Clean Coalition

Making Clean Local Energy Accessible Now

Electrification and Decarbonization in the Built Environment, Energy, and Transportation Sectors: Model Structures



GoToWebinar FAQ

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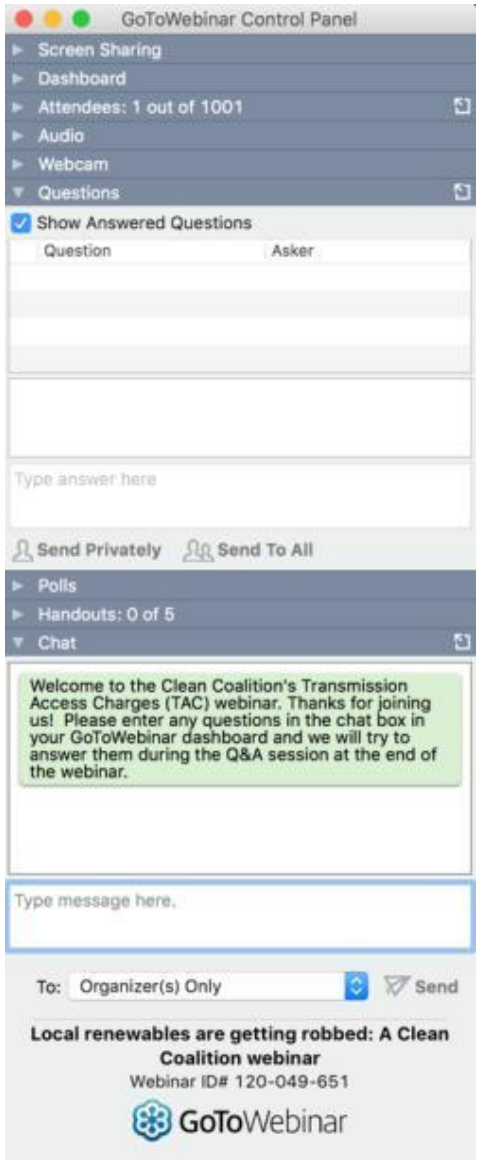
- Questions will be answered during the Q&A portion of the webinar
- Contact Josh for webinar questions: josh@clean-coalition.org

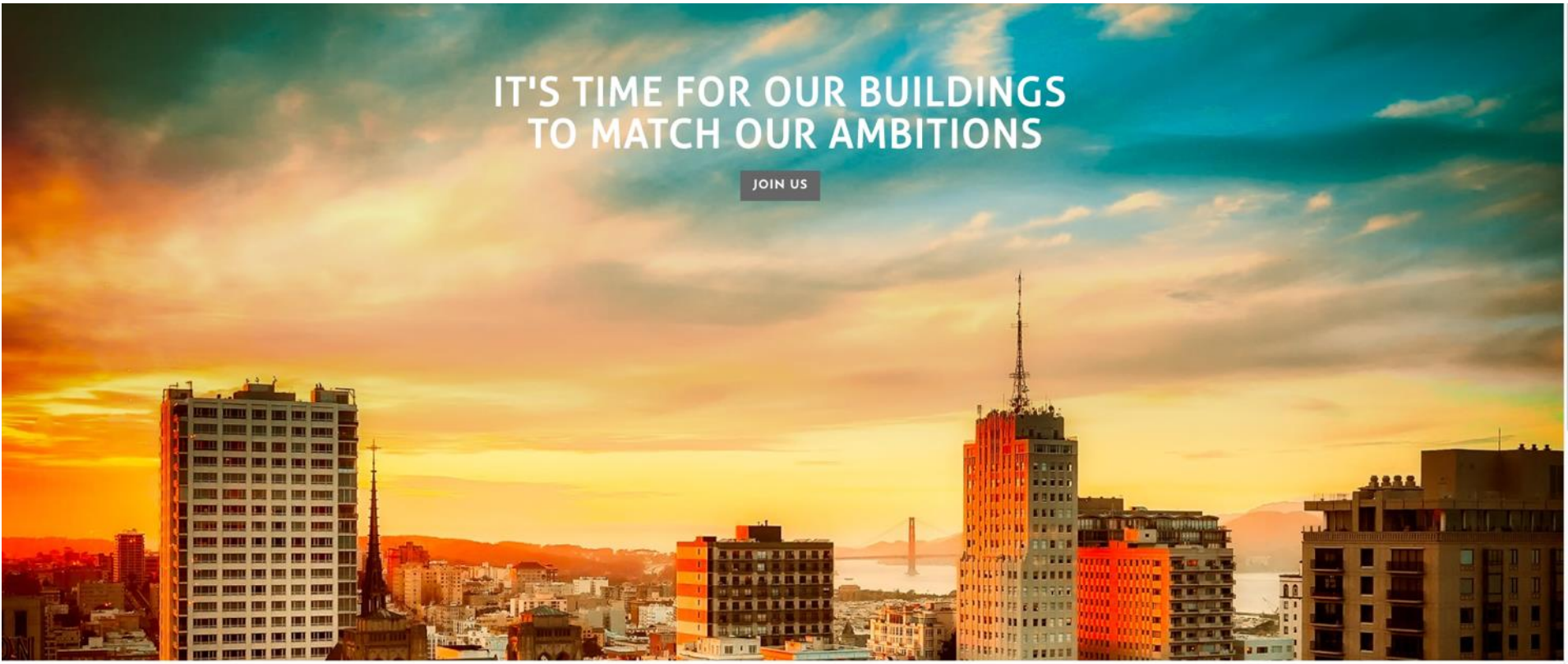


Today's presenters

John Sarter
Program Manager at the Clean Coalition
clean-coalition.org

Panama Bartholomy
Director of the Building Decarbonization Coalition
buildingdecarb.org

Sean Armstrong
Managing Principal of Redwood Energy
redwoodenergy.tech



BUILDING
DECARBONIZATION
COALITION


POINTENERGY INNOVATIONS
Greenbank Associates
CalCCA
California Community Choice Association
Sonoma Clean Power
TerraVerde ENERGY
CAL SMACNA
BAY AREA AIR QUALITY MANAGEMENT DISTRICT
NRDC
NATURAL RESOURCES DEFENSE COUNCIL
Local Government Commission
Leaders for Livable Communities
ANN V EDMINSTER
DESIGN AVENUES LLC
SIERRA BUSINESS COUNCIL
SIERRA CLUB
ABS
APPLIED BUILDING SCIENCE
FRONTIER energy
Western HVAC Performance Alliance Inc.
CITY OF PALO ALTO UTILITIES
CLEAResult
CUSHMAN & WAKEFIELD
MENLO SPARK
STEFFES
CUSTOMER FOCUSED. SOLUTION DRIVEN. FIELD PROVEN.
INVESTOR CONFIDENCE PROJECT
AMBAG
CITY OF OAKLAND
A-1 GUARANTEED Heating & Air, Inc.
Turner
AO Smith
Innovation has a name.
U.S. GREEN BUILDING COUNCIL USGBC
Rheem
EPRI
ELECTRIC POWER RESEARCH INSTITUTE
SIEGEL & STRAIN Architects
ARDENNA ENERGY
IR Ingersoll Rand
Redwood Energy
Leaders in ZNE Design
WRNS STUDIO
GLUMAC
A TETRA TECH COMPANY
SEA
stone energy associates
SMUD
Powering forward. Together.
RHTR
RURAL HARD TO REACH LOCAL GOVERNMENT PARTNERSHIPS' WORKING GROUP
MITSUBISHI ELECTRIC
AIR CONDITIONING SYSTEMS
ASSOCIATION FOR ENERGY AFFORDABILITY INC.
STOPWASTE
at home • at work • at school
the Energy Coalition
SPAN.IO
TRC
Results you can rely on
JouleSmart
Guttmann & Blaevoet
CONSULTING ENGINEERS
PERFORMANCE SYSTEMS DEVELOPMENT
Gensler
Sensgreen
LA DWP Los Angeles Department of Water & Power
CESC
SILICON VALLEY CLEAN ENERGY
CITY OF Fremont
OPEN
INTEGRAL GROUP
COLMAC WATERHEAT
A division of Colmac Industries.
Stantec
ReplaceNow
SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company
EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work
SUSTAINABLE SFUSD
WRCOG Western Riverside Council of Governments
BRADFORD WHITE
WATER HEATERS

A kiss for a gas cook !

The Gas COOK BOOK for YOUNG PEOPLE

Handsome is and handsome does

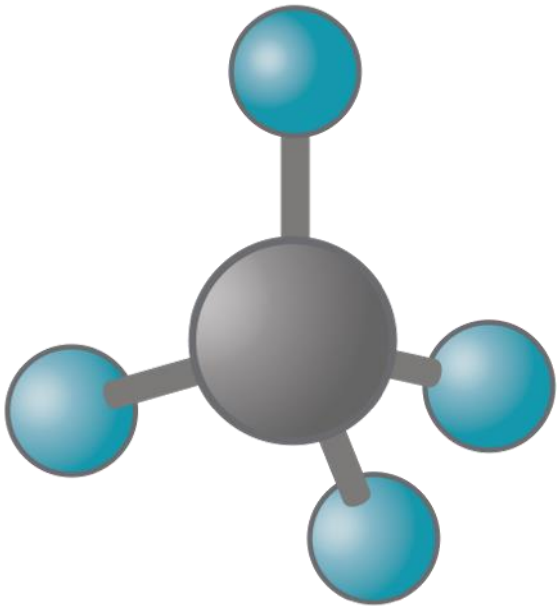
– that's the

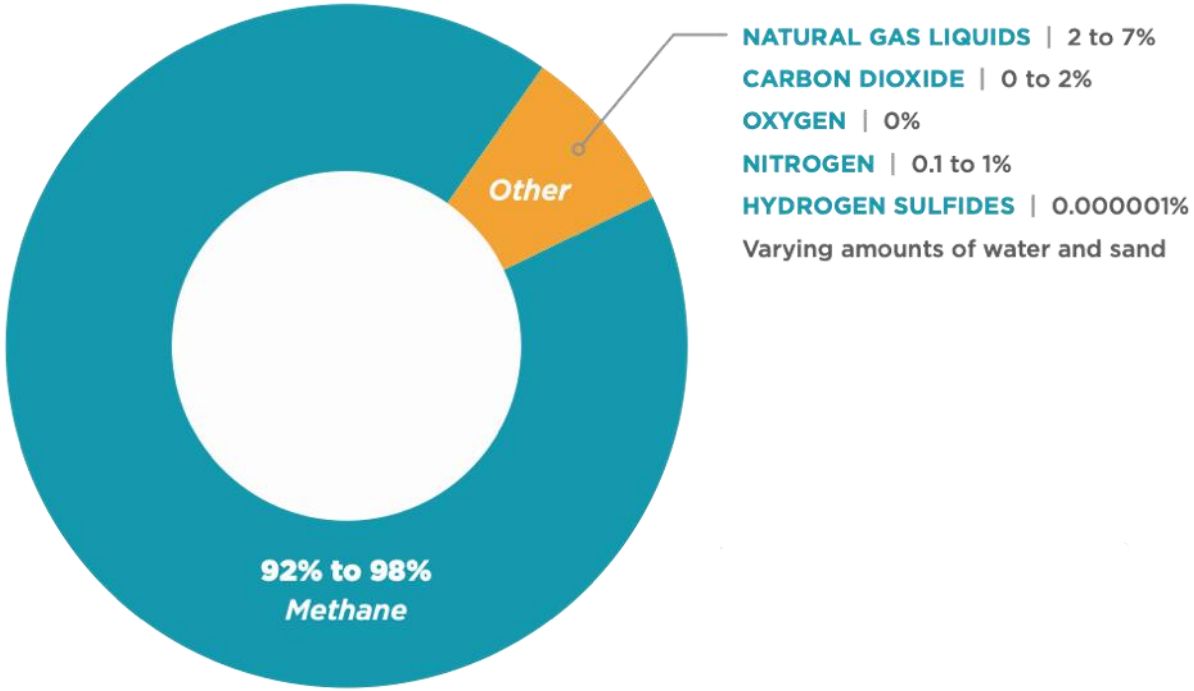
GAS *idea!*

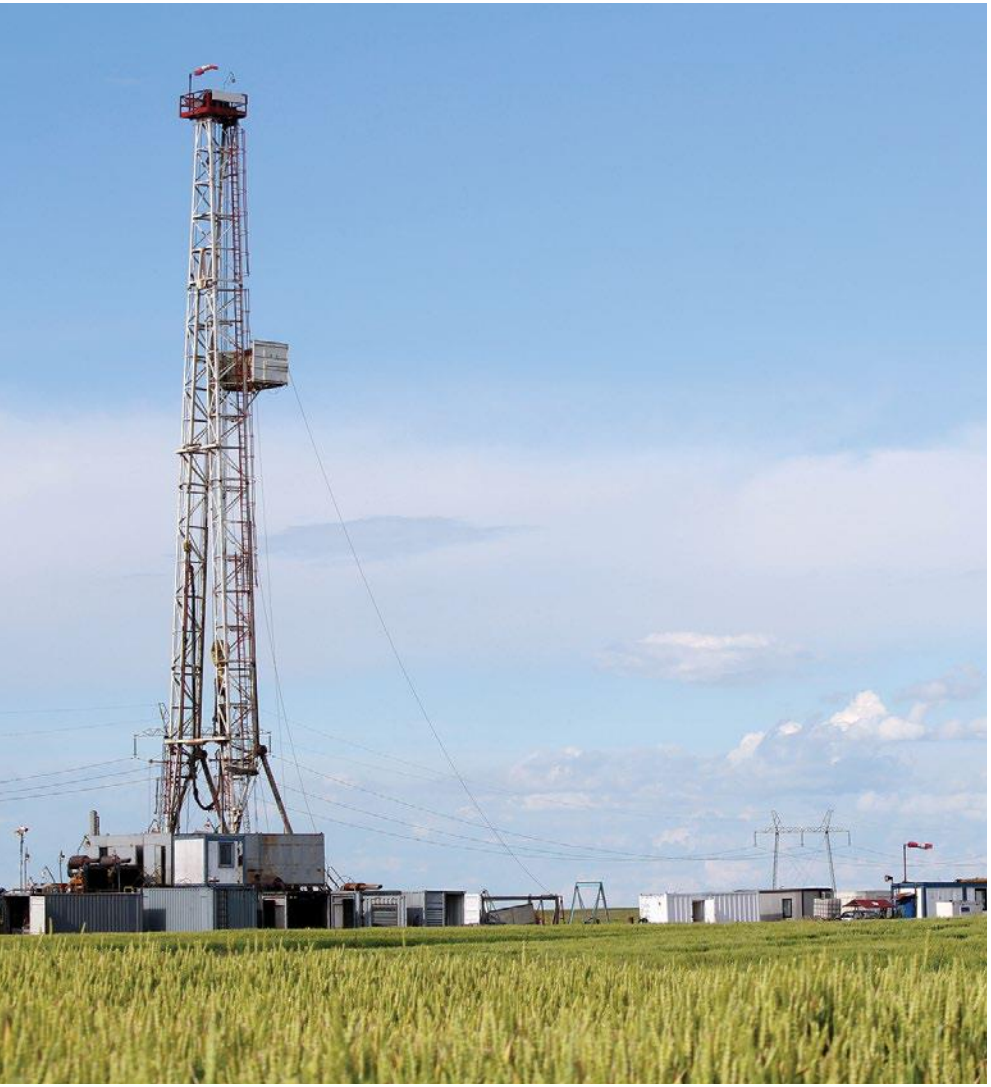
The new gas cookers make you a better cook because they are so easy to use— and a prouder housewife because they are so attractive to look at.

BRITISH GAS COUNCIL · 1 GROSVENOR PLACE · LONDON · S W 1

~~Natural Gas~~ Methane



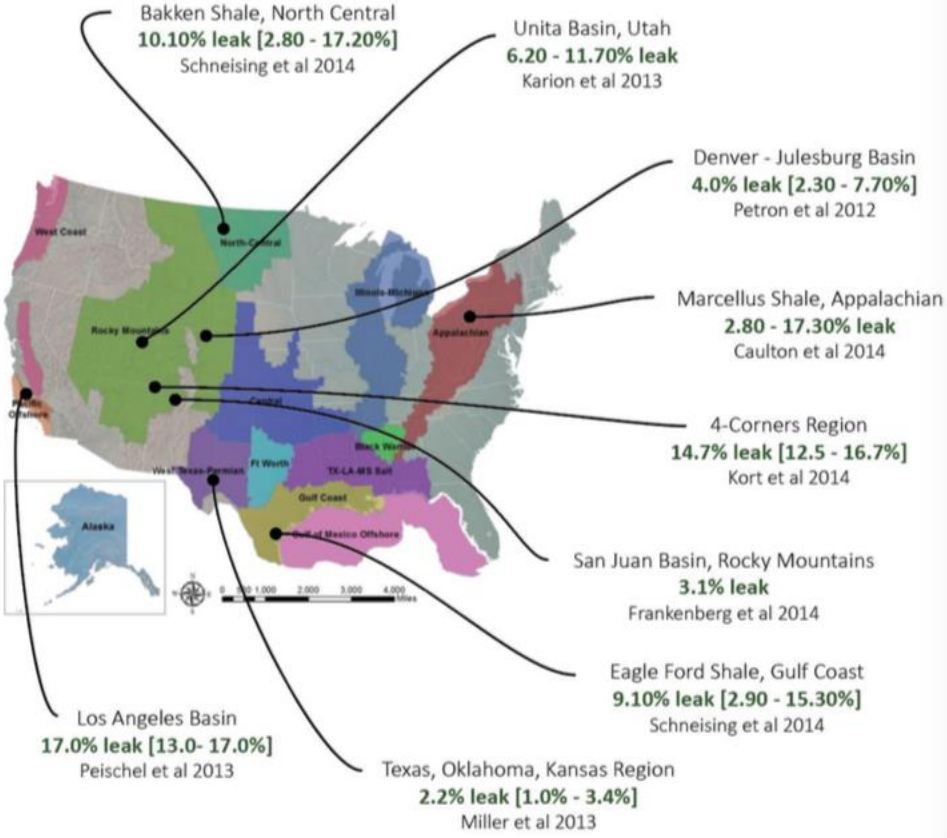




METHANE IS

84x more potent
than CO_2 in the short run

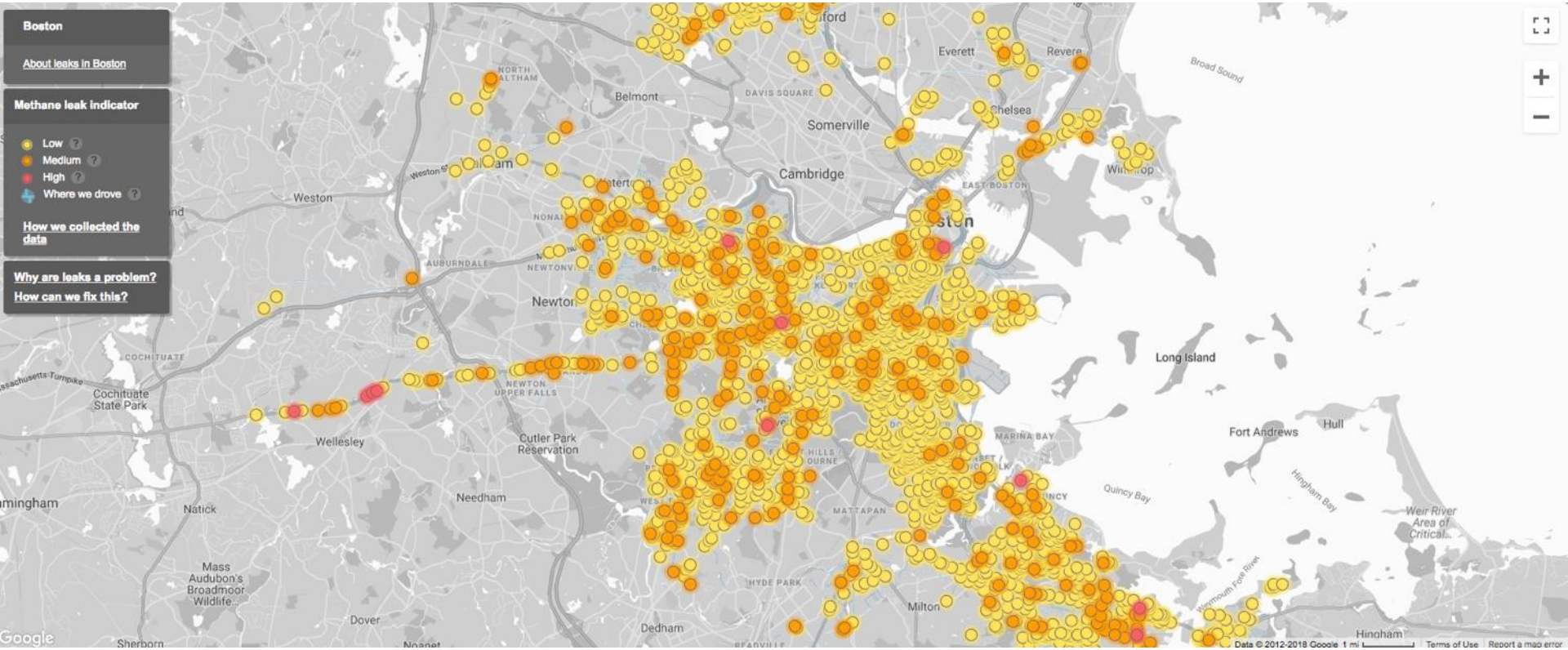
Leakage Varies by Production Zone



Leakage Attributed to California Natural Gas Demand

	Portion of CA Supply	Leak Rate Used (% of Production)	Leak Rate Sources	Total Production in Study Area (Billion Cubic Feet)
Permian	13.0%	2.2% [no range]	Presto 2017	2,300
San Juan	3.0%	3.1% [2.6 - 3.5%]	Kort 2014, Frankenburg 2015	1,300
Anadarko	13.0%	1.6% [0.6 - 2.0%]	Miller 2013, Presto 2017	1,500
Western Canada	0.01%	0.6% [no range]	Atherton 2017	951
Rocky Mountains	31.5%	4.1% [1.1 - 5.6%]	Petron 2014, Petron 2012, Robertson 207	600
Southwest Wyoming	26.0%	0.38% [0.12 - 0.86%]	Brantley 2014, Robertson 2017	516
California	10.0%	*CEC full lifecycle used*	*CEC Study*	*Lifecycle used.*

3.6% [2.4 - 4.3%]


Boston
About leaks in Boston
Methane leak indicator
Low
Medium
High
Where we drove
How we collected the data
Why are leaks a problem?
How can we fix this?
Belmont
Somerville
Cambridge
Everett
Revere
Chelsea
Broad Sound
Weston
Newton
Wellesley
Needham
Natick
Dover
Dedham
Milton
Long Island
Fort Andrews
Hull
Quincy Bay
Hingham Bay
Cochituate State Park
Cutler Park Reservation
Mass Audubon's Broadmoor Wildlife...
Google

Tweets 249 | Following 7 | Followers 303 | Likes 2

Follow

Gas Watchdog

@GasWatchdog

Nat gas & methane leaks happen more often than you think. This feed automatically posts news articles on leaks that threaten our safety & health. #GasWatch

Joined April 2018

Tweet to Gas Watchdog

2 Followers you know

Tweets | Tweets & replies

Gas Watchdog @GasWatchdog · 1h
PSA in Hammerfest LNG leak probe #gaswatch

PSA in Hammerfest LNG leak probe
Safety watchdog to investigate incident that resulted in evacuation at Equinor-run plant in northern Norway
upstreamonline.com

Gas Watchdog @GasWatchdog · 2h
Pipeline data sought as Aliso Canyon rebuilds gas storage #gaswatch

CALIFORNIA: Pipeline data sought as Aliso Canyon

Who to follow · Refresh · View all

Jasmine Salazar @JazSal... Follow

Dana Jones - JVS @dana... Follow

nanade @nanadebogre Follow

Find people you know
Import your contacts from Gmail

Connect other address books

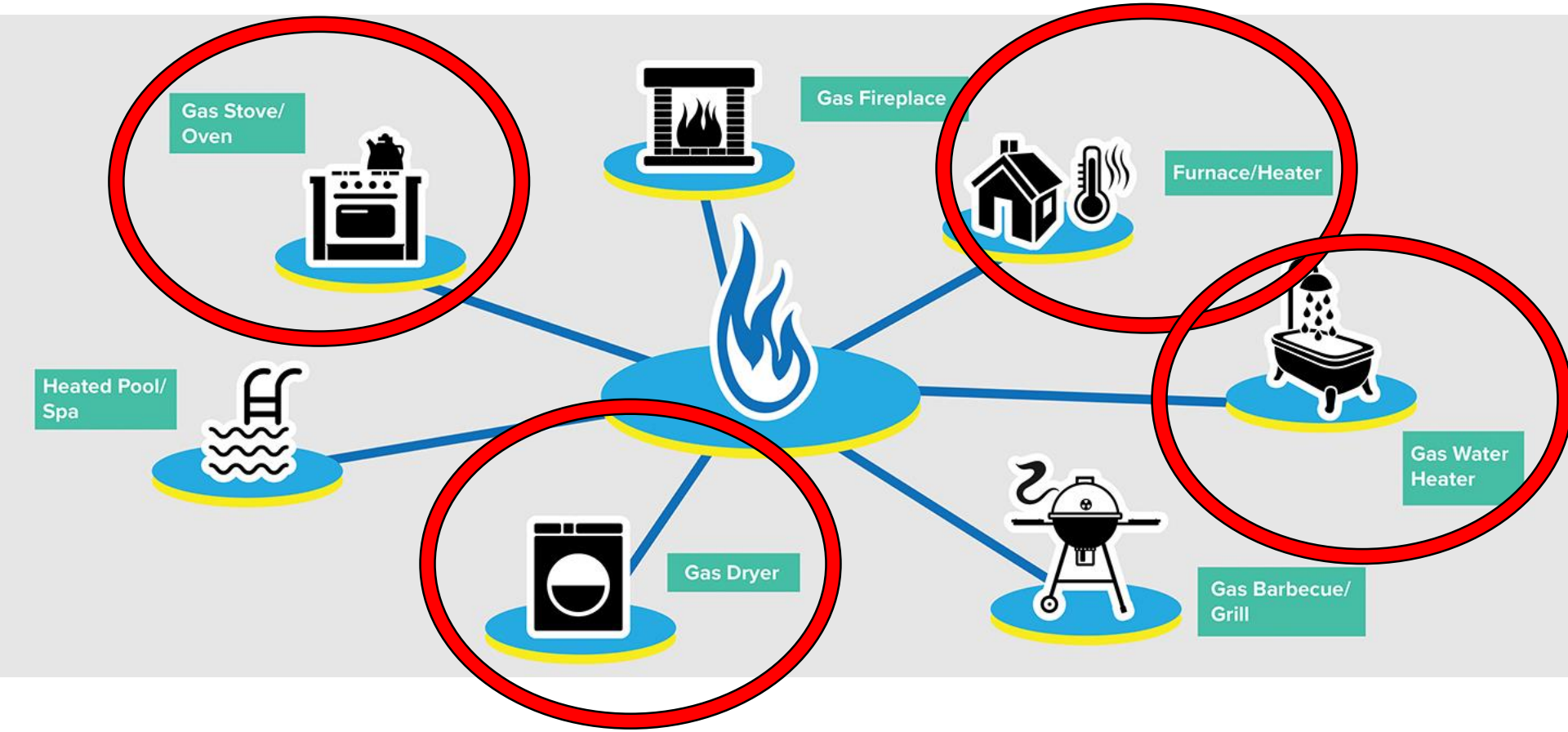
Trends for you · Change

#WorldRefugeeDay
@gfriend, @GreenForAll and 2 more are Tweeting about this

#WednesdayWisdom
87.1K Tweets

Dwight Howard
Hornets finalizing a deal to send Dwight Howard to the Nets, ESPN reports

GETTY


Gas Stove/
Oven
Gas Fireplace
Furnace/Heater
Heated Pool/
Spa
Gas Water
Heater
Gas Dryer
Gas Barbecue/
Grill

Cost

Gas Infrastructure Costs

$6,000-$15,000

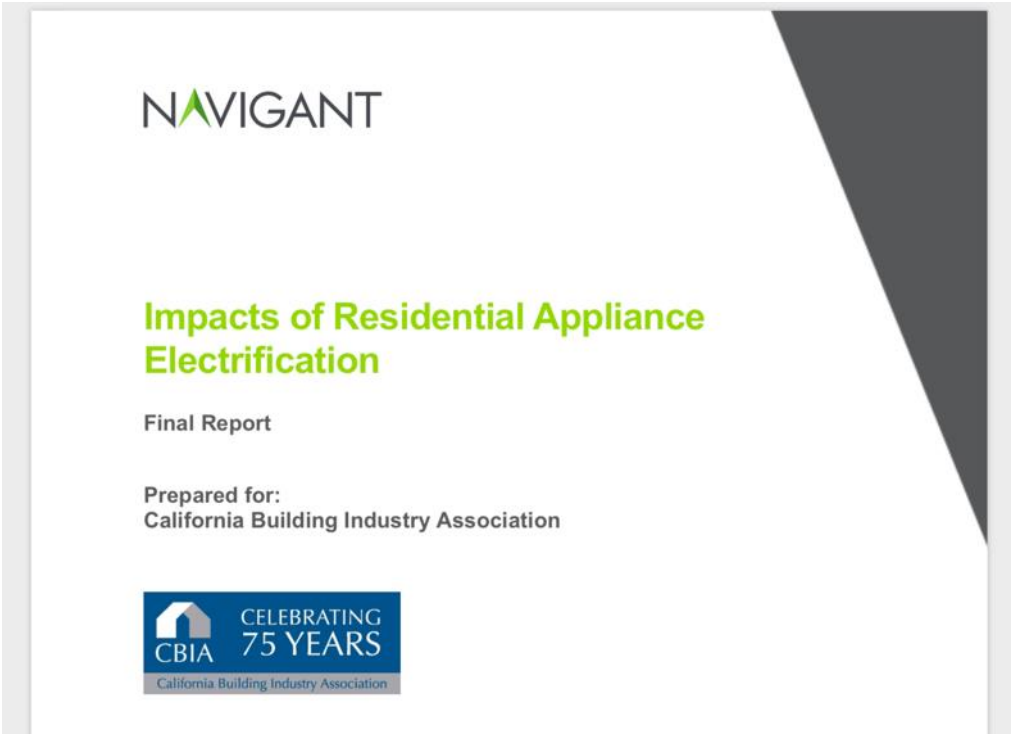
$270-$850

$7,000 X 9,897 = ~60,000 families priced out

$750-$2,400

Every $1,000 increase in house price prevents 9,897 California families from affording

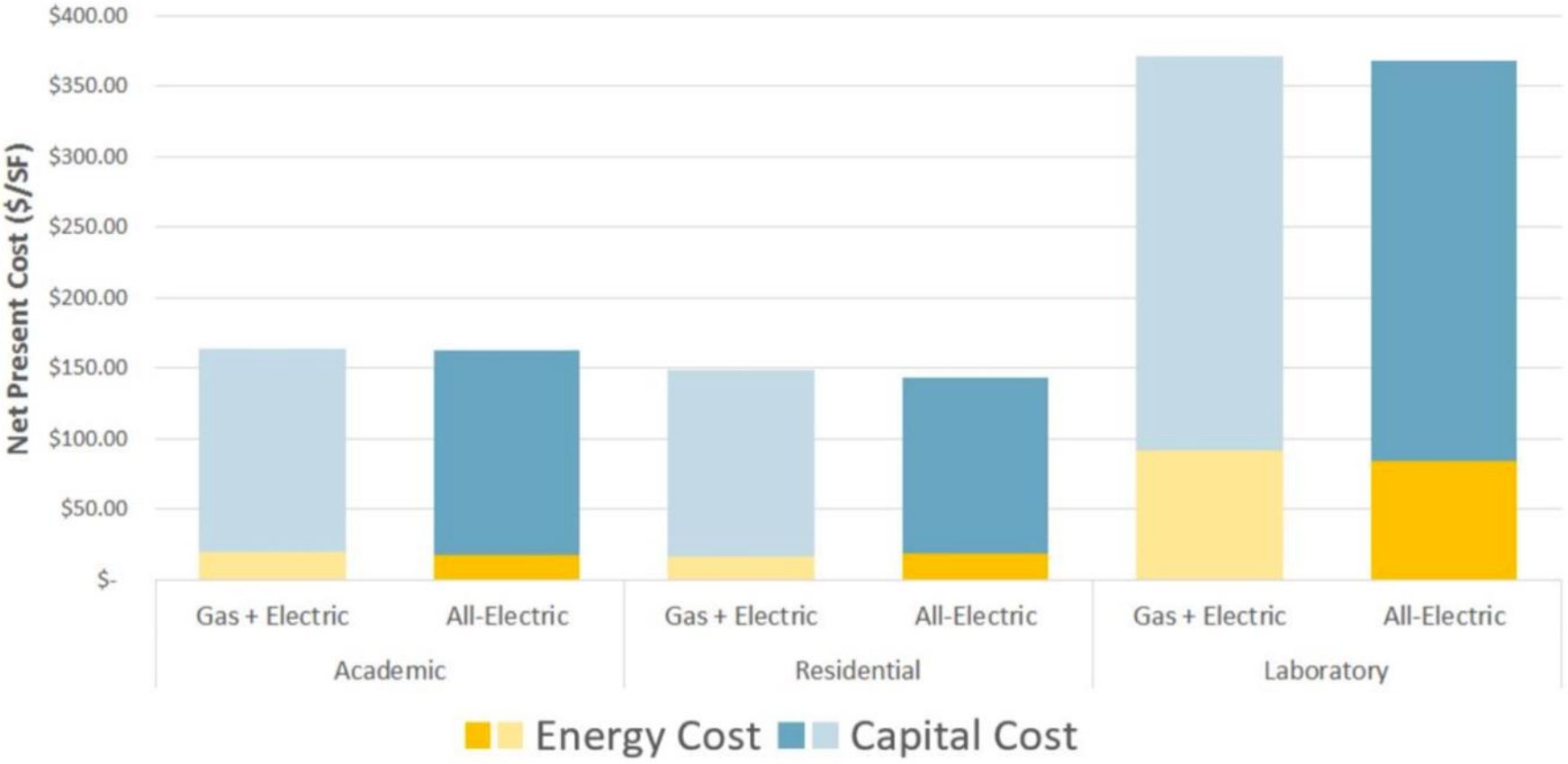
-NAHB, 2019



..electric appliances have similar or lower costs than natural gas appliances..

Replacing natural gas appliances with electric reduce an existing home's total GHG emissions by 35-66% in 2020 and 55-60% for new homes.

UC Carbon Neutral Buildings Cost Study

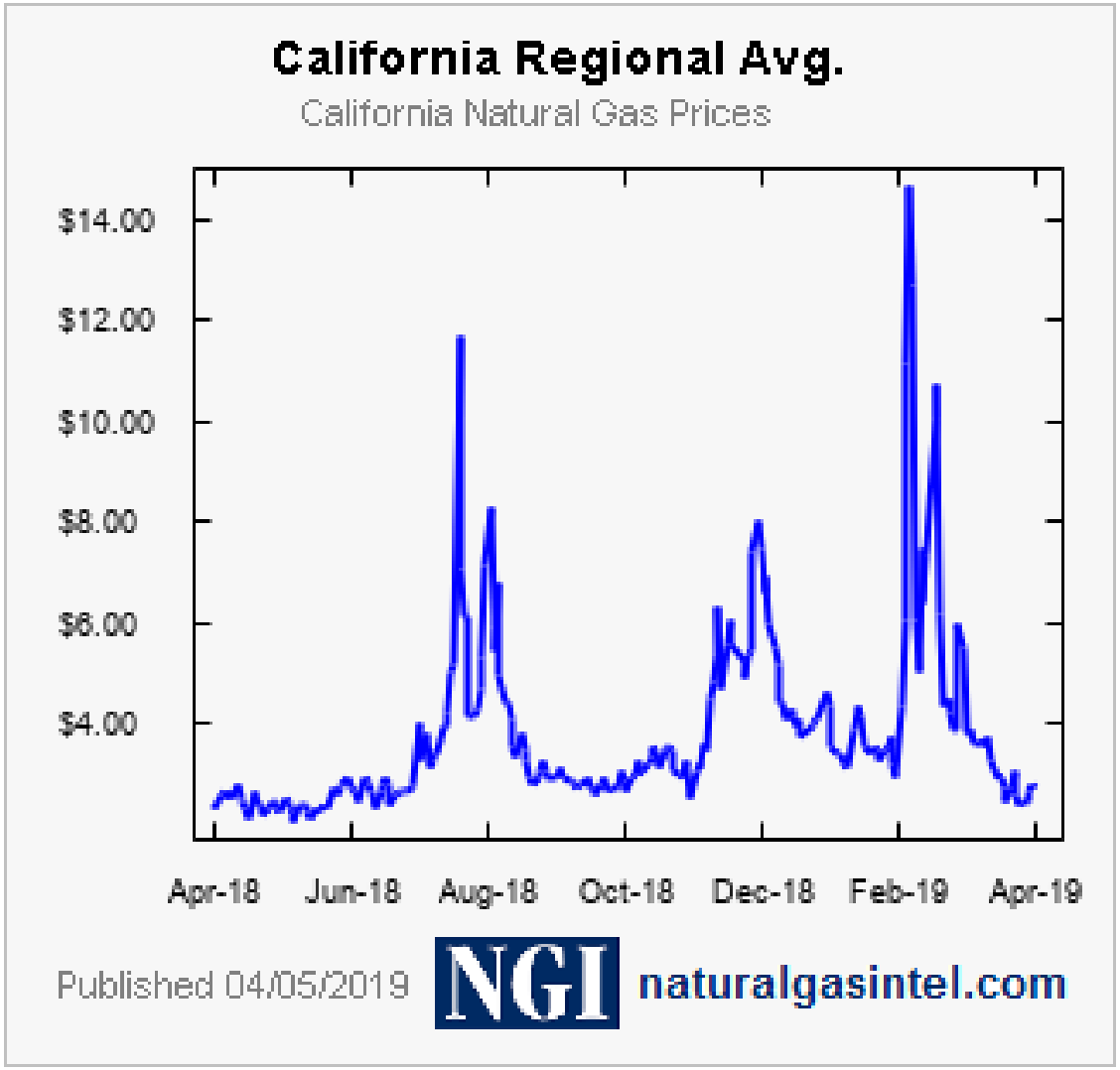


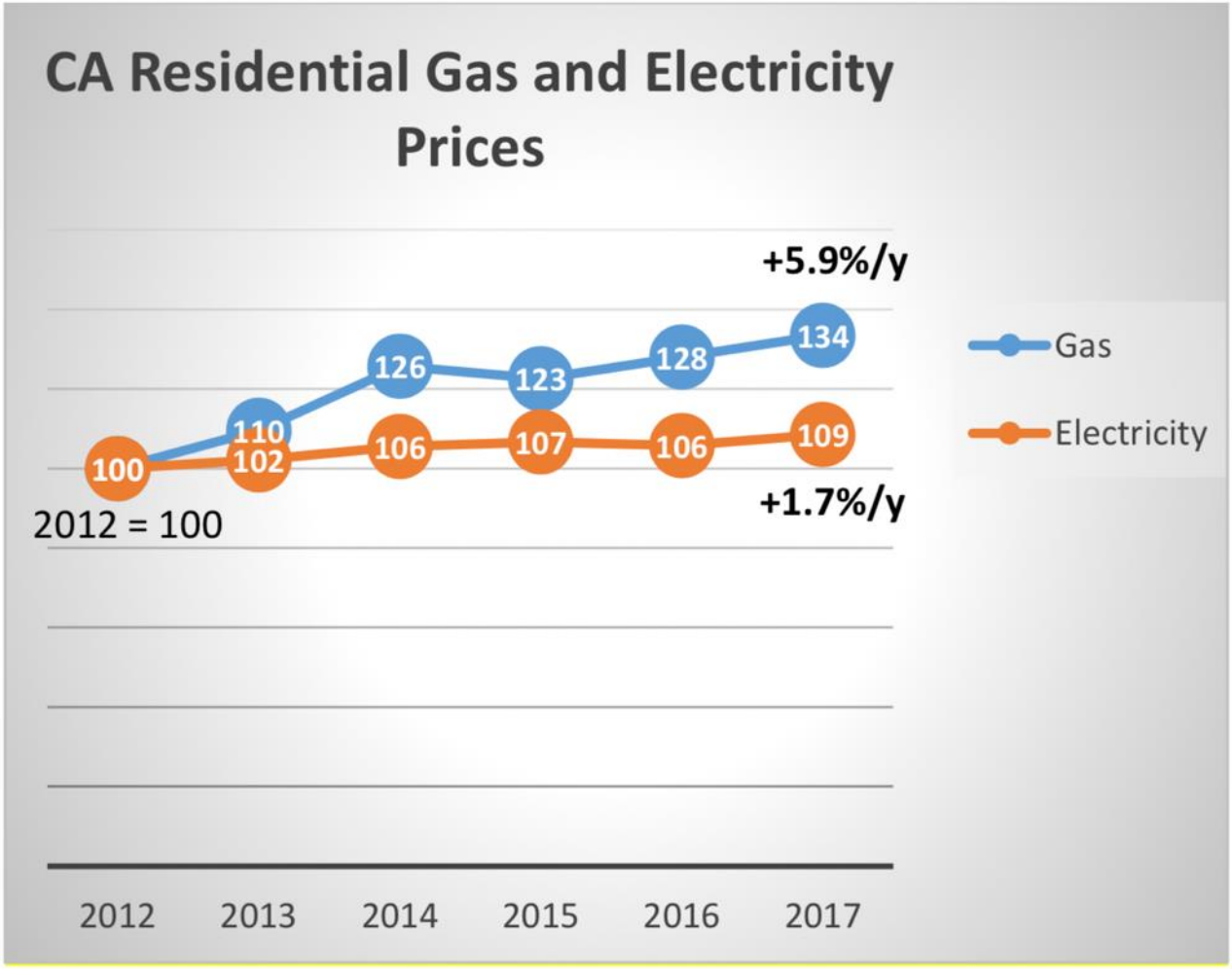
Equity

Lifting the High Energy Burden in America's Largest Cities:

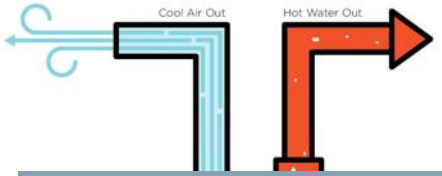
How Energy Efficiency Can Improve Low Income and Underserved Communities

Ariel Drehobl and Lauren Ross


California Regional Avg.
California Natural Gas Prices
$14.00
$12.00
$10.00
$8.00
$6.00
$4.00
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Published 04/05/2019
NGI
naturalgasintel.com



CALIFORNIA GAS AND ELECTRICITY PRICES 2012-2017 (EIA)[8]



HOW DO HEAT PUMPS WORK?

HOW AN AIR SOURCE HEAT PUMP WORKS

SUMMER

Refrigerant in outside coil releases heat to the air

compressor

Heat from the air is absorbed by refrigerant in indoor coil

WINTER

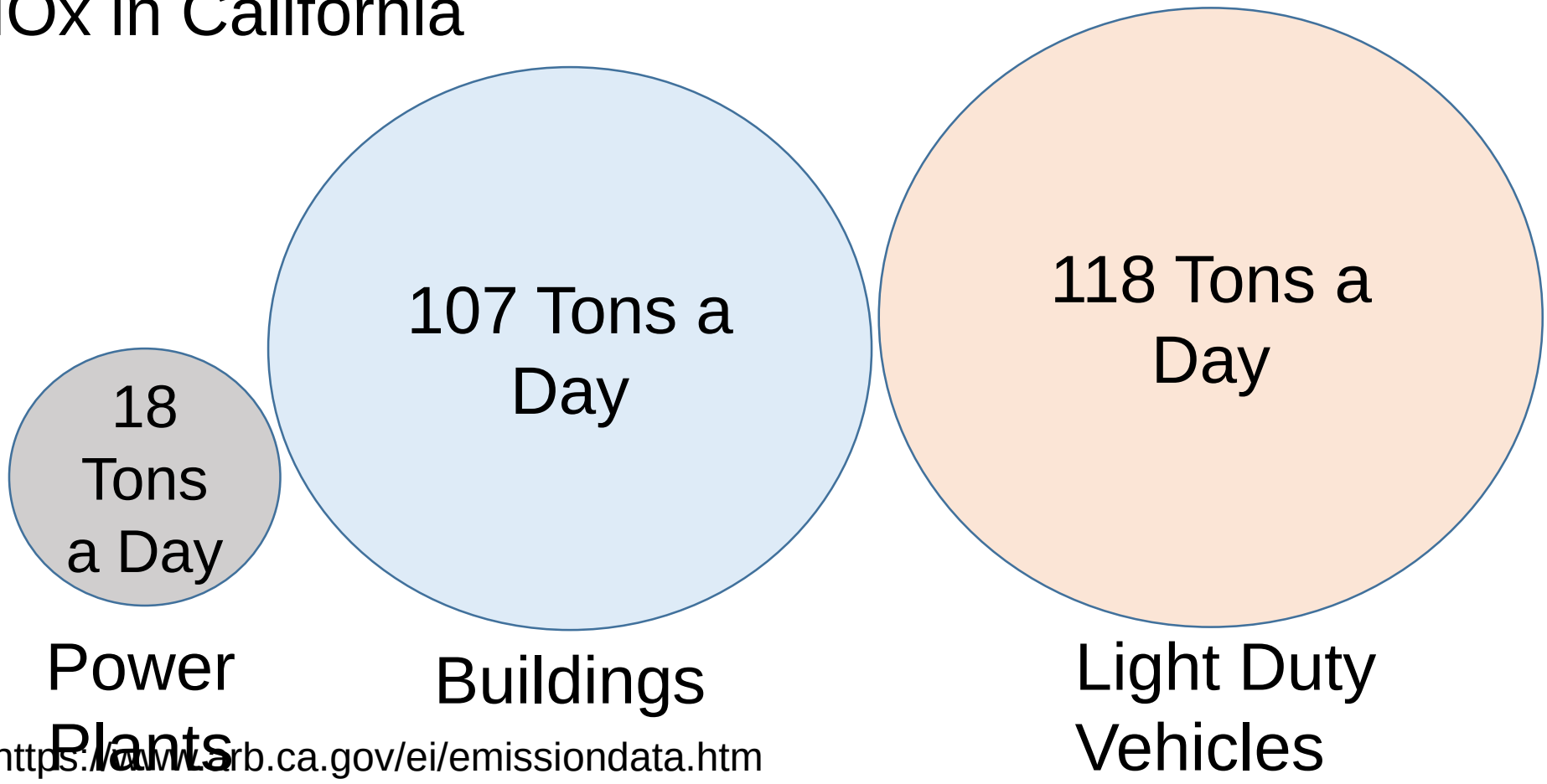
Heat from the air is absorbed by refrigerant in outdoor coil

compressor

Refrigerant in indoor coil releases heat into house

Health

NOx in California



https://www.arb.ca.gov/ei/emissiondata.htm

Pollutant Exposures from Natural Gas Cooking Burners: A Simulation-Based Asse

Jennifer M. Logue,[1,2] Neil E. Klepeis,[3,4] Agnes B. Lobscheid,[1] and Brett C. Singer[1,2,] 2014


Start
12:34
Timer On/Off
Set Clock
Cancel Off
Self Clean
Cook Time
Delay Time
Automatic Oven


350F

Inc

Consumer Reports Prefers Induction

Top 9 Ranges for 2018 were electric, top 2 were Induction

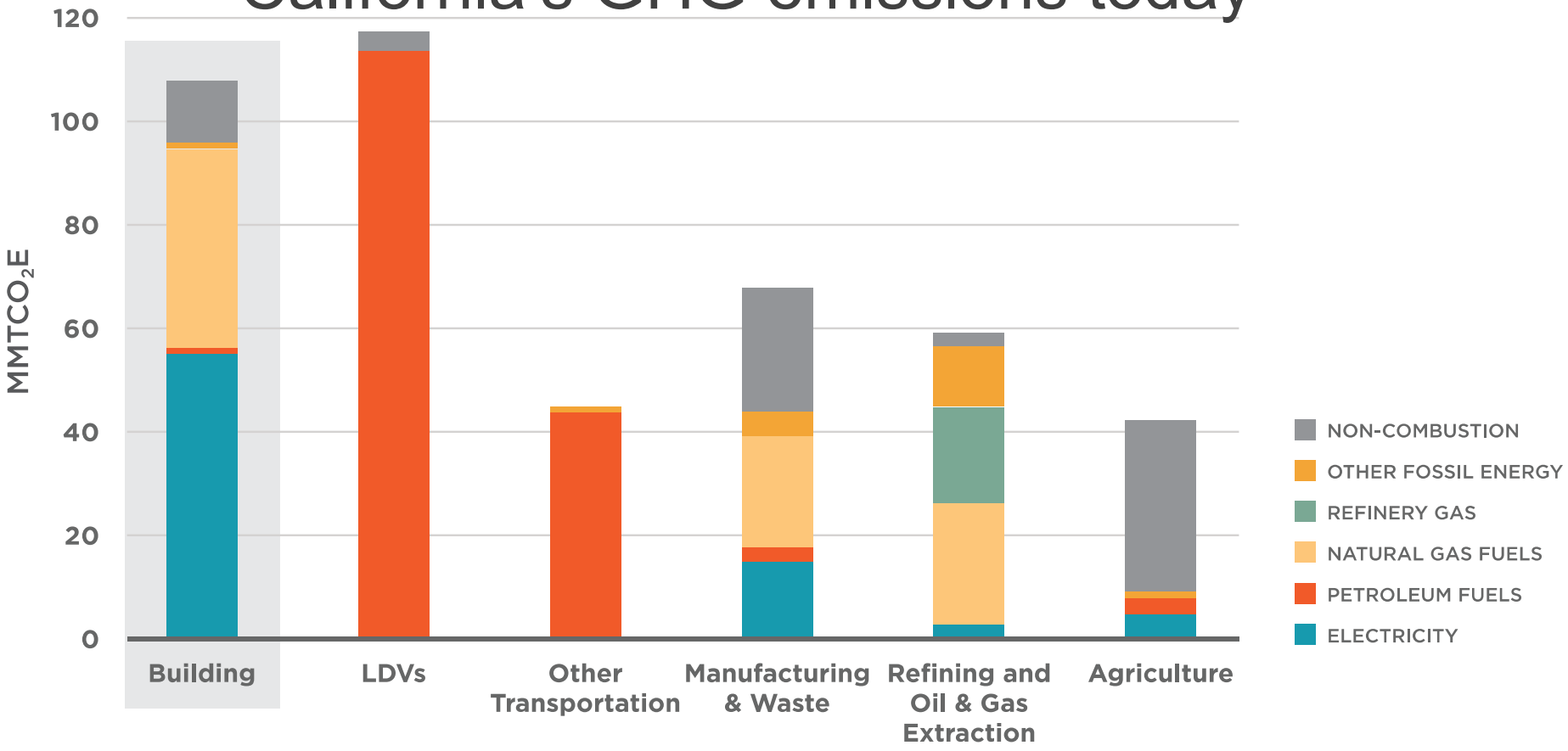
Fuel	Model	Rating	Cost
Induction	Kenmore Elite 95073	89	$1,530
Induction	Kenmore 95103	88	$1,000
Electric Smoothtop	Samsung NE58F9710WS	85	$1,800
Induction	GE Profile PHS930SLSS	83	$2,430
Electric Smoothtop	Samsung NE59J7850WS	82	$1,300
Electric Smoothtop	Samsung NE59J7750WS	82	$1,600
Induction	LG LSE4617ST	82	$3,330
Induction	Frigidaire Gallery FGIF3036TF	82	$990
Gas	LG Signature LUTD4919SN	81	$3,000



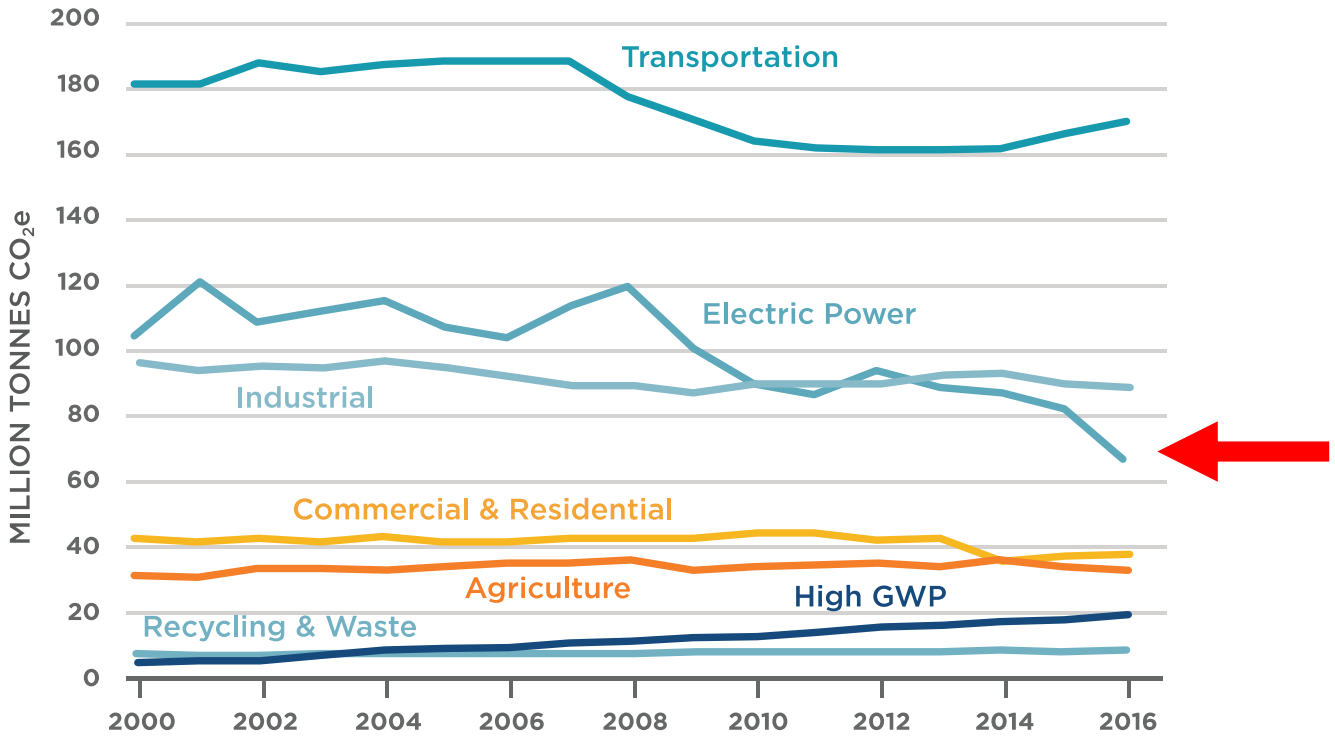



Climate

Buildings represent ~25% of California's GHG emissions today

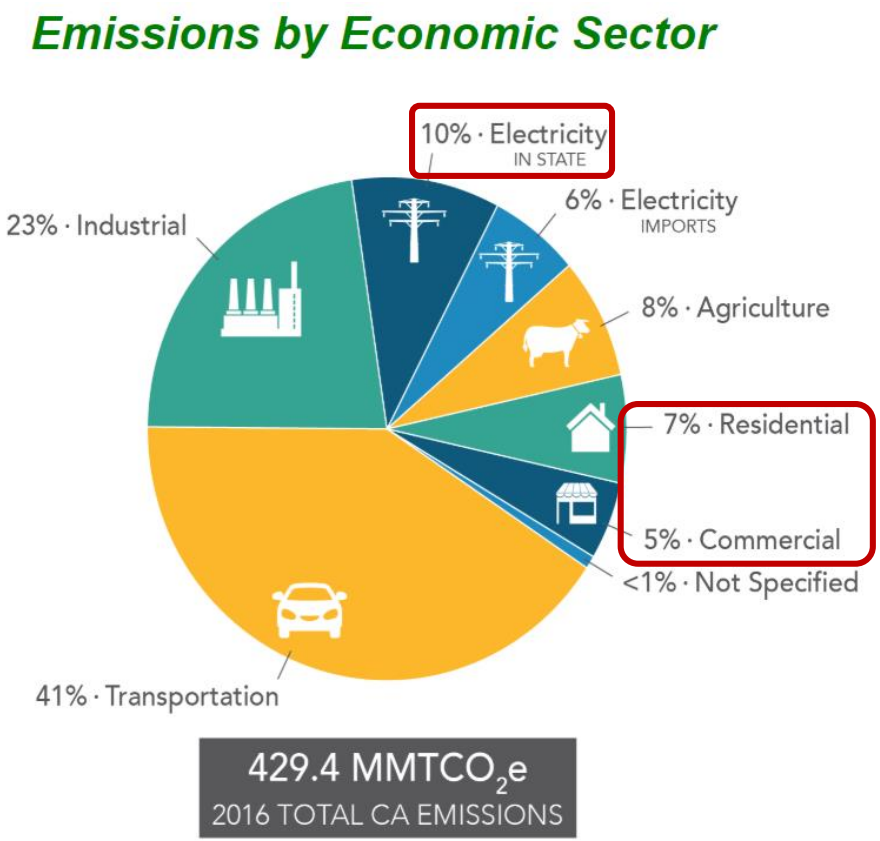


Electricity is getting cleaner, moving toward 100% carbon-free by 2045

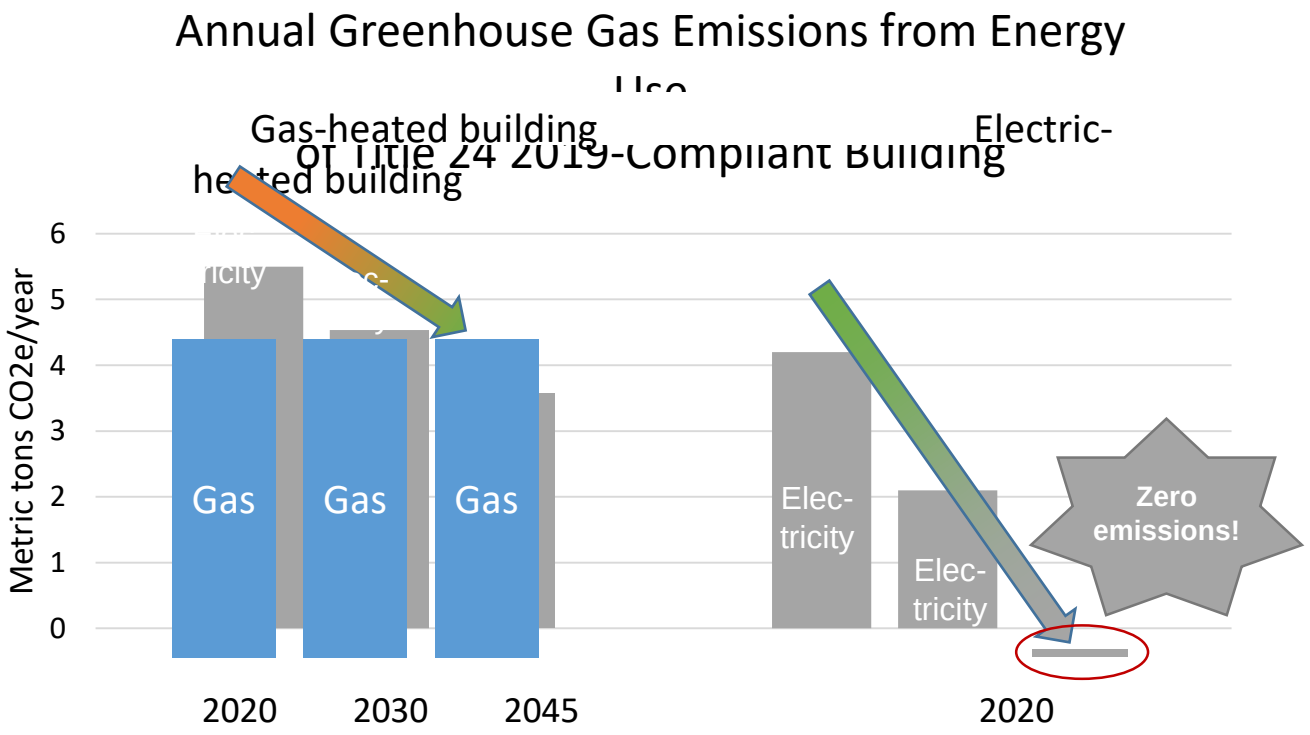


Source: CA Air Resources Board, Emission Inventory 2018.
https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf

Building emissions > all in-state power plants

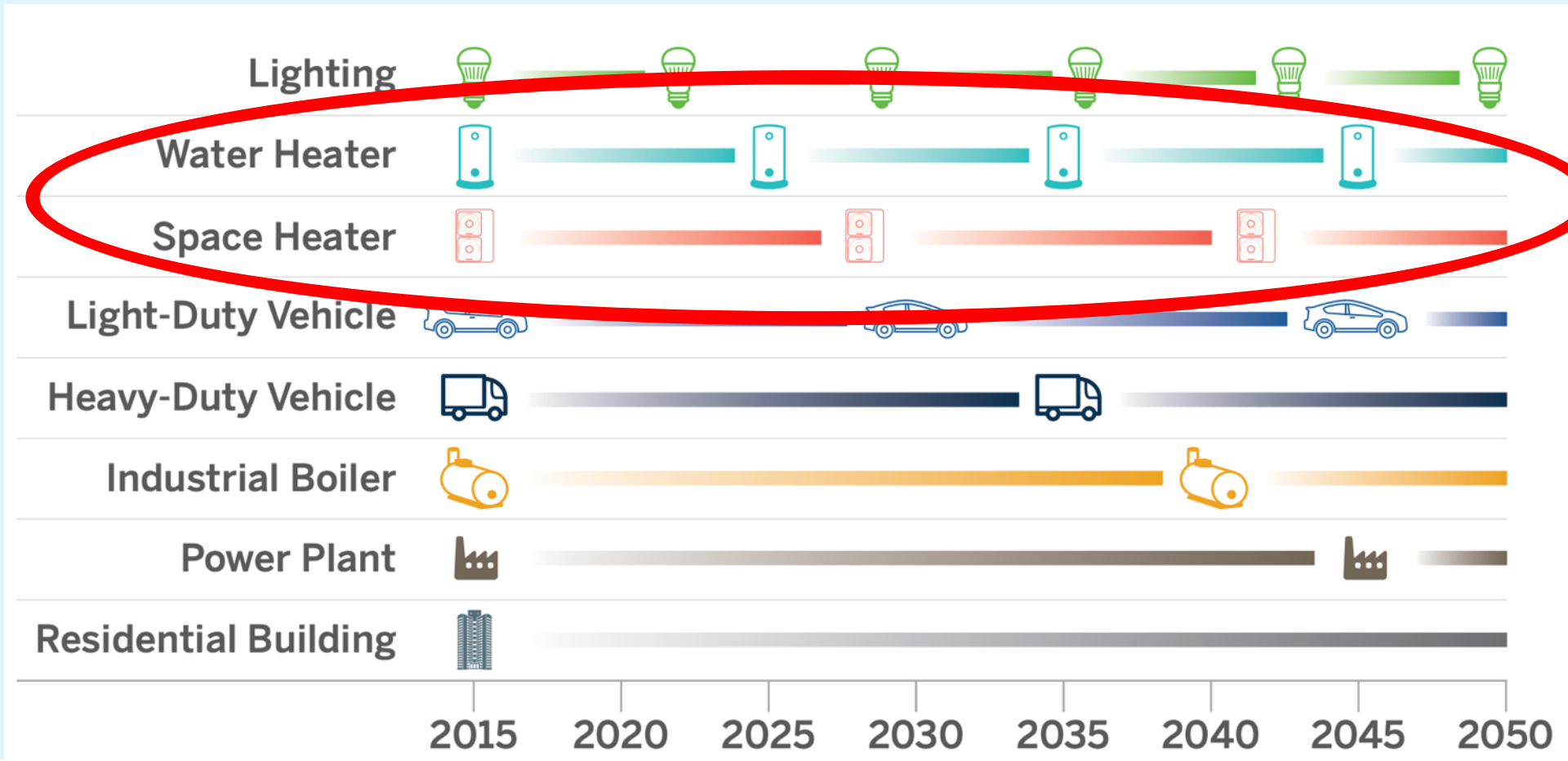


Electric Heat Offers Pathway To Zero Emissions



NRDC analysis, climate zone 13 (Fresno) with rooftop solar. Including methane leakage

Stock Turnover



Electric Buildings are …

Cheaper
More Equitable
Healthier
More Climate Friendly
Safer

New homes will no longer be heated by gas from 2025, government says

Fossil fuel heating systems banned in bid to tackle emissions

Chiara Giordano | Wednesday 13 March 2019 22:52 | 177 shares | 18 comments

THE HOLLAND TIMES

28 June 2018, National

The Netherlands to go completely gas-free


503

Energy Research and Development Division

FINAL PROJECT REPORT

Deep Decarbonization in a High Renewables Future

Updated Results from the California PATHWAYS Model

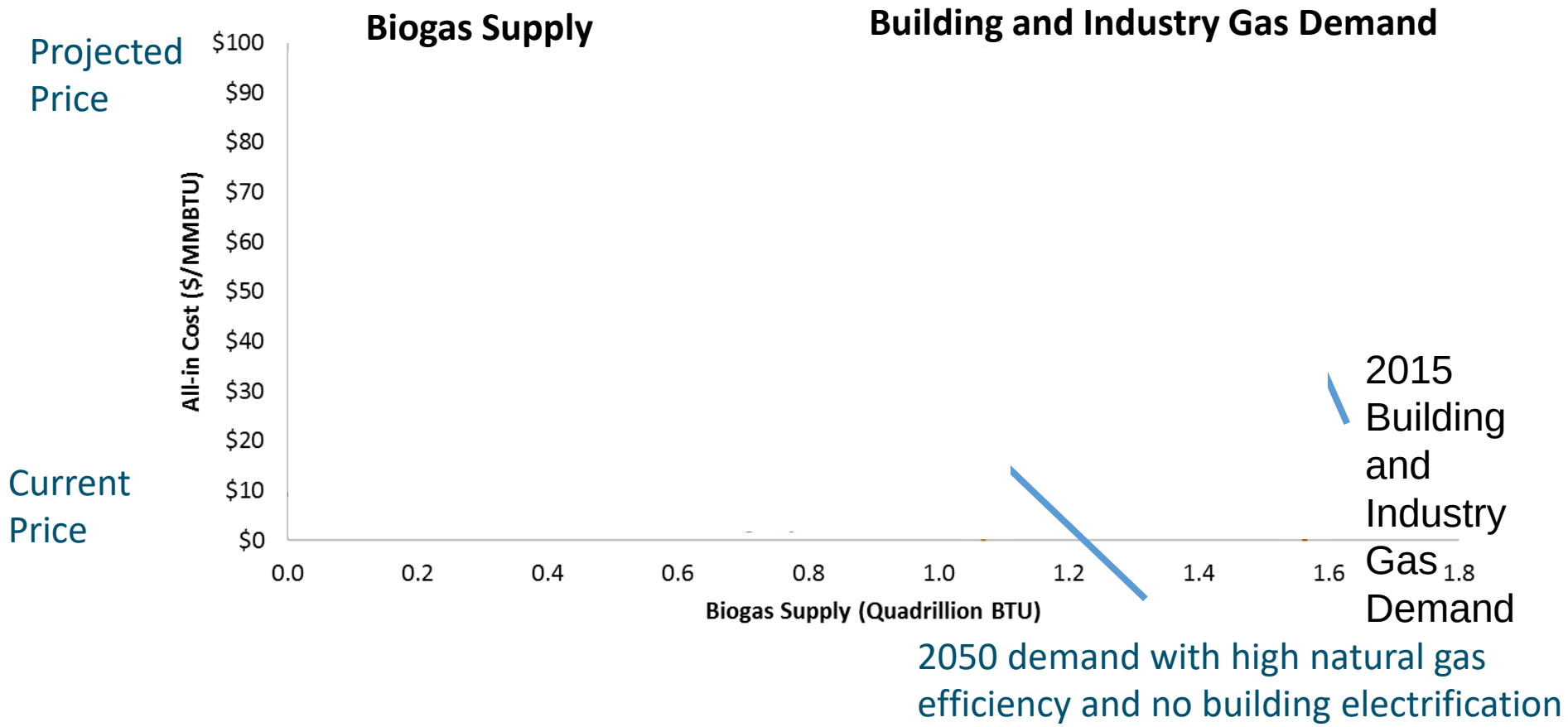
Energy+Environmental Economics

California Energy Commission

Edmund G. Brown Jr., Governor

June 2018 | CEC-500-2018-012

Biogas supply & gas demand in 2050



Current SMUD Electrification Programs

All-Electric New Homes Program

Up to $5,000 per home

- $500 for pre-wiring (required)
- $1,500 for HPSH
- $1,500 for HPWH
- $1,500 for induction cooktop

Discussion of whether program will require no gas to site

Electrification Focus in Home Performance Program (existing homes)

Up to $13,750 per home

- $2,500 for wiring and panel upgrades
- $2,500 for HPSH
- $3,000 for HPWH
- $250 for induction cooktop
- $3,000 for insulation and sealing

…and miscellaneous items

Midstream HPWH program under development

SMUD®

CPUC Decarbonization Pl

1. All Electric Rates
2. Resource Acquisition:
   - Incentives (eg Rebates)
   - Financing (eg Loans for all-electric customers)
   - Emerging Technology
3. Market Transformation

Overall: Focus goals on GHG emission rather than energy reduction.

California is building the homes of the future, today

Homes built to the new codes will:

BE EXTREMELY ENERGY EFFICIENT

New homes will feature high efficiency windows, appliances, and lighting and heating.

HAVE SOLAR POWER

All eligible residential buildings and homes will have access to renewable energy resources, such as rooftop solar.

INCENTIVIZE SOLAR + STORAGE

In some cases, the rules will allow a limited trade-off between solar + storage and efficiency. The credit is meant to help incentivize on-site energy storage for individual households, an essential tool for achieving emission reductions.

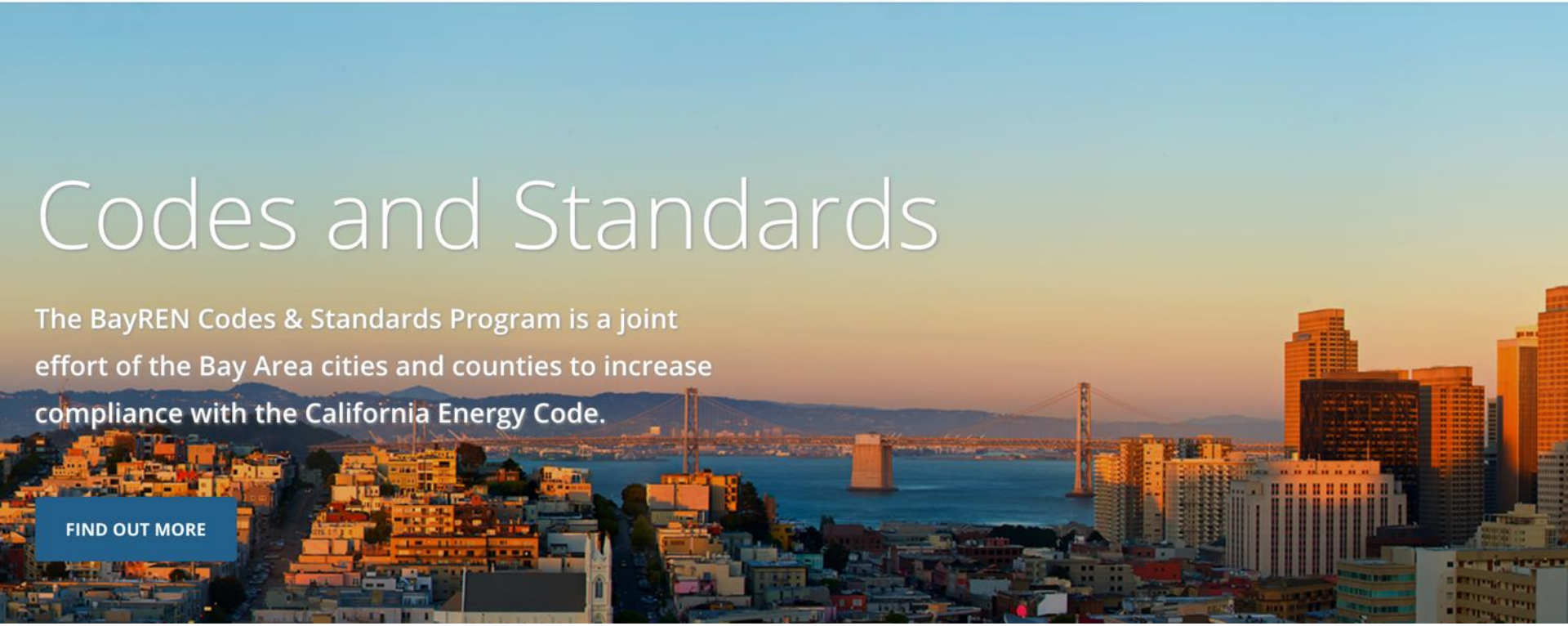
Encouraging All-Electric:

Provisions in the code will encourage more electricity use and all-electric homes to reduce natural gas consumption. Technology such as electric water heaters are becoming increasingly cost effective.

BAYREN

Local Governments Empowering Our Communities

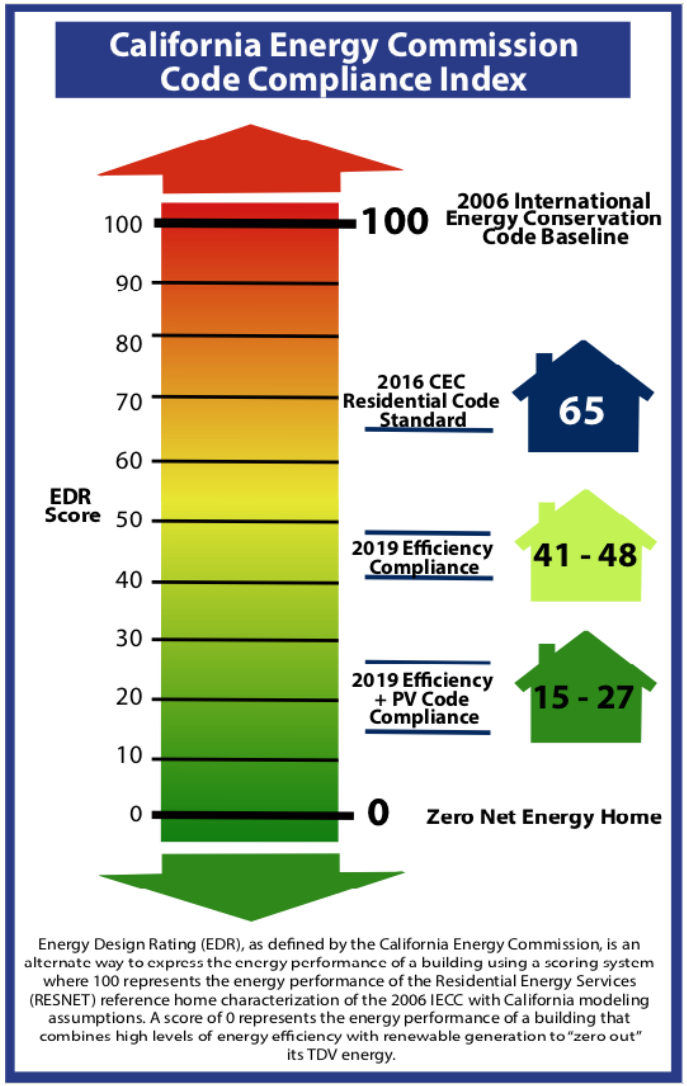
ABOUT EVENTS SERVICES RESOURCES CONTACT




Depreciation
NEXT EXIT


Welcome to Santa Rosa
FROM THE
ASHES
WE WILL
RISE
LIONS
CLUB

How to Build on Budget in 2020: All-Electric and Solar Powered

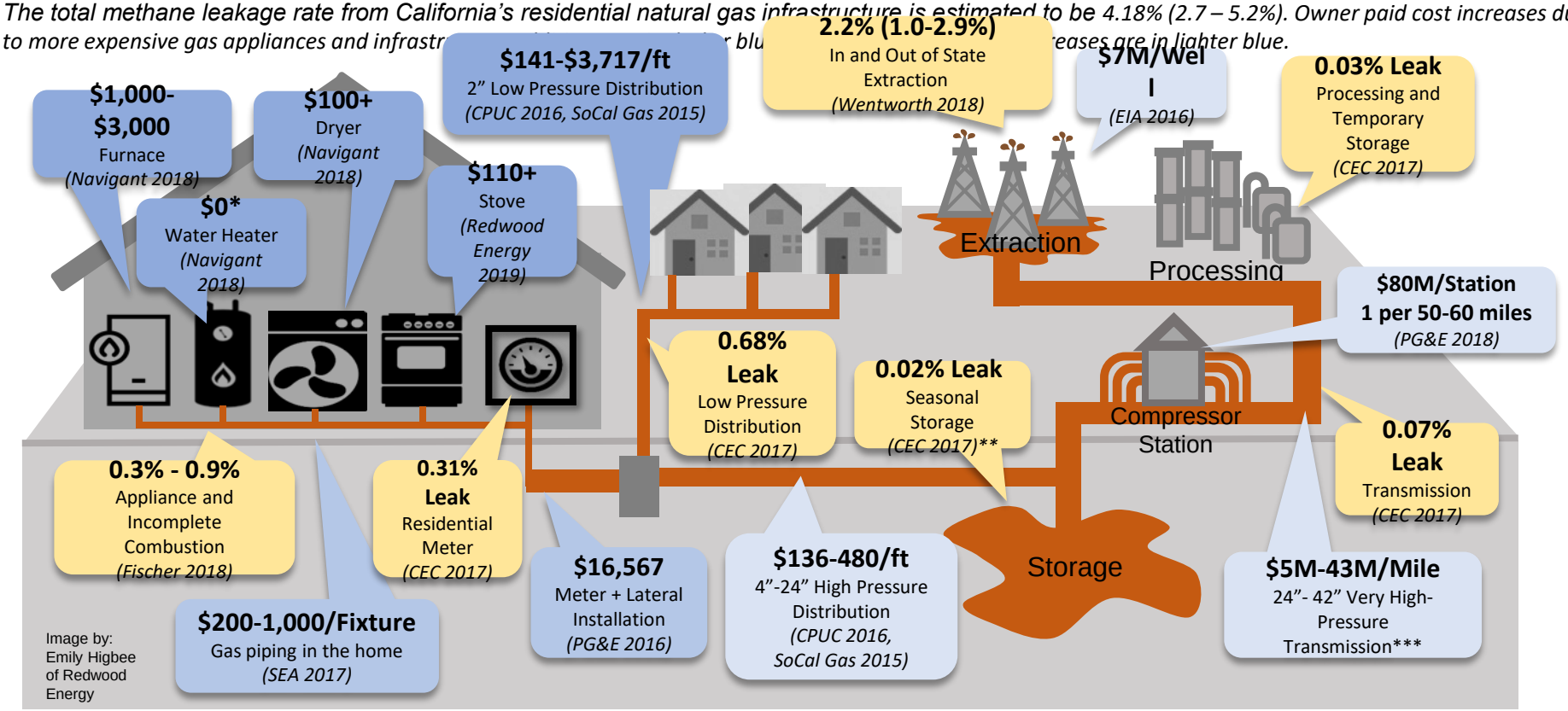


The 2020 Residential Code

- World's Most Efficient Building Code (as was 2016 Code)
- World's First State/Provincial Code to Mandate PV (2-4kW)
- Still Assumes ~40% Gas Powered Home

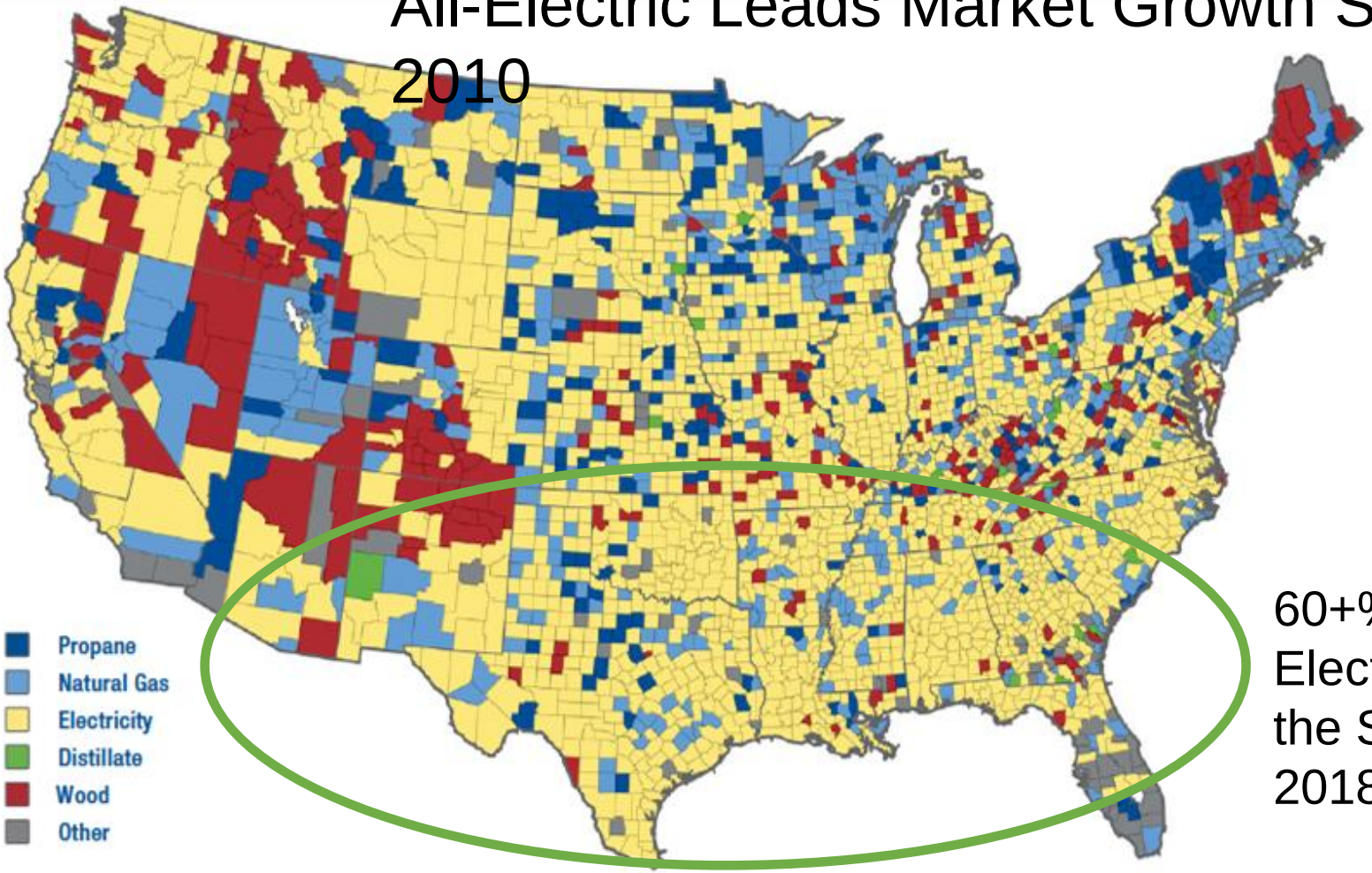
Residential Natural Gas Infrastructure Costs and Methane Leakage: $25,000+ per home, 2.7%-5.2% leakage

The total methane leakage rate from California's residential natural gas infrastructure is estimated to be 4.18% (2.7 – 5.2%). Owner paid cost increases due to more expensive gas appliances and infrastr... blu... ...eases are in lighter blue.



Appliance costs are the marginal cost ($) of gas over all-electric
*heat pump water heater equal in cost to on demand gas water heating
**Aliso Canyon leaked 4.62 Billion cubic feet and alone cost $1.014 billion shared by 5.6 million meters - $181/meter cost (Reuters, Aug 6, 2018)
*** Average of various sources *(Cochran 2018, Lennon 2019, SoCalGas 2014, Nemec 2015, Nogueras 2011)*

All-Electric Leads Market Growth Since 2010

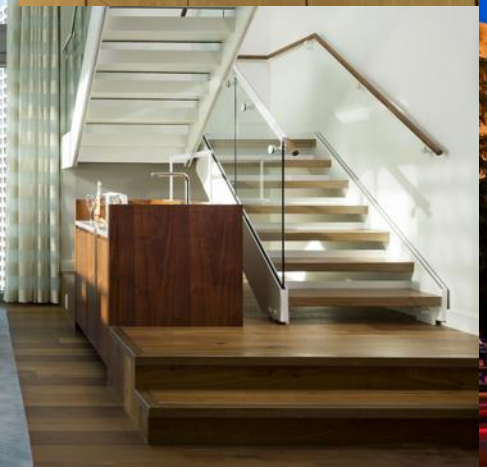


60+% All-Electric in the South in 2018

HYATT REGENCY®

WAIKIKI BEACH RESORT AND SPA

Ritz-Carlton Residences, Waikiki



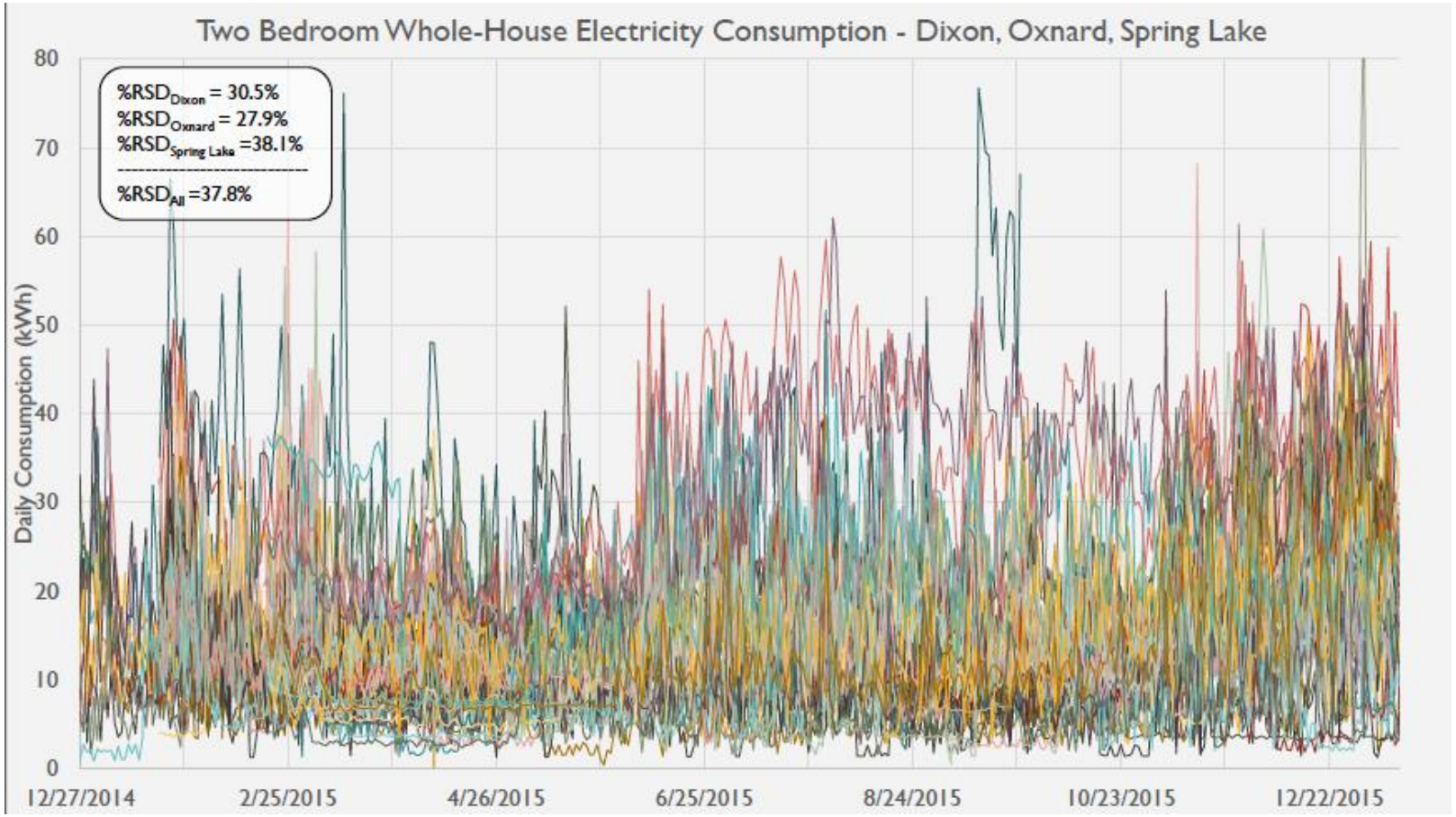
Tourists watching Trump protesters

Trump International Hotel & Tower-Waikiki

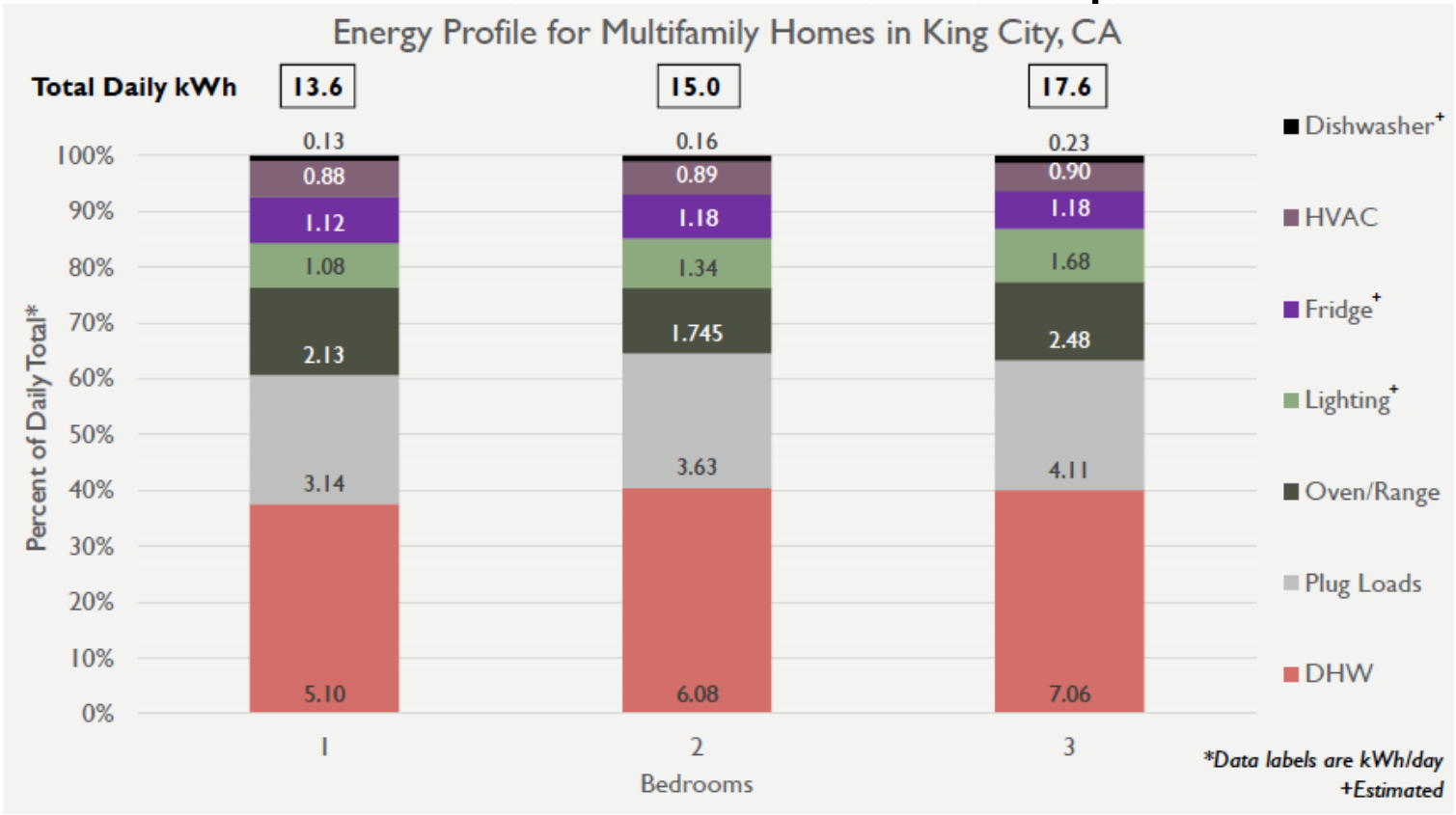

AURELIE DA

world habitat awards

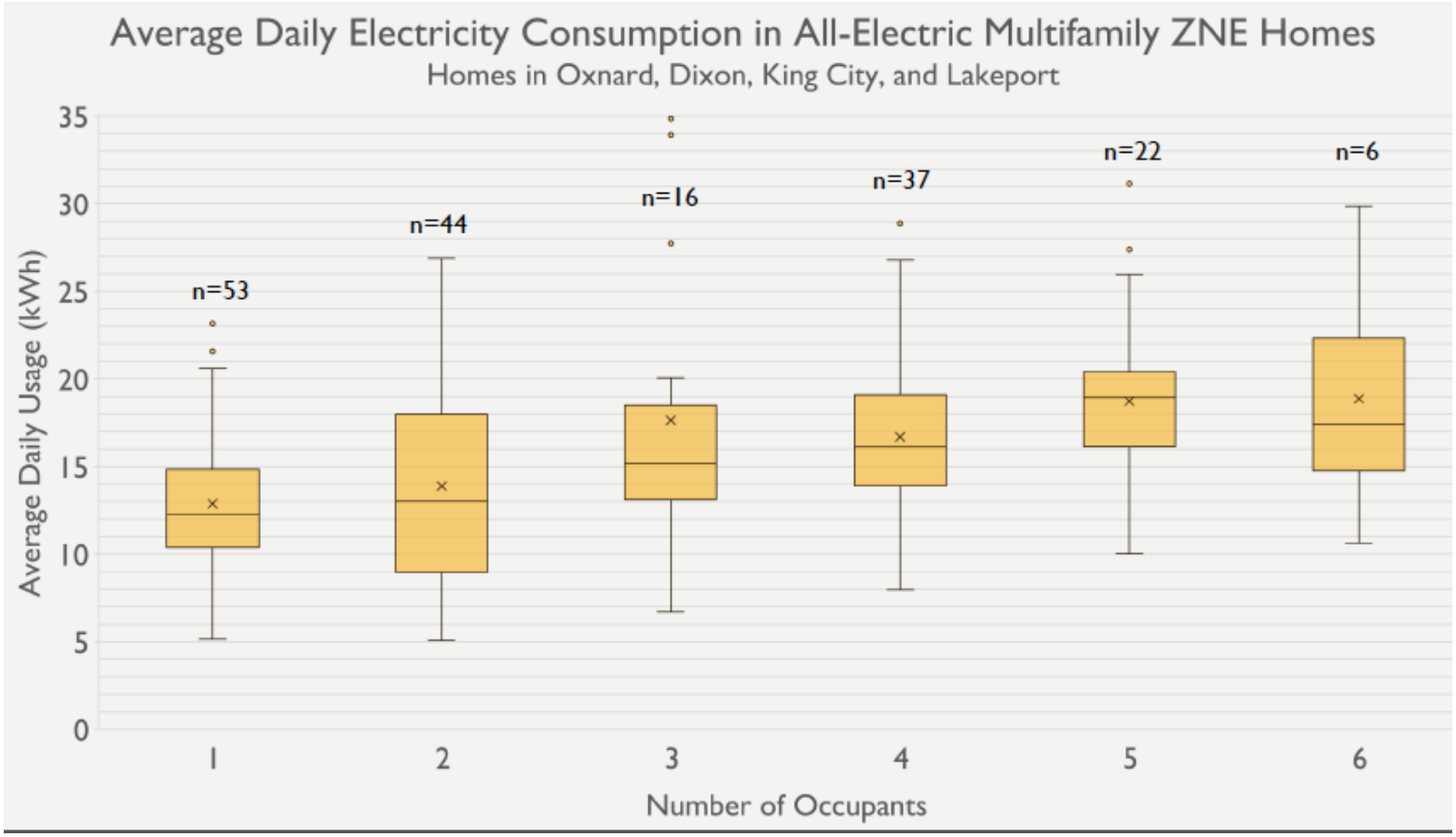
High variability in daily use among nearly identical households shows opportunities and challenges for savings



Usage Data on People Living in All-Electric 2020 Code Apartments



Variability is high, yet average consumption increases by only 1 kWh/person



"9 out of 10 townhome projects in Vancouver are all electric. At Brixton Flats, our gas utility offered free gas piping throughout the building if the developer had 3 gas loads per suite. But the Developer wanted all electric."-Chris Higgins, Green Building Planner of Vancouver, BC

Hillandale Gateway, Washington DC

Affordable, Quiet and Efficient Heat Pumps

$3k-
$6k/Residence

$5k-
$13k/Residence

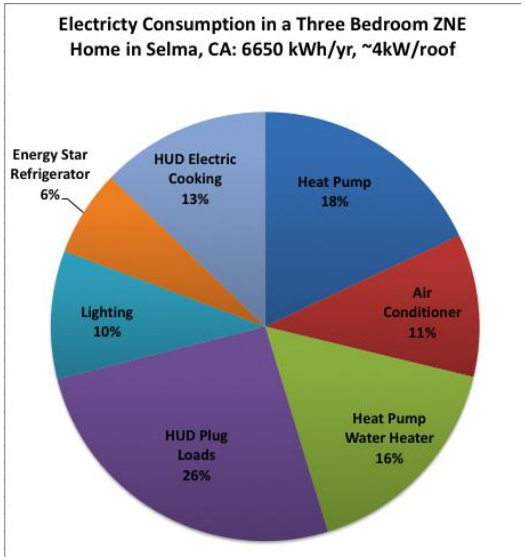
$10k-
$20k/Residence

Case Study: Cottages at Cypress, Fort Bragg, CA

-26 Homes
-4kW PV/House
-Ductless Minisplit HVAC
-Heat Pump Hot Water
-Electric Resistance Range
-R-49 attic and R-21 Walls
-ALL HERS Inspections

Case Study: Valley View Homes, Selma, CA

PSH1BG iQ Drive® | Maytag® M1200 up to 19 SEER, 10 HSPF Heat Pump



U.S. Government

Federal law prohibits removal of this label before consumer purchase.

ENERGYGUIDE

Water Heater – ELECTRIC
Tank Size (Storage Capacity): 59 gallons
Uniform Energy Factor: 3.7

Rheem Sales Company, Inc.
Model XE65T10HD50U1
B00150

Estimated Yearly Energy Cost

$161

$225 — Cost Range of Similar Models — $732

The estimated yearly energy Cost of this model was not available at the time the range was published.

First Hour Rating

(How much hot water you get in the first hour of use)

very small	low	medium	high 75 Gallons

Estimated Yearly Electricity Use

- Your cost will depend on your utility rates and use.
- Cost range based only on models fueled by electricity with a high first hour rating (75 gallons and over)
- Estimated energy cost is based on a national average electricity cost of 12.00 cents per kWh.
- Estimated yearly energy use: 1341 kWh

ENERGY STAR

www.ftc.gov/energy.

Part No AX4258

U.S. Government

Federal law prohibits removal of this label before consumer purchase.

ENERGYGUIDE

Water Heater – Natural Gas
Tank Size (Storage Capacity): 46 gallons

Rheem Sales Company, Inc.
Model ECORHE50
B00007

Estimated Yearly Energy Cost

$231

$225 — Cost Range of Similar Models — $297

First Hour Rating

(How much hot water you get in the first hour of use)

very small	low	medium	high 87 Gallons

Estimated Yearly Energy Use

- Your cost will depend on your utility rates and use.
- Cost range based only on models fueled by natural gas with a high first hour rating (75 gallons and over)
- Estimated energy cost is based on a national average natural gas cost of $1.09 per therm.
- Estimated yearly energy use: 212 therms

ENERGY STAR

www.ftc.gov/energy.

Part No. AX4258

Builder Models of Electric Radiant Ranges

Amana AER6303MFS	**Whirlpool** WFE320M0ES	**Frigidaire** FFEF3052TS	**GE Appliances** JBS60DKBB
			
$450	$500	$500	$510

Builder Models of Electric Induction Ranges

Kenmore Elite 95073	**Frigidaire** Gallery FGIF3036TF	**Samsung** NE58K9560WS	**Frigidaire** Gallery FGIF3036TF	**Electrolux** EI30IF40LS
				
$1,260	$ 1,075	$1,400	$1,200	$1,800

Heat Pumps for Hot Tubs and Swimming Pools

Sizing Tip: 4 BTU/Hr to 6 BTU/Hr per gallon of pool water

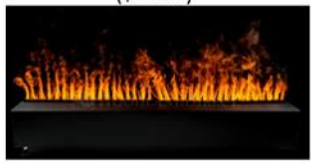
Hayward Heat Pro

Pentair

Aquacal Heatwave

Modern Electric Fireplaces

Dimplex Opti-Myst Pro 1000
($2099)



Napoleon See-thru
($2,008)

Dynasty DY-BT79
($1,299)

Amantii Zero Clearance
($1,308)

Amantii BI-40-SLIM (In/Out)
($1,618)

Modern Flames CLX Series
($7,449)

Dimplex Opti-Myst Pro 500
(outdoor) ($1300)

EnerG+ Patio Heater
(outdoor) ($186.99)

Touchstone Sideline
(outdoor) ($574)

Dimplex Opti-Myst Pro 400
($1749)

ClassicFlame Felicity
($349.77)

Altra Furniture
($160)

North Bay Community Resilience Initiative: Aims

- Track, publicize, and support cutting-edge resilience-creating energy efficiency, electrification, and microgrid incentives, plus policy advancements by SCP, MCE, BayREN, BAAQMD, and others.
- Procure and develop a database of model structures with “Community Microgrid–ready” designs: For new and retrofit residential, commercial, and municipal bldgs.
  - Develop “Electrification & Community Microgrid–Ready” (ECMR) document for homeowners and installers
- Develop Community Microgrid roadmap beginning with critical facility microgrid pilots such as fire stations, hospitals, and places of refuge.
  - Position these pilots in areas that are conducive to expansion into Community Microgrids.
- Develop <u>all</u> as a model for decarbonization and resilience in rebuilding, and for **proactive resilience** and community modernization.

Electrification & Community Microgrid–Ready (ECMR) document

Clean Coalition

BERKELEY LAB

EPRI ELECTRIC POWER RESEARCH INSTITUTE

IRESN

Developed by the Clean Coalition and a team of industry experts, as a guideline for homeowners, trades installers, and electrical engineers to easily plan and install necessary wiring and communications to be all-electric and communitymicrogrid-ready.

MICROGRID ENERGY SOLUTIONS

biraenergy

Stone Edge Farm Microgrid

CONTECH-CA

General MicroGrids

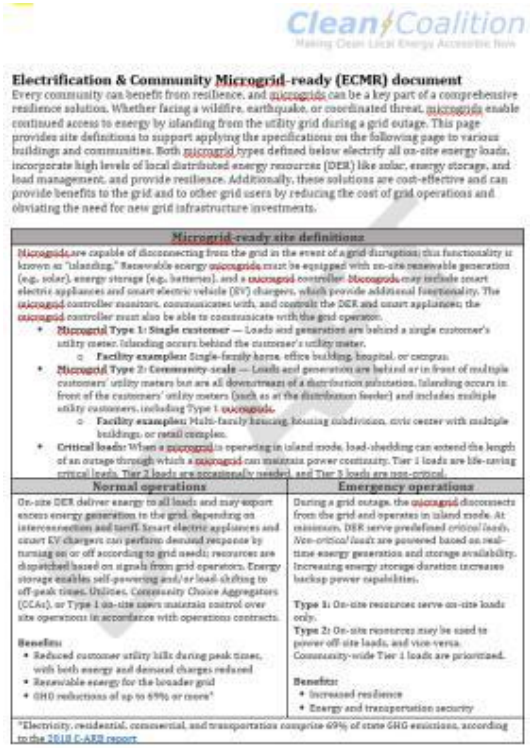
Balance Energy

ECMR document

Simple 2 page document

- Page 1: Definitions and Operations

- Page 2: Wiring for;
  - Connected Appliances
  - Solar/Solare ready
  - Energy Storage
  - Connectivity
  - Additional recommendations
  - Commercial Buildings



Electrification & Community Microgrid-ready (ECMR) document

Every community can benefit from resilience, and microgrids can be a key part of a comprehensive resilience solution. Whether facing a wildfire, earthquake, or coordinated threat, microgrids enable continued access to energy by islanding from the utility grid during a grid outage. This page provides site definitions to support applying the specifications on the following page to various buildings and communities. Both microgrid types defined below electrify all on-site energy loads, incorporate high levels of local distributed energy resources (DER) like solar, energy storage, and load management, and provide resilience. Additionally, these solutions are cost-effective and can provide benefits to the grid and to other grid users by reducing the cost of grid operations and obviating the need for new grid infrastructure investments.

Microgrid-ready site definitions

Microgrids are capable of disconnecting from the grid in the event of a grid disruption; this functionality is known as "islanding." Renewable energy microgrids must be equipped with on-site renewable generation (e.g. solar), energy storage (e.g. batteries), and a microgrid controller. Microgrids may include smart electric appliances and smart electric vehicle (EV) chargers, which provide additional functionality. The microgrid controller monitors, communicates with, and controls the DER and smart appliances; the microgrid controller must also be able to communicate with the grid operator.

- **Microgrid Type 1: Single customer** — Loads and generation are behind a single customer's utility meter. Islanding occurs behind the customer's utility meter.
  - **Facility examples:** Single-family home, office building, hospital, or campus.
- **Microgrid Type 2: Community-scale** — Loads and generation are behind or in front of multiple customers' utility meters but are all downstream of a distribution substation. Islanding occurs in front of the customers' utility meters (such as at the distribution feeder) and includes multiple utility customers, including Type 1 microgrids.
  - **Facility examples:** Multi-family housing, housing subdivision, civic center with multiple buildings, or retail complex.
- **Critical loads:** When a microgrid is operating in island mode, load-shedding can extend the length of an outage through which a microgrid can maintain power continuity. Tier 1 loads are life-saving critical loads. Tier 2 loads are occasionally needed, and Tier 3 loads are non-critical.

Normal operations	Emergency operations
On-site DER deliver energy to all loads and may export excess energy generation to the grid, depending on interconnection and tariff. Smart electric appliances and smart EV chargers can perform demand response by turning on or off according to grid needs; resources are dispatched based on signals from grid operators. Energy storage enables self-powering and/or load-shifting to off-peak times. Utilities, Community Choice Aggregators (CCAs), or Type 1 on-site users maintain control over site operations in accordance with operations contracts. **Benefits:** • Reduced customer utility bills during peak times, with both energy and demand charges reduced • Renewable energy for the broader grid • GHG reductions of up to 95% or more*	During a grid outage, the microgrid disconnects from the grid and operates in island mode. At minimum, DER serve predefined *critical loads*. *Non-critical loads* are powered based on real-time energy generation and storage availability. Increasing energy storage duration increases backup power capabilities. **Type 1:** On-site resources serve on-site loads only. **Type 2:** On-site resources may be used to power off-site loads, and vice-versa. Community-wide Tier 1 loads are prioritized. **Benefits:** • Increased resilience • Energy and transportation security

*Electricity, residential, commercial, and transportation comprise 69% of state GHG emissions, according to the 2018 E-ARB report

Page 1 of 2

Electrification & Community Microgrid -ready Guidelines DRAFT NBCEI (22_mk 21 Feb 2019).docx
Developed for the Clean Coalition's North Bay Community Resilience Initiative

ECMR guidelines

Residential properties participating in a microgrid and/or responding to emissions reduction targets are ideally all-electric. All-electric homes may provide increased value for microgrids and backup power because they rely on electricity for more essential services; however, all-electric homes may be impractical in some cold climates. If all-electric design is not currently possible, designs should at minimum include the electrical service features described below to facilitate future full electrification and on-site solar generation. The guidelines below vary by building; consult your electrician and/or engineer for site-specific recommendations.

Wiring: Install dedicated circuits and receptacles for all-electric appliances in SFDs:

- Connected heat pump (HP) water heater (15-30 amp, 240V)
- HP clothes dryer (30 amp, 240V)
- Induction electric range (50 amp, 240V)
- Connected HP space conditioner (30-60 amp, 240V)
- Connected EV charger (40-80 amp, 240V)

"Solar-ready" electrical service for future solar array:

- Main service panel (MSP) rated 225 amps (allows for a 200-amp main breaker plus bus bar capacity for a solar array of up to 70 amps)
- Double-pole circuit breaker
- Metallic conduit for future solar installation (from roof to inverter location/panelboard)

"Energy Storage System (ESS)-ready":

- Designated area for ESS. Size of this area will depend on required/desired loads to be served by system (i.e., critical loads for backup only vs. full operability in grid outage)
- Main electrical main line "loop" to battery location, between electrical service meter and main panel or subpanel
- Loop main subpanel power lead to designated ESS location
- Separate subpanel for loads that require backup (can be added during remodel)
- Capacity in sub panel for "Emergency circuits" to serve critical loads (e.g., refrigerator, HVAC, water heating, microwave) and outlets with battery power during grid outages
- Ethernet line from main router to ESS location
- Conduit for communication from solar inverter(s) to ESS location

Additional recommended features:

- Main electrical panel sized for all existing and future loads, including solar and ESS
- Conduit or wiring for level 2 V2B infrastructure
- Eaton "Pow-R-Command" main electrical panel (auto load sheds, monitors, and efficiency)
- Conditioned space air sealing (less than 1.0 ACH @ 50m pascal)
- Heat recovery / energy recovery ventilation (HRV or ERV; use w/ air sealing for high I.A.Q.)
- Communications conduit for demand response-capable electric appliances
- Connectivity: Open ADR, CTA 2045 @ appliances, IEEE 2030.5 @ energy storage

Microgrid-ready commercial structure/campus recommended features:

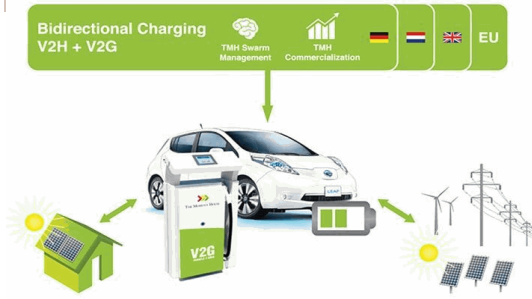
- Interconnected Eaton "Pow-R-Command" main electrical panel(s) and subpanels
- Wiring for level 2 and 3 DC-FC EV charging
- Wiring for level 2 (and 3 DC-FC) V2B and V2G

Page 2 of 2

Electrification & Community Microgrid -ready Guidelines DRAFT NBCEI (22_mk 21 Feb 2019).docx
Developed for the Clean Coalition's North Bay Community Resilience Initiative

ECMR Document Goals: Electrification and Decarbonization through community microgrids

- All-Electric benefits; Safer and healthier homes and communities
  - Elimination of natural gas which is highly flammable, and produces formaldehyde and other toxic gases within the home and community
  - Reduced reliance on outside fuel & energy sources = RESILIENCE
  - Reduction of greenhouse gases
  - EV adoption = Reduction and eventual elimination of all fossil fuels
  - EV's can become "mobile energy" assets, saving *and making* money
  - REVENUE for homeowners by using your connected assets as grid assets



ECMR: Staging Community Microgrids

- Microgrid benefits: **Resilient homes and communities**
- Ability to stay powered in grid outages = **Resilience and Security**
- LOCAL Renewable Energy + Storage = **Primary Power**
- Energy produced by local renewable sources = **Permanent local jobs**
- Ability to use behind the meter and community energy storage as “grid balancing assets” *and* revenue stream
- **Elimination of Fossil Fuel “Peaker Plants”**

Model structures: partners

Clean Coalition

Developing a **design database** for model structures for new and retrofit residential, commercial, and municipal buildings

- In collaboration with high “performance based” building organizations in the USA:
  - US DOE Zero Energy Ready Home Program & US DOE “Solar Decathlon” homes database
  - Passive House Institute US
  - USGBC / New Buildings Institute “Grid-Optimal”
  - Net Zero Energy Coalition
  - Rocky Mountain Institute

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

nbi new buildings institute

PHIUS Passive House Institute US

U.S. GREEN BUILDING COUNCIL USGBC

Net-Zero ENERGY COALITION

ROCKY MOUNTAIN INSTITUTE

Model Structures: Advanced Energy Rebuild homes

Clean Coalition

Showcase and provide case studies of homes being rebuilt utilizing the **Advanced Energy Rebuild** program. Up to $17,500 incentives from Sonoma Clean Power and MCE, to go “all electric” and “microgrid ready”

Having a “microgrid” means when the power goes out, your power **stays ON**

Hirsch solar-powered residence

Mini-split heat pump

H.P water heater

L.G. Chem energy storage

Induction cooking

Sonoma Clean Power currently has 190 homes enrolled and is soon opening their new Advanced Energy Center; A store in downtown Santa Rosa where SCP customers can test and purchase discounted, high efficiency electric appliances.

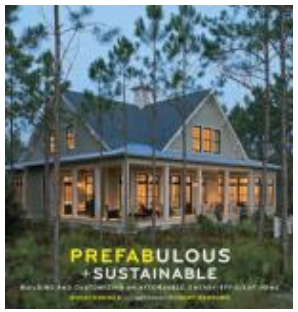
Model Structures: US DOE Solar Decathlon

NBCRI has partnered with the US DOE Building Technologies Division to showcase and utilize the Solar Decathlon homes for models of rebuilding ZNE homes.

- Bi-Annual competition since 2002 to design, build, and present ZNE homes.
- Design Challenge: prepare creative solutions for real-world issues
- Build Challenge: Construct Real World projects

Model Structures: Modular and Pre-fab

- Prefabrication = up to 20% reduction in cost and 40% faster!
- Many design options available
- Single Family and Muti-Family
- Increasing number of providers



3ONE STRUCTURE

KATERRA

Factory_OS™

s2e technologies

Sol Lux Alpha

SOL LUX ALPHA – First PH Certified multi-unit **nanogrid** to US market

- 4 unit, 6 story, N+E using only PV within the building envelope
- All electric: Fossil-fuel free
- Passive House PHIUS + US DOE Zero Energy Ready Home program
- (Includes Energy Star, Indoor Air Plus, EPA “WaterSense”)
- **WINNER of the US DOE Housing Innovation Award for Multi-Family**
- **WINNER of 2018 PHIUS “Best overall Project” in North America**

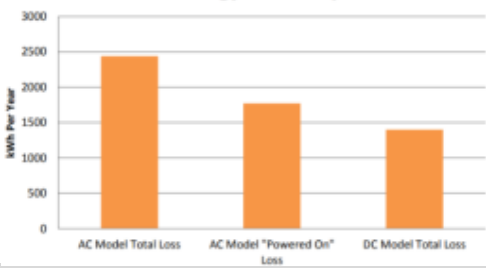
US DOE ZNERH recog

Clean Coalition

Net Positive Energy: How do you get there?

Passive House Baseline + industry best efficient systems
Passive House methodology reduces energy for HVAC by 80%

- Passive Solar design
- Air source heat pumps for HVAC, DHW, Clothes drying
- 100% L.E.D. lighting
- Automatic occupancy and vacancy sensors
- AEK – High efficiency Induction cooktops and Bosch "Benchmark" Appliances
- Next Gen projects - Moving to DC Appliances and systems



Sol Lux Alpha Nanogrid systems

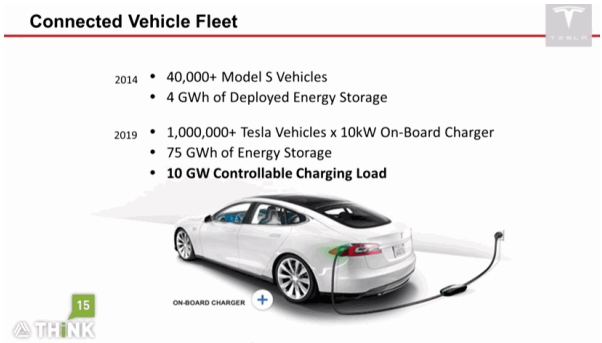
- **Sunpreme** GxB 380w Bifacial panels (up to 25% boost) = 475w
- **Tesla Energy** Powerwall x3 (triple redundancy, 2-3 days energy)
- **Blue Planet Energy** “Blue Ion” for 3 phase loads (elevator & commons)
- **VEHICLE-TO-BUILDING (V2B) ENERGY** enabled

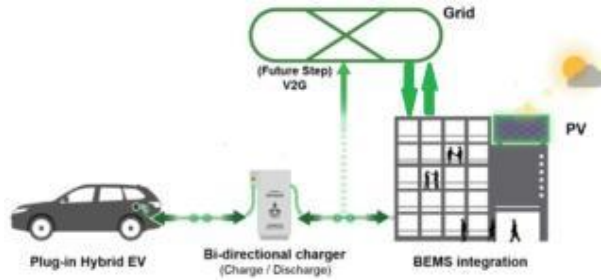
V2B and V2G technologies

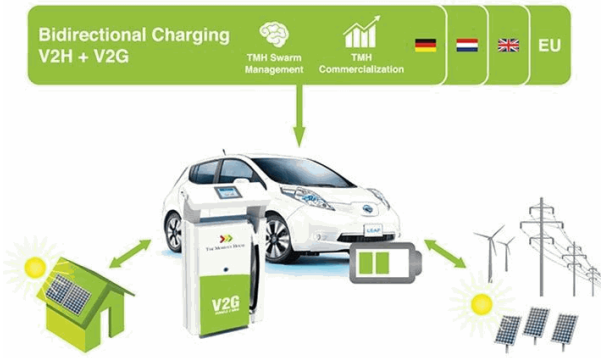
V2B

(Vehicle to building energy transfer)

- Enables V2G
- Extends **energy** beyond the building
- **Reduces** need for site based Energy Storage System (ESS)
- **Mobile energy assets** for community resilience







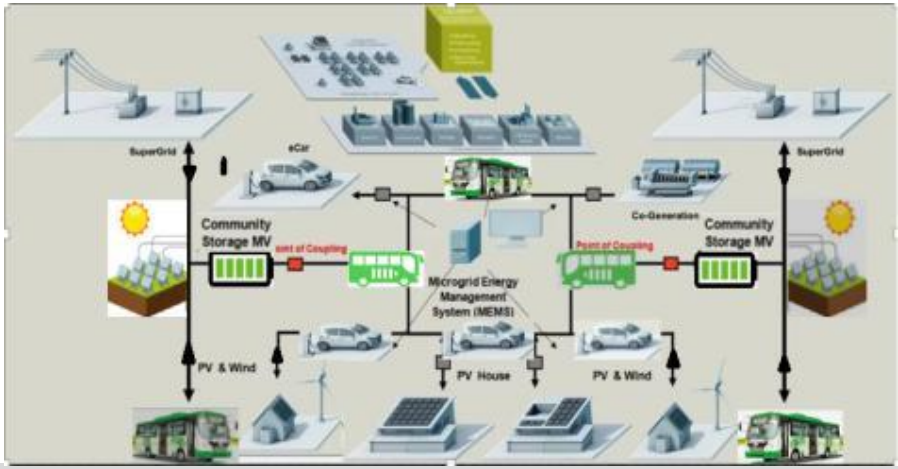
Future trends: “Mobile energy” microgrids

Clean Coalition

Microgrids + bi-directional EV’s = Aggregated “mobile” Community Microgrids

- Solar PV can export to grid or charge EV’s at daytime when solar energy is peaking
  - EV’s can bring that energy “home” and use for residential power at evening/night
- Charge EV’s when rates are low, and use in evening when rates are high (load shifting)
- Once stationary and mobile ancillary ESS grid services are enabled at scale, (and aggregated) fossil fuel peaker plants become unnecessary
- More behind meter ESS + mobile ESS assets results in reduced need for community scale solar / wind + ESS’s
- Greater resilience is created by virtue of distributed systems, and fewer single points of failure
- “Mobile energy” from bi-directional EV’s reduces need for site based ESS & transmission wires
- Add Community Scale R.E. & (mobile) storage at:
  - Points of grid connection to provide ancillary
  - Grid and microgrid services = revenue for the microgrid system

Volkswagen Announces: “Elli”



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STATIONARY VS MOBILE

Which is better?

OR

OR

Questions?

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Thank you for attending!

Questions?