

Delivering Net Zero Energy Buildings

... for zero cost increase?

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elementa

Member of Integral Group



**ADVANCING
NET ZERO**

Business

City

States & Regions

INTEGRAL GROUP

Global engineering firm

Tenant

Company drive to build high performance buildings that respect and enrich the earth. Have designed over 100 net zero energy projects including 10 projects completed that have gone through certification and verification pathways.



16 offices

1.7 tCO₂e portfolio
carbon emissions

500 employees

4 countries of operation

1 Commit

Committed to occupying only net zero Scope 1 and 2 carbon assets by 2030 with an accelerated target of 2020; and aspirational target for zero carbon emissions from operational waste, water, business flights, and employee commute by 2030.

2 Disclose

Disclose social and environmental metrics through an annual report which includes: environmental footprint, equity & diversity, health & well-being, education & impact.

3 Act

Implement ongoing energy efficiency upgrades across tenancies and work with landlords on renewable energy procurements.

4 Verify

Verify our annual Corporate Social and Environment Responsibility (CSER) report by 2020 to ensure integrity and alignment with our goals and commitments.

5 Advocate

Provide a net zero pathway for every design project undertaken by 2020 and only work on net zero carbon buildings by 2030.



a member of four GBCs globally

EP 100 | °C

10 years of Net Zero Energy Projects



Every New Building by 2030

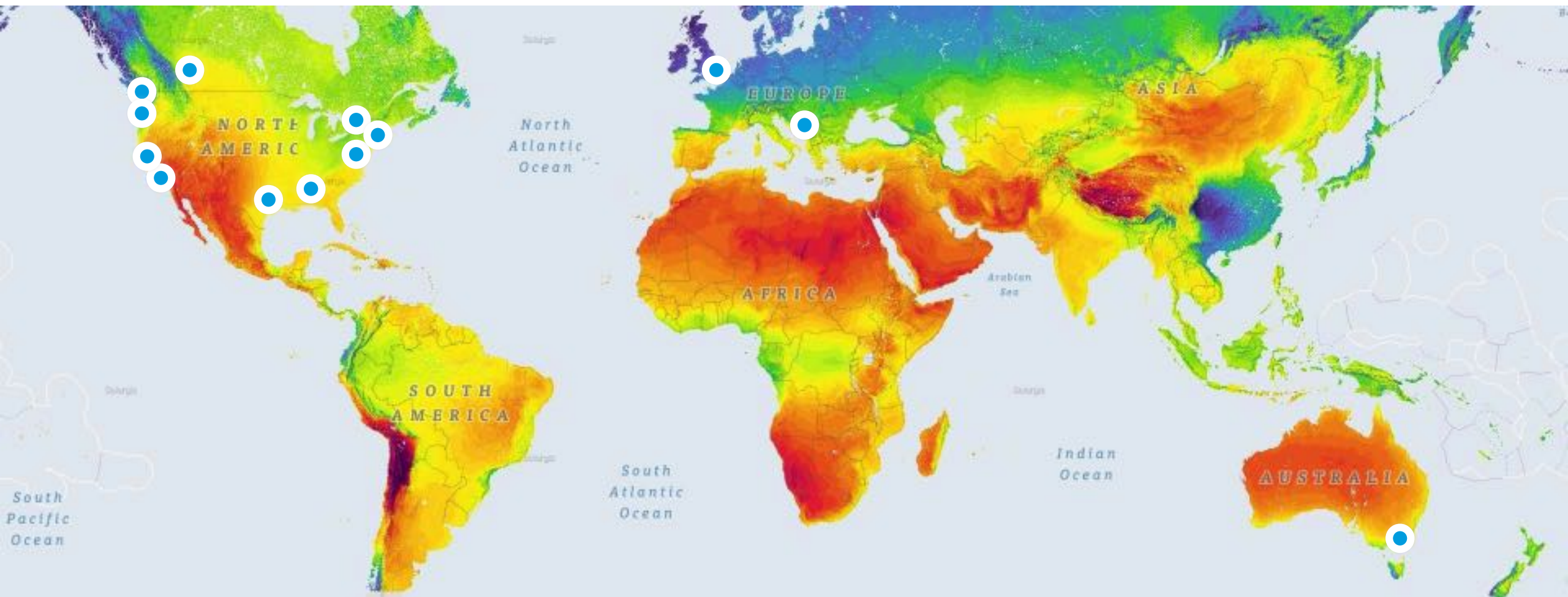


~1% of
stock

Every building by 2050



~99% of
stock



everywhere is different



everywhere is the same



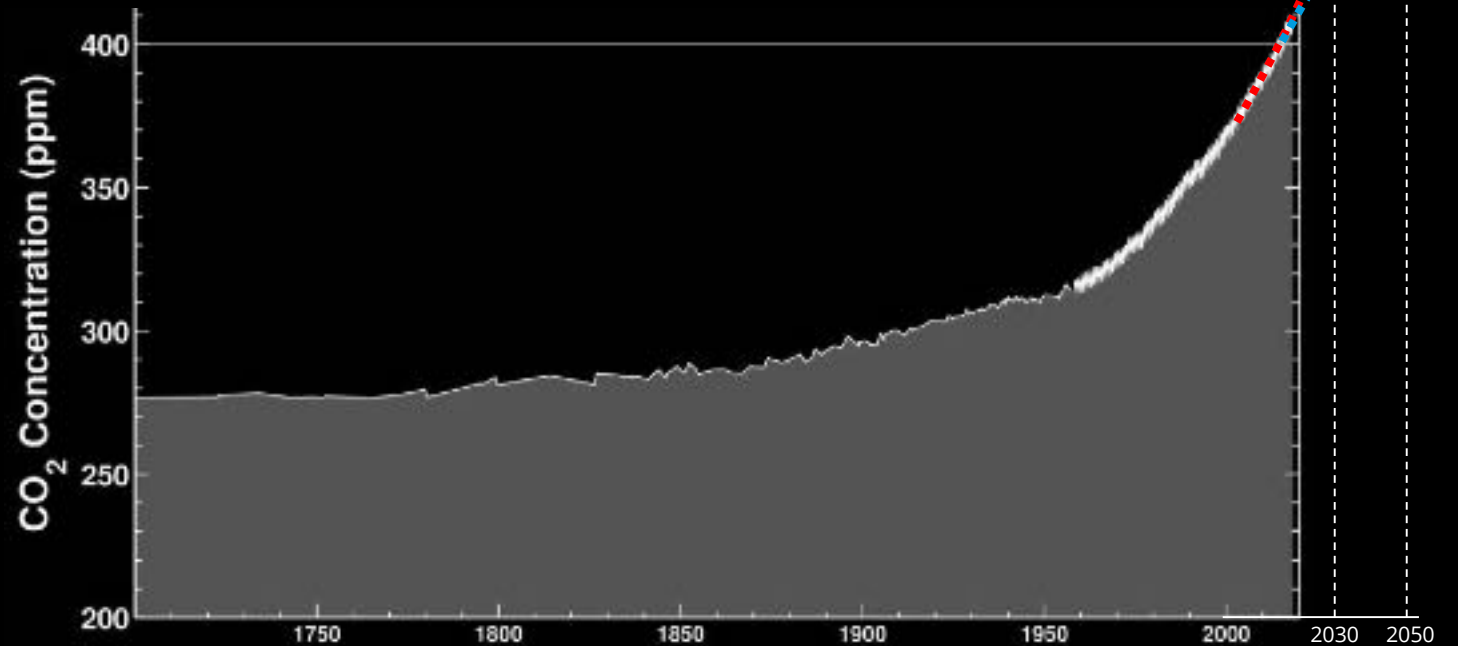


Latest CO₂ reading
May 15, 2018

412.60ppm

Ice-core data before 1958. Mauna Loa data after 1958.

Paris COP 21 Imperative $\leq 2^{\circ}\text{C}$



Sick Planet Earth with no Planet B



IMAGINE | PERFORM | ACCELERATE | SUSTAIN



there's no extra money for green



**Net Zero
Projects aren't
built because
they save on
energy costs**

***but it helps**



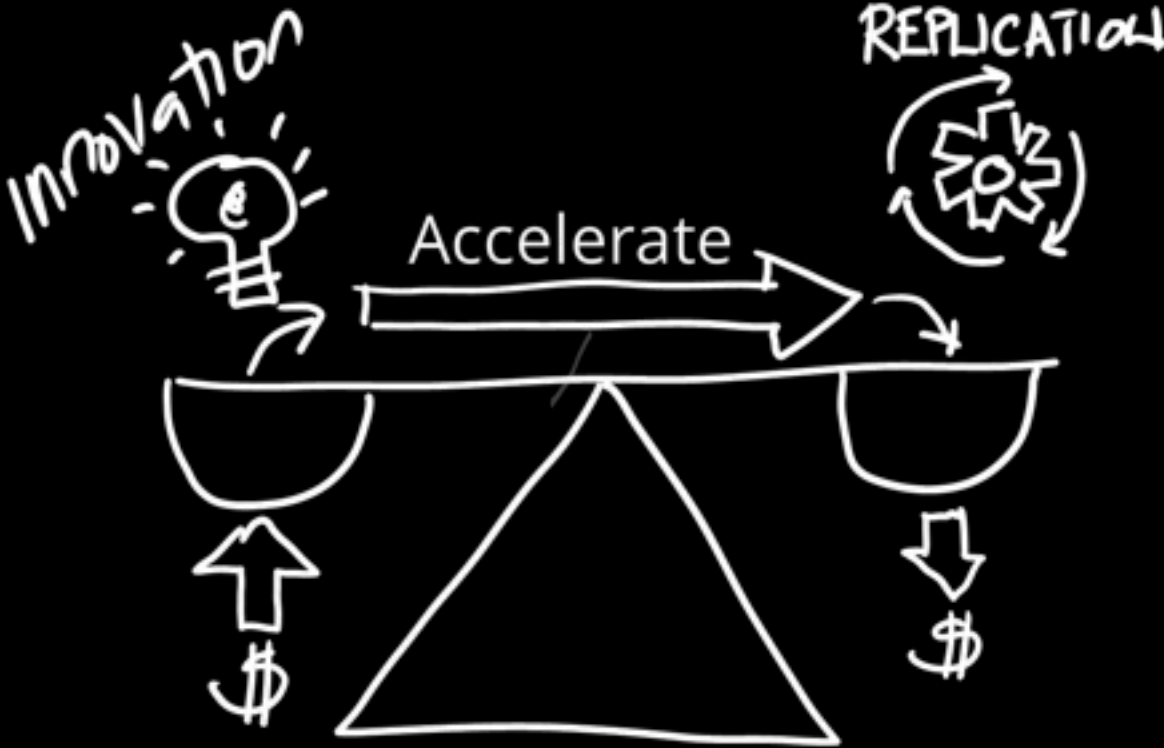
Reasons to be Optimistic



We're Well Past the Bleeding Edge



2000



2010

find out what works + do it again



More Achievable. Affordable. Comfortable. Elegant. Integrated. Simple



IDeAs HQ

10,000 SQFT
Retrofit
Office

2007

Passive +
GSHP +
Radiant

Market Cost +
PV Grants

First Certified ILFI Net
Zero Energy Building



Packard
Foundation

49,000 SQFT
New Build
Office

2012

Passive +
DOAS +
Chilled Beam

Institutional

2012 ENR - Best
Green Project
2013 ASHRAE
Technology Award
First Place 2013



Exploratorium

210,000 SQFT
New Build
Museum

2013

Baywater Cooling
+ Radiant

Museum +
PPP \$10m

2014 Honor Award
Energy +
Sustainability, AIA SF
Chapter
2014 ULI
Global Awards for
Excellence



J Craig Venter
Institute

45,000 SQFT
New Build
Laboratory

2013

DC Vent +
Chilled Beam

Laboratory

2015 Architizer A+
Awards –
Architecture +
Sustainability Award



DPR

22,000 SQFT
Retrofit
Office

2014

Passive +
Roof Top Unit

Market Cost

2014 ENR California
Project of the Year
2014 ENR California
Best Green Project



Indio Way

32,000 SQFT
Retrofit
Office

2015

Passive +
Roof Top Unit

Market Cost

2015 Silicon Valley
Business Journal
Best Reuse/Rehab



Mathilda
Avenue

30,000 SQFT
Retrofit
Office

2015

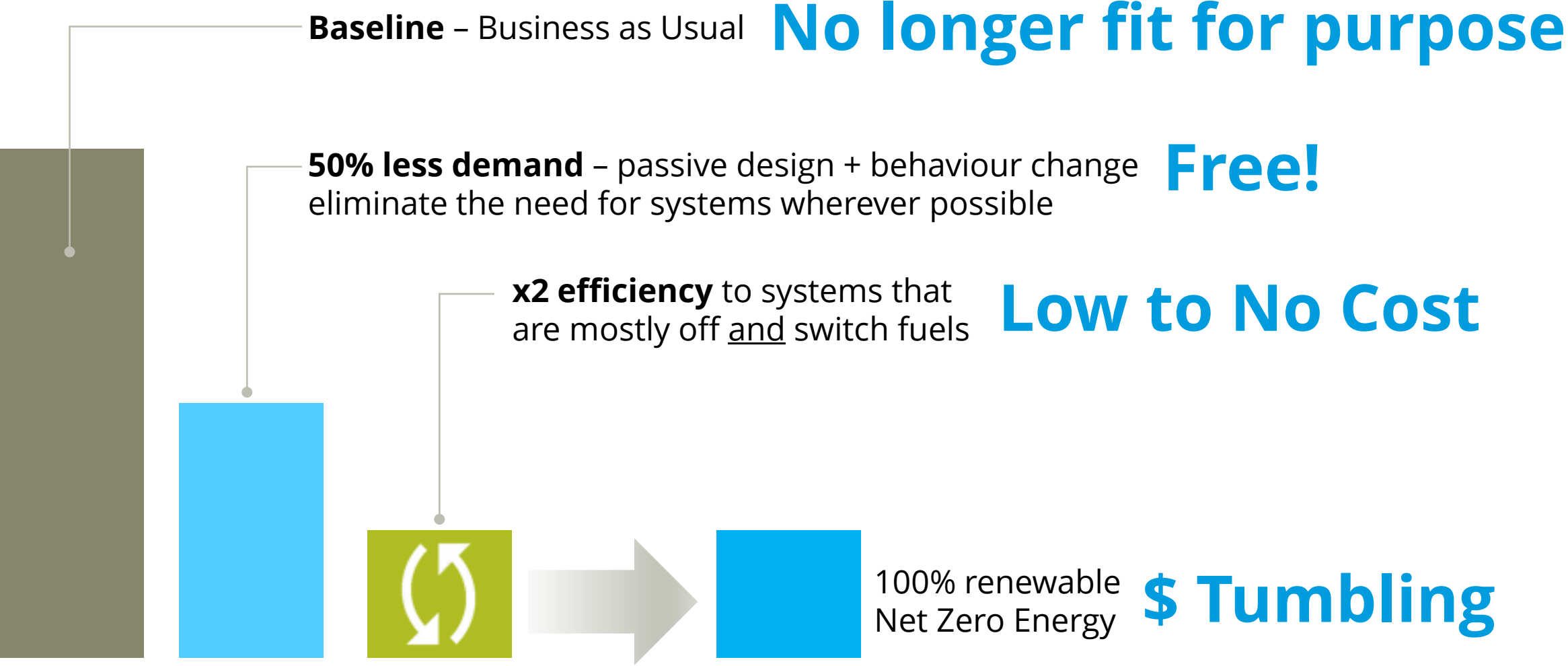
Passive +
Roof Top Unit

Market Cost +
PV Grants

2015 Silicon Valley
Business Journal
Green Project of the
Year



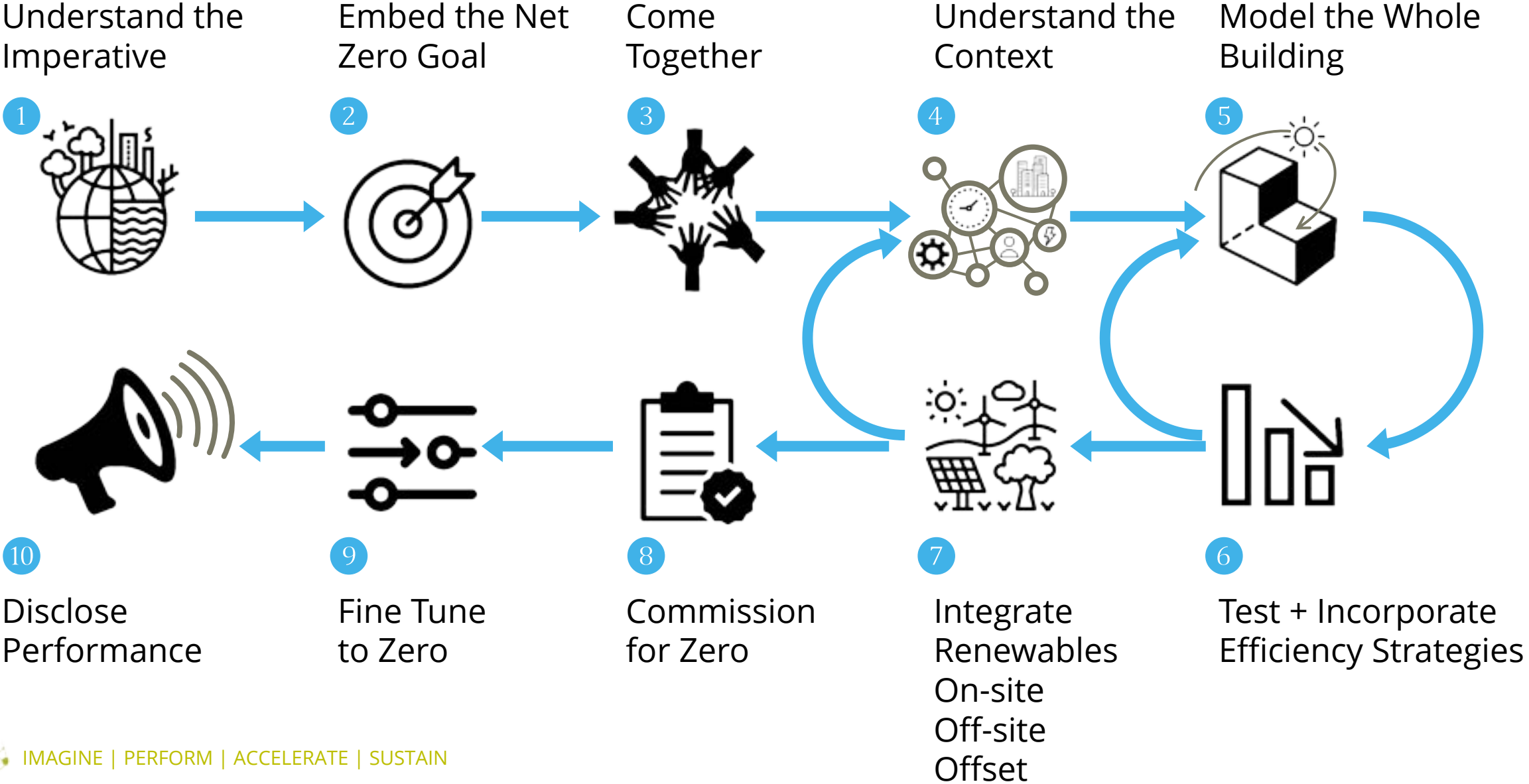
Net Zero Energy Buildings are possible, and needn't cost more



Essential Need for Integrated Design

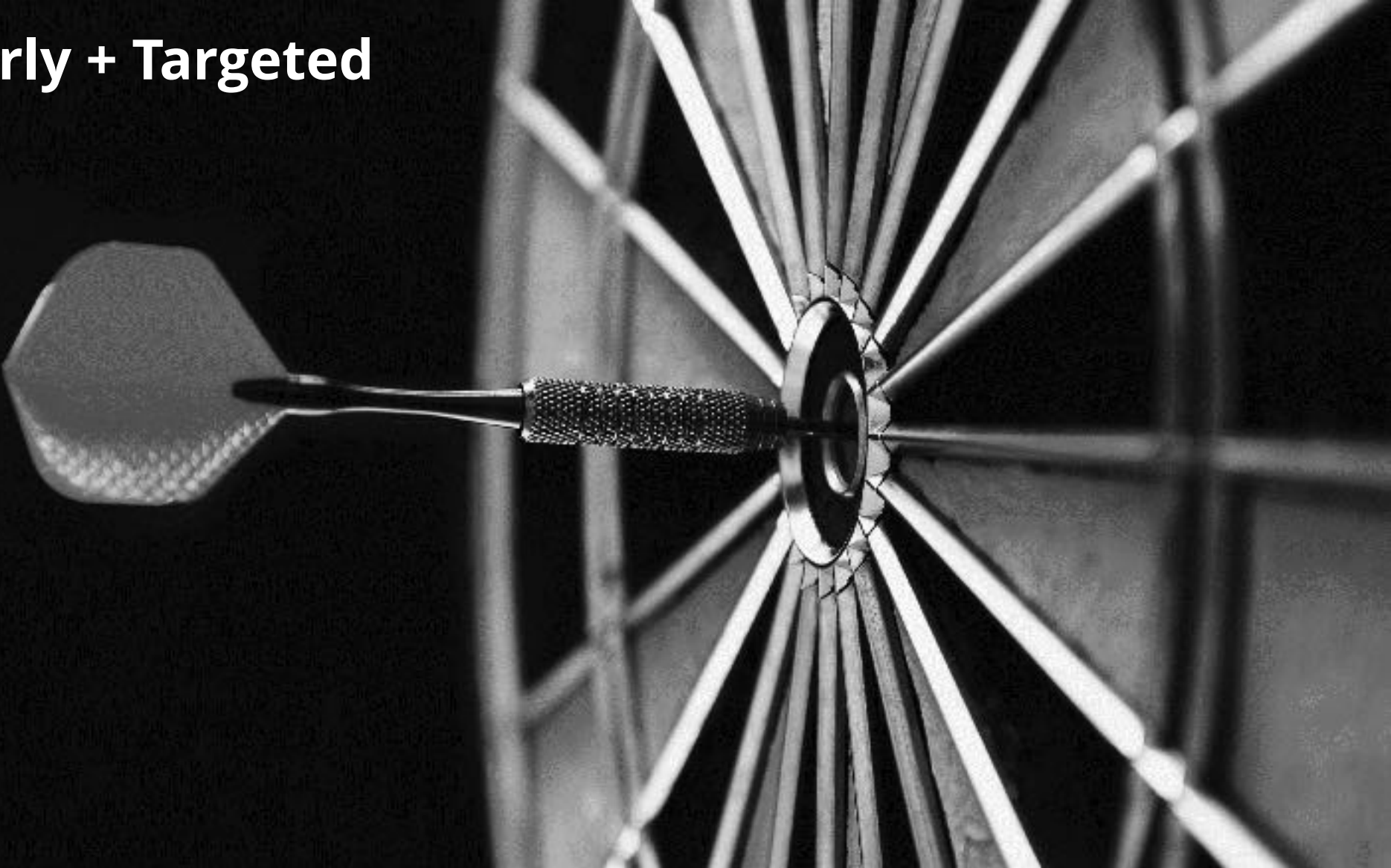


Costs Optimised by Collaboration and Whole Systems Thinking



Embed Net Zero at Day One

Early + Targeted



1 Understand the Imperative



2 Embed the Net Zero Goal



3 Come Together



Get Everyone On Board



Collaborative
Convene goal-setting workshop

1 Understand the Imperative



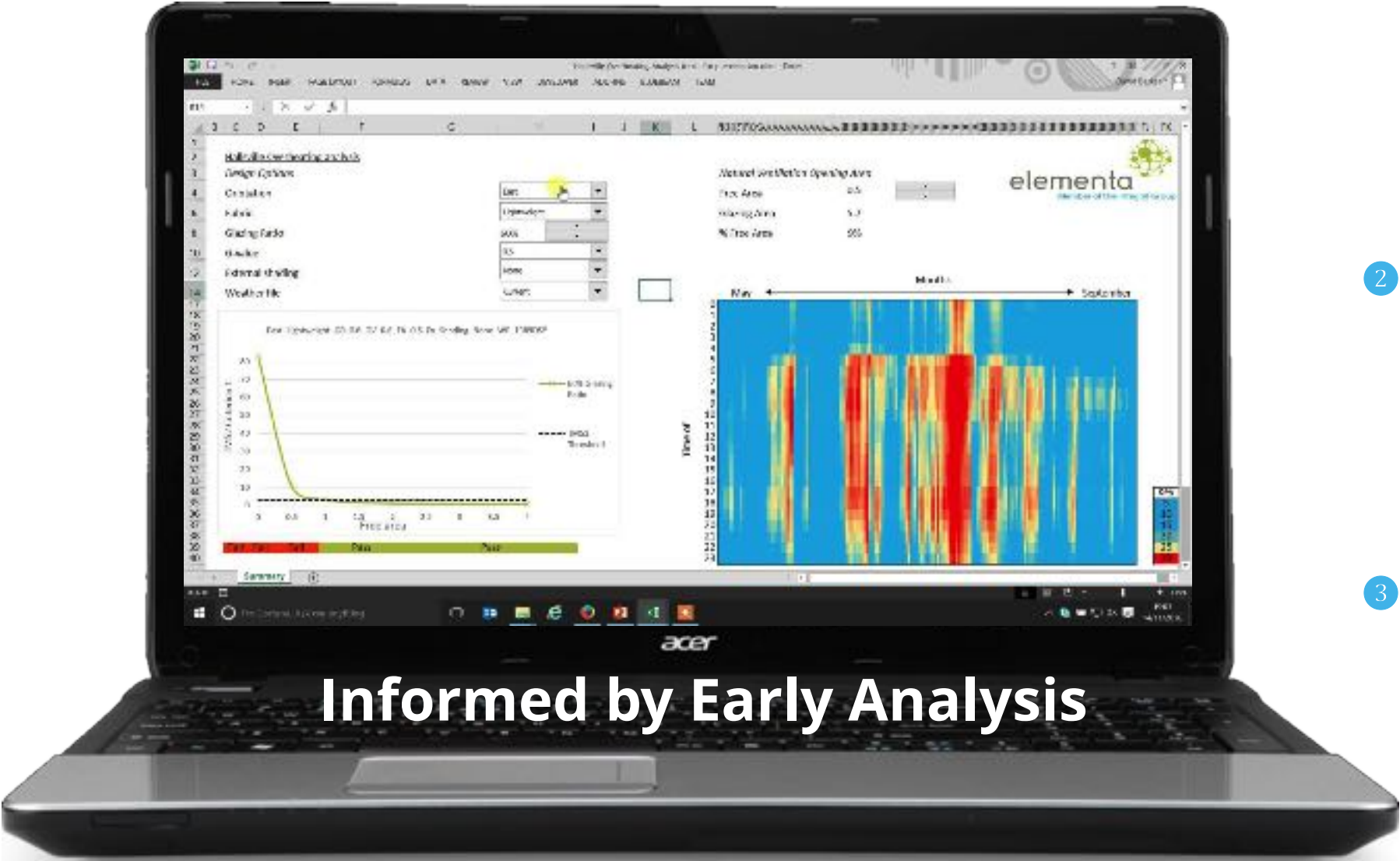
2 Embed the Net Zero Goal



3 Come Together



Work Out Which Levers to Pull



Informed by Early Analysis

1 Understand the Imperative



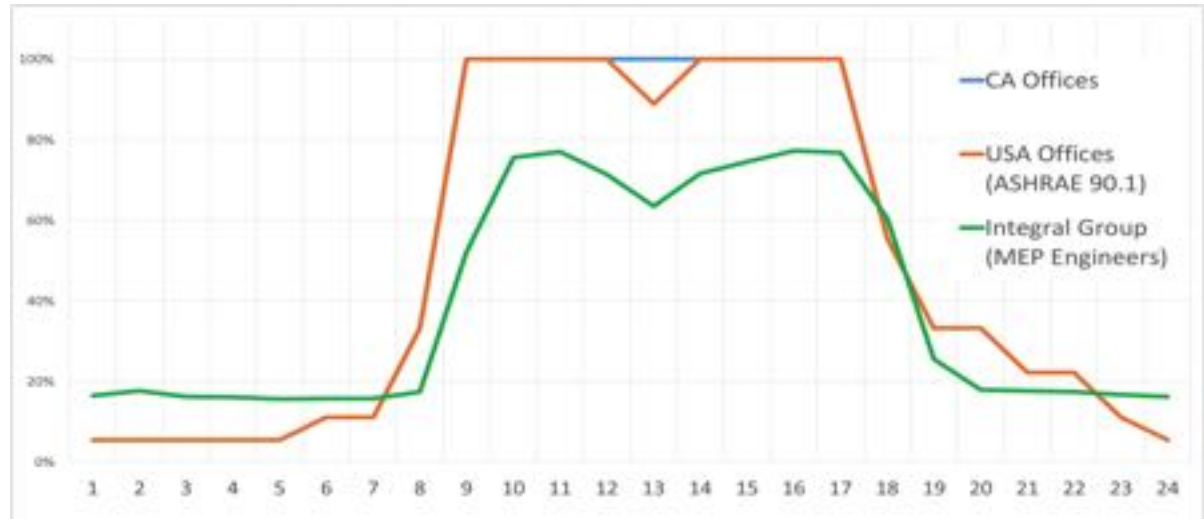
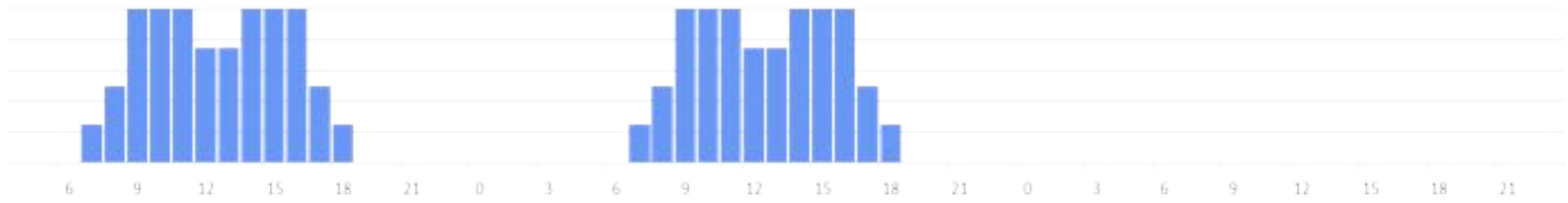
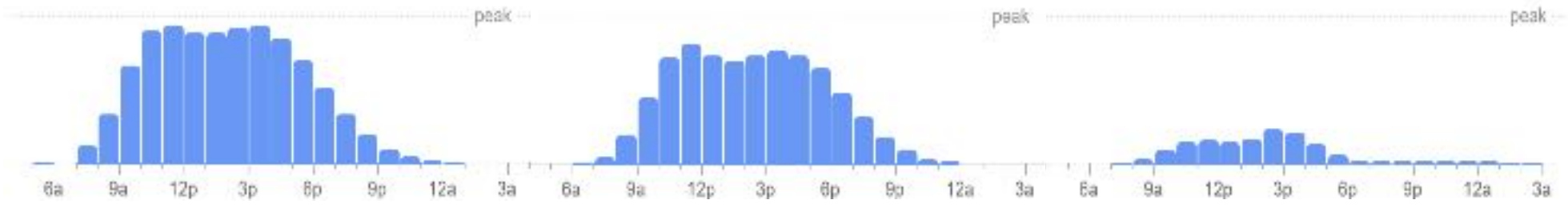
2 Embed the Net Zero Goal



3 Come Together



Understand When Your Building Will be Used



4 Understand the Context

5 Model the Whole Building

6 Test + Incorporate Efficiency Strategies

7 Integrate Renewables

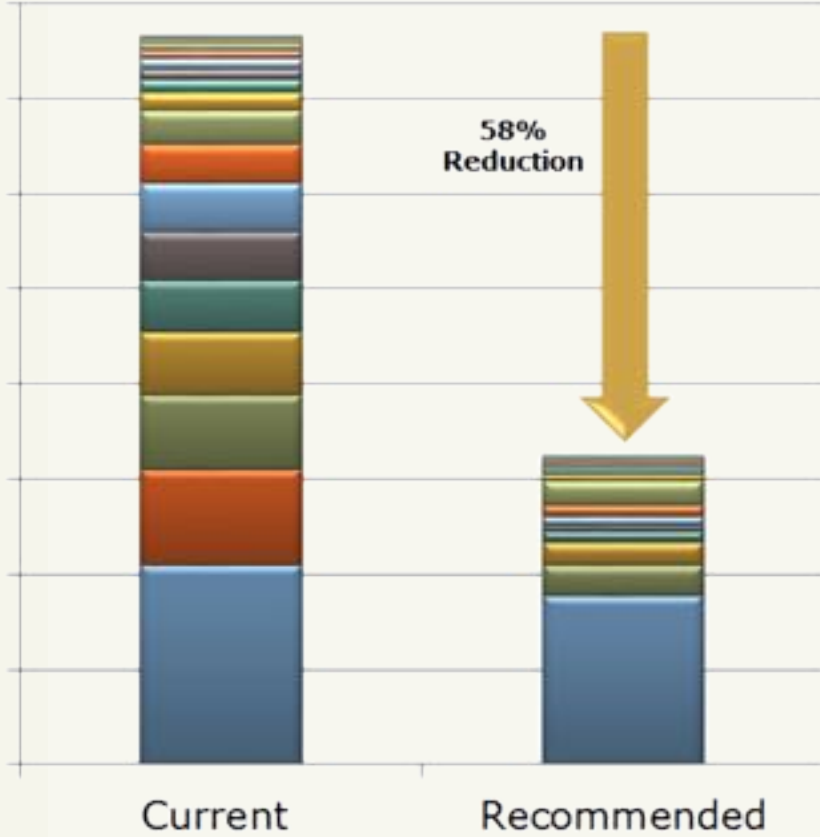
On-site
Off-site
Offset

Drive the Plug Loads Down - Design for 2020 not 1990



Today's iMac uses 0.9 watt of electricity in sleep mode. That's 97 percent less than the first iMac.

Packard Foundation - Plug Load Reduction



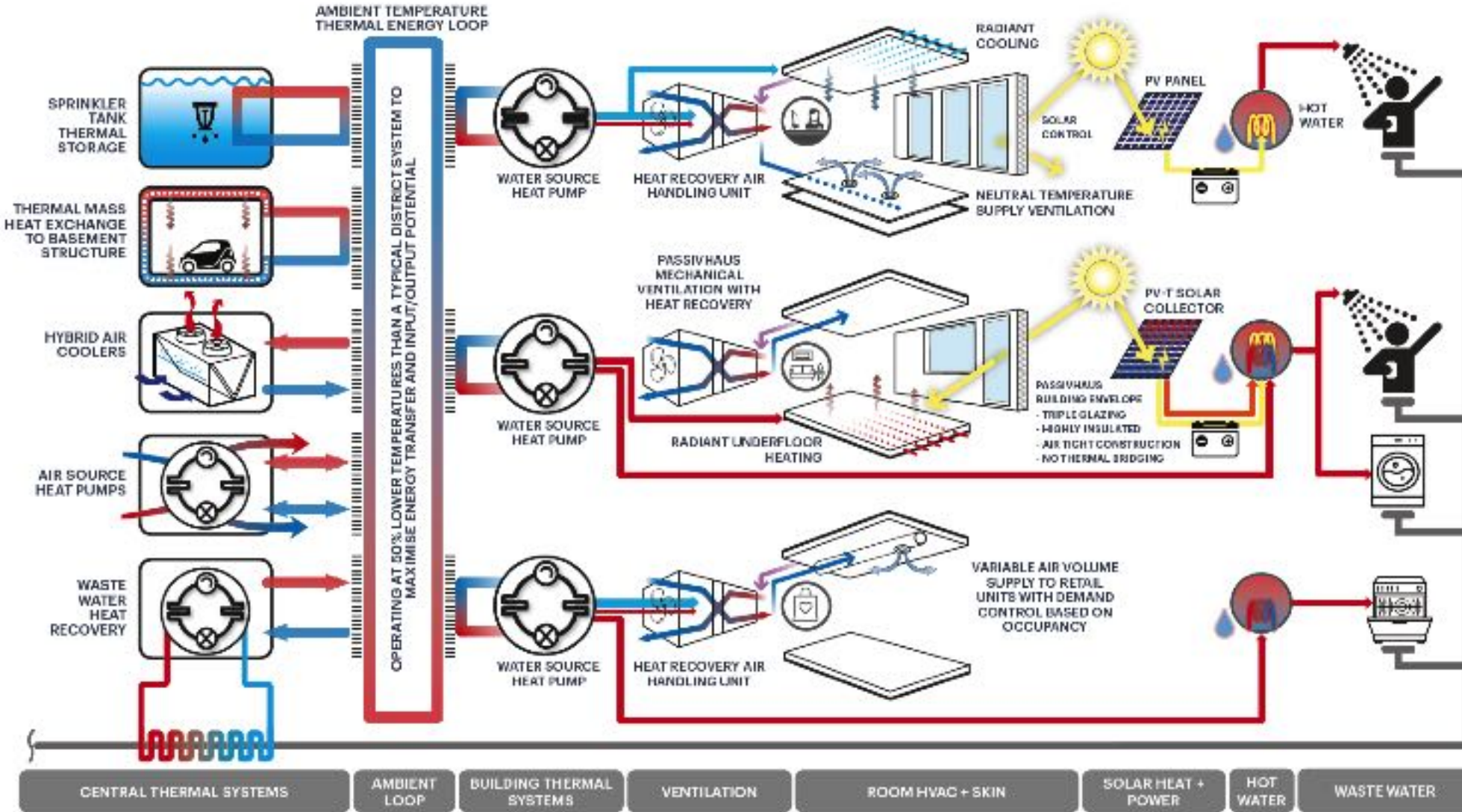


Think
outside
the
building.

We've temporarily moved... everywhere.



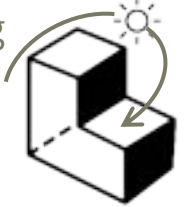
Look for Opportunities to Share Energy



4 Understand the Context



5 Model the Whole Building



6 Test + Incorporate Efficiency Strategies



7 Integrate Renewables

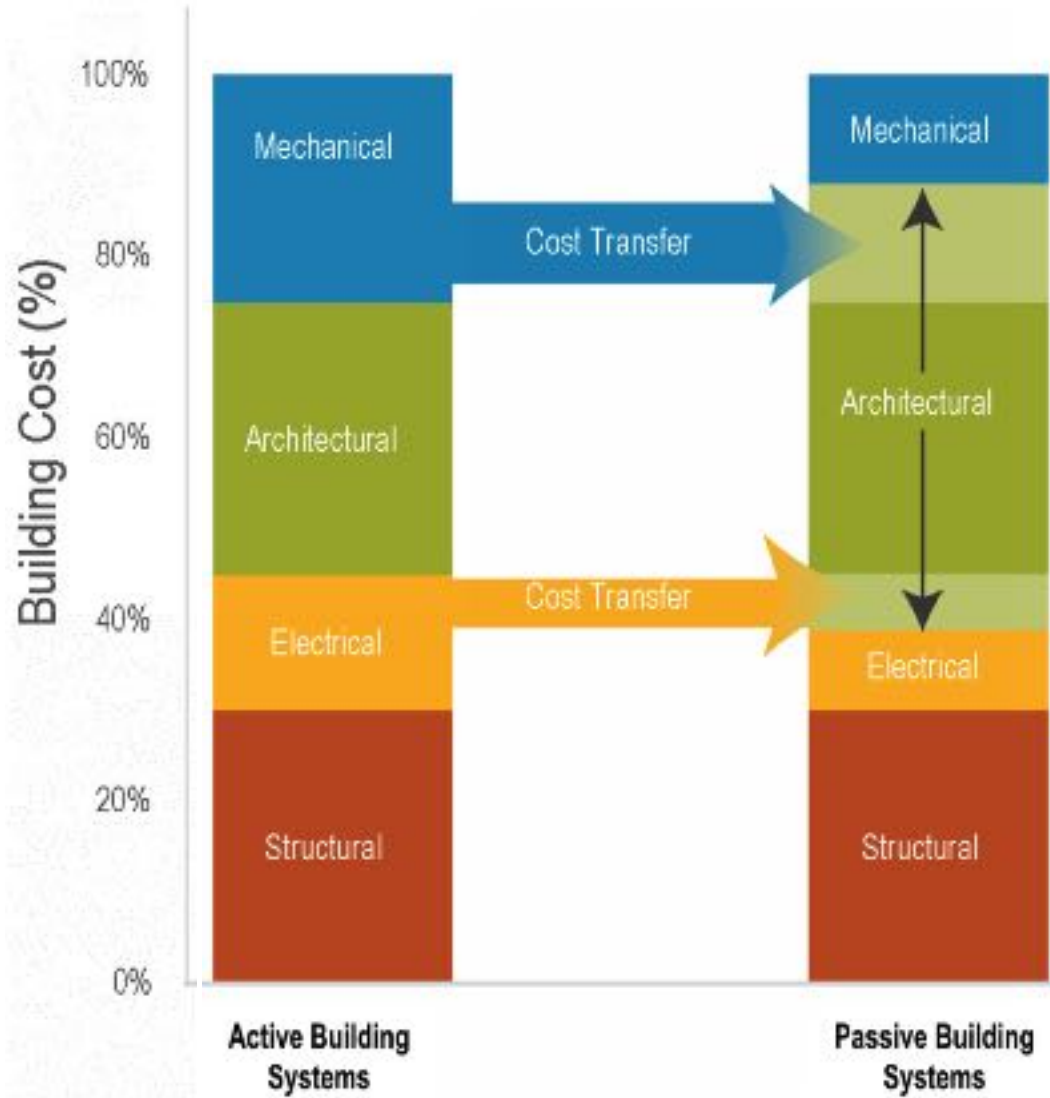
On-site
Off-site
Offset



Test + Incorporate Strategies



Find What Works For Your Building's Skin



4 Understand the Context

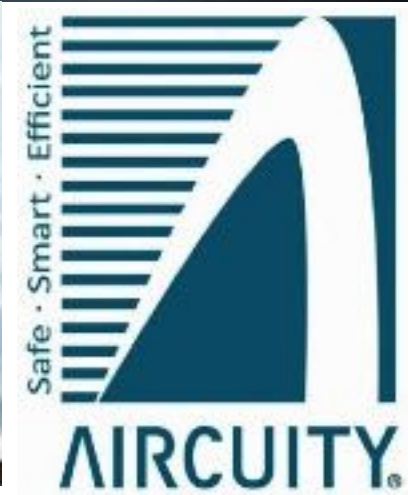
5 Model the Whole Building

6 Test + Incorporate Efficiency Strategies

7 Integrate Renewables

On-site
Off-site
Offset

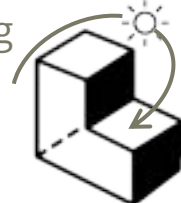
Rethink How Your Building Breathes



4 Understand the Context



5 Model the Whole Building



6 Test + Incorporate Efficiency Strategies



7 Integrate Renewables
On-site
Off-site
Offset



Test + Incorporate Strategies



Visualization helps us make the case for value added by integration of structure, skin and services

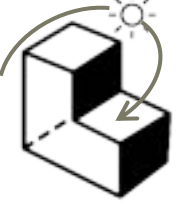
Harness Your Own Energy



4 Understand the Context



5 Model the Whole Building



6 Test + Incorporate Efficiency Strategies



7 Integrate Renewables

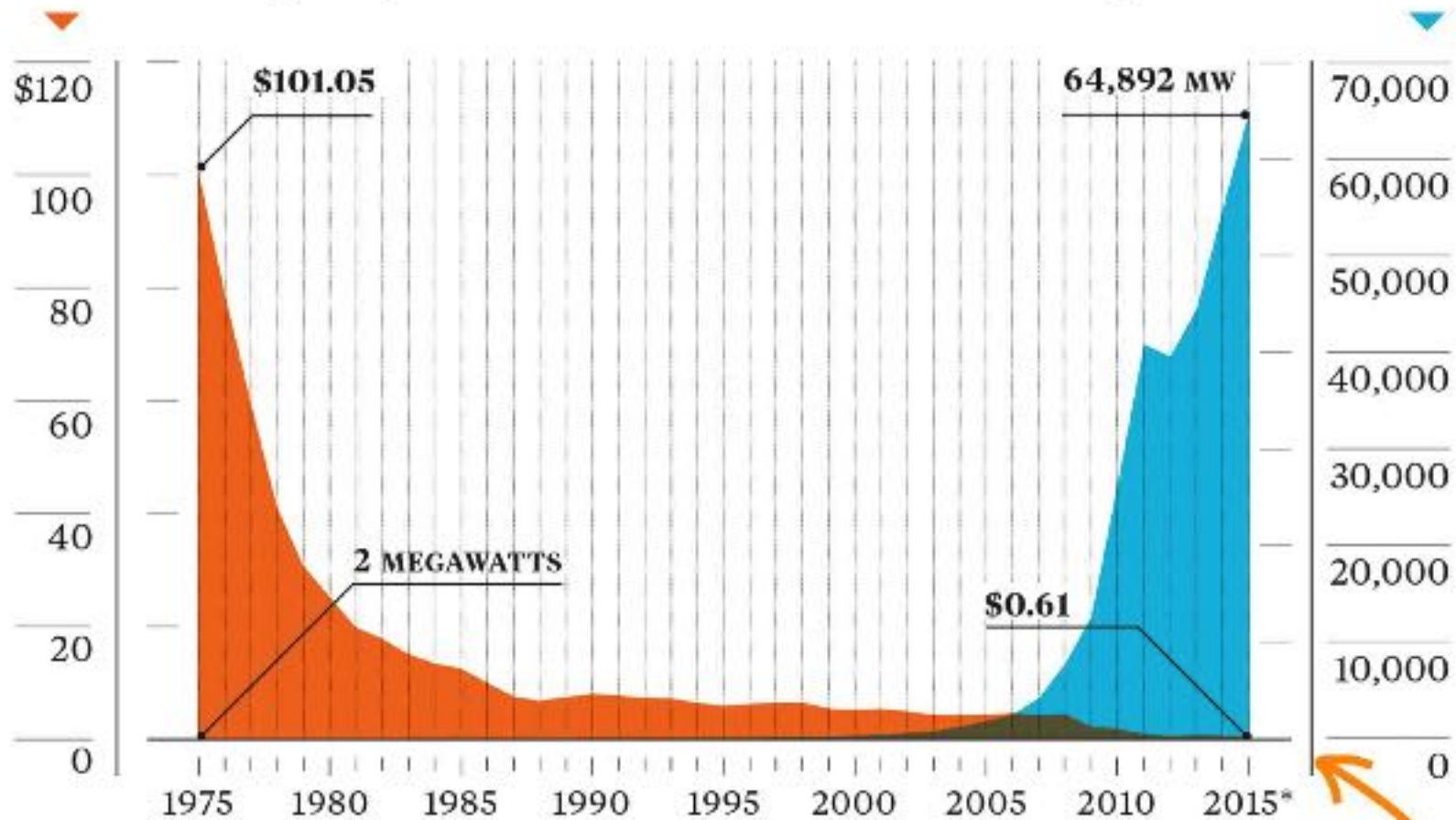


Source it from Further Afield – PPAs below \$0.05/kWh



Price of a solar panel per watt

Global solar panel installations



Now \$0.30

4 Understand the Context

5 Model the Whole Building

6 Test + Incorporate Efficiency Strategies

7 Integrate Renewables

- On-site
- Off-site
- Offset



Energy Storage Costs down 80%

Figure 1. Lithium-Ion battery prices fell 80% from 2010-2017 (\$/kWh)

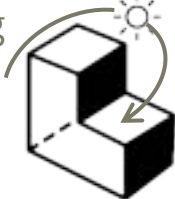


Source: Bloomberg New Energy Finance, Lithium-ion Battery Price Survey

4 Understand the Context



5 Model the Whole Building



6 Test + Incorporate Efficiency Strategies



7 Integrate Renewables

On-site
Off-site
Offset



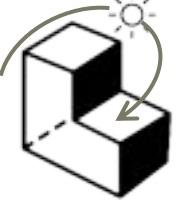
Making Grid Storage Cheaper Than New Power Plants



4 Understand the Context



5 Model the Whole Building



6 Test + Incorporate Efficiency Strategies

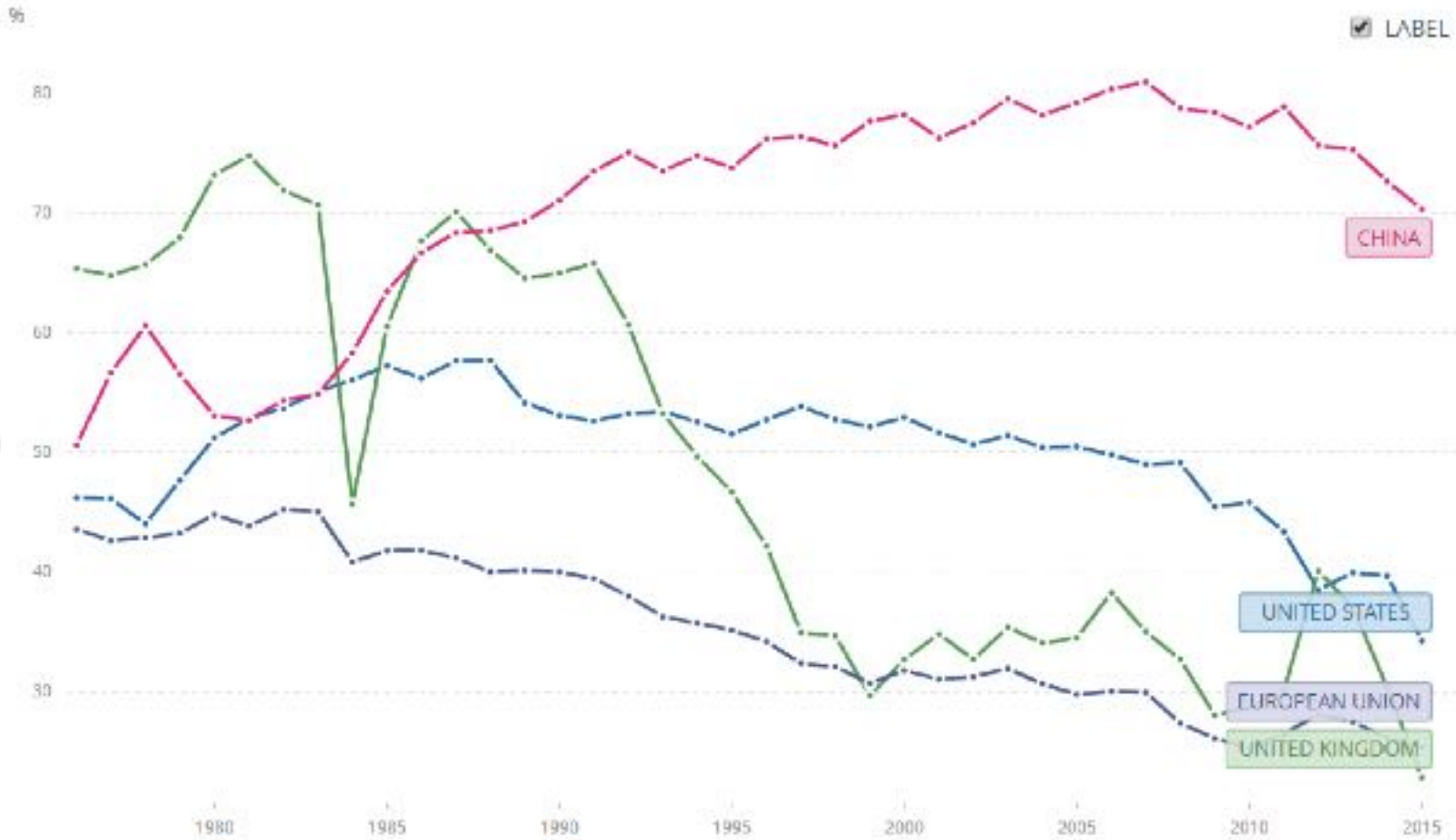


7 Integrate Renewables



Grids Decarbonise – but demand still has to fall

% of Electricity Generated by Coal 1987-2015



<https://data.worldbank.org/>



IMAGINE | PERFORM | ACCELERATE | SUSTAIN

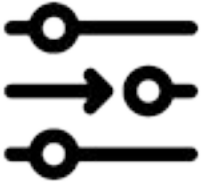
Commission + Fine Tune to Zero



8 Commission for Zero



9 Fine Tune to Zero



10 Disclose Performance



Embrace Operational Data + Occupant Interaction

8 Commission for Zero



Sensor network

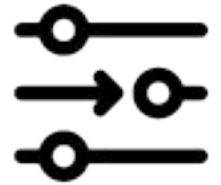
- OCCUPANCY**
 - PRESENCE/OCCUPANCY
 - TRAFFIC FLOW
 - DOOR COUNTER
 - PARKING
- POSITIONING**
 - POSITIONING
- ENERGY METERING**
 - ELECTRICITY
 - GAS
 - WATER
 - WASTE
- USER SATISFACTION**
 - FEEDBACK POLLING
- WELL-BEING**
 - TEMPERATURE
 - CO₂
 - HUMIDITY
 - NOISE



Big data platform

- OTHER INPUTS**
 - CAFM/IWMS
 - PERFORMANCE BENCHMARKS
 - 3RD PARTY DATA
 - ACCOUNTING
 - BMS
 - CA/IBIM
- ADVANCED ANALYTICS**
 - DATA VISUALIZATION
- USER OUTPUT**
 - IMPROVEMENT INITIATIVES
 - END USER APPS
 - KIOSKS

9 Fine Tune to Zero



10 Disclose Performance



@

O

Switch on ventilation when Air Quality is poor

by foobot

Add

IFTTT



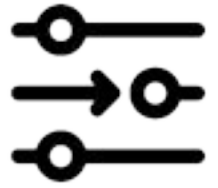
Disclose Performance



8 Commission for Zero



9 Fine Tune to Zero



10 Disclose Performance



435 Indio Way

The Investment Case Net Zero @ Market Rate





435 Indio – Actual Economic Results

-The additional cost to renovate to meet Developer Goals	(\$49.84/SF)
-The Value of Actual operating expense savings (\$0.45/SF/mo.) at a 6.5% market capitalization rate	\$83.08/SF
-The Value of above market rent achieved (\$0.20/SF/mo.) at a 6.5% market capitalization rate	\$36.92/SF
-Additional rent received due to early lease-up (3 mos. vs. avg. market time of 18 mos.)	\$22.81/SF
-Additional leasable SF due to 6" of exterior insulation (building grew 326 SF)	<u>\$7.32/SF</u>
Total Additional value if sold the day after occupancy	\$100.29/SF
Potential Value of lower reserve requirements (HVAC replacement, TI reserves, etc.)	\$29.85/SF



Powering positive change

“The business model proves you are \$2 million better from doing it this way if you sold it,” Bates said. “If you don’t sell it, it pays for itself in 3-4 months. It’s a pretty strong economic case for a building of this size.”

THE POWER OF
ZERO
 OPTIMIZING VALUE FOR NEXT GENERATION GREEN

LEED Platinum 4.0 2008 | **Lee Forthman, P.E. & Associates, Inc.** | **Tom Hertz, LEED Accredited** | **Ray Taylor, LEED Accredited**

...the business model proves you are \$2 million better from doing it this way if you sold it.” Bates said. “If you don’t sell it, it pays for itself in 3-4 months. It’s a pretty strong economic case for a building of this size.”

PROJECT INFO
 Location: ...
 Building / ...
DELIVERED
 LEED Platinum 4.0 2008







The figures
really hit home
when we talk
about people





Masha Eizner

Benchmark March 2014 Air-conditioned

£28.45/sqm/yr



158 x

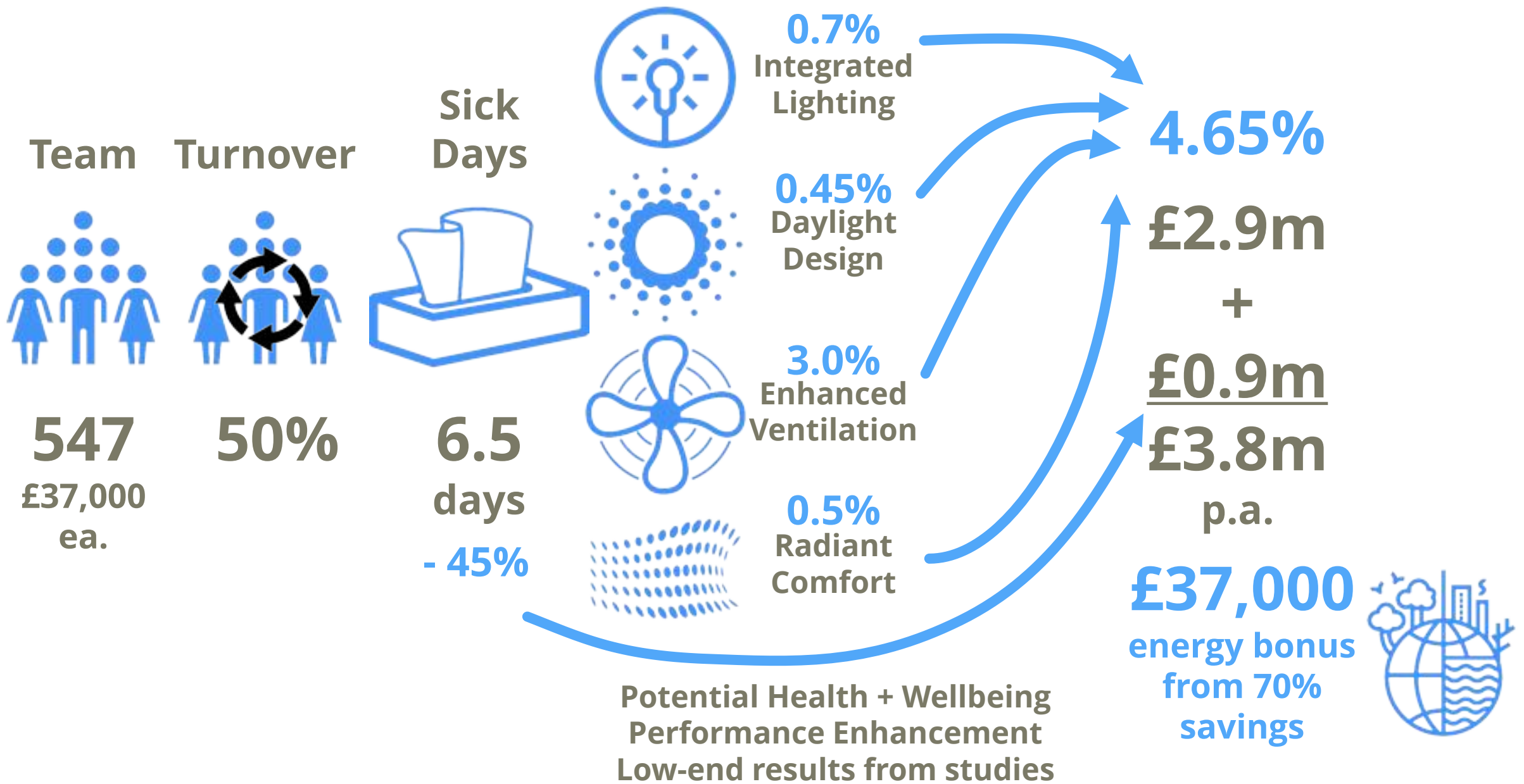


Piotrek Chuchla

£45,000 employee cost
1 person per 10 sqm

£4,500/sqm/yr





945 Front Street San Francisco

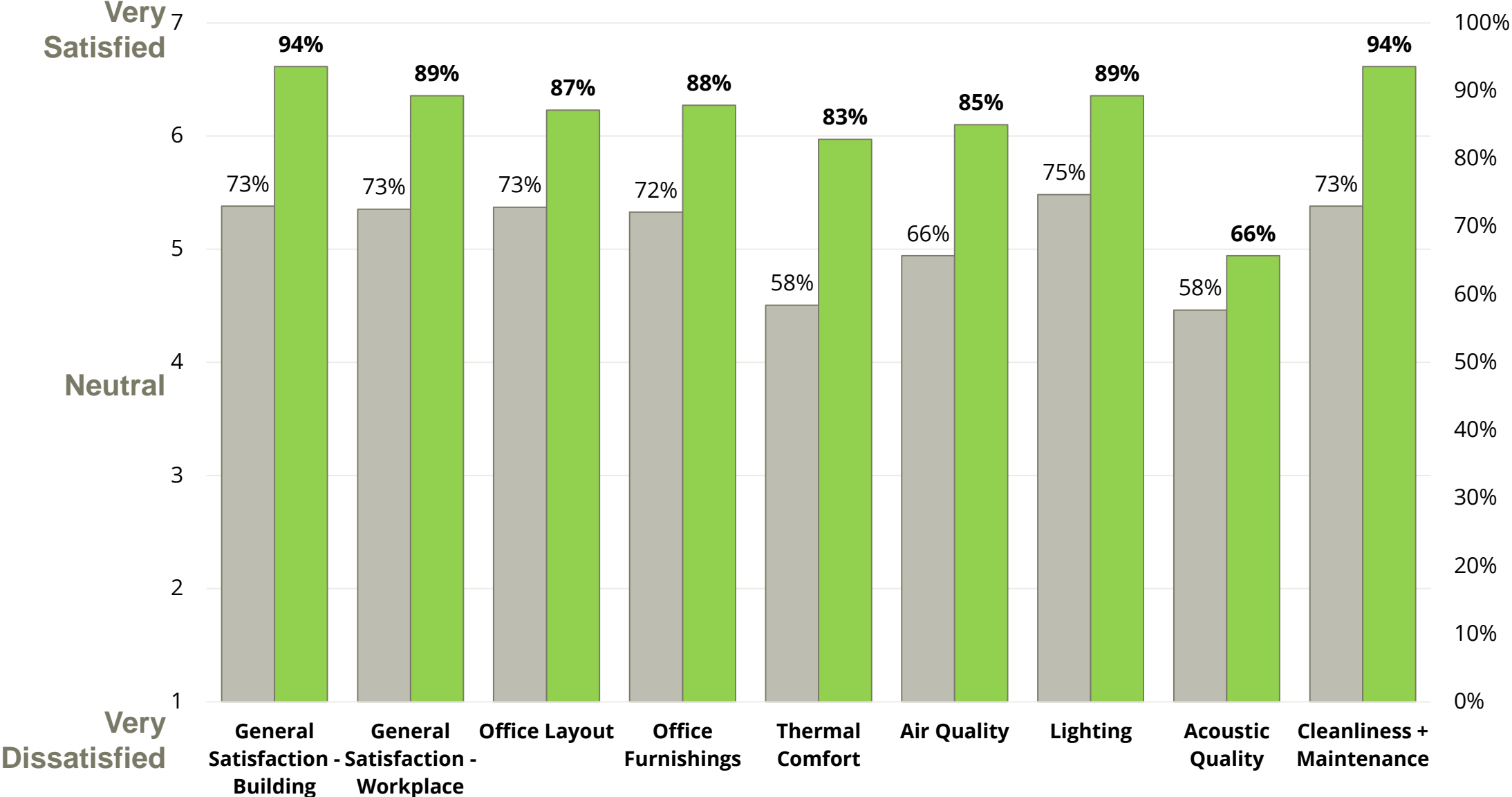
Exploratorium

The Satisfaction Case
Net Zero Buildings are Happier

945 Front Street San Francisco



Net Zero + 20% higher satisfaction levels



An aerial photograph of a modern architectural complex. The central focus is a large, multi-story building with a unique, angular facade made of light-colored panels. It features several levels of green terraces with plants. To its right is a tall, slender glass skyscraper. The surrounding area includes other buildings, some with green roofs, and a dense urban landscape. The sky is clear and blue, suggesting a bright day.

The Resilience Case
Losses Loom Larger than Gains
Net Zero Buildings *Survive*

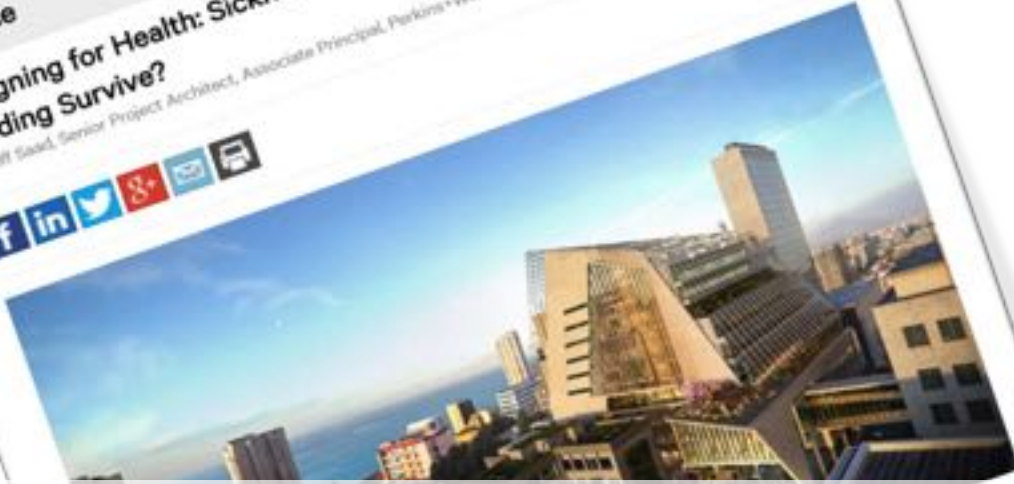
contract

NEWS PROJECTS PRODUCTS PRACTICE CO

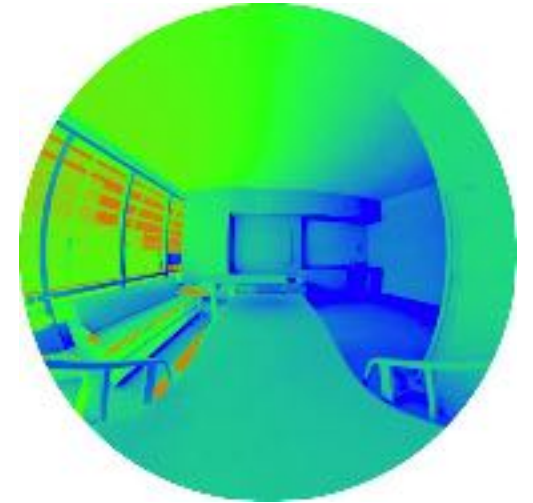
Practice

Designing for Health: Sickness and Recovery How Long Will Your Building Survive?

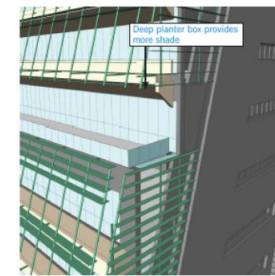
By Jeff Saad, Senior Project Architect, Associate Principal, Perkins+Will • November 14, 2017



Building skins that work for patients and protect the building from climatic extremes

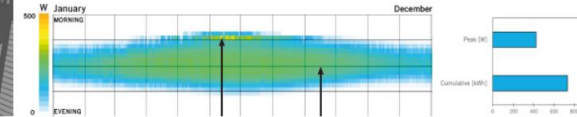


NORTH-WEST LEVEL 9 - SHADING OPTIMISATION



422
WATTS
PEAK SOLAR LOAD

733
KILOWATT-HOURS
CUMULATIVE SOLAR LOAD



BASILINE COMPARISON

There are several key differences between the SD and DD designs, which have resulted in a reduction in peak solar gain (-18%) and an increase in cumulative solar gain (+17%).

The first significant change is the profile of the planter box located at Level 10. The Schematic Design model indicated a planter box with a raked profile, which reduces the level of shading at the glass. This change is likely responsible for the increase in cumulative solar load.

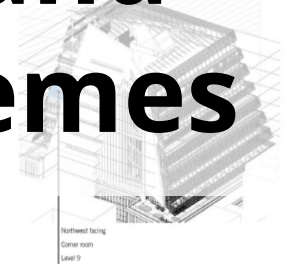
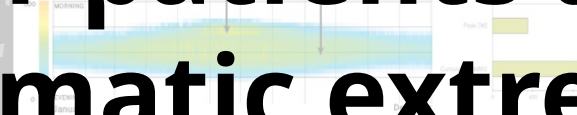
The second significant change is the increase in the number of shading fins directly in front of the glazing. In Schematic Design, two shading fins were positioned above the glazing, while the proposed shading features four fins positioned in front of the glazing. This change is likely responsible for the reduction in peak solar gain.

KEY OUTCOME
Due to the negligible increase in peak solar gain, a parametric analysis has not been performed for this space.



348
WATTS
PEAK SOLAR LOAD

859
KILOWATT-HOURS
CUMULATIVE SOLAR LOAD



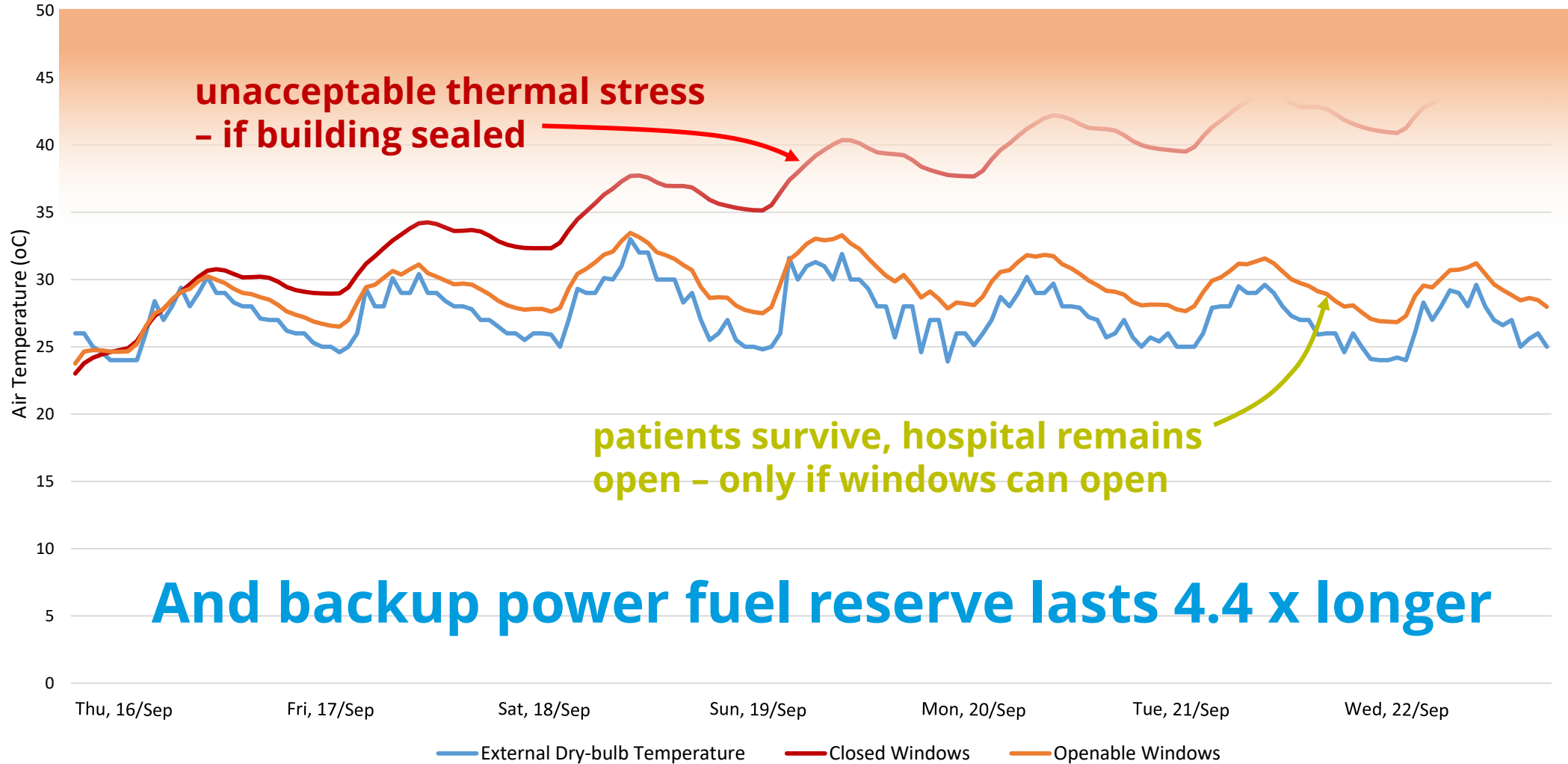
Breathing in Beirut





Challenge the code: hospital rooms can breathe

Daily Outdoor/Indoor Temperature (16th-22nd of September)



What happens if power is cut during the peak of summer?

Hackbridge Primary School, London

© Architype

BedZED – the UK's first zero fossil fuel emissions community

**The Planning Case
Net Zero in place of BREEAM**

Hackbridge Primary School – November 2017



Energy Performance Certificate
Non-Domestic Building

Building ID: 628 Certificate Reference Number: 0000 0040 0020 9000 0008

This certificate shows the energy rating of this building, including the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for the type of building, one appropriate for new buildings and one appropriate for existing buildings. There is more space on how to interpret this information on the Government's website www.compare-energy-ratings.gov.uk.

Energy Performance Asset Rating

More energy efficient

A+ **-25** This is how energy efficient the building is. Relative CO₂ emissions

A	9-25
B	26-50
C	51-75
D	76-100
E	101-125
F	126-150
G	Over 150

Less energy efficient

Technical Information

Plot area (sqm)	10224 (gross plot area)
Building area (sqm)	1764 (net internal floor area)
Total useful floor area (m ²)	2451.905
Building complexity (AC0 level)	5
Building volume (cubic metres)	15100

Benchmarks

Building grade for this asset class ranges as follows:

- 57** (typical of new buildings)
- 55** (typical of existing buildings)

Summer 2018



Zero Net Energy

[Environment > Zero Net Energy](#)

At SFO, every kilowatt of energy used for our guest's journey is a combination of electricity (330 GWh), supplied emissions-free greenhouse gas (GHG) from the San Francisco Public Utilities Commission's [Hetch Hetchy Hydroelectric System](#), or natural gas.

[Overview](#)[Our Climate Story](#)[Your Journey](#)[Facts & Figures](#)[Zero Net Energy](#)[Zero Waste](#)[Zero Carbon](#)[Transit First](#)[Healthy Buildings & People](#)[Water Conservation](#)[Biodiversity & Resilience](#)

Net Zero Public Commitment



SFO – Integrated Design

1/2 Chiller Size
1/3 # of VAVs
1/4 AHU Size
Compared to typical systems approach



©Henrik Kam 2018



©Henrik Kam 2018

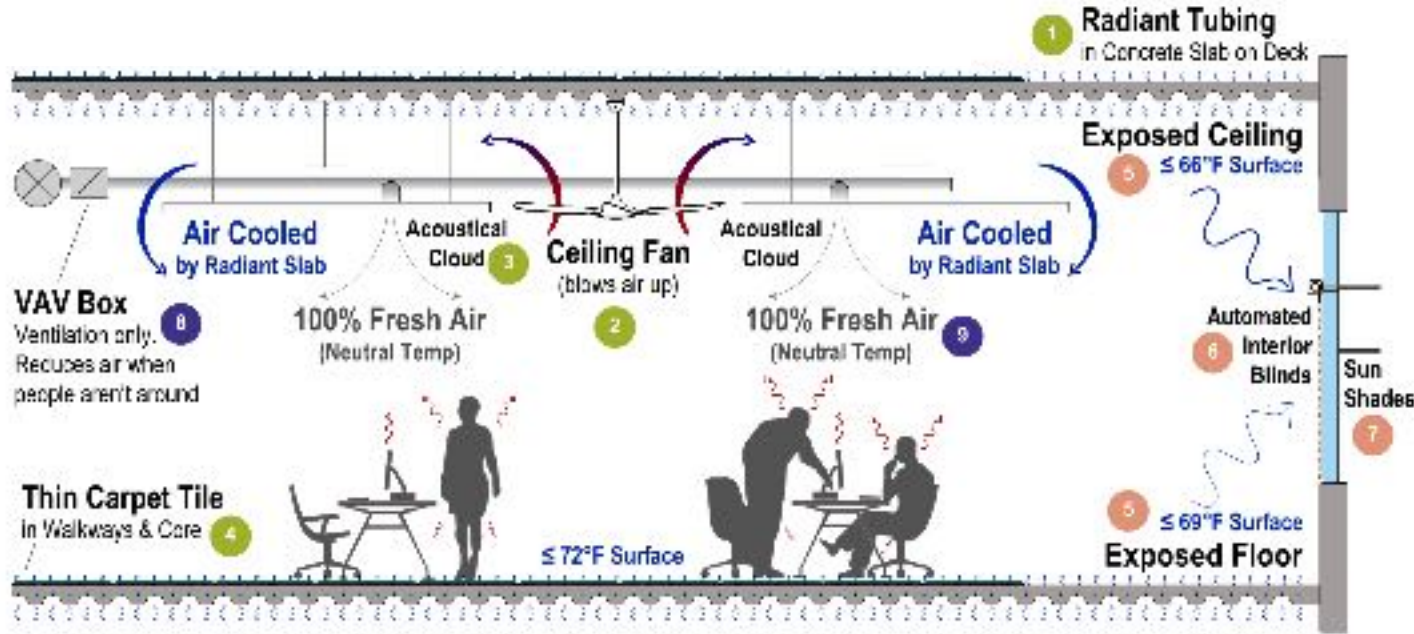


©Henrik Kam 2018

SFO



Everything Works Together



Radiant + Ceiling Fans

- 1 **Inslab Radiant (100,000 SF)**
Heats & Cools all Office Space.
Large zones minimize cost & manifolds
- 2 **Ceiling Fans (72 Haiku L Series)**
Empower radiant around clouds,
Increase occupant comfort & control.
- 3 **Acoustical Clouds**
Great acoustical performance that
still allows for high radiant capacity.
- 4 **Thin Carpet Tile**
Acoustical strategy that still allows
enough radiant capacity.

Architecture Reduces Load

- 5 **Exposed Perimeter Radiant Surfaces**
5 ft wide strip free of clouds & carpet allows
Radiant to powerfully handle envelope loads.
- 6 **Automated Interior Blinds (MechoShades)**
Reduces direct solar gain to help radiant's
success and visual & thermal comfort.
- 7 **Sun Shades (Two 14" Overhangs)**
Reduces solar so radiant can cool by itself
Eliminates need for supplementary fan coils

More Fresh Air, Less HVAC

- 8 **VAV Boxes (No Reheat Coils)**
Ventilation only, so boxes serve larger areas
Eliminates nearly 70% of VAV boxes.
- 9 **Neutral Temp Fresh Air**
Fresh air supplied at a neutral temp providing
both thermal comfort and energy savings.

“This project was successful because the team worked together towards common goal. SFO decided early on that they wanted a ZNE building, and the architects, contractor, and engineers all pushed to reach this commitment.”

Noah Zallen, Integral Project Manager



**Finally:
Some Reasons to be Careful....**



Let's burn lots and lots of wood.....?



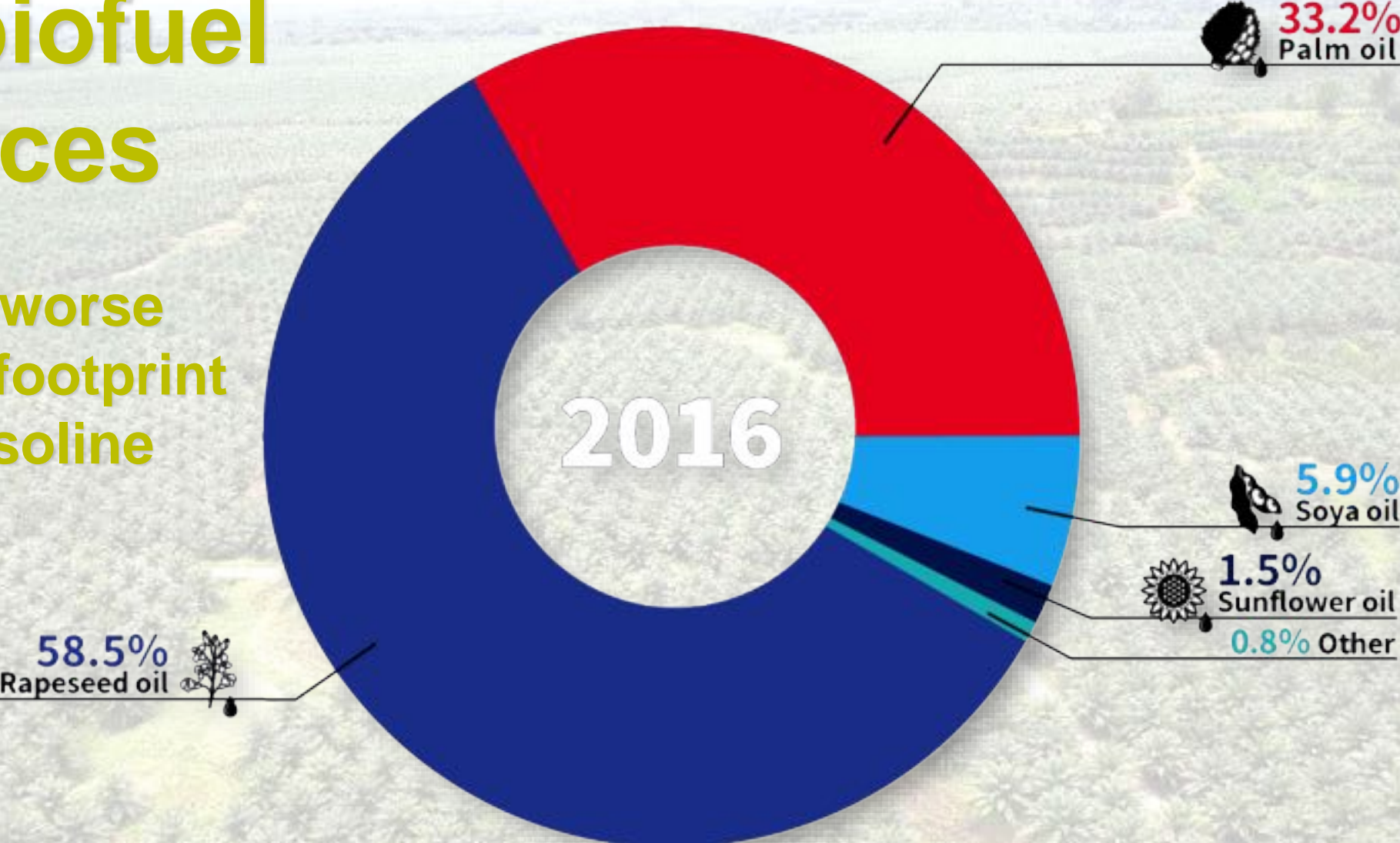
Contributes to Air Quality like this: London 2015



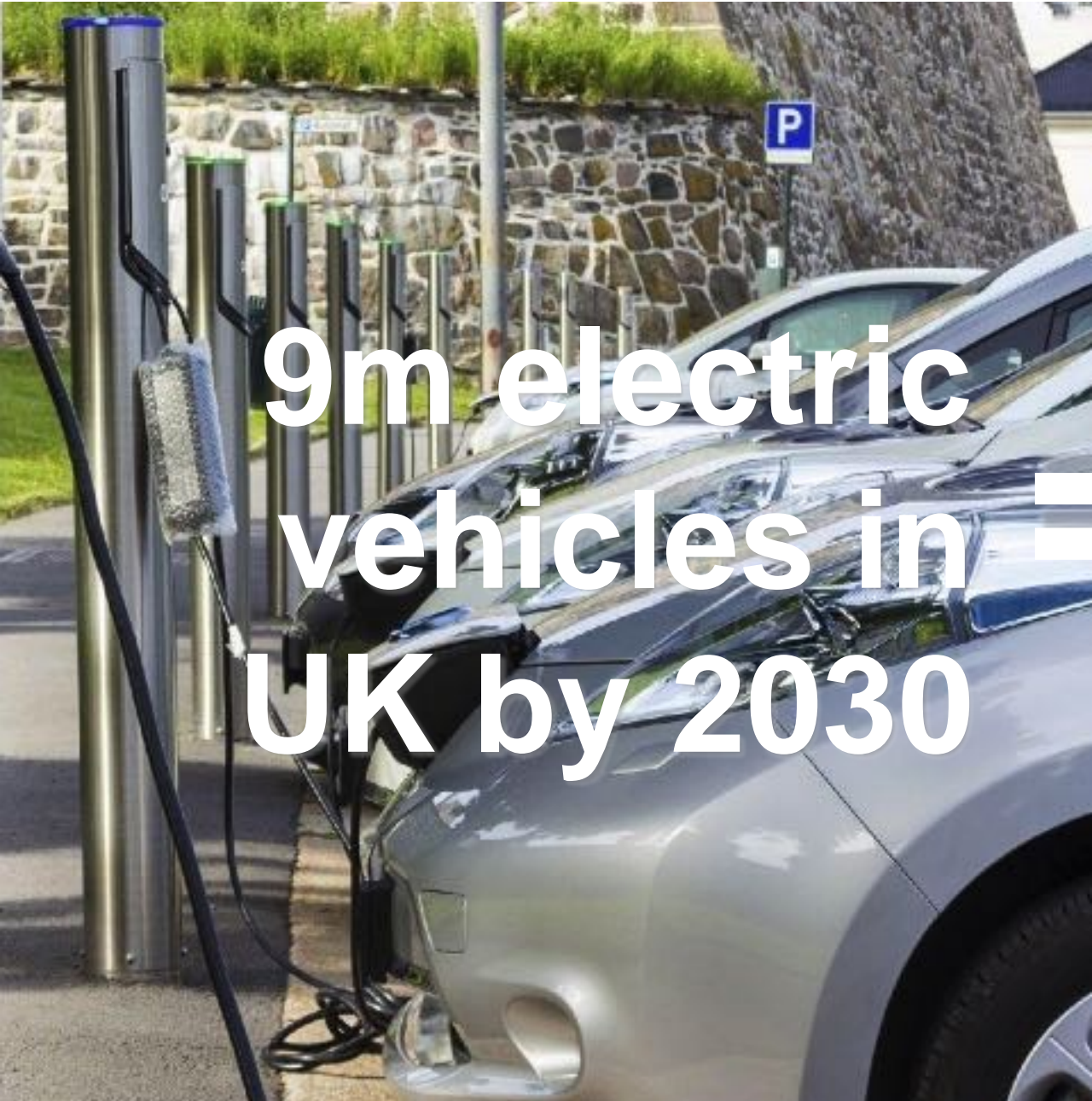
Switching to biofuels..... destroys rainforests

EU biofuel sources

and 3 x worse carbon footprint than gasoline



UK EV Charging anticipated to add 3.5 GW to peak demand



9m electric vehicles in UK by 2030

=



1 x Nuclear Power Plant*

*only with smart charging... otherwise it's 3 x