meter to actively support the transition to a carbon free grid



GridOptimal Technologies and Strategies:

- renewable energy
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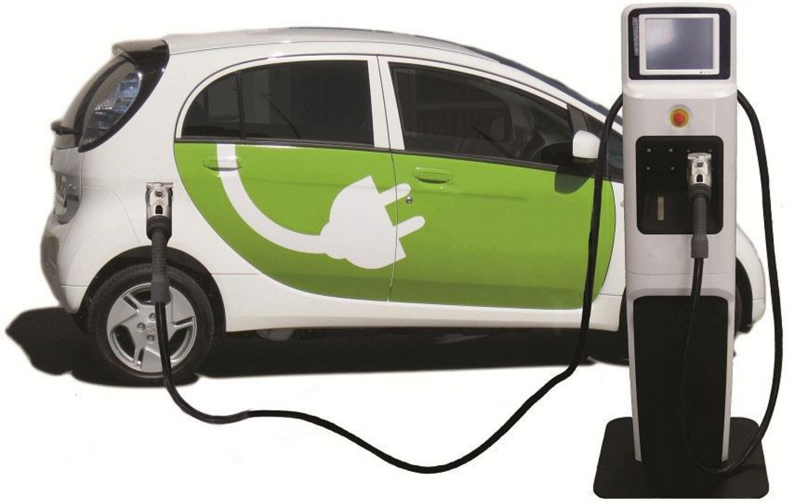
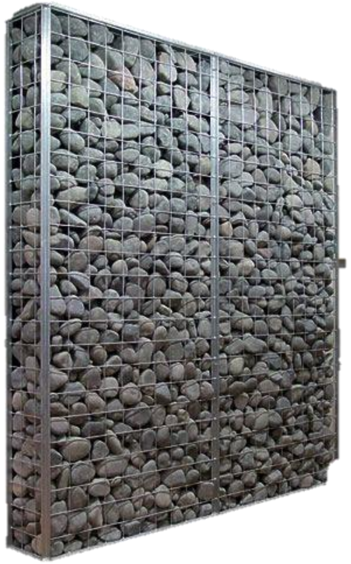
- smart connected controls

GRIDOPTIMAL BUILDINGS INITIATIVE

Opportunities for Building Integration with Grid

- **Permanent Efficiency**
  - Reduce building energy loads…
- **Peak Shifting**
  - Design to modify time of peak building energy use to adapt to grid…
- **Dynamic Response**
  - Actively reduce building energy use in response to short-term grid constraints…
- **Dispatchable Energy Storage**
  - Actively manage energy use patterns based on grid signals…





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Electrification

Making Headlines

Electrification of buildings: A cornerstone of Canada's low-carbon future

The Electrifying Path to Decarbonization — Part 3

OPED - Jan. 10, 2018 - By Dylan Heerema

PEMBINA institute

Goodbye, gas furnaces? Why electrification is the future of home heating

CBC

Emily Chung · CBC News · Posted: Jan 20, 2020 4:00 AM ET | Last Updated: February 4

No more fire in the kitchen: Cities are banning natural gas in homes to save the planet

Elizabeth Weise USA TODAY

Published 10:33 a.m. ET Nov. 10, 2019 | Updated 7:47 p.m. ET Nov. 21, 2019

USA TODAY

Cost, comfort emphasized as building electrification takes off in Colorado

In a first for Massachusetts, Brookline votes to ban oil and gas pipes in new buildings

The Boston Globe

Cities Look to Natural Gas Bans to Curb Carbon Emissions

SCIENTIFIC AMERICAN

Forward-Looking Cities Lead the Way to a Gas-Free Future

By Matt Gough February 11, 2020

Cities are banning natural gas in new homes, citing climate change

CBS NEWS

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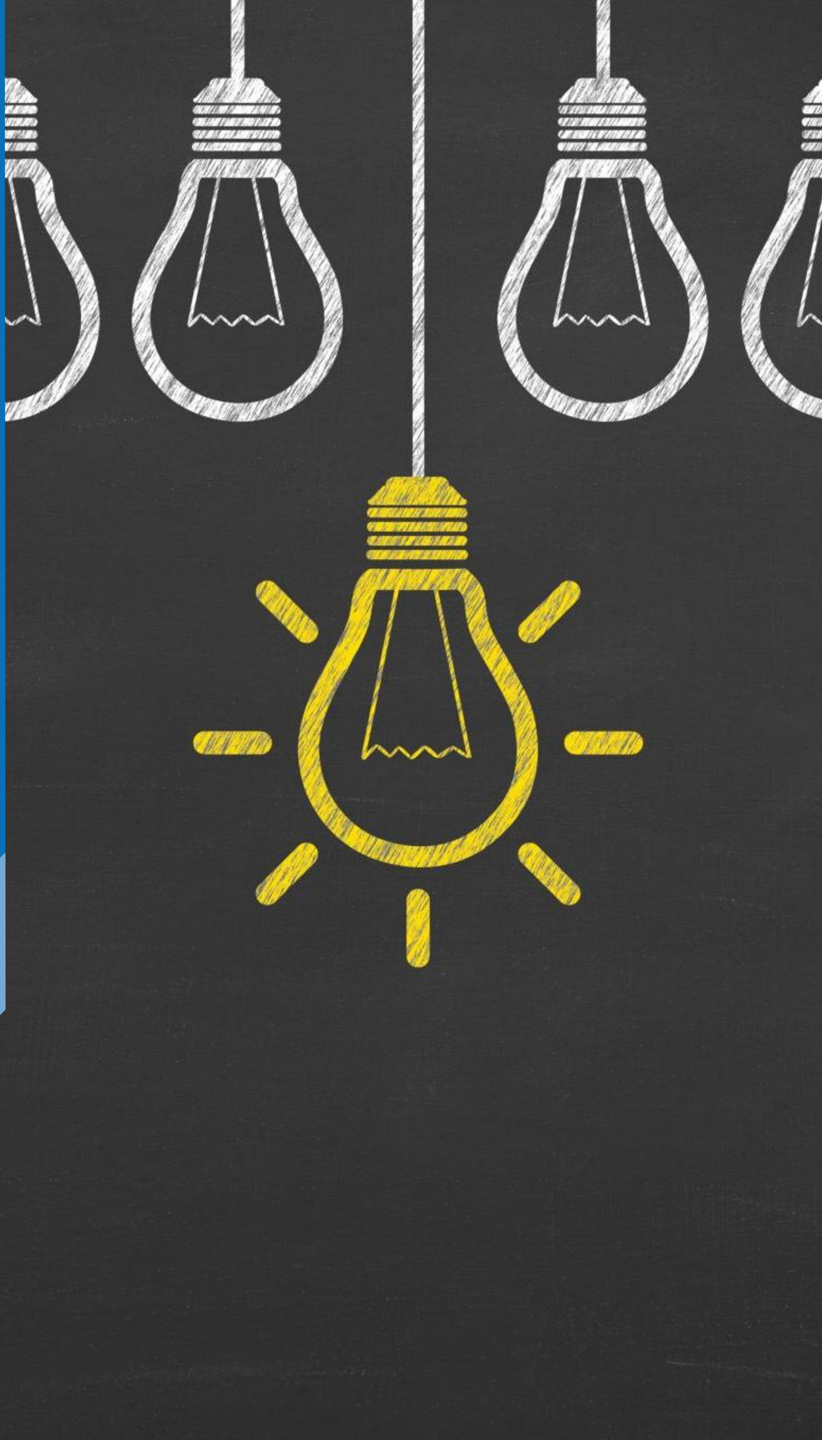
Beneficial Electrification

- Saves consumers money over the long run;
- Enables better grid management; and
- Reduces negative environmental impacts.



Principles to Electrify

- Efficiency First
- Value of Flexible Load for Grid
- Understand Emissions Impact
- Use Emissions Efficiency
- Account for Life of Measure
- Rate Design

Building Electrification Technology Roadmap (BETR)

- Collaboration between NBI, BDC and EPRI
- **Goal:** Accelerate the development and adoption of advanced electric technologies
- **Objectives:**
  - Characterize the industry status of technology readiness for electrification including product optimization and site barriers to adoption.
  - Provide guidance that supports building electrification (BE), carbon reduction, energy efficiency and research programs over the next 10 years.

Concept Paper: Building Electrification Technology Roadmap (BETR)

A Roadmap for accelerating the development and adoption of advanced electric technologies that lead to decarbonization in residential and commercial buildings

Background and Context

Since the early 1980s, there have been significant and impactful efforts to improve the energy efficiency of buildings through codes, policies and programs. In today's context, the spotlight is focused on carbon emission reductions rather than solely saving kWhs or therms to support climate action plans and policies for greenhouse gas (GHG) reductions. This shift has put momentum behind renewable energy production, both distributed and at utility scale, to decarbonize the grid. While generation-side efforts are critical, the role of buildings' energy use remains an important intervention area for efficiency programs and jurisdictional activities. Building electrification – reducing or eliminating direct use of fossil fuels at the building through advanced electric technologies – is gaining interest as a key strategy to employ along with grid decarbonization.

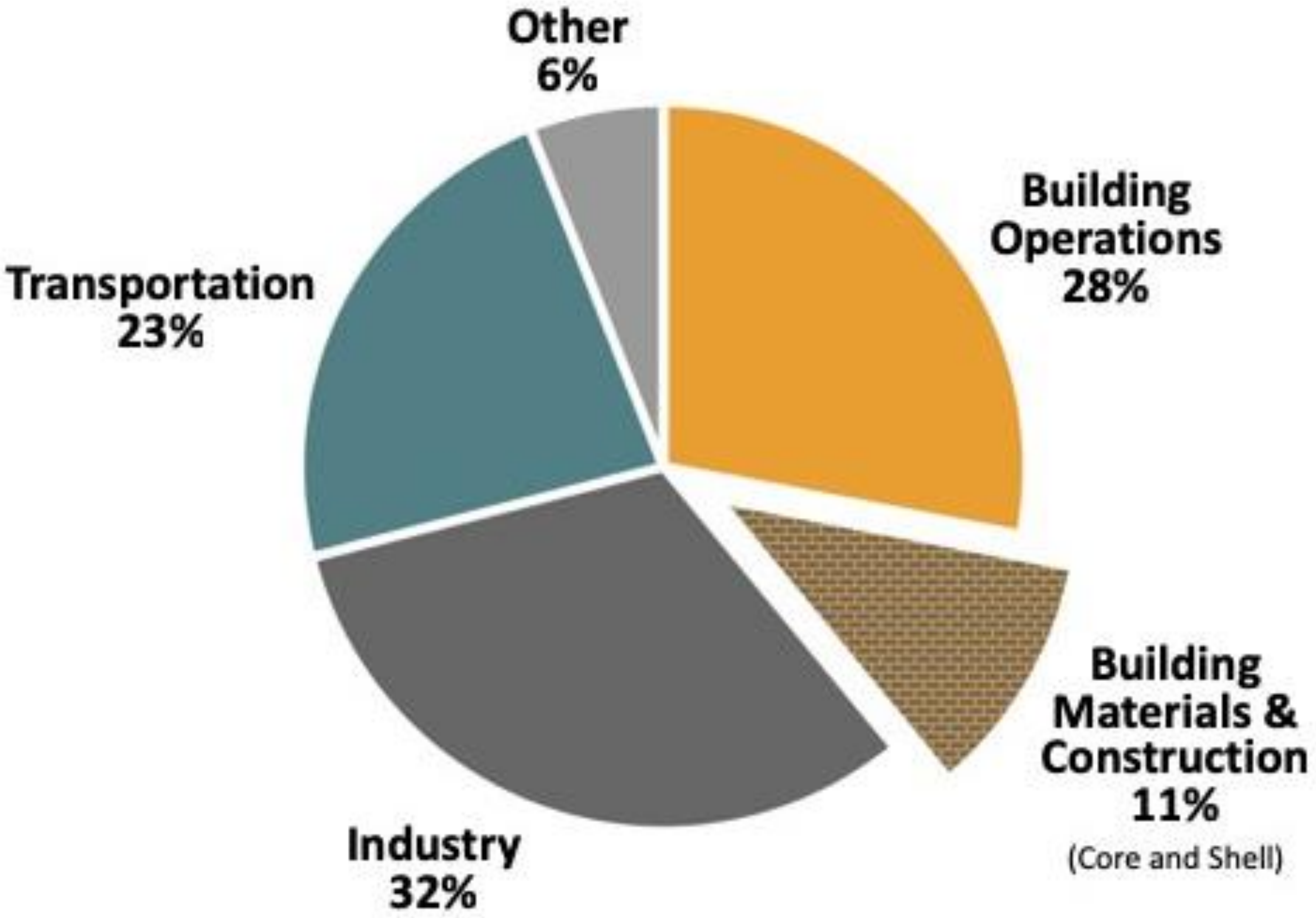
The Need for this Project. Nationally, natural gas accounts for an average of 44% of a home's total energy use varying regionally from 26-60%. For commercial buildings, the range varies more widely by sector from 20-60% of energy use as shown in the figure below[1]. Direct site natural gas use, combined with leakage in delivery, can be responsible for as much as 60% of the CO_2 emissions of a mixed-fuel home with electricity that produced by natural gas fired generation while the same all-electric home has 45% lower carbon emissions[2].

To significantly reduce building site carbon emissions requires broad adoption of efficient electric technologies that are available today but not yet widely adopted, as well as adoption of newer products that can provide the same or improved level of service as incumbent technologies. In response to this need, New Buildings Institute (NBI), the Building Decarbonization Coalition (BDC) and the Electric Power Research Institute (EPRI) identified a set of research tasks to provide information, data and direction on electric technologies that will support efficiency programs and policy makers. Most importantly, the proposed research recognizes, leverages and builds on existing studies and efforts underway on assessing and advancing electric technologies that improve both energy and emissions performance in buildings. The Building Electrification Technology Roadmap (BETR)[3] will put this good work together, fill gaps, and translate it into meaningful results and technical pathways[4] that support decarbonizing the built environment.

[1] EIA Residential Data and CBECs Commercial data. Statistic on homes with natural gas (~50% of U.S. homes) from the American Gas Association Commercial Sector Summary is slightly higher.
[2] E3 2019 Study on Residential Building Electrification in California

Embodied Carbon

Global CO_2 Emissions



Source: Global Alliance for Buildings and Construction 2018 Global Status Report

Questions?

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