Africa Energy Efficiency Policy in Emerging Economies Training Week

Nairobi

18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

Deep dive on passive design and cooling in buildings

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SEforAll

	STRATEGIC PILLARS		
	1 **Global advocacy and knowledge dissemination** for SDG7 and a just and equitable energy transition	2 **Scalable solutions and platforms** that develop and provide replicable solutions to address common challenges to regional or global issues	3 **Tailored country support** to address country-specific needs for a just and equitable energy transition
Objectives	Rally political momentum, create awareness, and **drive decision making** on an international stage	Unlock **financial flows**, foster **enabling business and policy environments**, and test implementation models	Build **system capacity** and advise around national **planning and implementation**
Why SEforALL?	Exceptional **convening power** and unique ability to **influence decision-making**	Track record for designing solutions, and **coordination capabilities** and network to build alliances	Reputation as a **trusted broker**, with **flexibility and agility** to deliver on-ground solutions quickly

Overview of session

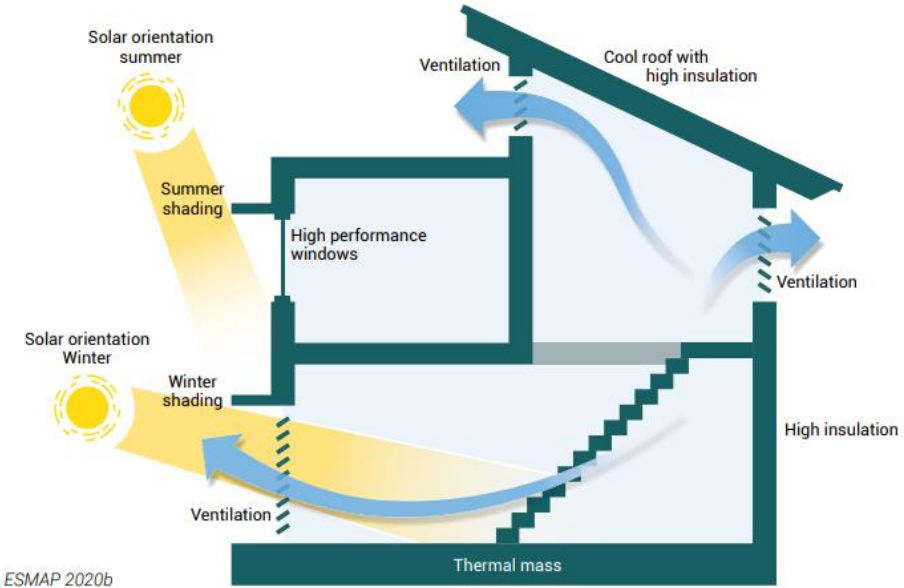
1. What is passive design and passive cooling in buildings?
2. Why is it important?
3. Climate & comfort analysis
4. Passive design and cooling solutions
5. Supporting policies and enabling actions

...and after the break, we'll explore some case studies!

What is passive design and cooling in buildings?

Passive design for buildings responds to the local climate and uses the building orientation, layout, form, materials and other physical design features to reduce or remove mechanical cooling, heating, ventilation and lighting demand.

Passive cooling relies on natural processes to reduce and manage heat to help maintain comfortable temperatures indoors or reduce cooling demand.

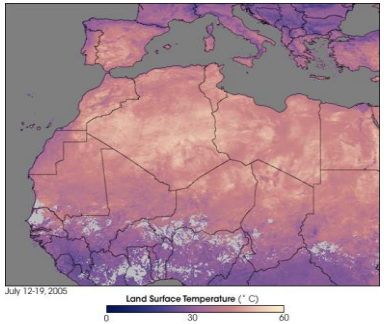


Source: Adapted from ESMAP 2020b

Why is passive cooling design in buildings important?

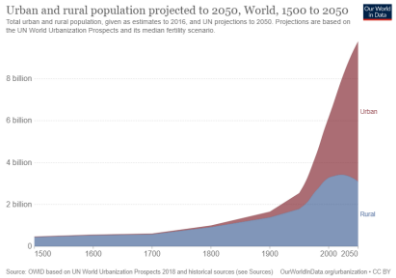
Increasing heat exposure & cooling demand

Increasing temperatures & heatwaves



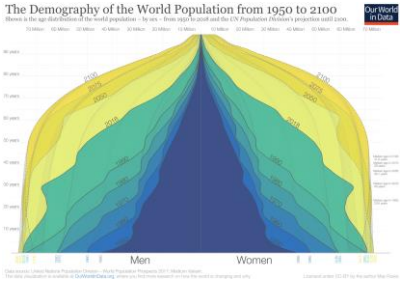
Source: https://earthobservatory.nasa.gov /images/15255/heatwave-in-northern-africa-and-southern-europe

Rapid urbanization



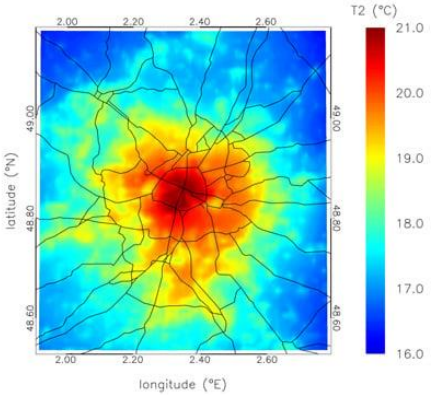
Source: Our World in Data

An increasing & aging population



Source: Our World in Data

Urban environments & buildings trap heat



Mean air temperature in Paris, France at 22:00 CESTin summer 2003 (VITO, Planetek)

Increasing heat exposure & cooling demand

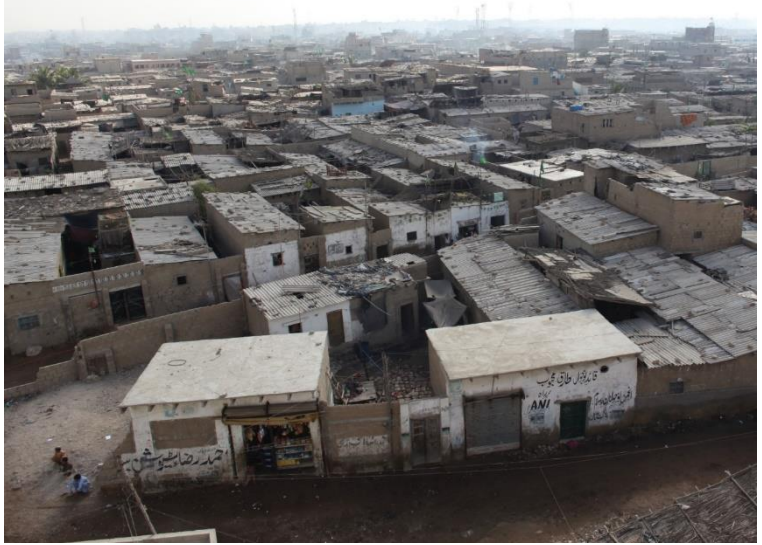
The Urban Heat Island Effect (UHIE)

Urban environments are trapping heat due to:

Dark surfaces that absorb solar radiation

- A lack of vegetation that shades and cools
- Human-generated heat from electrical and mechanical equipment.
- Building designs that trap heat, such as those with heavily glazed facades or metal roofs

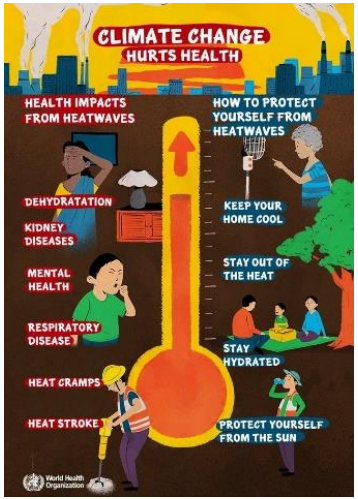
A study found that the UHIE caused the city of Accra to be between 4oC and 6oC hotter than the surrounding rural area.*



*Wemegah et al, Assessment of urban heat island warming in the greater accra region, Scientific African, Volume 8, 2020, e00426, ISSN 2468-2276, https://doi.org/10.1016/j.sciaf.2020.e00426.

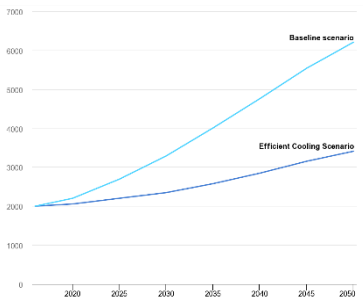
Consequences of heat exposure and increased active cooling

Heat mortality & heat-related illnesses



Source: WHO

Increased peak energy demand and reduce energy resiliency



Source: IEA (2028)

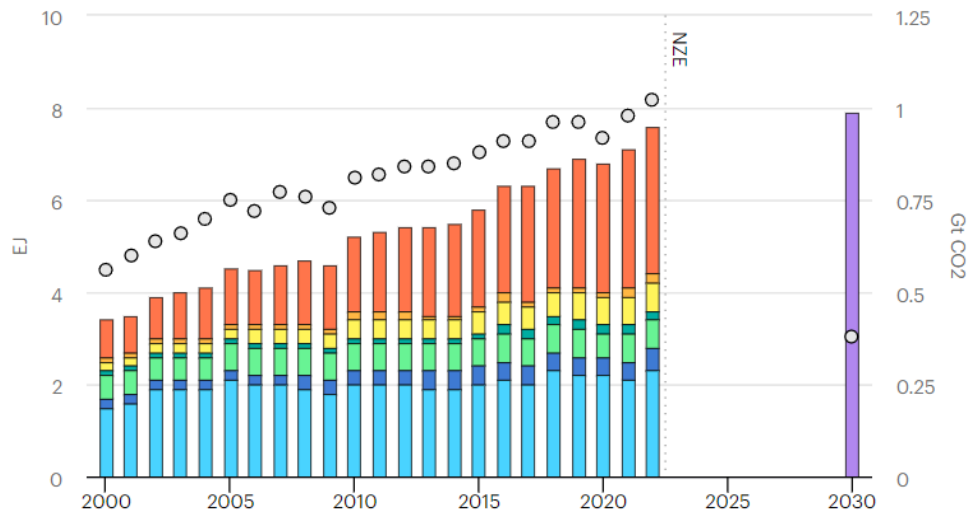
Economic & productivity losses

Social equity & justice consequences

More global heating, more active cooling, more emissions

Final energy consumption and carbon emissions for space cooling by region in the Net Zero Scenario, 2000-2030

Open



North America · Central and South America · Europe · Africa · Middle East · Eurasia · Asia Pacific · World · Total carbon emissions

Passive design significantly reduces cooling load & energy use

UNEP Global Cooling Watch 2023:

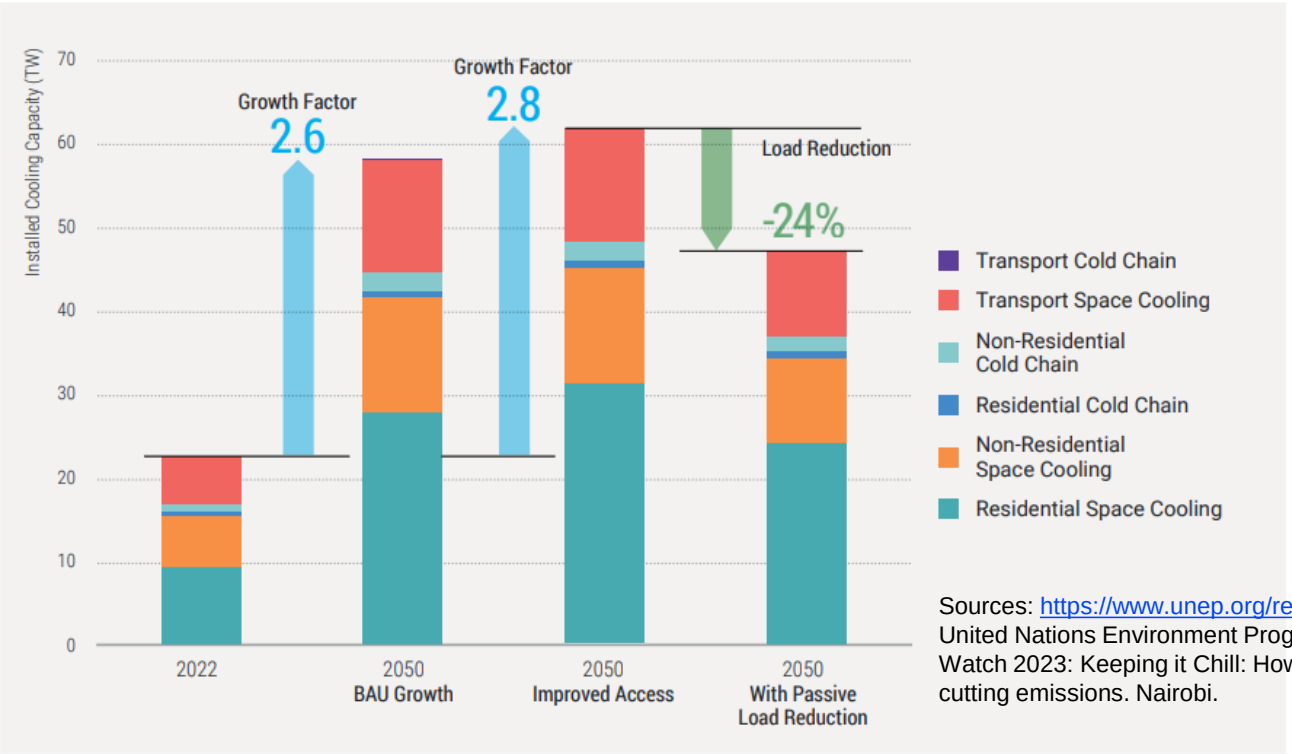
- With widespread adoption of passive design, *global cooling capacity can be reduced by 24%*
- For new building, cooling load reductions 30% to 40% are typical, and in some circumstances *reductions of more than 50% are feasible*
- For existing buildings, cooling loads can be reduced through retrofits, resulting in typical load reductions of 10% to 20%.

The National Government Participants of the **Global Cooling Pledge**:

Commit to establish national model building energy codes that incorporate market appropriate measures such as passive cooling .. by 2030 for new and refurbished buildings…

Passive design significantly reduces cooling load & energy use

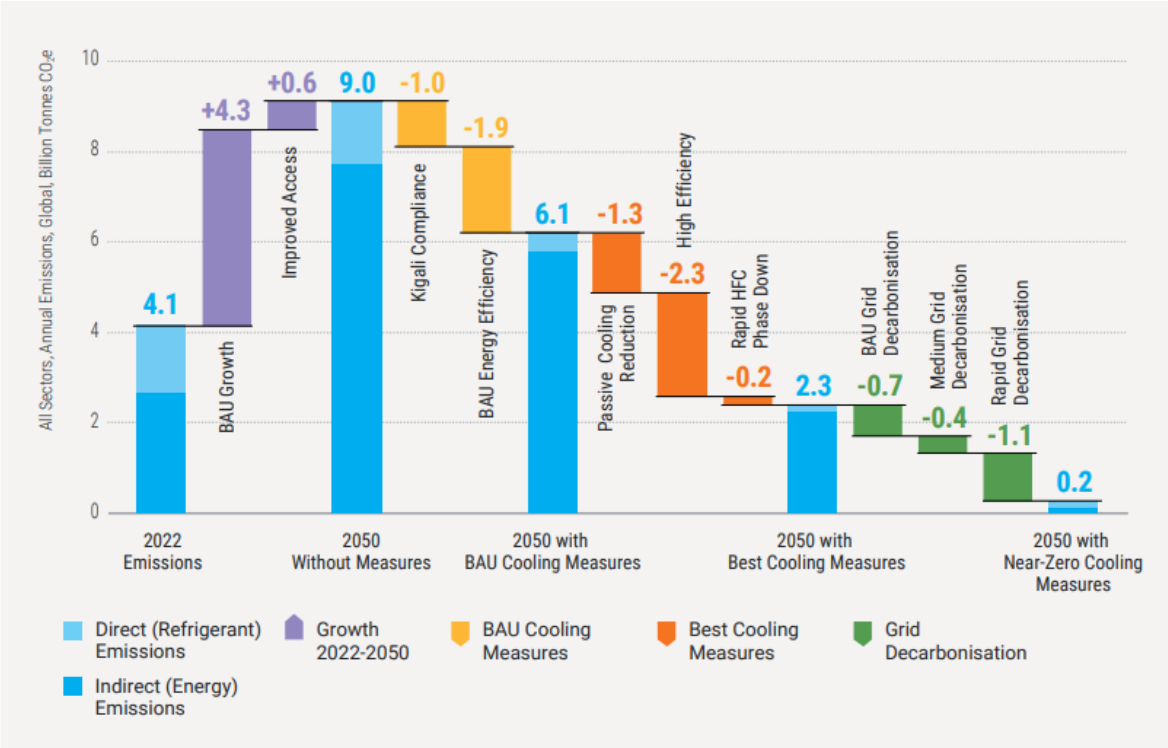
Figure 2-1: Global cooling capacity in 2022 and under three scenarios for growth to 2050



Sources: https://www.unep.org/resources/report/global-cooling-pledge United Nations Environment Programme (2023). Global Cooling Watch 2023: Keeping it Chill: How to meet cooling demands while cutting emissions. Nairobi.

Source: Global Cooling Emissions Model

Figure ES-1: Global pathway and key steps to achieve near-zero GHG emissions from cooling, 2022-2050



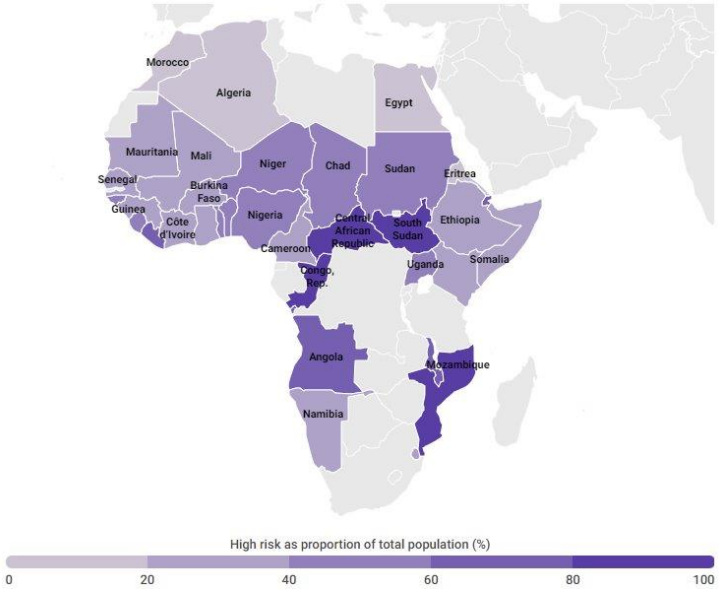
Note: Blue bars show emissions in 2022 and 2050. Purple bars indicate growth. Yellow bars indicate BAU Cooling Measure emission reductions. Orange bars indicate Best Cooling Measure emission reductions. Green bars indicate emission reduction due to electricity grid decarbonisation.

Passive solutions reduce heat exposure for the most vulnerable

In a warming world, access to cooling is not a luxury. It is an issue of equity, necessary to adapt and thrive.

1.12 bn

People at high risk among the rural and urban poor die to a lack of access to cooling



Source: SEforALL Chilling Prospects

Build better, prioritising passive solutions for cooling

Gando primary school, Diébédo Francis Kéré's first construction project after finishing his studies in Germany. Photograph: Siméon Duchoud/Kere Architecture

The alternatives

'We don't need air con': how Burkina Faso builds schools that stay cool in 40C heat

Architects use local materials and merge traditional techniques with modern technology to make schools and orphanages cool, welcoming places

by Èlia Borràs in Burkina Faso

Build better, prioritising passive solutions for cooling

Climate & Comfort Analysis

Audience Question

What ambient wet-bulb temperature is the limit of human body tolerance under prolonged periods?

A. 35°C

B. 38°C

C. 43°C

D. 46°C

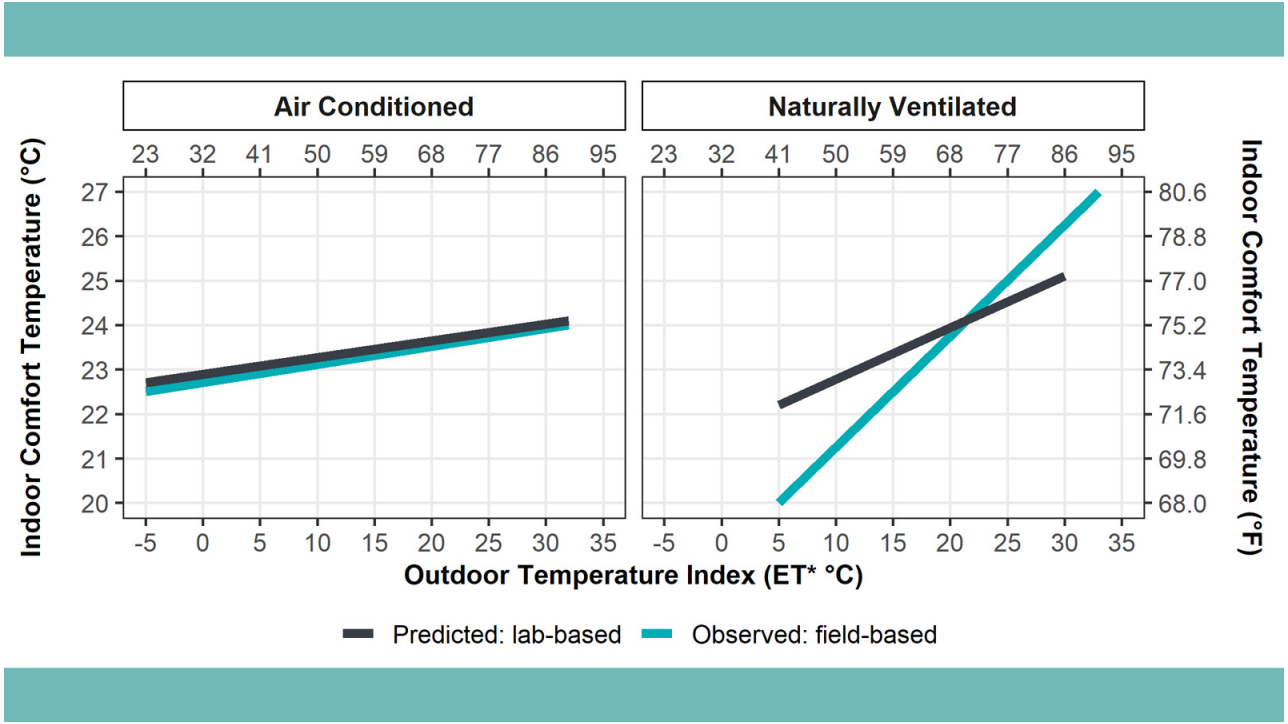
Thermal Comfort

Local **climate**, **culture**, **behaviour** and **technology** influence our perceived thermal comfort. **Physical**, **physiological** and **socio-psychological** characteristics affect how comfortable we feel.

Influencing factors include:

- Air temperature
- Radiant temperature
- Humidity
- Airspeed
- Clothing
- Activity rate and blood flow
- Responses such as shivering and perspiring
- Recent climate conditions
- Individual health & mood
- Expectations & personal background
- The ability to adapt our local environment

Adaptive Comfort



Source: A standard for thermal comfort in naturally ventilated buildings included in ASHRAE Standard 55 (https://cbe.berkeley.edu/research/adaptive-comfort-model/)

Climate Analysis

Understanding how these different climate elements may influence/inform design of a building.

Building codes, land-use planning policies, passive design guides and building use all needs to respond to your local climate.

- https://clima.cbe.berkeley.edu/ - detailed analysis with nice diagrams
- https://weatherspark.com/ - helpful for quick comparisons between locations

Humidity

Solar Radiation

Wind

Ground temperature

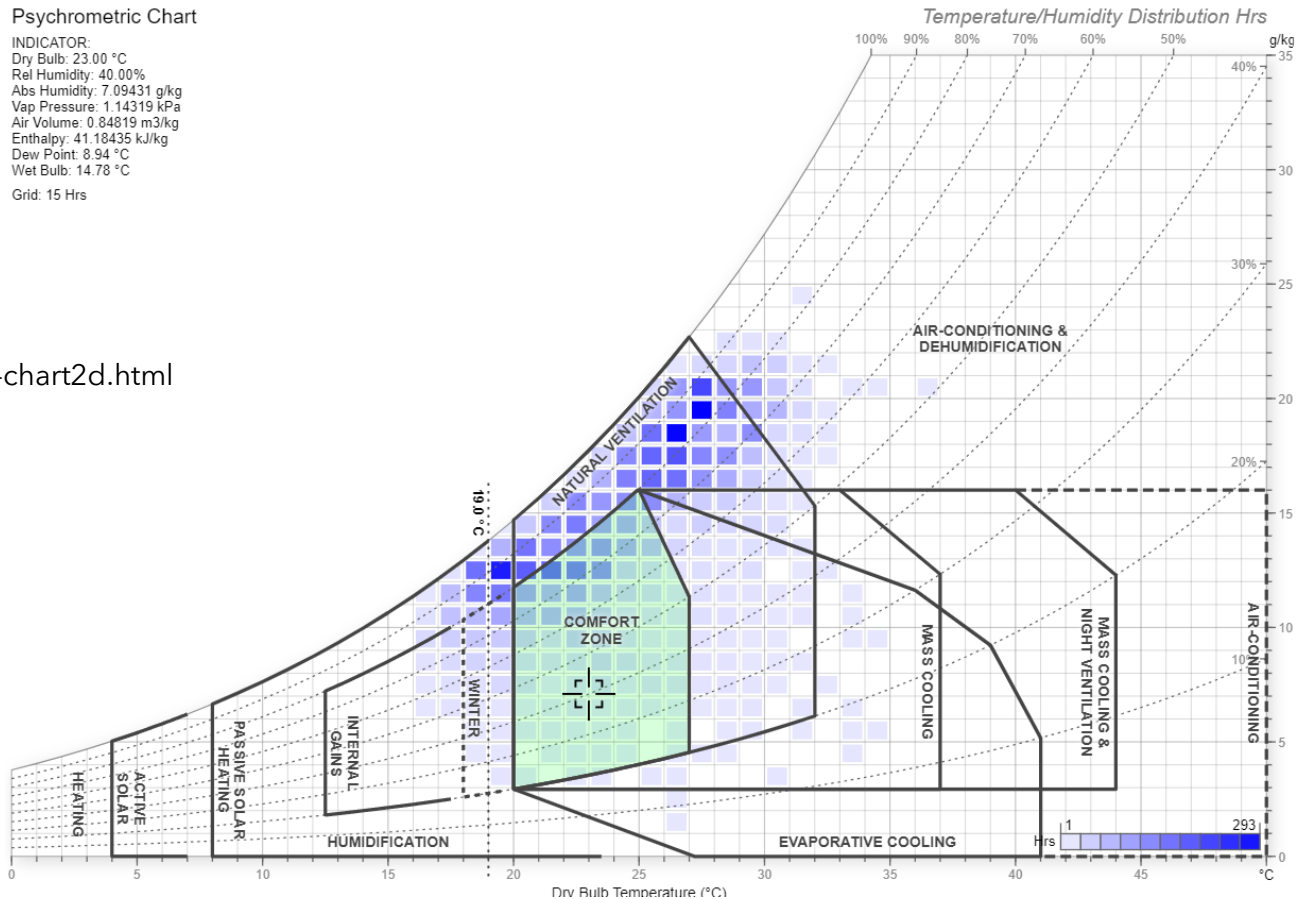
Precipitation

… What? … Why? … How?

Climate Analysis – Psychrometric Chart

Dakar, Senegal

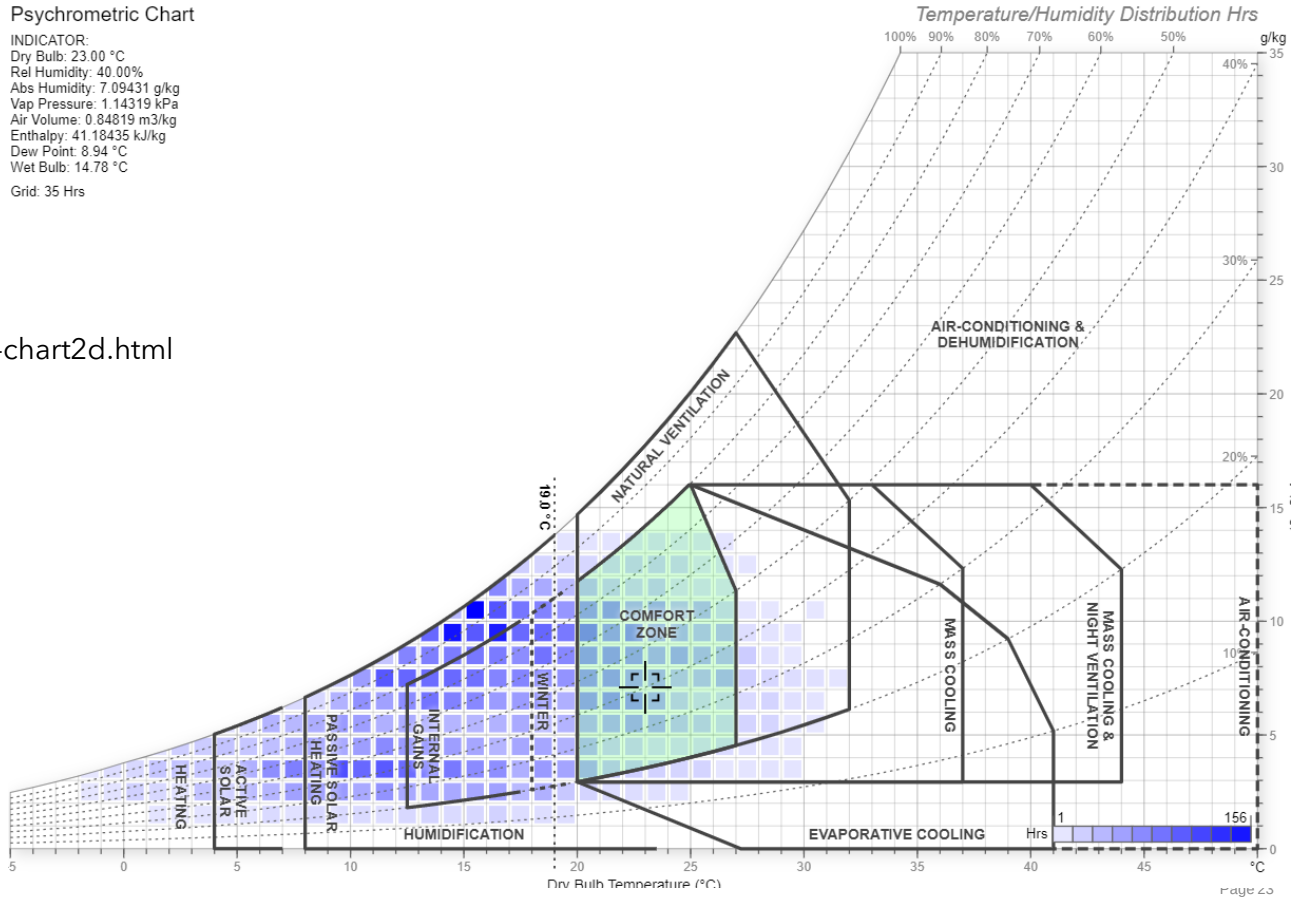
Online tool:
https://drajmarsh.bitbucket.io/psychro-chart2d.html



Climate Analysis – Psychrometric Chart

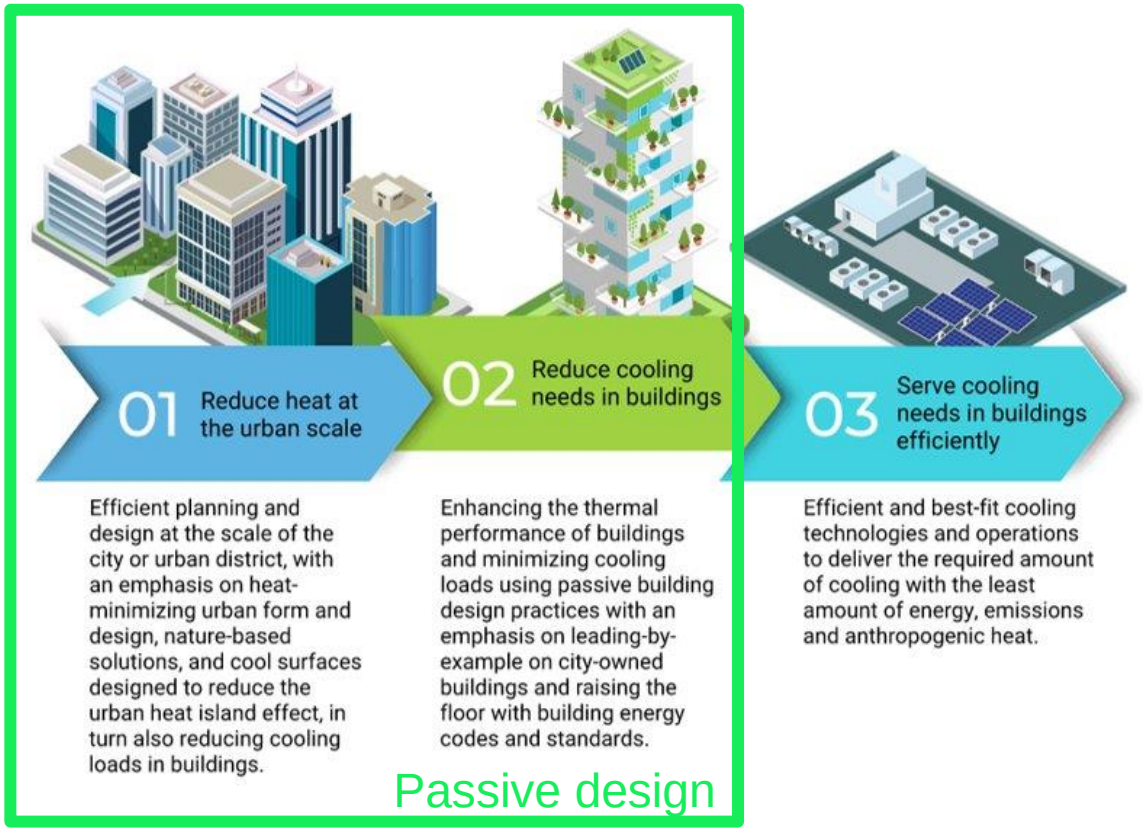
Johannesburg, South Africa

Online tool:
https://drajmarsh.bitbucket.io/psychro-chart2d.html



Passive Design & Cooling Solutions

A pathway to sustainable cooling



Source: RMI Whole-system approach to optimally addressing urban cooling

Efforts will require multiple stakeholder actions from:

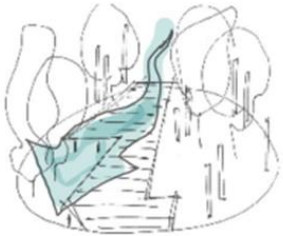
- National governments
- Subnational government
- Utility companies
- Property & project developers
- Financial Institutions
- Architects & engineers
- Manufacturers & suppliers
- Labourers & installers
- Building owners & occupants
- Civil society

Heat mitigation in cities

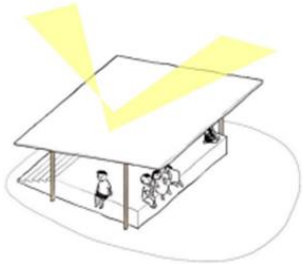
Trees, plants, landscape and playground features to shade buildings & prevent internal overheating.

Trees & plants to provide outdoor cooling through shading and evapotranspiration.

Water features to provide evaporative cooling in the hot and dry season.



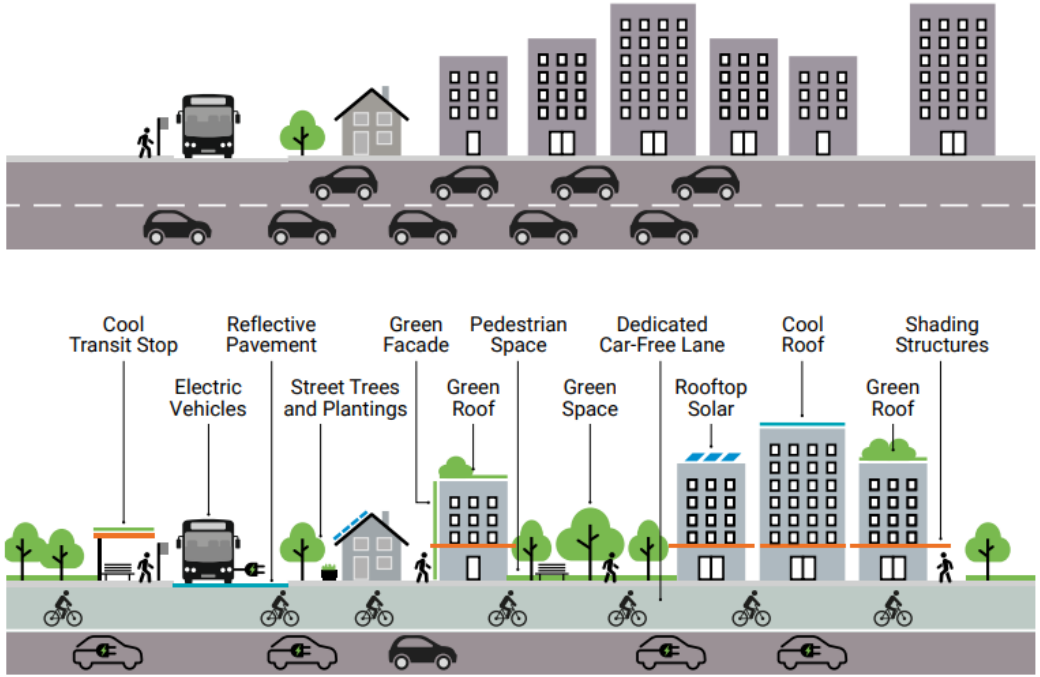
Wind corridors formed with landscape to encourage breezes through the site and buildings



Light coloured surfaces to reflect heat and prevent a local urban heat island effect

Illustration Credit: Amie, MASS Design Group

Heat mitigation in cities



Source: RMI

Note: In the figure, the conventional urban area has a high proportion of impervious surfaces and single-occupancy vehicles. By comparison, the heat-resilient urban area has a higher proportion of green space, cool surfaces, alternative modes of transport and electric vehicles.

Solar Shading

Methods:

- **Orientation** Orient buildings to reduce east and west elevations which receive the most direct solar radiation
- **Limited glazing:** Lots of glass can cause heat to become trapped in buildings. Typically, window-wall ratios should not exceed 20-30% (depending on the location) to limit solar heat gain.
- **Overhangs & Shades** Use elements of the building such as colonnades and projecting overhangs to shade windows and walls from direct sunlight. Provide shutters & shading fins where overhangs do not shade from the sun entirely.
- **Trees and vegetation** can be used to shade exposed windows and walls, particularly on the east and west elevations.
- **Double Roof** Create a second skin beneath the roof to reduce the radiant temperature and help to cool the roof through enhanced ventilation.

Solar Shading

Aim: reduce heat gain and prevent overheating due to solar radiation

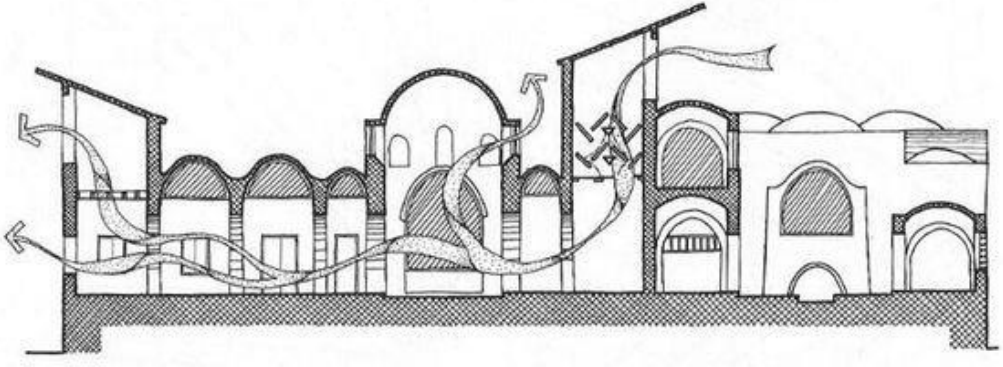
Natural Ventilation

Methods:

- **Prevailing Wind:** Expose the building to the prevailing wind direction to capture wind-driven ventilation.
- **Openings:** Ventilation openings can be created using hit-and-miss bricks, metal, timber, or concrete screens or louvers.
- **Cross Ventilation:** Windows and vents on opposing sides of a building benefit from wind-driven cross ventilation, particularly if they face the prevailing wind direction.
- **Stack Ventilation:** Buoyancy-driven stack ventilation uses temperature differences to move air. This can be enhanced by solar chimneys driving faster ventilation.
- **Nighttime ventilation:** Secure vents and openings that can be left open at night can help flush heat from buildings

Natural Ventilation

Aim: Bring the outdoor air inside to flush heat and create breezes that improve thermal comfort



Materials & Finishes

Methods:

- **‘Cool’ roofs & walls:** A shiny or very light roof finish will reflect solar radiation, helping to reduce radiant heat transfer to interior spaces. Light-coloured walls also help reduce heat gains.

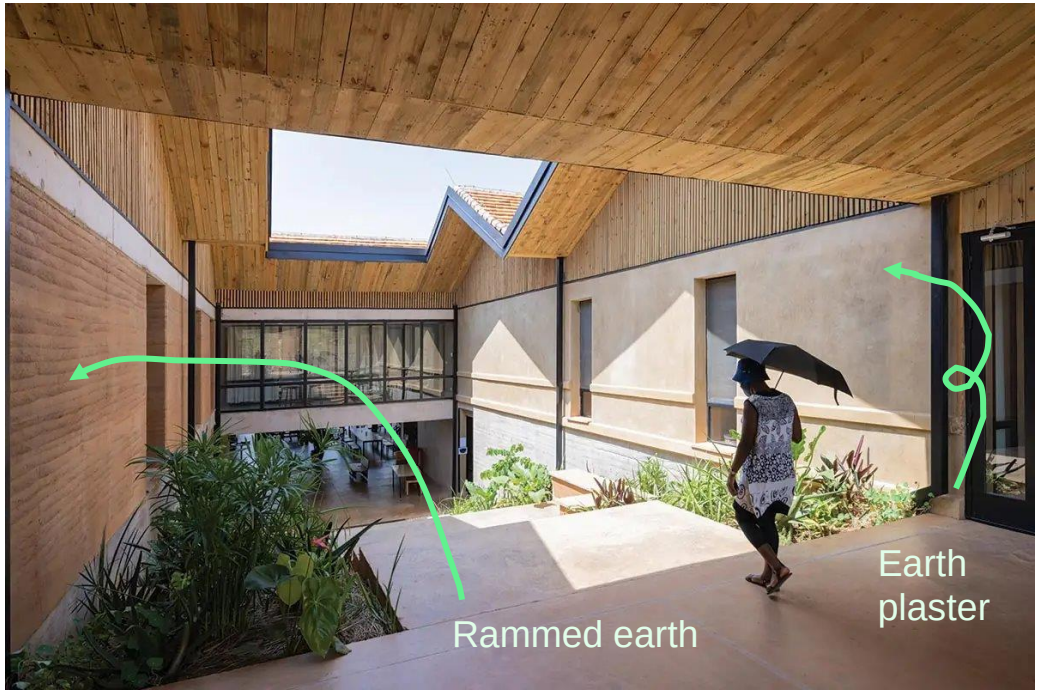
- **Insulating materials** Insulation in the roof and an internal ceiling will reduce heat gain. Wall insulation can help, particularly where active cooling is needed to reduce demand.

- **Thermal mass or ground coupling** Dense and thick walls can help buffer internal temperatures and lower the peak internal temperatures, particularly when coupled with night-time ventilation. *Best for hot & dry climates with a lower nighttime temperatures.*

- **Light & permeable construction** Light, permeable materials can help prevent heat build-up in the structure and provide opportunities for natural ventilation. *Best for hot & humid climates.*

Materials & Finishes

Aim: Reduce, buffer and delay heat through the building fabric.



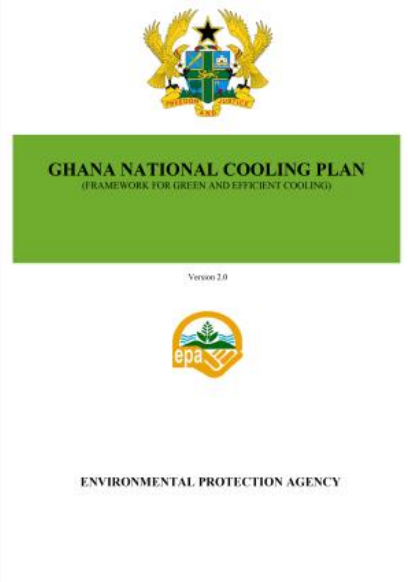
Rwanda Institute for Conservation Agriculture

Mahila Housing trust, India
found white roofs
reduced internal temperatures by 4-5^{o}C

Supporting policies and enabling actions

Policies & actions supporting passive design and cooling

- National Cooling Action Plan embedded with national strategy for increasing passive design and cooling in buildings
- Heat action plans & heat risk mapping to focus resources
- Land-use policies
- Passive design requirements integrated into National Building Codes
- Minimum performance standards for buildings of a certain size, e.g. Rwanda Green Building Minimum Compliance System
- Voluntary building standard's standards, such as EDGE
- Online database/repository of passive solutions for your context, including material and equipment supplier details



Policies & actions supporting passive design and cooling

- Capacity building and training for architects, engineers, builders, contractors
- Evidence-based academic research, conduct monitoring and evaluation of buildings without and with passive design to demonstrate benefit and generate knowledge
- Government leading by example, e.g. by adopting passive designs in public buildings
- Tax incentives for passive cooling materials and products
- Consider passive cooling materials and products in nation industrialization & manufacturing plans
- Community awareness raising campaigns
- Behavior change campaigns
- Community retrofit and greening schemes

Examples of independent NGO campaigns: The campaign for reduction of indoor heating during winter periods in Republic of Korea[10]

Figure 3: "Wearing warm underwear can help save energy"

(Source: Korea NGO's Energy Network, November 2006, Gangneung YWCA, November 29, 2007)

Thank you!

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Buildings

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International Energy Agency

Energy Efficiency Training Week - Buildings - Day 2: 5. Toolkit – Energy efficient building technologies

Introduction

Building envelope technologies

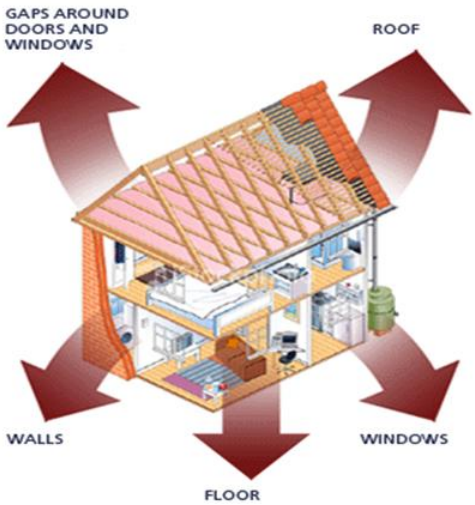
Insulation

Air sealing

Windows and doors

Shading (interior, exterior and vegetative)

Roof (roof system, cool roof and green roof)

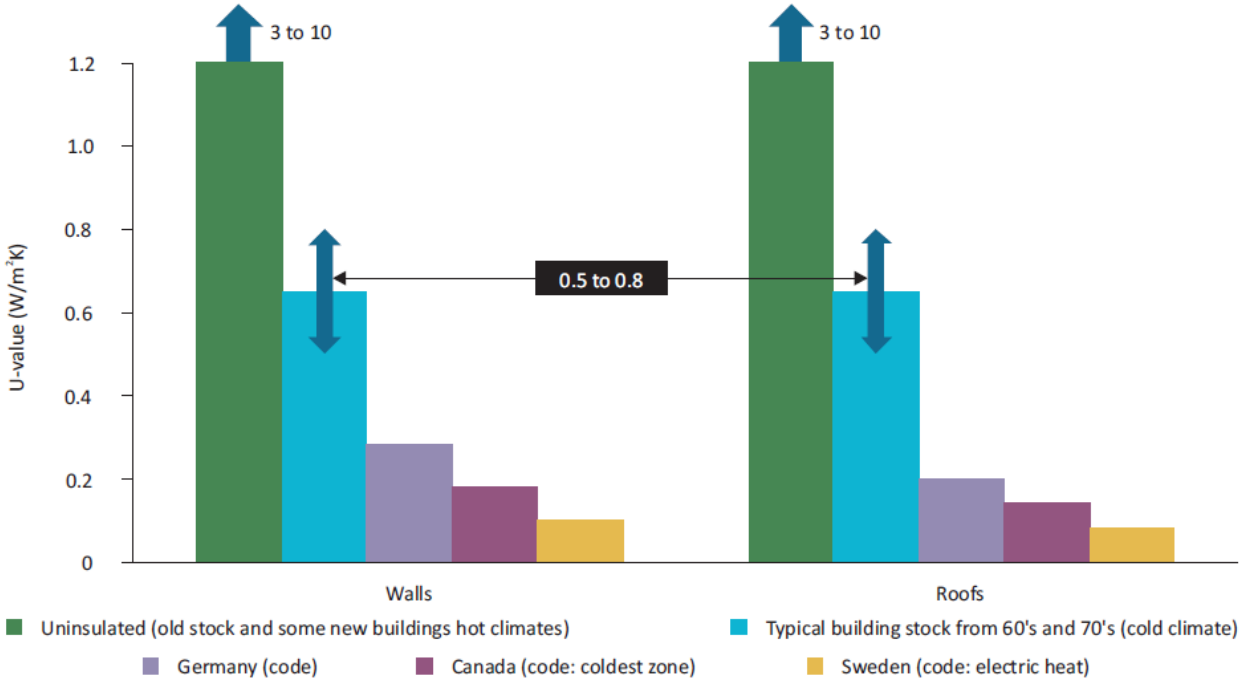


Building envelope technology: insulation

Recommended average wall and roof U-values based on lifecycle cost effectiveness:

≤ 0.15 W/m²°C cold climate

≤ 0.35 W/m²°C hot climate



Insulation levels vary widely in the existing building stock.
Efficient new buildings have increased insulation (low u-value)

Source: IEA Building Codes Policy Pathway and Transition to Sustainable Buildings

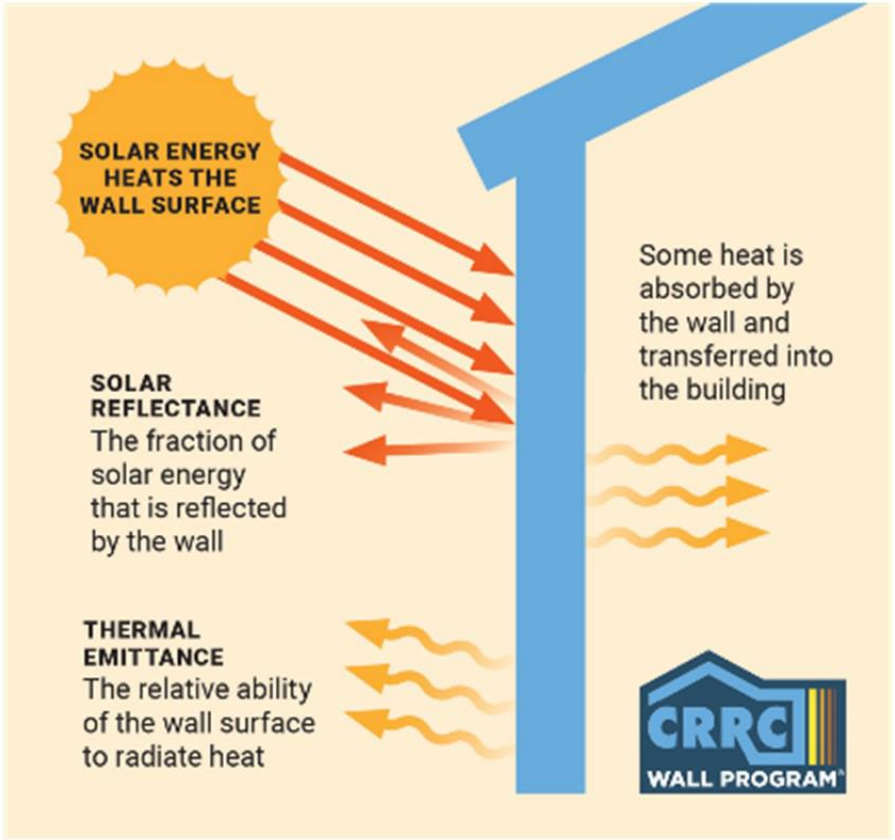
Building envelope technology: insulation (exterior)

Before **After**

Exterior insulation is best approach to reduce thermal shorts/thermal bridges and can applied with external material. Applicable to all building types, but challenging for historic buildings.

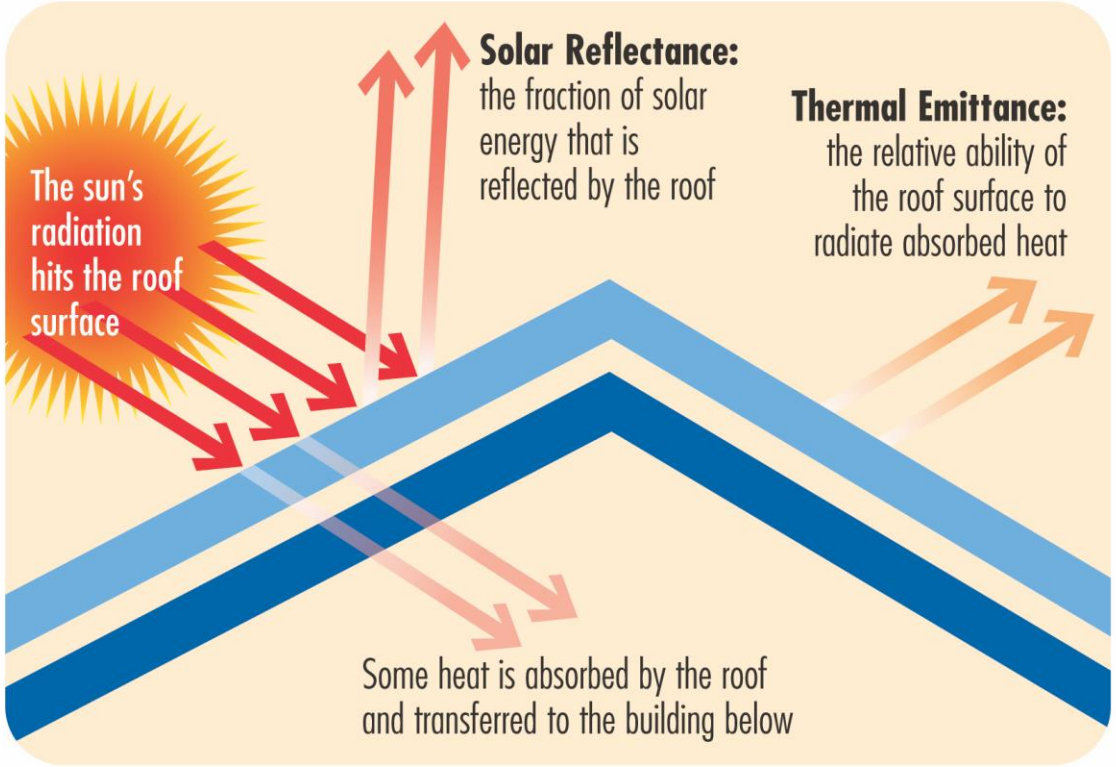
Source: Sto Corporation

Building envelope technology: insulation (exterior)



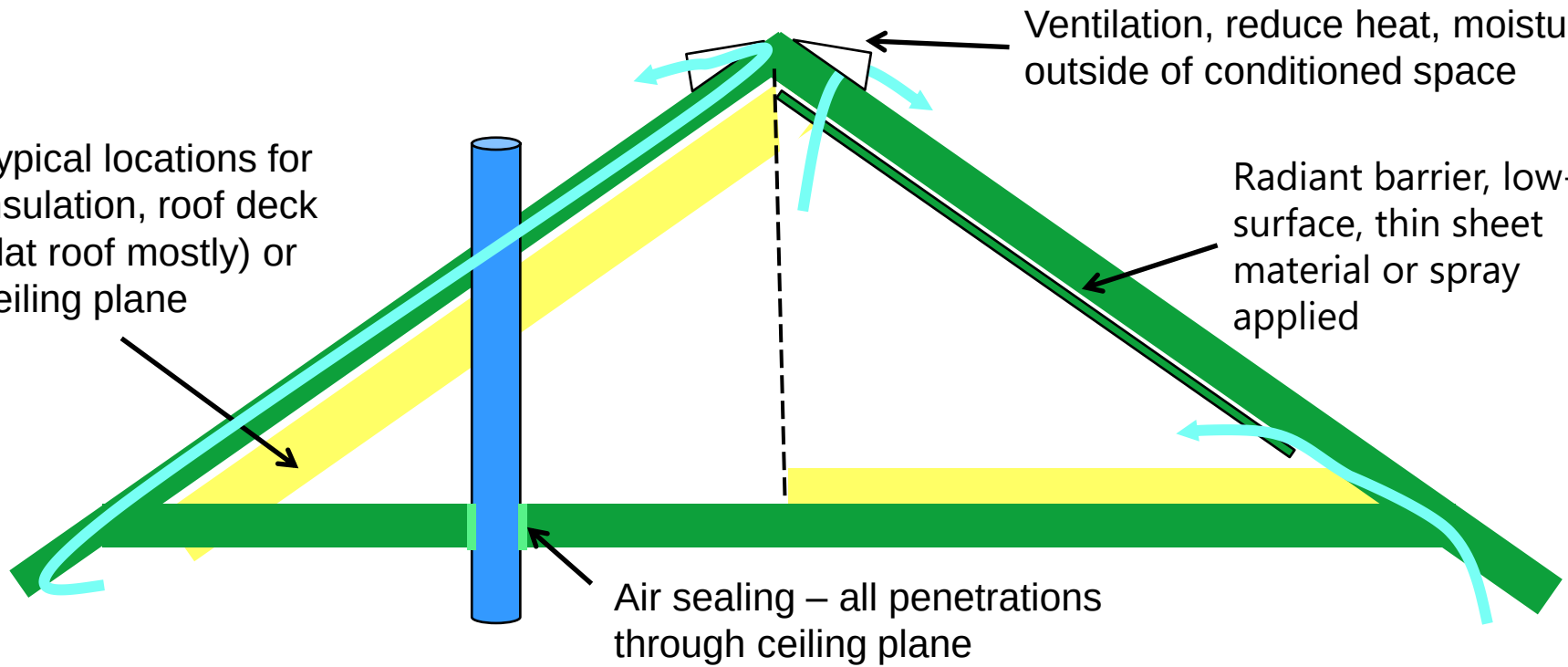
Source: Sto Corporation

Building envelope technology: roof insulation



Source: LBNL

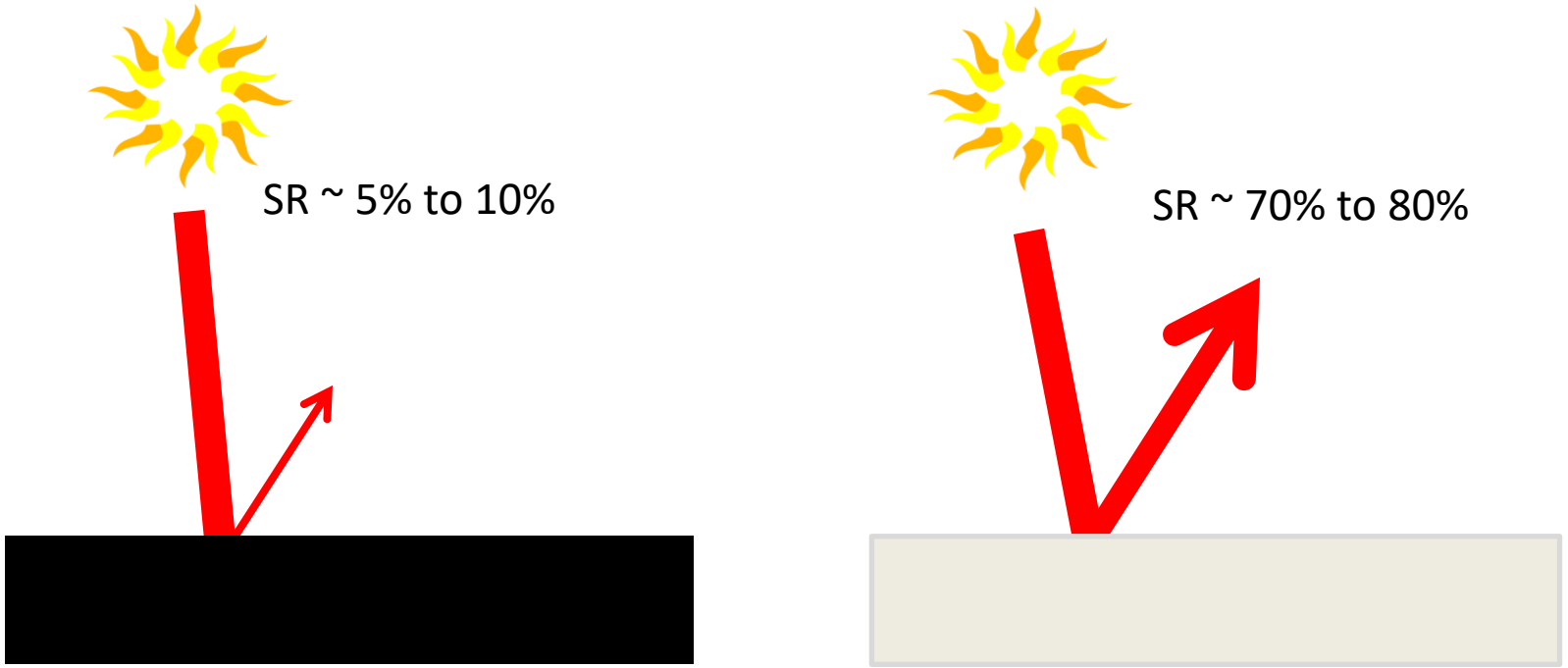
Building envelope technology: roof as a system



Insulation, air sealing, ventilation, radiant barriers, are all important factors, with the best approach depending on the type of roof (pitched, low-slope, or flat)

Source: IEA Energy Efficiency Training Week

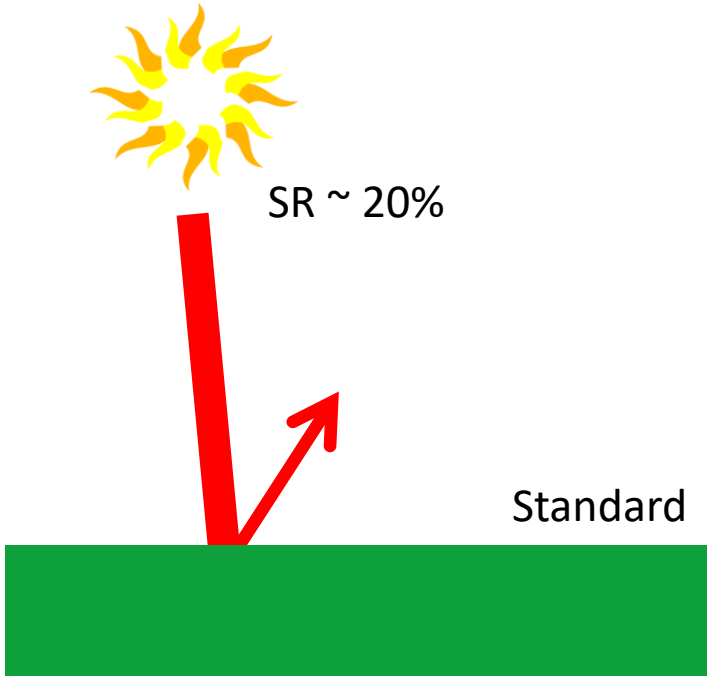
Building envelope technology: roof solar reflectance (visible colour)

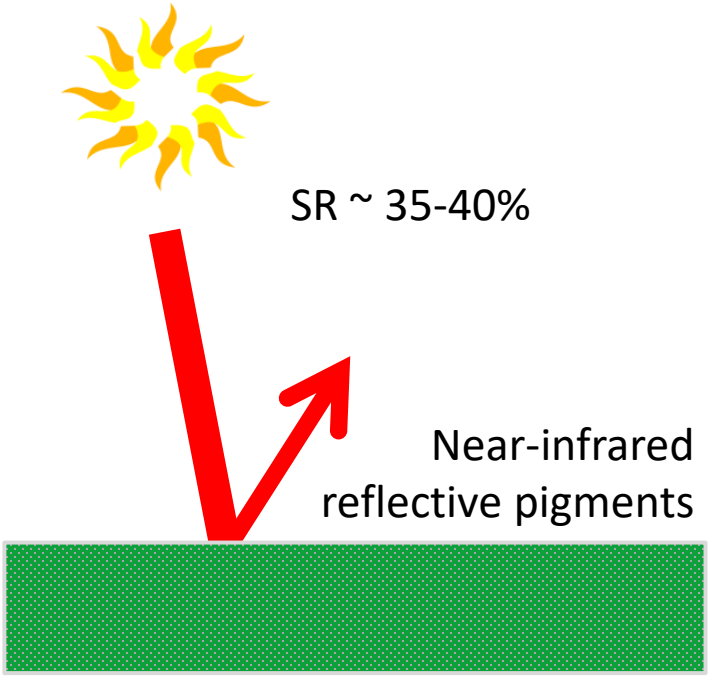


Solar reflectance rejects heat from sun.
Visible colour can change the amount of heat that enters the building.

Source: IEA Energy Efficiency Training Week

Building envelope technology: roof solar reflective pigments

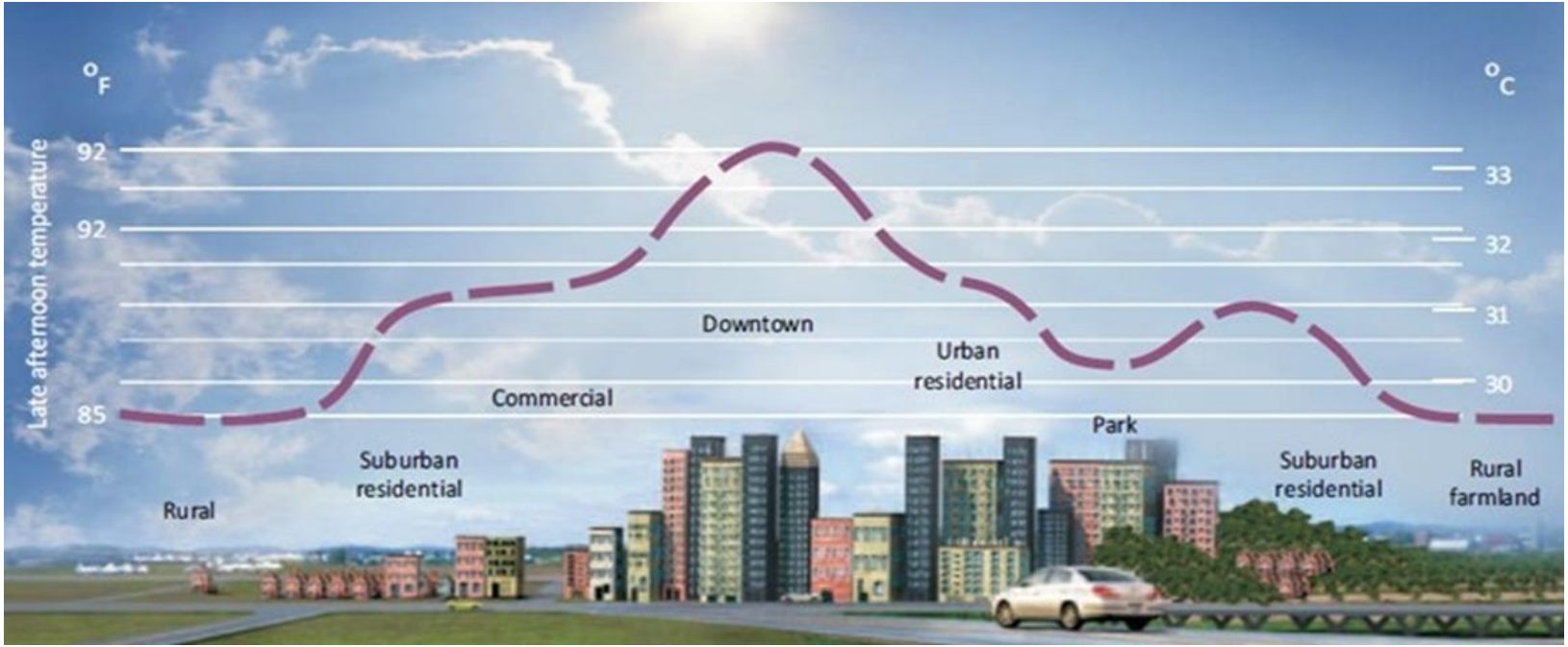




Near infrared reflective pigments reflect the heat we feel, not the visible light.

Source: IEA Energy Efficiency Training Week and www.sciencedirect.com/science/article/pii/S1877705812014531

Building envelope technology: reflectance impact on heat island

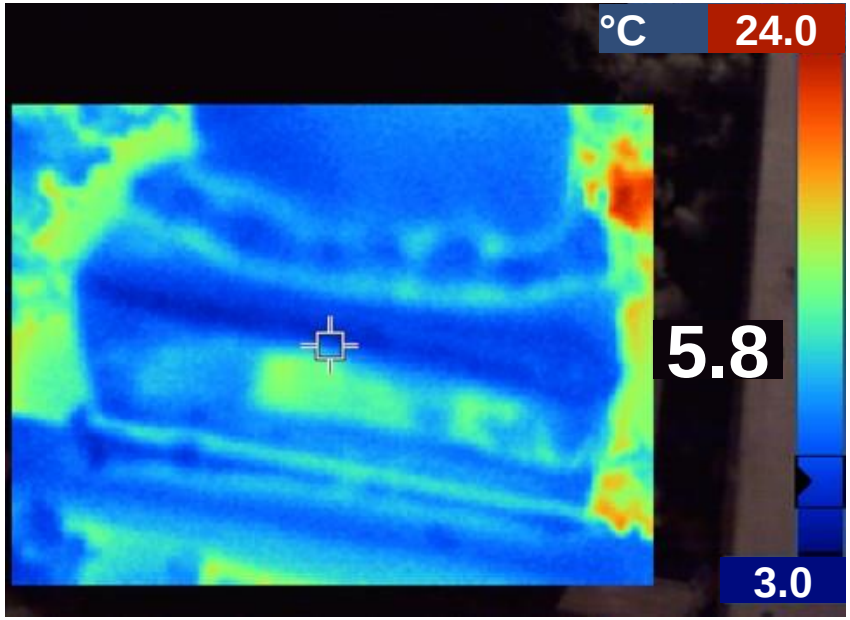


High density of low solar reflectance surfaces increases the heat absorption and heat islands in cities.

Source: LBNL

Building envelope technology: air sealing

Sealing the connection



thermal image

Air sealing typically accounts for 10-30% of heating and cooling loss. However, air sealing can be easily applied and verified with infrared camera and air pressure tests.

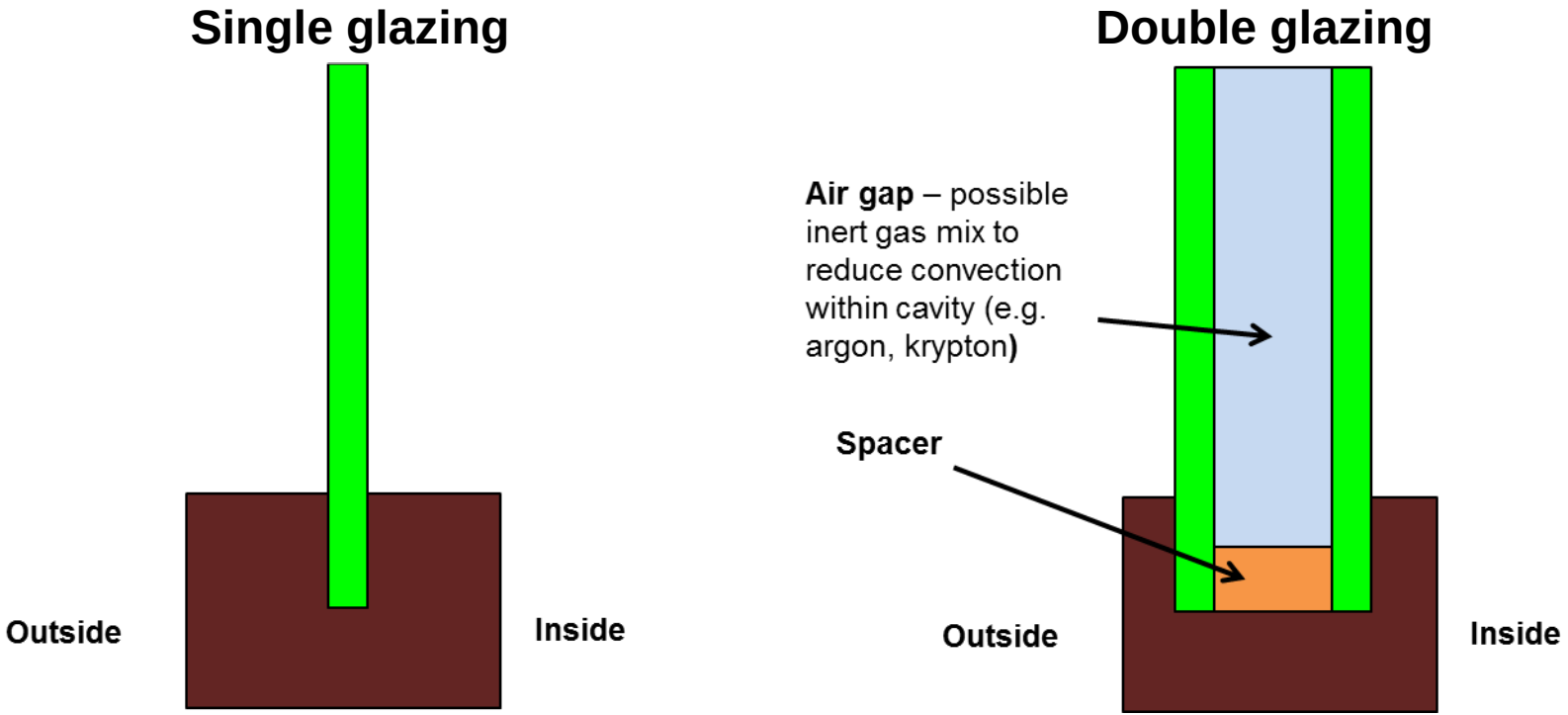
Source: Marc LaFrance

Building envelope technology: air sealing

- **Validated air sealing** is a critical measure for building codes and renovation
- Testing of large multi-family buildings can be expensive – possible to institute **sampling and workmanship criteria to reduce cost**
- More research needed to offer more affordable testing but **many low cost and simple solutions exist today**
  - New research is occurring on a whole building air-based sealant (to seal the building envelope), by the inventors of Aeroseal (for duct sealing)

Source: Oak Ridge National Laboratory

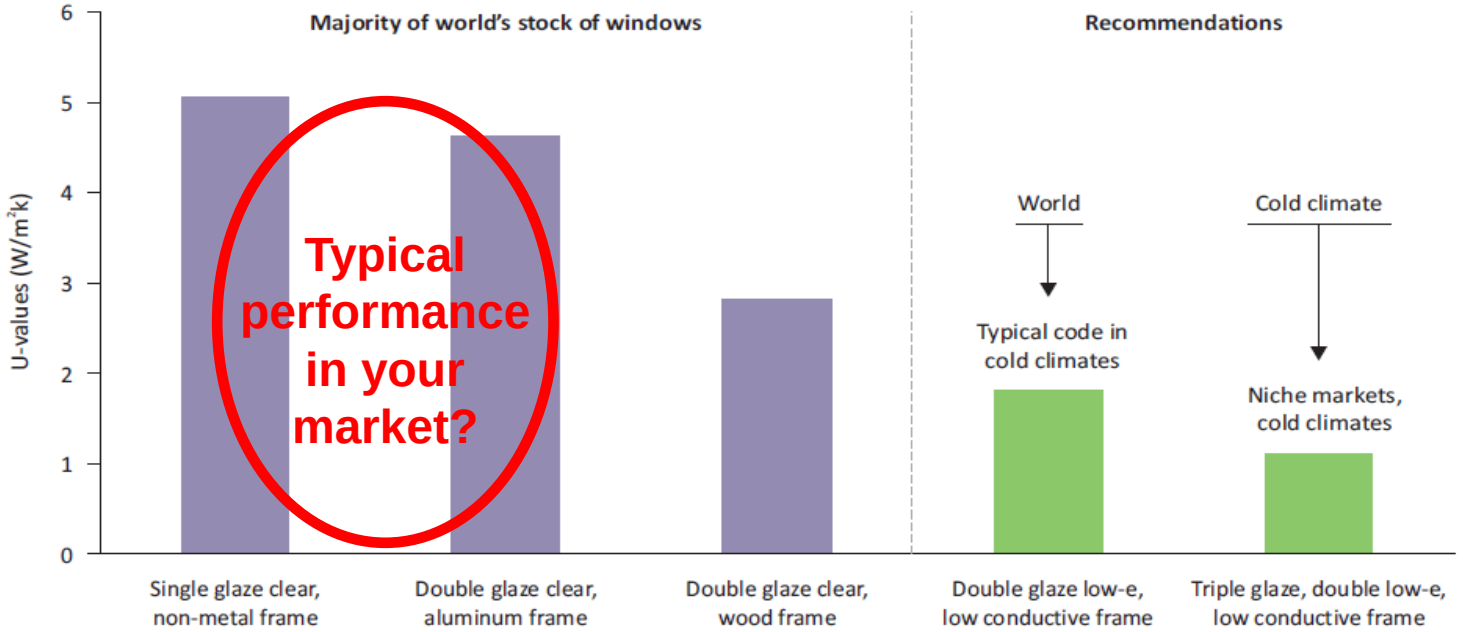
Building envelope technology: windows



Single glazing windows are highly inefficient in all climate types.

Source: IEA Energy Efficiency Training Week

Building envelope technology: window market



The majority of the world's installed windows can be significantly improved and more work is needed to ensure that new sales meet more stringent performance criteria.

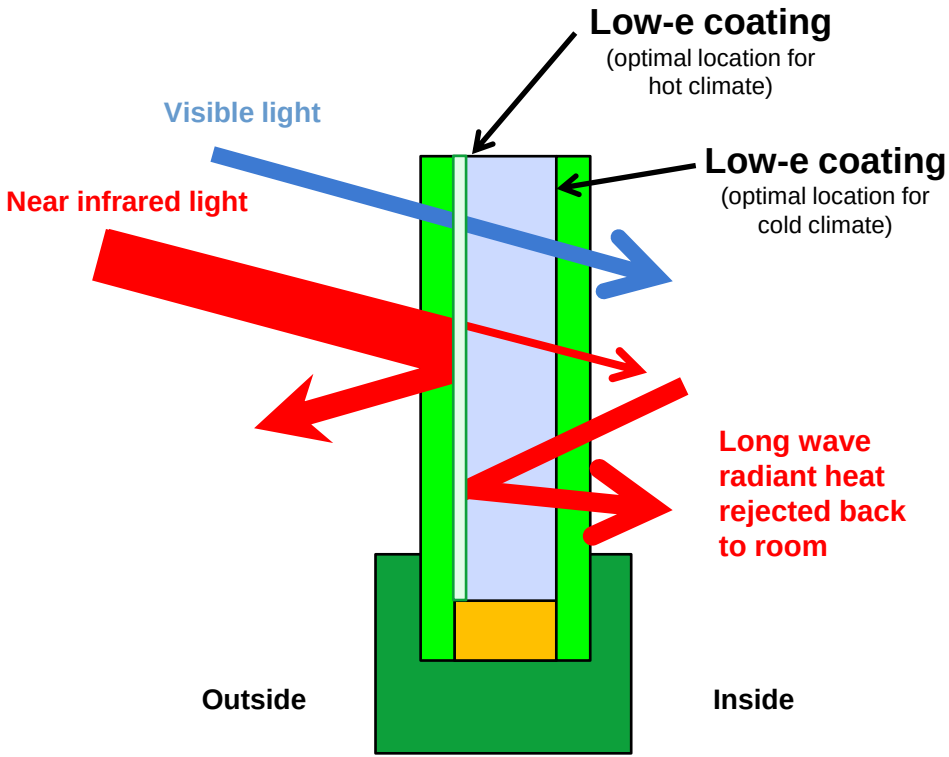
Building envelope technology: window coatings

Low emissivity films

Transparent metal coatings that reflect radiant heat (long wave radiation) combined with solar selective coatings that reflect visible light and near-infrared light (heat we feel)

Typical savings of 30% to 40%

Commonly applied to new windows, but can also be installed in retrofit low-e storm panels and low-e window films when window replacement is not possible



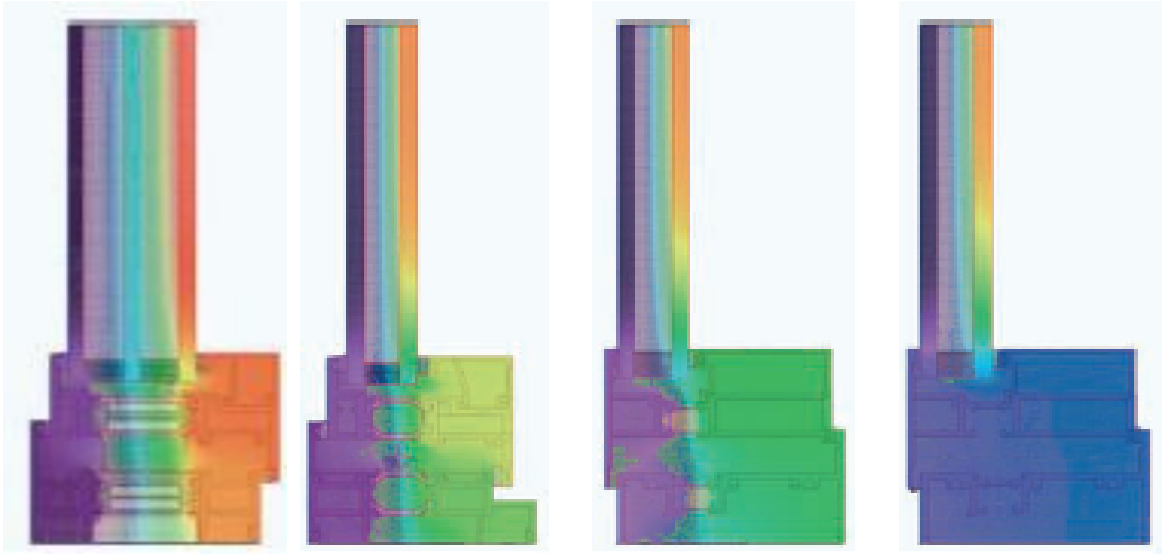
Low-e coatings can be a low cost and highly efficient addition to windows.
Is double glazing or low-e glass common in your country?

Source: IEA Energy Efficiency Training Week

Building envelope technology: window frames

Window low conductive frames

Outside



Inside

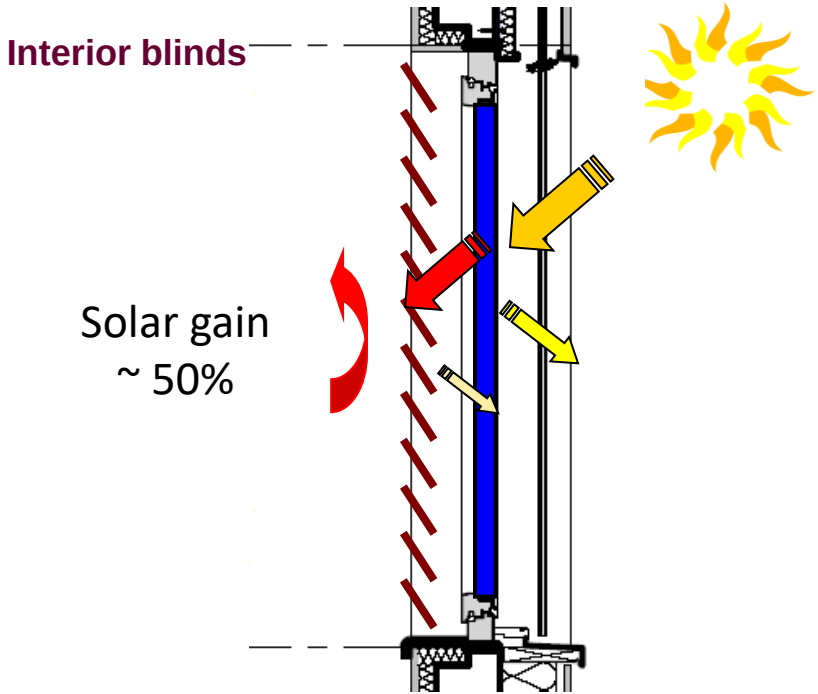
Advanced, warm interior in winter

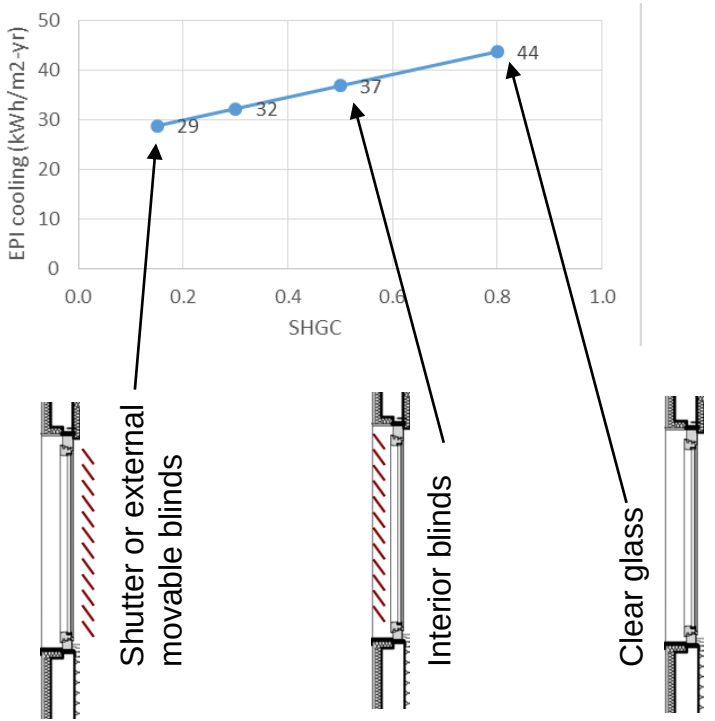
Improving performance

Old, no thermal break, cold interior in winter

Source: Alcoa/Kawneer

Building envelope technology: internal vs. external shading

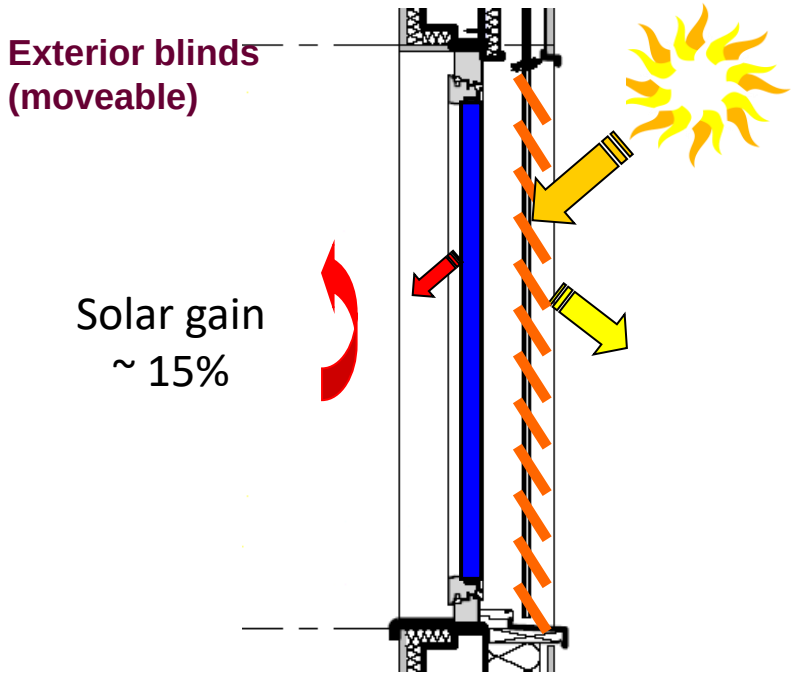


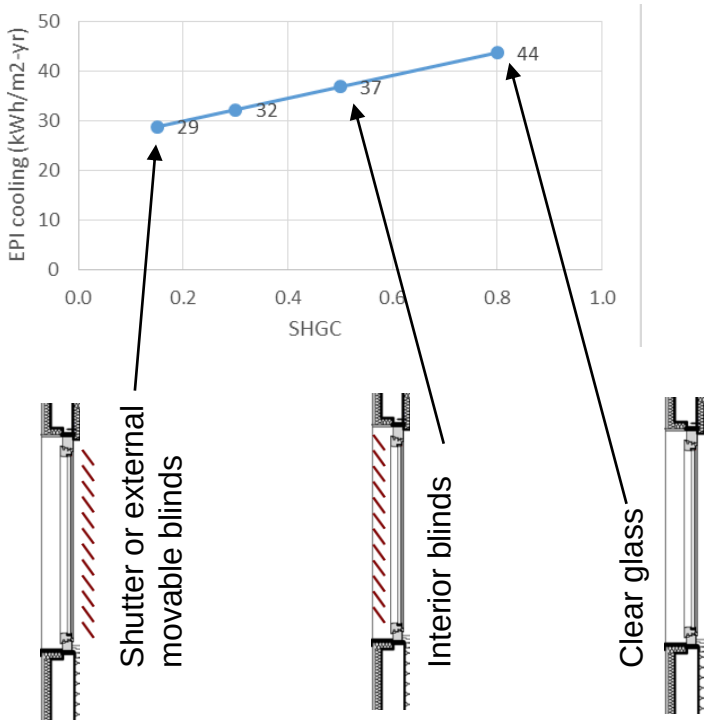


Internal shades still allow the solar heat gain to enter the building.

Source: BEEP India

Building envelope technology: internal vs. external shading





External shades keep out much more heat than internal shades.

Source: BEEP India

Building equipment and systems

Space heating

Water heating

Space cooling

Ventilation

Lighting

Controls

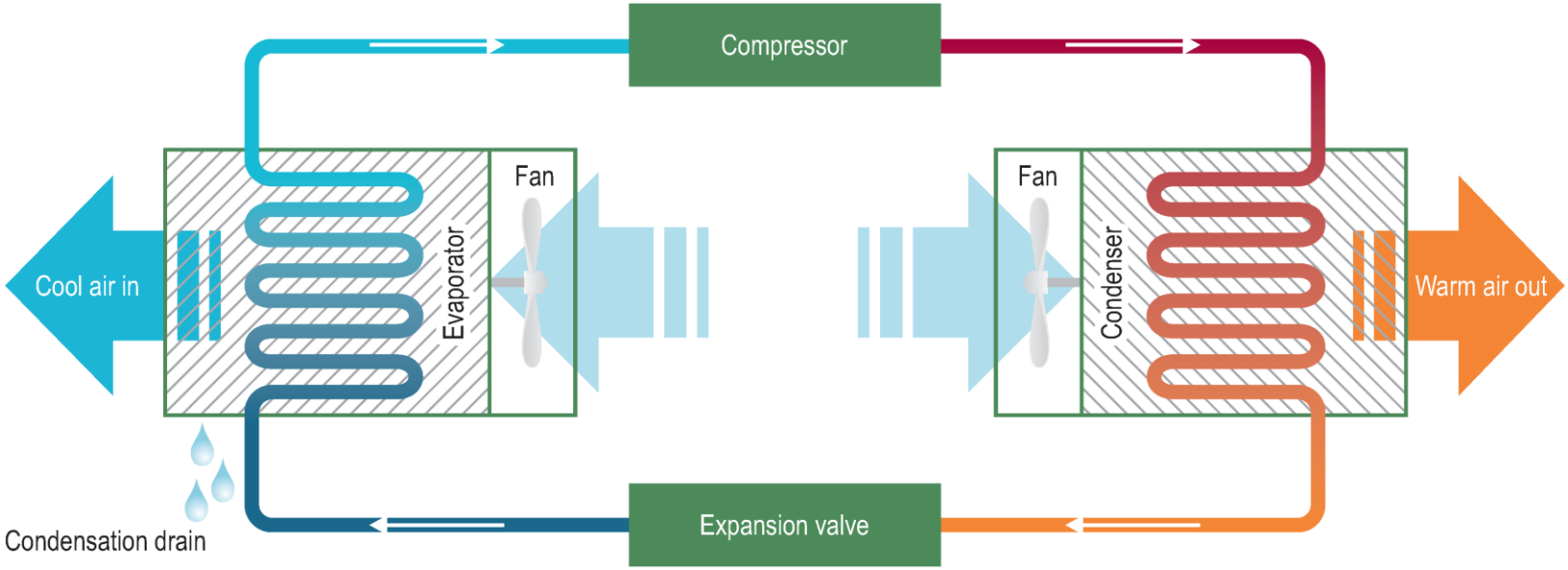
Innovative technologies

Building equipment and systems: space and water heating

Shifting to more efficient and renewable integrated technologies.

Sources: wood-furnaces.net, asapburnerservice.com, altal.eu, redinfratech.com

Building equipment and systems: cooling



ACs use a refrigerant and a vapour compression cycle to move heat from one space to another, providing comfort and the sensation of fresh, cool air

Source: IEA The Future of Cooling 2018

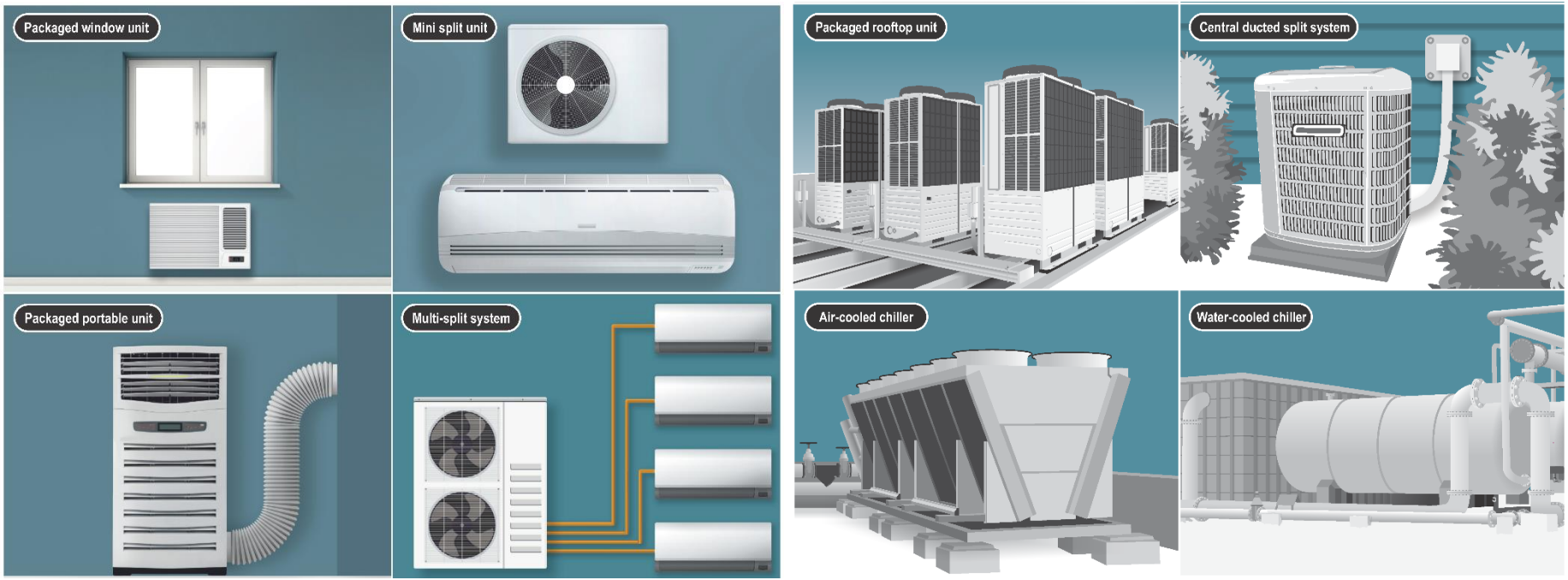
Building equipment and systems: cooling equipment types

Packaged ACs	• Window air conditioners • Portable units • Packaged rooftop units
Split System ACs	• Chilled water systems • Rooftop and air handling units • Variable Refrigerant Flow (VRF)
Chillers	• Water cooled chillers • Air cooled chillers
Other systems	• Evaporative coolers • Absorption chillers • Ground source or geothermal

What makes an Energy Efficient system?

- ✓ Reduced energy used for same output of cooling
  - ✓ High COP or EER
  - ✓ High CSPF or SEER
- ✓ Correctly sized
- ✓ Ability to reduce output according to load
- ✓ Ability to integrate smart controls

Building equipment and systems: cooling equipment



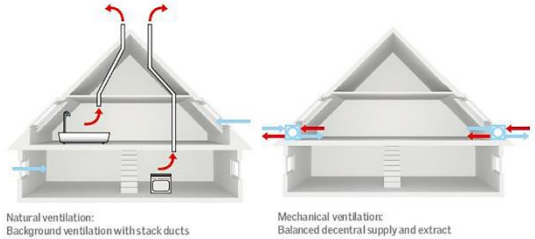
Building equipment and systems: cooling equipment

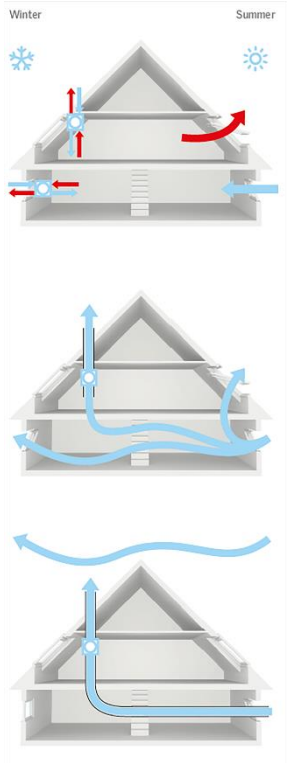
Building equipment and systems: cooling equipment features

Flexibility	• Variable speed compressors, “inverter”, variable speed fans, variable flow refrigerant.
Storage	• Ice or chilled water • For peak demand control
Thermal recovery	• Heat and/or enthalpy exchangers
Smart controls	• Pre-cooling, free-cooling • Set point adjustment and demand-side management • Integration with other building systems

Building equipment and systems: ventilation

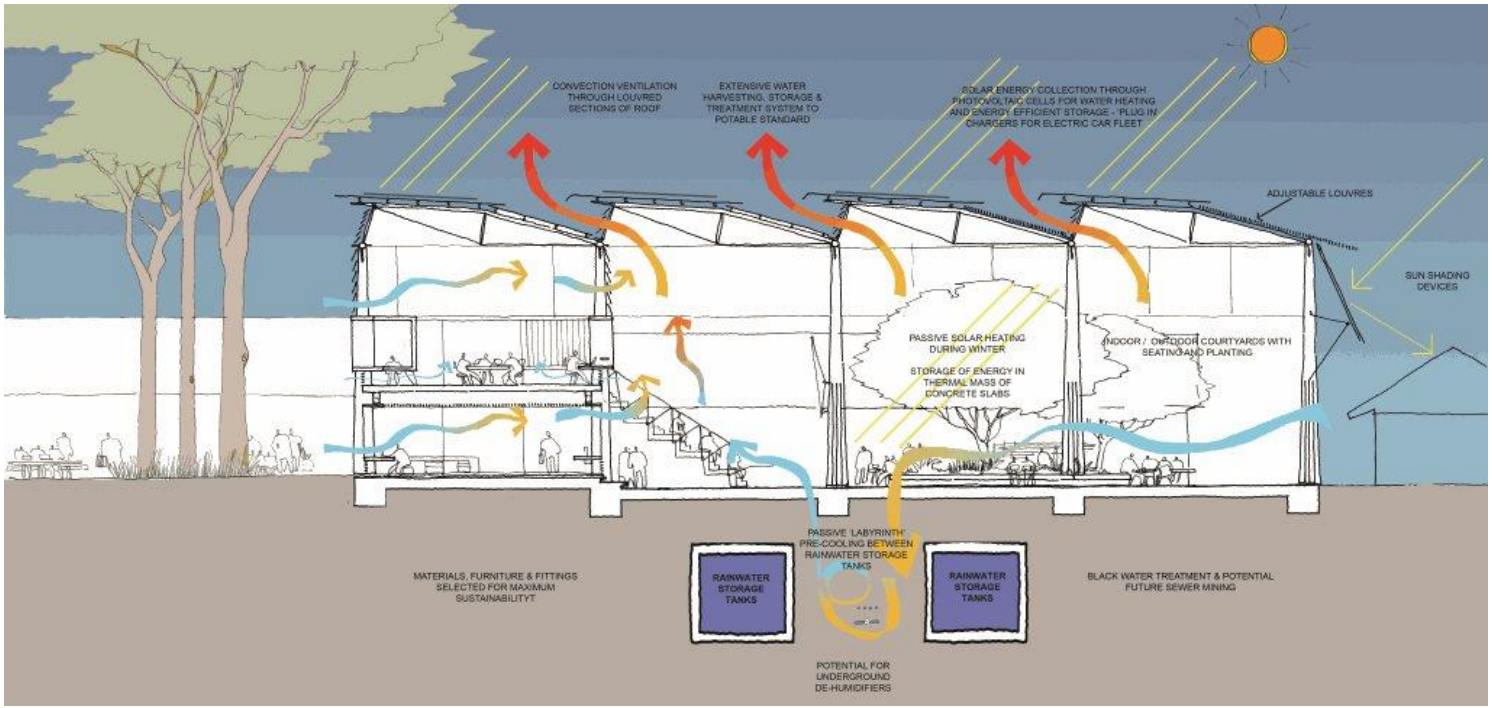
- Mechanical
  - Fan exhaust or supply
  - Heat/energy recovery ventilation
- Natural
  - Cross ventilation
    - via wind
    - via temperature
  - Stack ventilation
    - via air stratification
    - via temperature induced exhaust
- Hybrid, or mixed-mode





Source: Velux

Building equipment and systems: hybrid ventilation



Natural ventilation (stack/stratification) in combination with mechanical ventilation to enable comfort

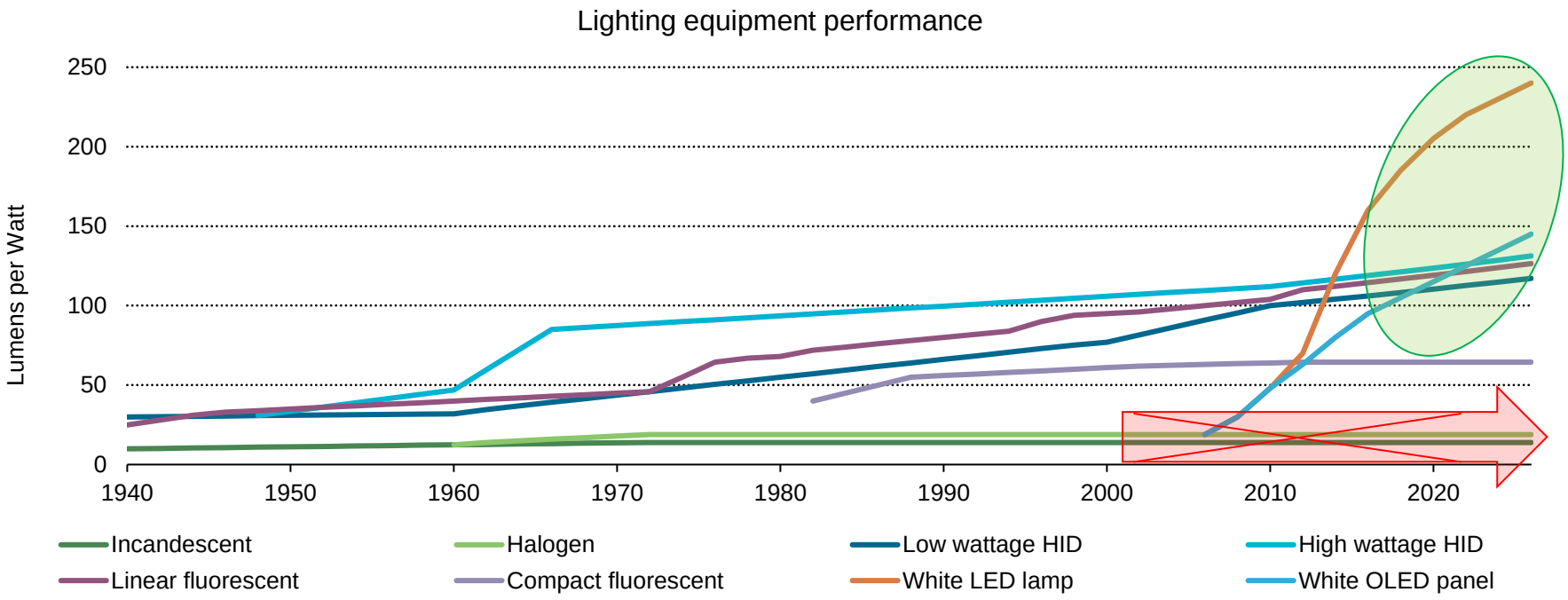
Source: ESD Diagram: WMK Architecture.

Building equipment and systems: lighting

Shifting to high performance technologies

Source: premierlightbulbs.com

Building equipment and systems: lighting



Technology performance improvements continue to drive energy efficiency, but energy policy needs to keep up with the technology…

Source: IEA ETP

Building equipment and systems: controls

Controls can be used to regulate and/or automate the operation of building systems to optimise performance.

Increasing level of complexity

Simple timer or presence detection for on/off operation

- Lighting circuits
- Small power circuits
- HVAC systems

Ability to adjust according to occupancy and/or external conditions

- Daylight dimming of lighting circuits
- Variable speed drives on central HVAC components.
- Controlled blinds and windows in response to solar radiation and/or outdoor temperature.

Centralised Building Management Systems (BMS)

- Remote control and programming of building systems.
- Can be combined with data collection and energy management.

New generation controls: remote thermostats, load shifting for demand side management.

Improving building system operations

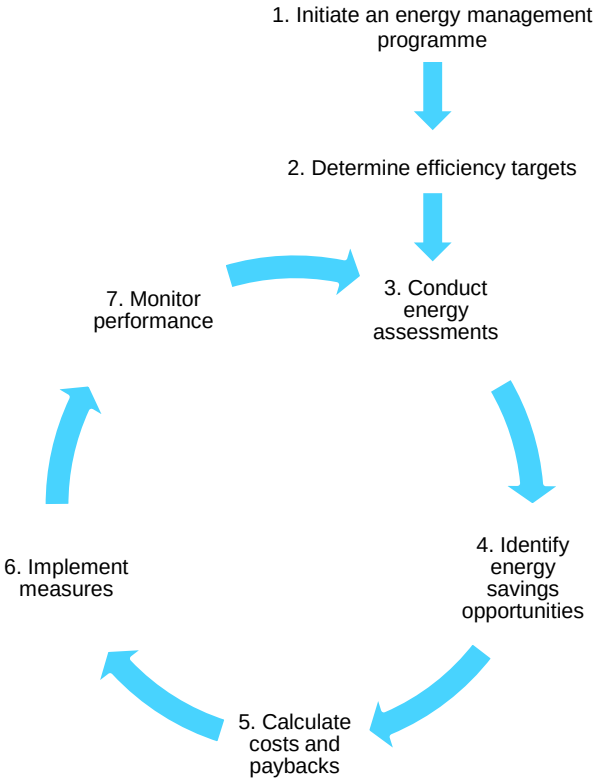
What operations are we talking about?

- Building operations consists of the activities necessary to **operate**, **maintain**, and **manage** buildings. This includes maintaining the HVAC systems, plumbing, electrical, and building system configuration.
- Operation and management activities, methods, and approaches should **enable energy savings** while maintaining or enhancing **indoor environmental quality** and **equipment reliability**.
- Good operation and management practices will lead to the efficient operation of buildings. Can also lead to increased **productivity** of occupants, and a **longer lifetime** of the building and its components.

Asys smart management, 2019

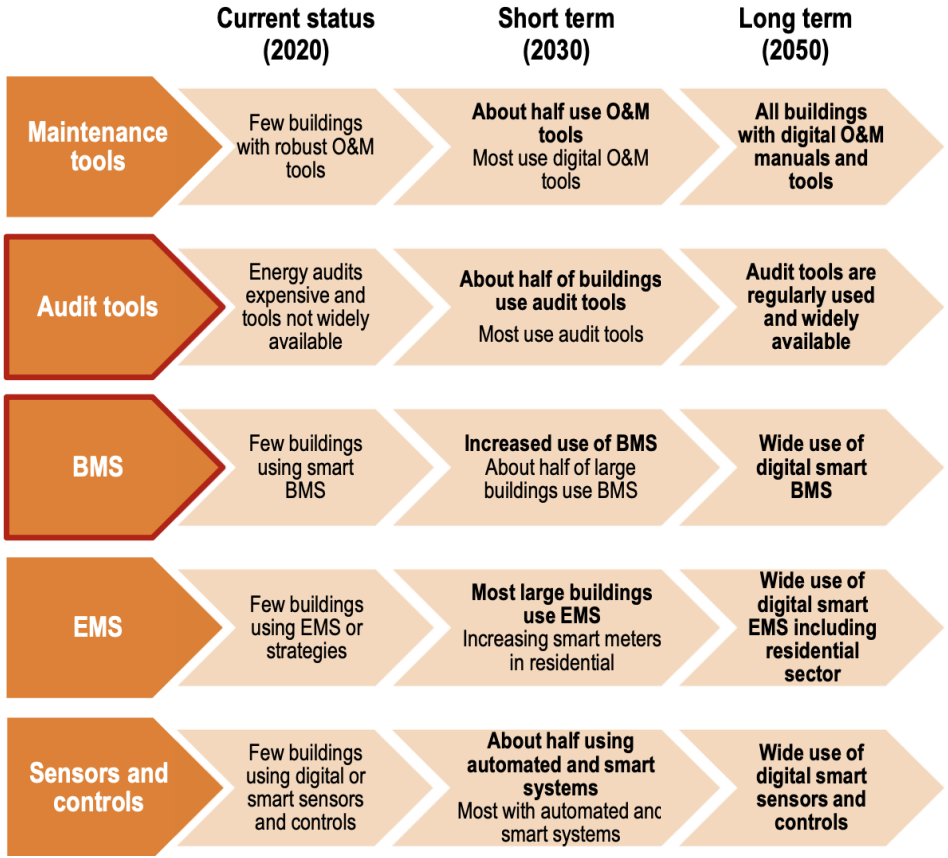
Energy management in buildings: 7 key steps

- Implement energy efficiency measures
  - All cost effective measures that have benefit to owners and occupants
- Monitor performance
  - Evaluation of energy efficiency
  - Data collection / sensors / energy management systems
- Continuous improvement
  - Use the information collected to continue the process again back at step 3 to identify more energy savings opportunities for continuous improvement

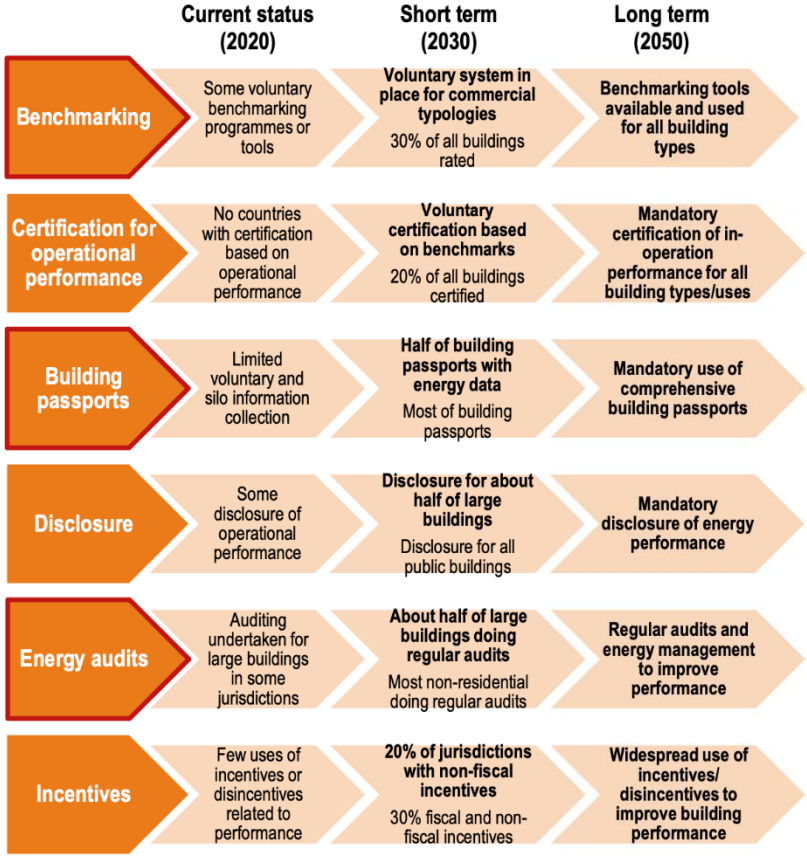


Adapted from: India Bureau of Energy Efficiency, Energy Management in your School, Hospital, Hotel.

Path to net zero emission buildings



Path to net zero emission buildings



Session Activity

International Energy Agency

Activity – Energy efficiency building technologies

For each of the following elements, describe	Current practice	Best available practice	Net zero practice
Cooling technology			
Hot water heating			
Ventilation			

Technology game

International Energy Agency

Energy efficiency building technologies game is…

Charades!

- Each group of 3-4 people will be given an image of an energy technology, one at a time.
- **DO NOT SHOW ANYONE ELSE THE PICTURE**
- In 3 minutes, come up with a way to ‘act out’ the energy technology - without speaking.
- Each group then gets to write down their guess.
- The group with the most correct guesses gets a prize.

International Energy Agency

Energy Efficiency Training Week

Africa Energy Efficiency Policy in Emerging Economies Training Week

Building Energy Performance Certificates in South Africa and Related Policies: Design to Implementation

By

Ms. Nqobile Ngcobo
EPC Programme Lead

South African National Energy Development Institute

Nairobi

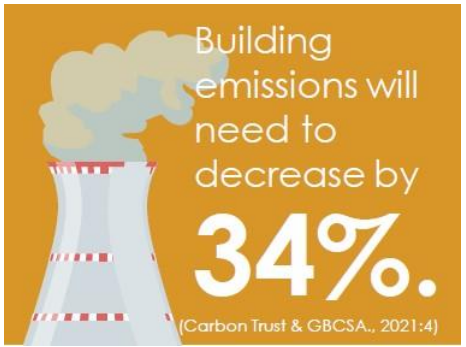
18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

OUTLINE

- Why Focus on the Buildings Sector?
- Energy Efficiency in the South African Context
- Timeline for Energy Efficiency in South Africa
- Insight on the Buildings Sector – NEES (Post 2015)
- Principle of Energy Performance Certificates
- Implementation of EPCs - Regulation
- 6-Step Process for Implementation
- The Online NBEPR
- EPCs in South African Landscape - Status
- A Solid Foundation to Buildings Sector Improvements
- Long Term Strategy – EPCs, The Beginning
- Key Takeaways

Why Focus on the Buildings Sector?



Source: EPC Guideline,2021

South Africa is committed to GHG emissions reduction as well as promoting economic growth & development

Our electricity generation is ppredominantly coal based and hence emissions intensive

Buildings identified as high energy consumers at end use and hold great EE potential

Energy Efficiency in the South African Context

International Protocols

UN Sustainability Developmental Goals

Department of Mineral Resources and Energy's Strategy

SANEDI's Strategy

Local Government

Women & Youth Development

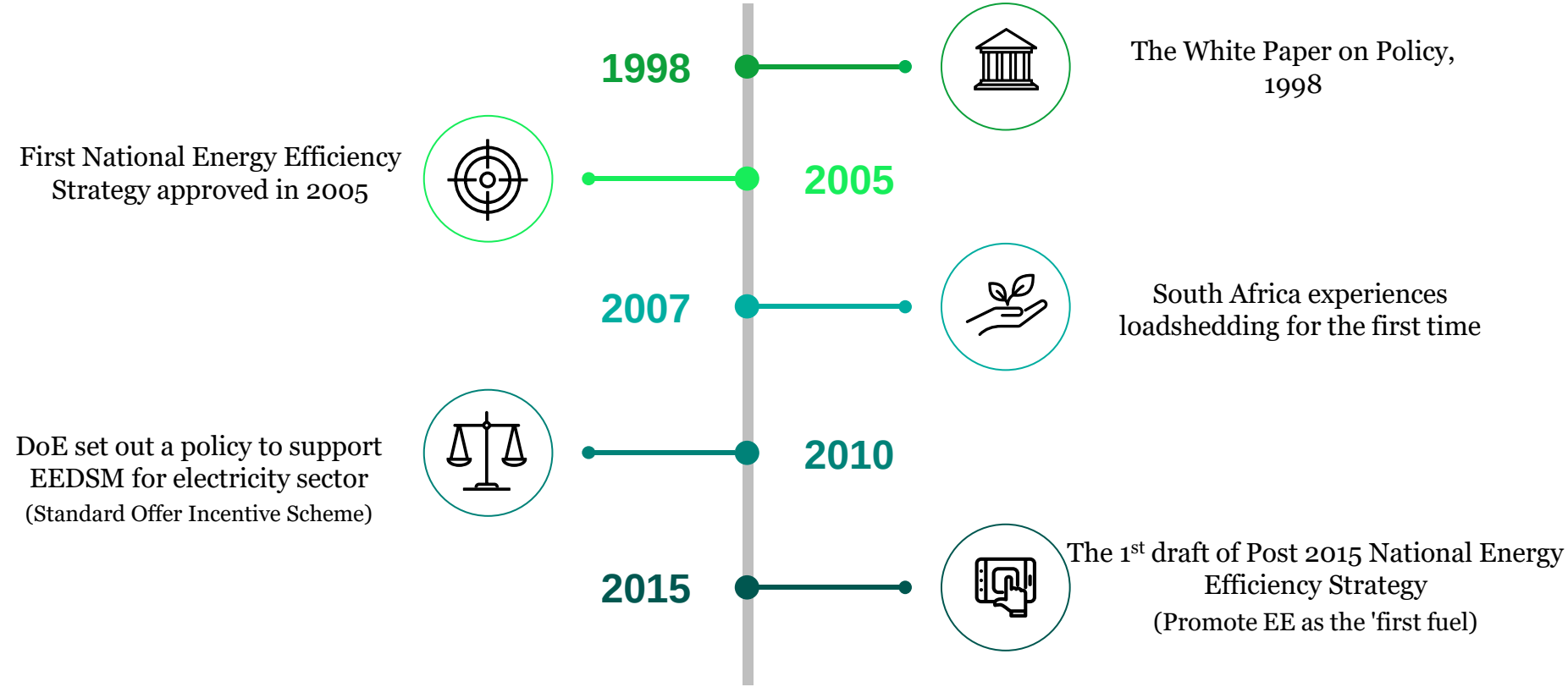
Other National Departments (NT/DFFE/dtic/DPWi)

Medium Term Strategic Framework

National Energy Efficiency Strategy and the Implementation of Interventions

- Energy security of supply & address supply constraints
- Environmentally friendly, health & wellbeing and lowering GHG emissions
- Industrial productivity & competitiveness to other markets
- Enabling investments that accelerate economic & inclusive growth
- Increase asset value and useful life of assets
- Increase financial benefits for public budgets, reduce utility bills & operational cost for companies

Timeline for Energy Efficiency in South Africa



Insight on the Buildings Sector – NEES (Post 2015)

Goals

- **Accelerate** the current rate of **improvement in the energy consumption per square metre** in buildings occupied by the **public sector** at the national, provincial and municipal levels
- **Accelerate** the current **rate of improvement in the energy consumption per square metre** of lettable/ inhabited floor space in the **commercial sector**

Targets

Targets for publicly owned and commercial buildings stipulate a **50% and 37% specific energy consumption reduction respectively**, must be met by the two sectors in 2030 relative to the 2015 baseline.

EPCs is an initiative by government to meet these targets

Principle of Energy Performance Certificates

Energy Performance Certificates are a key instrument in promoting energy efficiency in buildings

The core principle of EPCs lies in the standardised assessment of buildings (SANS 1544:2014 in the South African context)

Purpose of EPCs

- An EPC is an indication of how much energy is being used to operate a building based on certain parameters.
- Improve energy performance of existing building stock (target of over 250k buildings in South Africa).
- The post 2015 NEES target for reduction in energy consumption - public buildings 50% and commercial buildings 37% by 2030.

Core Principles

- Assessments are conducted using SANS 1544:2014, thus using a standardised approach
- Usage of an energy efficiency rating, immediately indicating the efficiency/inefficiency of a building
- Triggering recommendations for improvements of a building's efficiency
- Providing transparency and informed decisions with regards to property transactions

Implementation of EPCs - Regulation

Regulation

Section 19(1)(b) of the National Energy Act of 1998 (Act No. 34 of 2008) and SANS 1544:2014

Mandatory display of Energy Performance Certificates (EPC)

Issued by a SANAS accredited body prior to 31 July 2024, thereafter by a registered professional

Application

Private buildings with a net floor area greater than 2000 m² and public buildings with a net floor area greater than 1000 m²

Occupancy classes, **A1** – Entertainment & Public Assembly; **A2**- Theatrical & Indoor Sport; **A3** – Places of Instruction & **G1** – Offices

Two years and without major renovations within the last two years

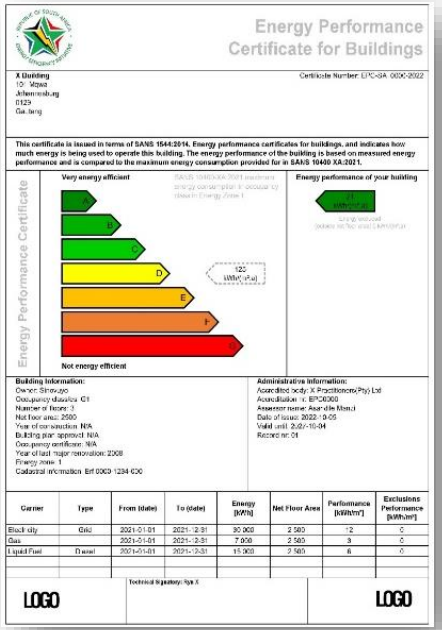
Parameters

Failure to comply will be met by prosecution with fines of up to 5 million Rand and imprisonment for up to 5 years

Deadline for compulsory registration of type and size of buildings till 2 Aug 2024

Deadline to compliance 7 Dec 2025

Renewal of EPC is every 5 years


Energy Performance Certificate for Buildings

X Building
10 Mzad
Johannesburg
0129
Gauteng

Certificate Number: EPC-GA 0000-2022

This certificate is issued in terms of SANS 1544:2014. Energy performance certificates for buildings, and indicates how much energy is being used to operate this building. The energy performance of the building is based on measured energy performance and is compared to the maximum energy consumption provided for in SANS 10400 XA:2021.

Energy Performance Certificate

Very energy efficient

A
B
C
D
E
F

Not energy efficient

Energy performance of your building

Building information:
Owner: Sibusiso
Occupancy classes: G1
Number of floors: 3
Net floor area: 2500
Year of construction: N/A
Building plan approval: N/A
Occupancy certificate: N/A
Year of last major renovation: 2008
Energy zone: 1
Cadastral information: Erf 0000-1234-000

Administrative information:
Accredited body: X Practitioners (Pty) Ltd
Accreditation nr: EPC0000
Assessor name: Asandile Mbadi
Date of issue: 2022-10-05
Valid until: 2027-10-04
Record nr: 01

Carrier	Type	From (date)	To (date)	Energy (kWh)	Net Floor Area	Performance (kWh/m²)	Exclusions Performance (kWh/m²)
Electricity	Grid	2021-01-01	2021-12-31	90 000	2 500	12	0
Gas		2021-01-01	2021-12-31	7 000	2 500	3	0
Liquid Fuel	Diesel	2021-01-01	2021-12-31	15 000	2 500	6	0

Technical Signatory: Nya X

LOGO

LOGO

6-Step Process for Implementation

1. Building Registration

Compulsory registration of type and size of buildings for mandated buildings on NBEPR

2. EPA in Line SANS 1544:2014

Appoint expert to conduct assessment in line with SANS 1544:2014

3. The NBEPR & EPC Data

Upload all collected and analysed data onto the NBEPR for issue of certificate

4. Display and Submit EPC

Building owner must publicly display certificate at entrance of buildings and submit copy to SANEDI

5. DMRE Compliance Audits

DMRE to commission compliance audits

6. Renewal Reminders

Initial renewal reminders to be sent in Year 3 and final reminders in Year 4.

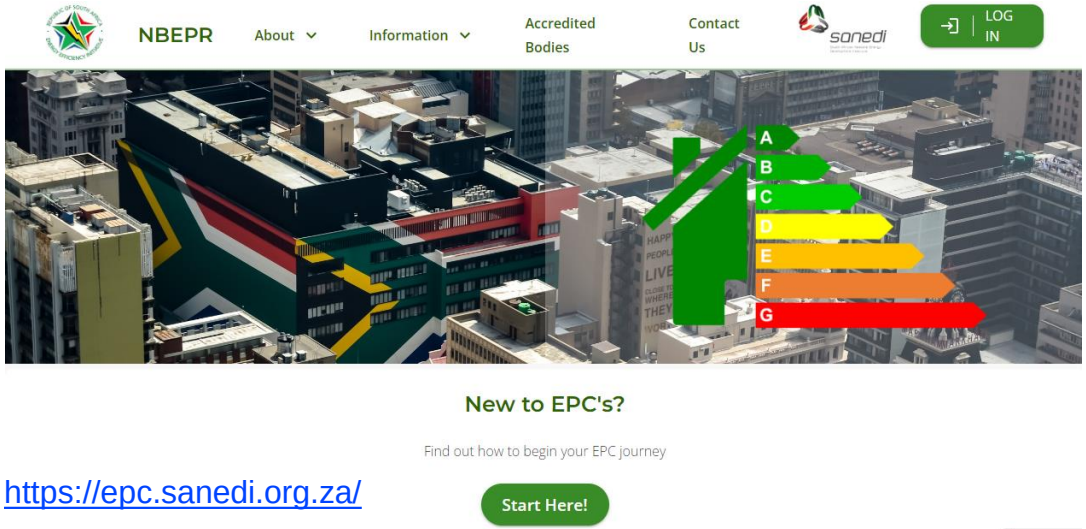
The Online NBEPR

Purpose

To respond to Regulatory requirements as mandated by the DMRE and to host and maintain a centralised data repository for building and EPC data nationally.

Focal Points

Credible Data	Building Stock	Compliance	Standardisation



https://epc.sanedi.org.za/

EPCs in South African Landscape - Status

Energy Performance Certificate DASHBOARD
12 March 2024

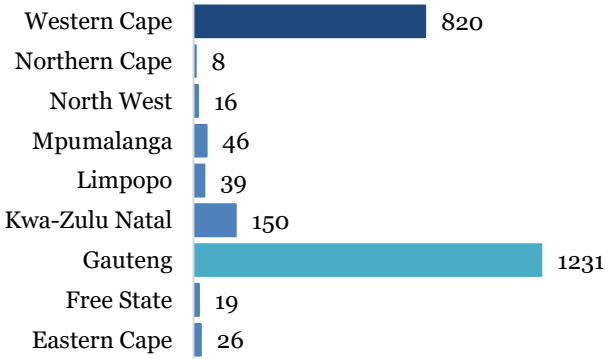
Registered Buildings
3491

EPCs Issued to Date
2355

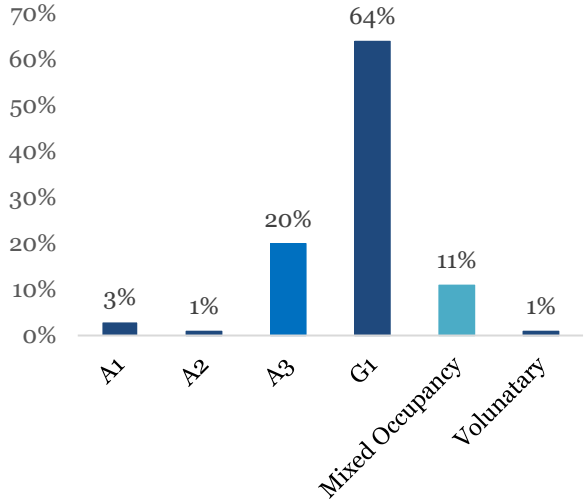
Submitted Certified EPCs
1854

Inspection Bodies
19

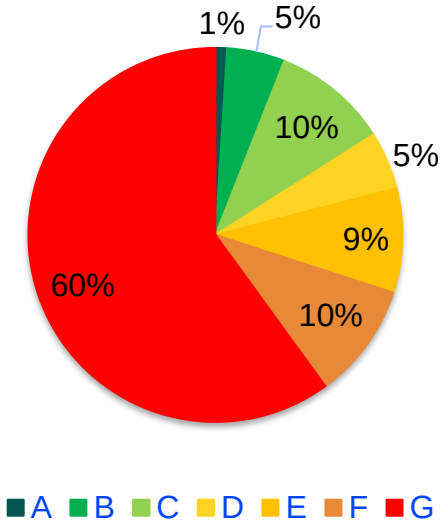
Provincial Footprint
EPCs issued per each province



Occupancy Class
Percentage per each occupancy class



Performance Scale
Percentage per grading



Consumption Baseline
3424 GWh

A Solid Foundation to Buildings Sector Improvements

Small-Scale Embedded Generation (SSEG)

Solar PV (Renewable Energy) that can meet the building's energy demand/consumption

Insulation

Reduces heat transfer during summer and prevents heat loss during winter

HVAC System

Smart/Centralised HVAC systems which must be used sparingly

LED Lights

Light Emitting Diodes (LEDs) replacing incandescent and fluorescenr light

Electrical Appliances

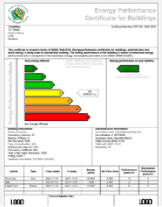
A+++ Electrical Appliances must be rated with an energy efficiency logo

Overhangs(Windows)

Reduces heat loss in winter and prevents heat gains in summer.

Smart Devices

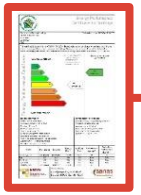
Introduces digitalisation in buildings which accelerates the promotion of energy efficiency



Energy Performance Certificate

Can be used as a foundation to approach sustainable buildings. EPC provide credible data and benchamrks which can be used for energy efficiency interventions and environmental sustainability.

Long Term Strategy – EPCs, The Beginning



PHASE 1: EPCs for Sustainable Buildings

1. Obtain EPC to understand building's energy consumption & benchmark energy use
2. Conduct further energy audits and receive recommendations
3. Set realistic targets & timelines for implementation of the recommendations
4. Create implementation plan

PHASE 2: Energy Efficiency Retrofits to Net Zero Carbon Ready

5. Provide training and awareness plans for the building occupants – behaviour change initiatives (conservation)
6. Lighting
7. Heating cooling & ventilation
8. Tenant Loads

Active design interventions

PHASE 3: Getting to Climate Mitigation

10. Installations of on-site renewables – solar
11. Off-site renewables
12. Carbon offsets

Source: Adapted from GBCSA (2021)

Key Takeaways

EPCs are tools

Used to determine energy consumption of buildings, thus allowing building owners and accounting officers to become aware and implement EE interventions using credible data.

Research & Development

SANEDI's hosting of the NBEPR will assist in further research and development around buildings in responding to legislation and ultimately, climate change.

Monitoring & Evaluation

The NBEPR will allow government track implementation progress, thus assisting government in setting attainable targets with regards to energy efficiency and GHG emissions reduction for the building sector.

Policy & Standards

EPCs credible data for policy and standard development towards energy efficient and sustainable buildings of the future.

International best practice

EPCs are an international best practice, Europe has had EPCs for several decades, regulating the construction and maintenance of sustainable buildings.

Socio-economic benefits

There are secondary benefits to EPCs, such as employment opportunities for qualified unemployed individuals, design regulation around objectives.

Key Stakeholders

Africa Energy Efficiency Policy in Emerging Economies Training Week

Buildings

Nairobi

18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

International Energy Agency

Energy Efficiency Training Week - Buildings - Day 2: 7. Energy efficiency policy package

Why do we need policies?

"What if we don't change at all ...
and something magical just happens?"

Why do we need policies? Addressing the barriers

Source: Institute for Building Efficiency, WRI

Policy Package for Buildings

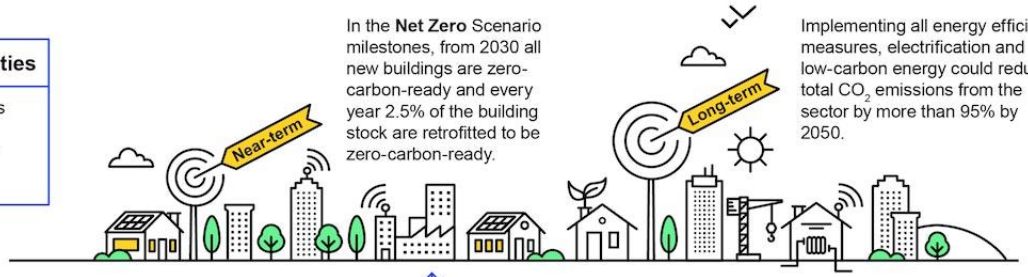
Buildings Energy Efficiency Policy Package

Immediate opportunities

Replacing fossil fuel boilers with high efficiency heat pumps can reduce energy use by up to 75%.

In the **Net Zero** Scenario milestones, from 2030 all new buildings are zero-carbon-ready and every year 2.5% of the building stock are retrofitted to be zero-carbon-ready.

Implementing all energy efficient measures, electrification and low-carbon energy could reduce total CO_2 emissions from the sector by more than 95% by 2050.



REGULATION

- **Targets for energy efficiency** in buildings, including for renovation rates, fosters market growth and facilitates long-term investment decisions.
- **Building energy codes** for new buildings and retrofits are essential to accelerate the transition to zero-carbon-ready buildings.
- **Minimum energy efficiency requirements** for renovation help guarantee performance and accelerate the process of renovation through instruments such as the standardisation of services.
- **Regulations** ensure that buildings can become "demand response ready" to enable future flexibility.

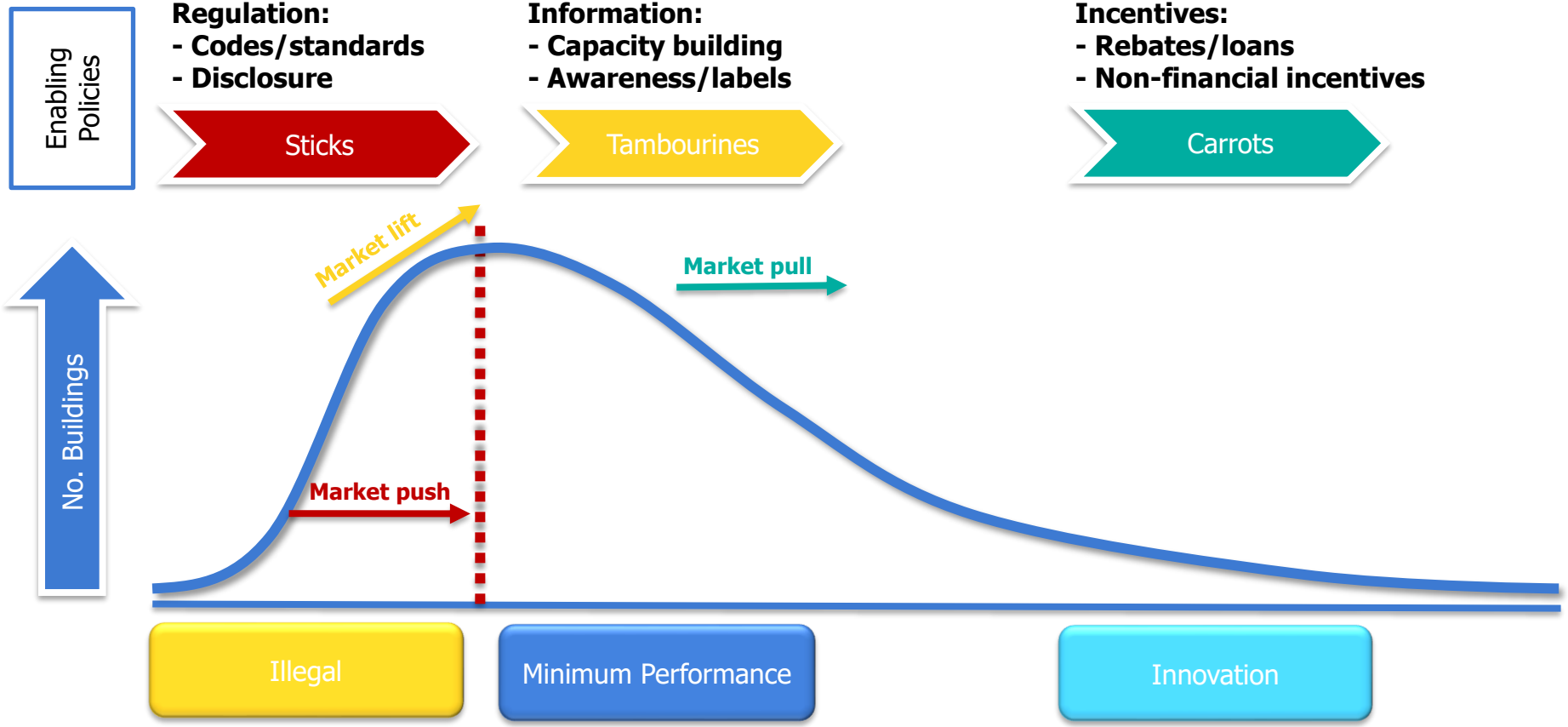
INFORMATION

- **Information on building performance** allows consumers to identify the most efficient options when buying or renovating buildings. Examples include energy performance certificates, disclosure programmes, one-stop shops for upgrades and renovation passports.
- **Smart interactive technologies** can show real-time energy performance and help adjust occupants' behaviour.
- **Training and education programmes** for building sector workers are important to ensure a suitably skilled work force.
- **Public awareness campaigns** designed to include behavioural insights encourage low-cost actions, such as thermostat adjustment.

INCENTIVES

- **Financial incentives** such as green mortgages, energy performance-based preferential loans and tax rebates and grants can motivate consumers and developers to increase investment in energy efficient solutions.
- **Expedited administrative procedures**, including accelerated permitting, targeted at high performing new build or retrofit projects, encourage the implementation of energy efficient measures.
- **Award and recognition programmes** encourage the development of highly energy efficient buildings.

Why do we need policies? Market transformation



Source: adapted from GBPN

Policy package for buildings

	New buildings	Existing buildings
Incentives	Green mortgages, performance-based preferential loans, tax rebates for efficient equipment and low-carbon materials; non-financial incentives: awards, expedited development review and approvals, fee reductions, performance-based density bonuses and development allowances	Financial incentives and financing for deep renovation, performance-based preferential loans and low-carbon materials; non-financial incentives: expedited administrative procedures and approvals, fee reductions, performance-based awards
Information	Energy performance certificates, labelling, energy performance disclosure at the point of occupancy, smart metering, smart heating and cooling, training and education programs for construction professionals	Energy performance certificates, labelling, energy performance disclosure at the point of lease, smart metering, smart heating and cooling, training and education programs for construction professionals, one-stop shops
Regulations	Building energy codes with minimum requirements for buildings energy performance, electrification readiness, low-carbon materials and integration of on-site renewables with compliance tied to building and occupancy permits	Minimum requirements for buildings energy performance, low-carbon materials and integration of on-site renewables to be achieved after renovation with on-site compliance checks

Enabling institutional framework and governance

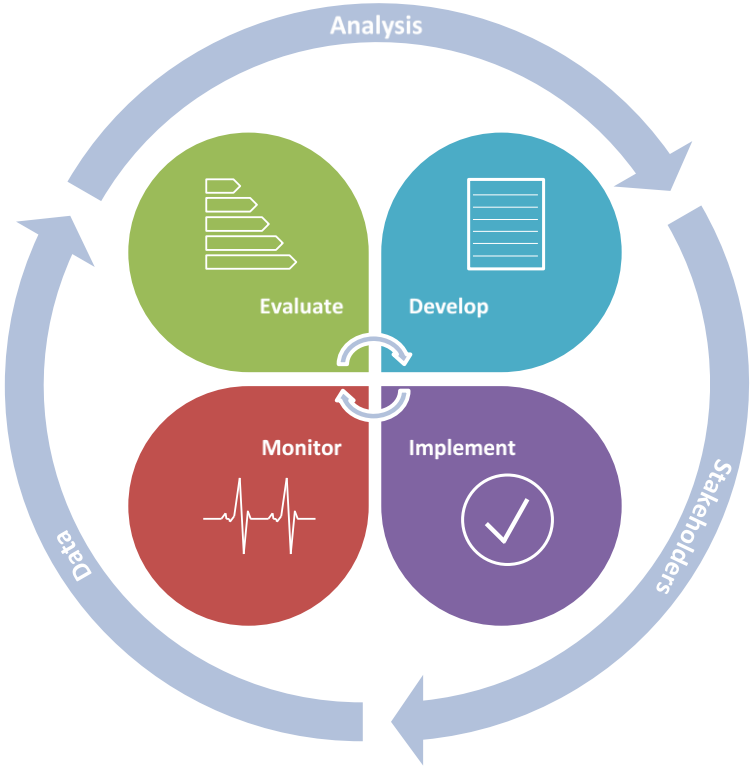
Long-term plans
targets, plans, strategies, voluntary agreements, monitoring and verification schemes

Capacity
Institutions, agencies, centres of excellence, certification of energy auditors and managers, international collaboration

Financing
reflective energy pricing, EE obligations, utilities policies, budgetary policies, public and private finance, funding for clean energy R&D

Digitalisation
Demand-side management, smart grids, smart meters rollout, grid interconnection rules, distributed energy resources management

The policy implementation cycle



Key stakeholders in the policy process include:

- ✓national and sub-national governments;
- ✓product manufacturers,
- ✓suppliers and installers;
- ✓building designers,
- ✓constructors, owners and operators;
- ✓financial lenders and guarantors;
- ✓data collectors, evaluators and statisticians;
- ✓and sustainability researchers, advocates and advisors.

Need a plan of goals and indicators to measure progress

Targets

Target setting: definition and characteristics

- **Targets:** the desired level of performance you want to see, as measured by indicators, that represents success at achieving your outcome.

- **Stretch Target:** challenging but realistic target should be able to reach with some effort

- **Specific:** what you plan to achieve is clear
- **Measurable:** there is a way to determine whether or not you have achieved it
- **Attainable**
- **Relevant**
- **Timeframe** is specified

Target setting: the process

Things to consider

- **Timeline:** Be clear about how long you need to achieve your target. Will you need to set intermediary targets?
- **Scenario:** Conditions will be changing over the course of the policy development cycle and this will be important for setting the recent trends and baselines in the preceding years
- **Possible Target:** Set the target as it relates to change you are focused on achieving and by what end point (e.g. X% of appliance sales achieving best available technology (BAT) by 2025)
- **Resources:** Do you have the necessary resources needed (funding, staff, processes, buy-in, etc.) to achieve the target?
- **How can it be achieved?** Can it be achieved by incentives, regulations, standards or certificates, more resources, improving a process, an investment in technology?

Regulations and Standards

Mandatory regulation

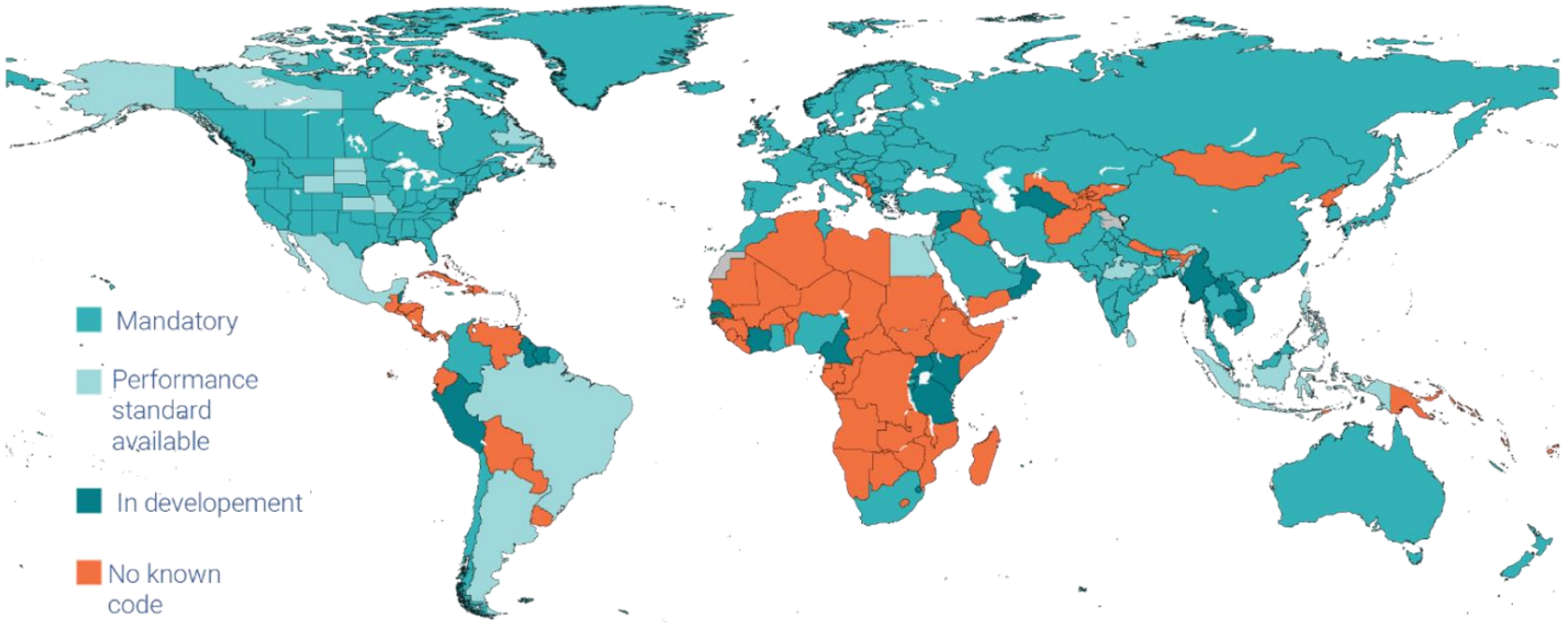
- **Codes:** regulation for energy efficiency and sustainability for a whole building.
- **Standards:** regulation for individual products or services, often referenced within a building code for individual building components.
- **Mandatory disclosure:** regulation that requires organisations or individuals to report or disclose how their building is performing, such as disclosing the energy performance certificate or energy usage.

Obligations

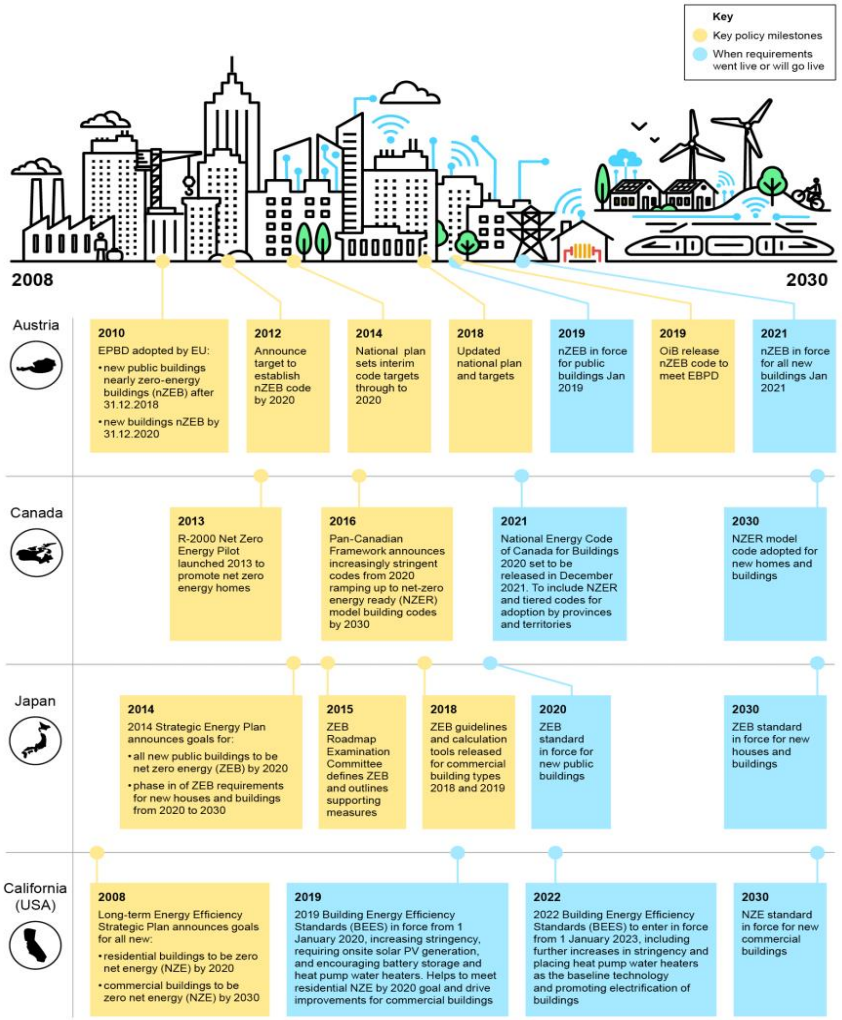
- **Utility obligations:** rules for regulated utilities that enable increasing investment in energy efficiency and passing the costs system-wide in the energy prices
- **Public procurement:** rules for government organisations to purchase products and services that meet certain criteria, such as energy performance or certification.

What can drive potential: policies

REGULATION | INFORMATION | INCENTIVES



Total number of adopted mandatory national building energy codes for residential and non-residential buildings were 81 and 77, respectively. 17 national level building energy codes are in development as of 2023



Urgency for Building Energy Codes development

It could take from 6 to 22 years from the announcement of net zero goal for buildings to development and implementation of the relevant building energy code

To develop a zero carbon ready building code that comes into force by 2030 – and the necessary supporting policies, tools and capacity building measures – a one- to three-year window currently exists

Source: IEA Energy Efficiency Market Report 2021

Building energy code types

Prescriptive codes

Specify requirements for key elements such as wall and ceiling insulation, window and doors, roofs, foundations, heating, ventilation air-conditioning, equipment efficiency, water heating, lighting fixtures, and controls.
Compliance with these codes is commonly assessed by checking the list of prescribed requirement

Simple trade-off codes

Allow for trade-offs between similar building components.
For example, less efficient insulation for more efficient windows in the building envelope

Performance codes

Specify a minimum required level of energy consumption or intensity for the whole building. They require energy modelling to be conducted at design stage.
Compliance is commonly checked by comparing the modelled energy performance of the design with a reference building of the same type

Outcome-based codes

Demonstration of performance during the operation of buildings.
Compliance is typically possible through energy performance certificates or with energy disclosure policies

For more information see IEA EE in Buildings online course

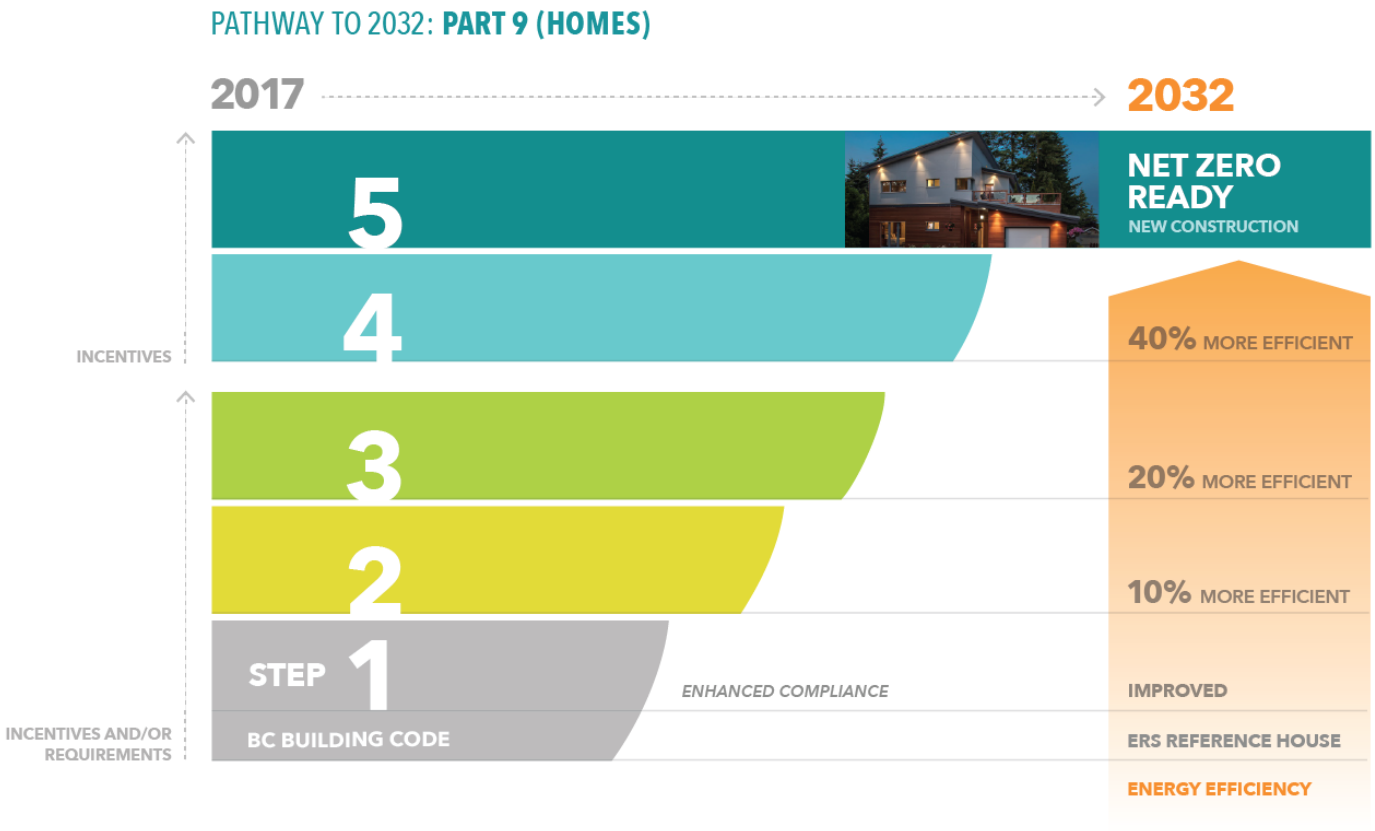
Model code: a code document that is designed to be copied and adopted for implementation by multiple jurisdictions.

- To enable increased consistency across multiple jurisdictions
- To simplify the code adoption and implementation process

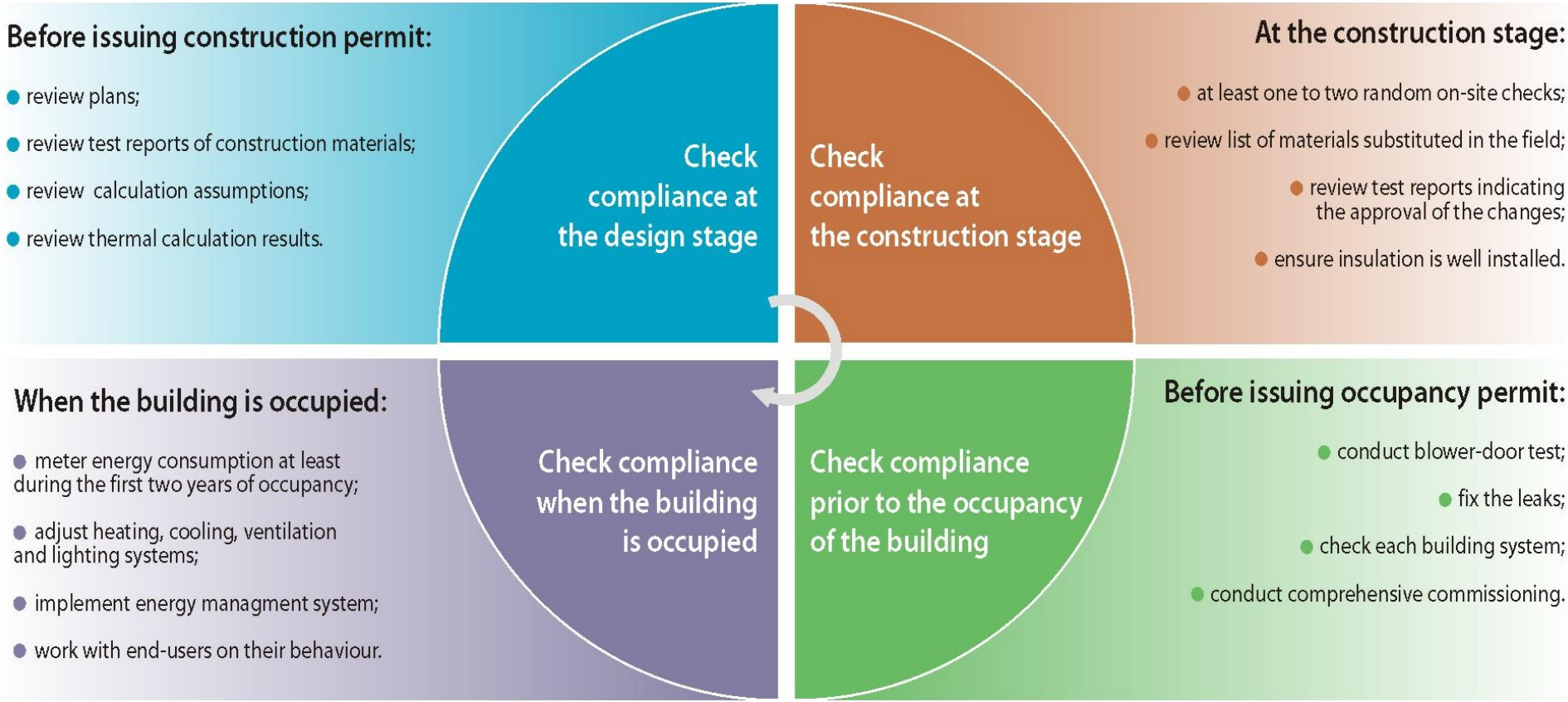
Regulation: a code becomes a regulation when it is legally adopted for implementation by a jurisdiction.

- A legal regulation that has been notified or adopted by a government
- Binding requirements that are able to be enforced by the government

What is step code?

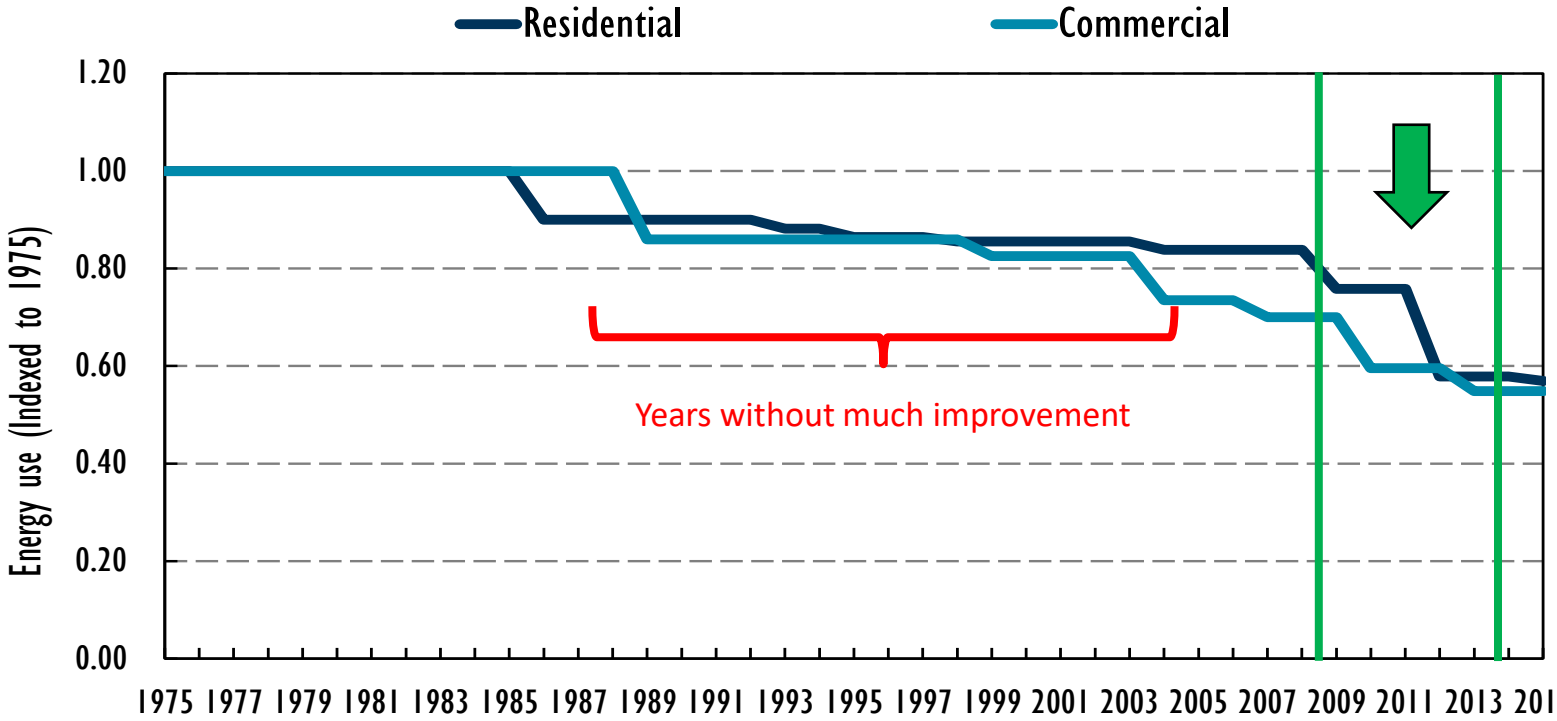


Building energy codes: implementation



Building energy code impact: United States

2007 Target: **resulted in 32% improvement** over two code cycles. More energy savings than any period since 1975.

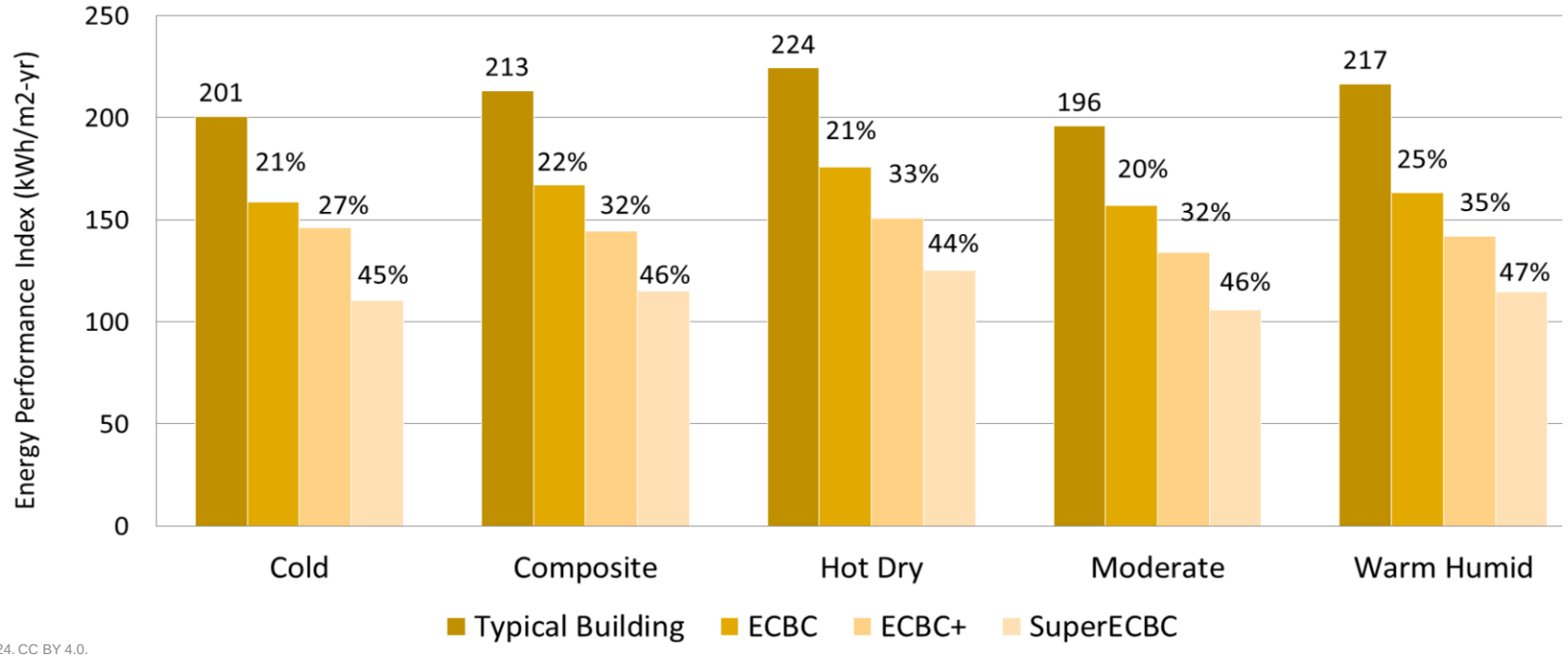


Source: US DOE and IEA Energy Efficiency Market Report

Building energy code impact: India

ECBC 2017 sets three Tiers of Building Energy Performance:

- ECBC = 25% less energy than typical building;
- ECBC+ = 35% less energy than typical building;
- SuperECBC = 50% less energy than typical building.

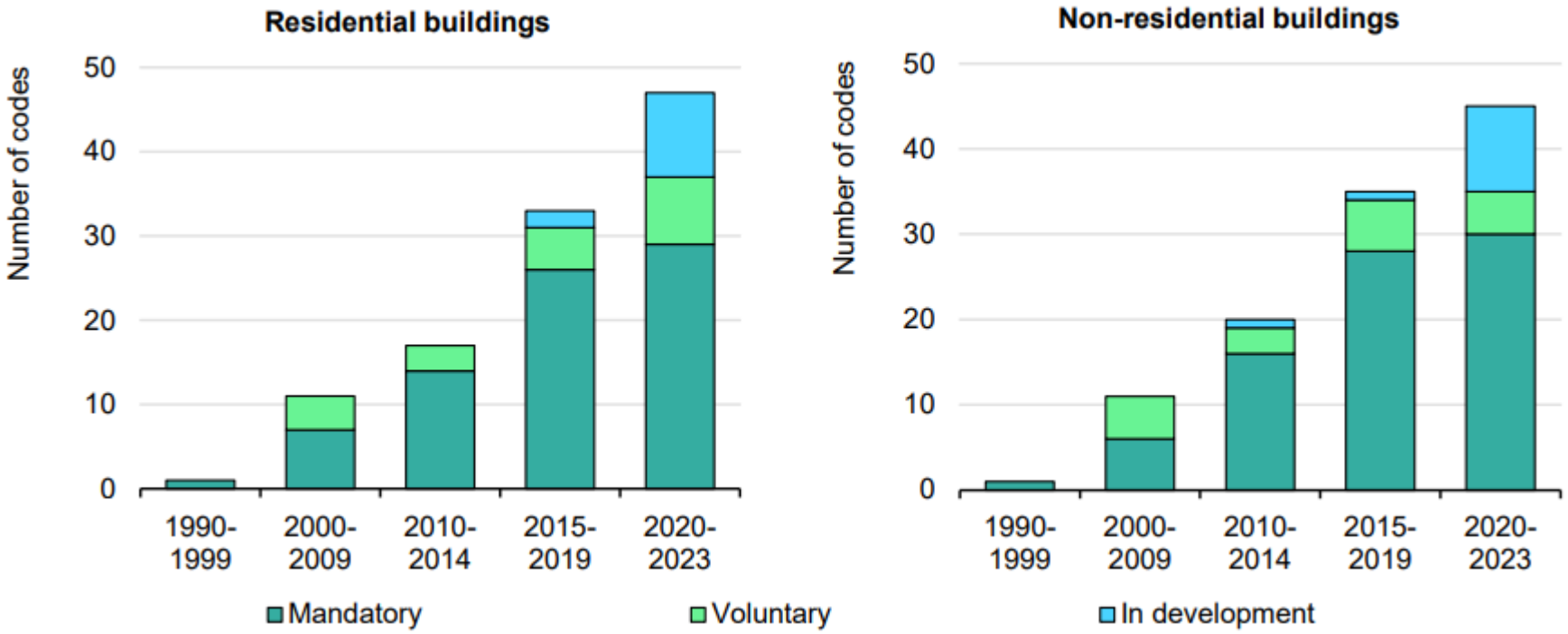


What should a good building energy code cover?

1	**Last update**	updated in last five years, 0 otherwise
2	**Obligation**	mandatory, or can start as voluntary with a clear and short timeline to make it mandatory
3	**Coverage**	covers all building stock is covered
4	**Compliance mechanism**	includes a compliance mechanism (e.g. penalties, inspections) that is well described
5	**New/existing buildings**	covers both existing and new buildings
6	**Energy performance requirements**	included
6	**Prescriptive requirements for components**	requirements for envelope and systems are covered: fabric, glazing, heating/cooling, hot water, and lighting
7	**Energy management system**	includes mandatory energy management systems requirements and technologies
8	**Smart solutions**	smart and/or grid-flexible solutions and space or charging for EV required
9	**Onsite renewables**	includes requirements for onsite renewables
10	**Zero-carbon readiness**	includes mandatory net-zero emission targets, could start with stringent nearly-zero emission requirements

Building energy codes need to be updated regularly

Building energy codes globally, year of most recent update, 1990-2023



Standards for new buildings

Standards can be integrated into mandatory building energy codes or complement them with minimum energy requirements

- New buildings & buildings undergoing renovation
- Building envelope and equipment
- Developed and adopted to set the minimum standards
- Enforced and regularly strengthened
- To minimise life-cycle costs.

Standards for existing buildings

Minimum energy performance standards are key for improving energy efficiency of existing buildings

- Ambitious timeline and renovation rate
- MEPS for and significant improvements to building envelopes and systems during renovations
- Energy audits, energy ratings and energy performance certification
- Finance and incentives to encourage investment to increase market penetration of long-lasting high efficiency improvements
- Training to improve building retrofit services
- Improvements to the efficiency of public-sector buildings

Standards for building components and systems

Improved energy performance of building components and systems to improve the energy performance of all buildings

Windows and other glazed areas

- Maximum share of glazed area
- MEPS for windows to minimise life-cycle costs
- A requirement for performance labelling
- Standard test protocols and certified product testing

HVAC systems

- MEPS for HVAC systems to minimise life-cycle costs
- A requirement for energy efficiency labelling
- Information and training for building designers, owners and others
- HVAC systems size, installation, testing and maintenance

Energy management and control systems

Information instruments

Data and information

- **Energy performance certificates:** documentation of basic building information plus energy performance
- **Building passport:** documentation of most buildings data and information, including basic information, construction materials, systems, renovations and energy use.

Awareness

- **Labels and branding:** easily identifiable visual that enables consumers to recognise product or service as efficient.
- **Awareness raising** campaigns

Capacity building

- **Education and training:** learning efforts to increase the knowledge of building sector professionals or general population.
- **Labour certification:** searchable documentation of professional expertise in deliverin

For examples on information instruments in different countries see IEA Buildings MOOC

Energy performance certificates

provide information to consumers on buildings they plan to purchase or rent.

They include an energy performance rating and recommendations for cost-effective improvements.

Energy Performance Certificate (EPC)

SAP

17 Any Street, District, Any Town, B5 5XX

Dwelling type:	Detached house	**Reference number:**	0919-9628-8430-2785-5996
Date of assessment:	15 August 2011	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	13 March 2012	**Total floor area:**	165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	**£5,367**
Over 3 years you could save	**£2,865**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	£5,367	£2,502	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 plus) A		
(81-91) B		76
(69-80) C		
(55-68) D		
(39-54) E	49	
(21-38) F		
(1-20) G		
Not energy efficient - higher running costs		

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.

COMMON EUROPEAN VOLUNTARY ENERGY PERFORMANCE CERTIFICATE

ALDREN

AWARD (only for classes A, B, C): B

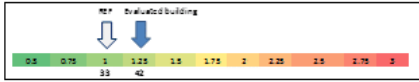
EUROPEAN VOLUNTARY CERTIFICATE

ENERGY PERFORMANCE RATING — **Building category** (% of each category for mixed use)

	Most efficient	Max. limit (ratio to Ref)	Rating
	Energy +	< 0	
A		≤ 0.35	
B		≤ 0.50	B
C		≤ 0.71	
D	REFERENCE*	≤ 1.00 Ref EP*	
E		≤ 1,41 Ref	
F		≤ 2,00 Ref	
G		2,00 Ref <	
	Least efficient		

Non-renewable primary energy balance	0.50 Ref EP	59.6 kWh EP/(m².a)
*Reference Ref EP		120 kWh EP/(m².a)
Exported primary energy		10 kWh EP/(m².a)
CO_2 emissions		25.7 kg/(m².a)

Non-renewable primary energy	69.6	kWh EP/(m².a)
Total primary energy (nearby, distant)	80.04	kWh EP/(m².a)
Final energy	42	kWh/(m².a)
Ratio of renewable (including all renewables)	13 %	



Final energy 1.25 Ref EP

Year of construction:	1970	Year of last renovation:	2015
Reference floor area:	5000 m²	Number of floors	8
Building volume:	20 000 m³	Climate locality:	JBC

Building: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Issued by:
Contact:

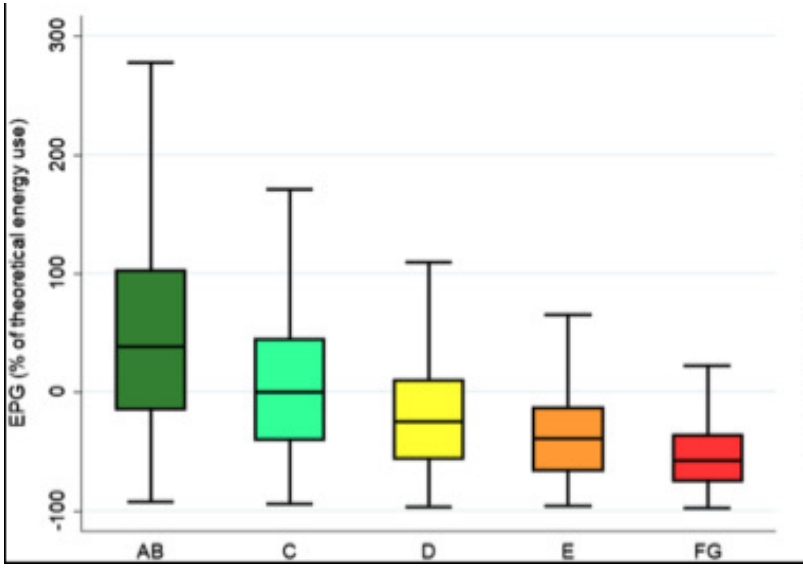
Parcel No: 3500 Cadaster: Brussels
Date: 20.4.2016 Validity: 20.4.2026
Signature

No. of energy certificate: 00001/SK_0001/2017

Energy Performance Gap (EPG)

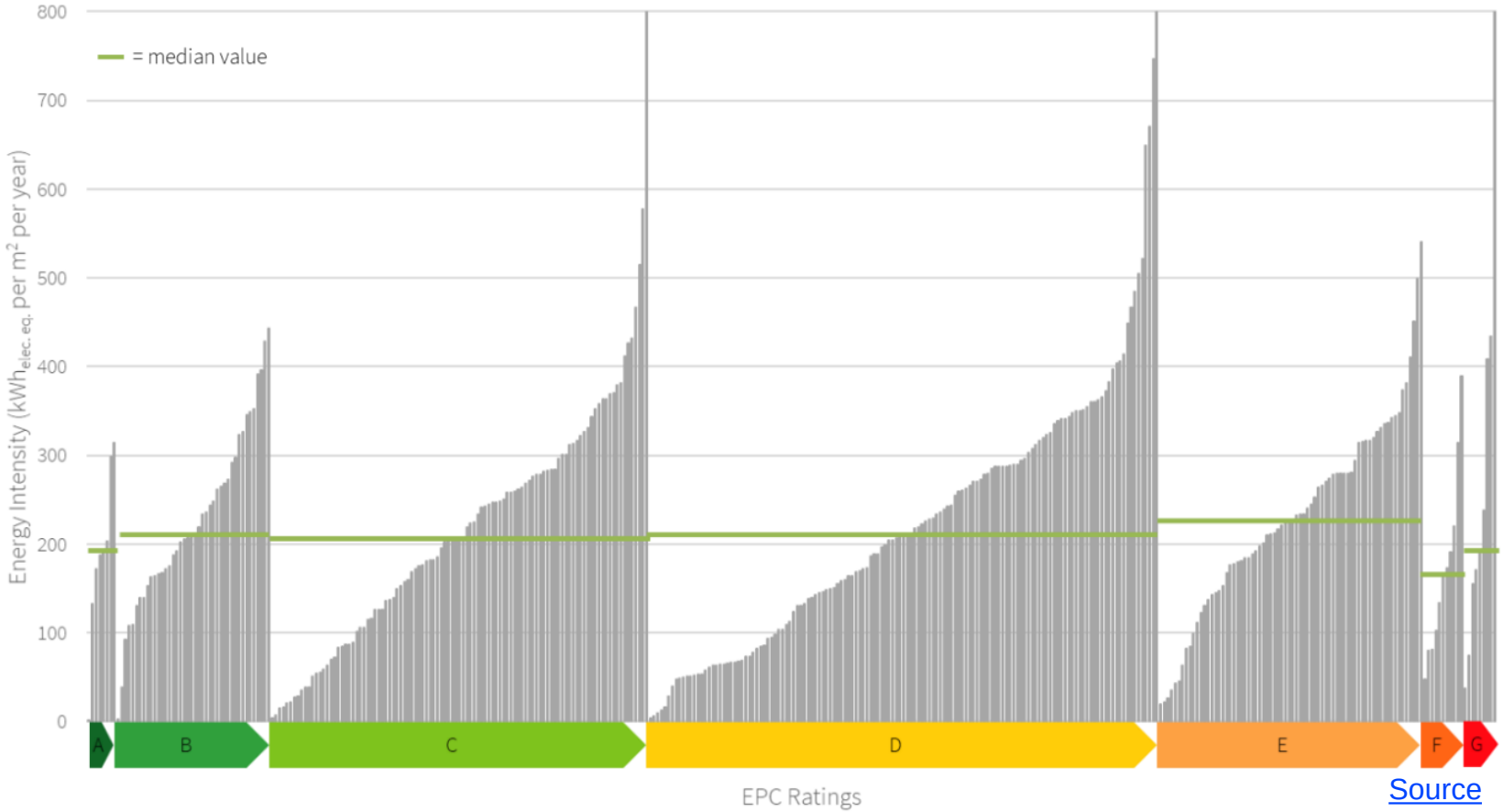
Discrepancy between theoretically estimated/modelled buildings energy performance (usually only for heating) of EPCs and the actual/metered energy use of buildings

- **Ireland (2021):** EPG for the least EE dwellings feature from -15 to -56%; EPG for EE houses display from +39 to 54% of the relevant EPC.
- **Sweden (2020):** energy savings for retrofit based on the theoretical consumption were overestimated by 37%, whereas the prediction of savings using measured consumption before retrofit were in line with the actual savings (3.6% overestimation).
- **Serbia (2020)**: large EPG in buildings with individual boilers than those connected to DHS
- **Netherlands (2013)**: energy inefficient homes consume less than predicted and EE homes consume more than predicted
- **UK (2012) & (2019):** data does not show correlation between how efficiently a building uses energy and its EPC rating



Data for Ireland (2021)

Offices' actual energy intensities show little correlation with EPC rating in the UK

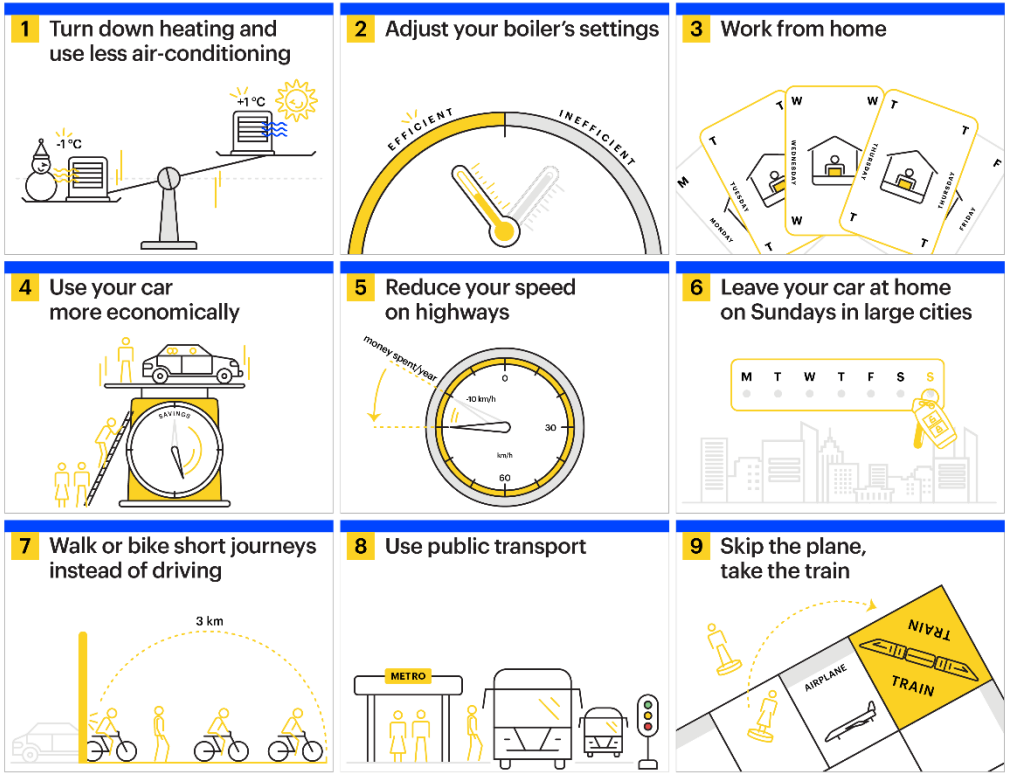


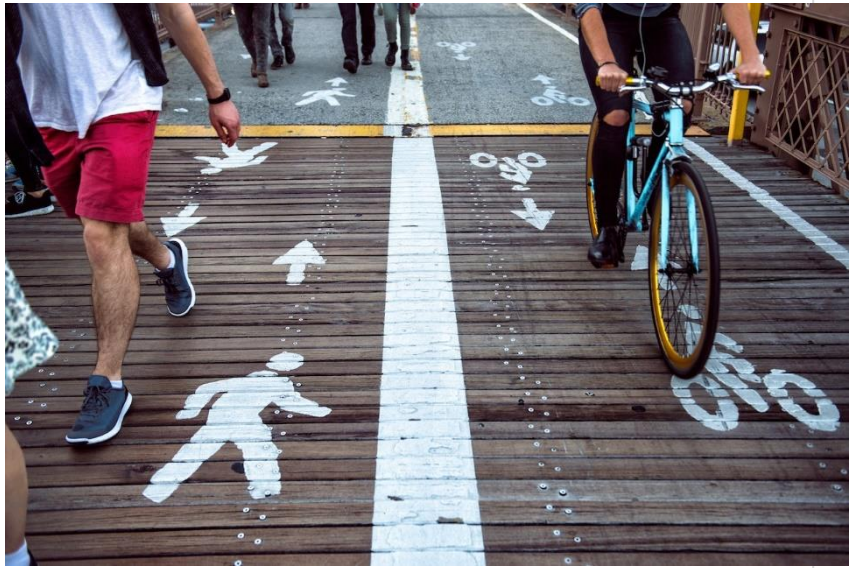
Source

Playing my part:

How to save money, reduce reliance on Russian energy, support Ukraine and help the planet

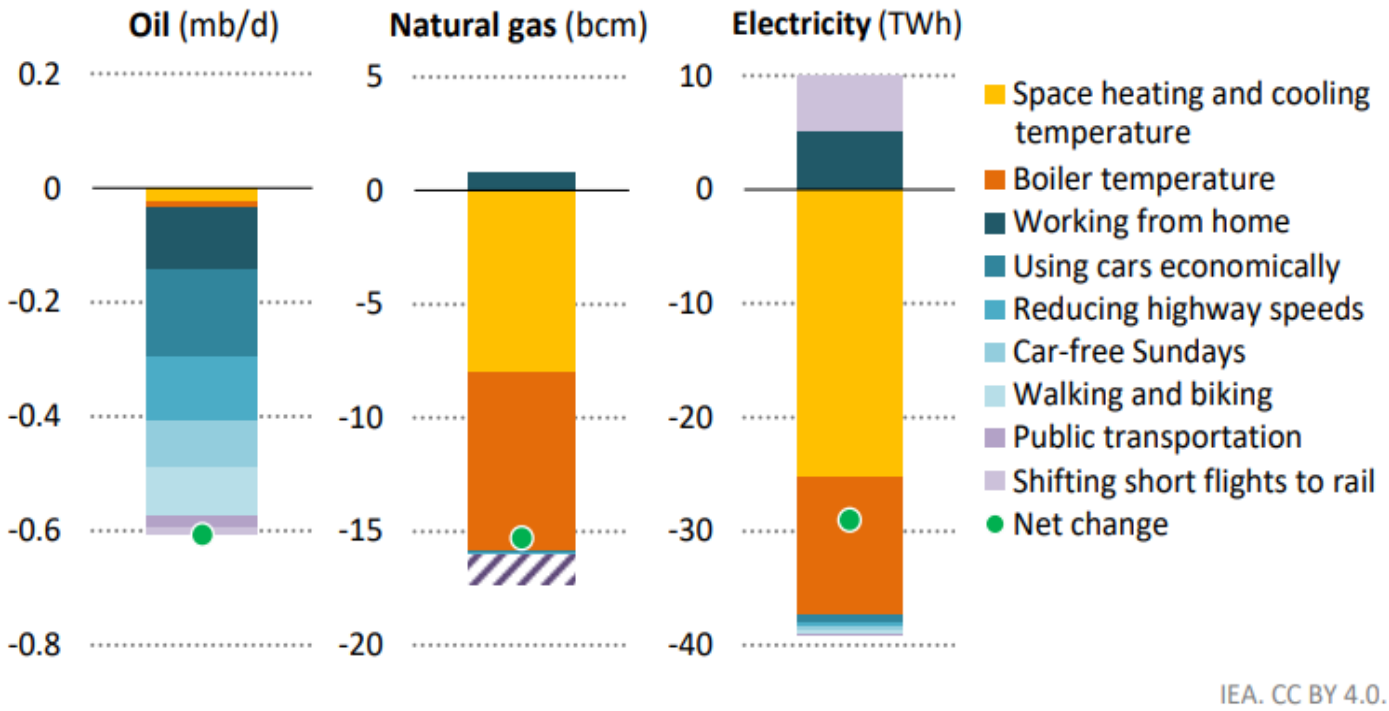
iea.org





https://www.iea.org/reports/playing-my-part

Demand reductions from EU citizen actions of Playing My Part



These behavioural changes can reduce Europe's reliance on Russian gas by one third, reduce oil consumption by 15% and cut household energy bills by more than EUR 450 per year

Incentives

Non-financial incentives

- **Time:** expedited approval for permits
- **Scope:** increased floor area, building height or number of floors

Financial incentives

- **Finance:** enabling private investment, including through loan guarantees, preferential loan terms or increased access to funds
- **Direct credit:** improving the cost of energy efficiency to consumers through grants, rebates, tax credits and discounts

Examples of financial incentives

Incentives in France:

- VAT reductions scheme (5.5%) for energy-saving works and renewable heating systems in new/existing dwellings
- Interest-free loans for energy renovation works
- Grant to finance thermal insulation, heating, ventilation or energy auditing work in existing dwellings. It includes performance incentives based on an energy audit report

Grants in Scotland:

- “Warmer homes Scotland“ – grant to cover up to 100% of the costs of upgrades to reduce home heating costs for homeowners and private tenants. The upgrades are determined through a property assessment by accredited evaluators during a home visit. They often include a variety of insulating, draught-proofing, and heating.

Energy Efficient Mortgages

- Energy Efficient Mortgage (EEM) to incentivise borrowers to improve the energy efficiency of their buildings and/or acquire highly energy efficient properties. Such programs already exist in the EU, India, China

Examples of non-financial incentives

EXPEDITED PERMITTING

Buildings have to apply for permits in order for the buildings to be habitable and in operation, but this process may take a long time since it is a fairly complex and some times bureaucratic process. However, different American cities have opted to offer a quicker process for issuing the permits whenever the projects meet specific green standards. Some examples of expedited permitting incentives are:

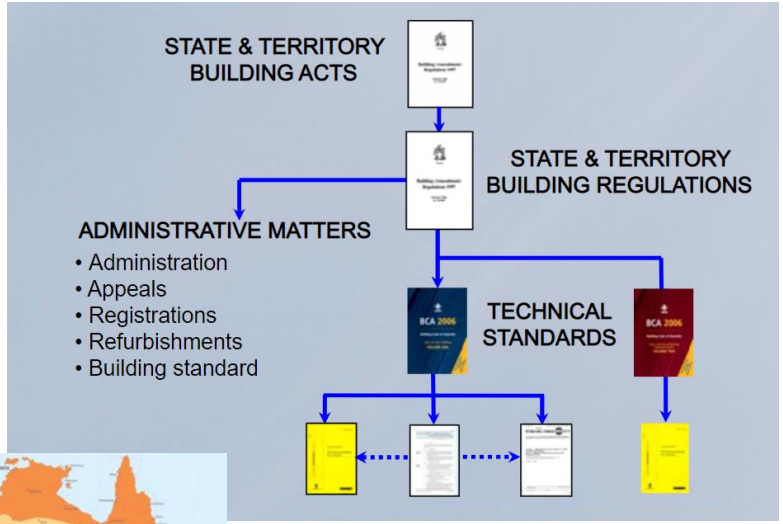
- **Houston, TX:** expedited permitting to commercial buildings that meet LEED standards;
- **San Francisco, CA:** priority is given to all new and renovated buildings with LEED Gold certification or other pre-approved high sustainability ratings;
- **Seattle, WA:** the city offers expedited permitting to green building projects through its Priority Green Expedited program. Accepted green building certifications are Built Green, LEED, LBC or Passive House Institute scores.

Policy package example for Australia

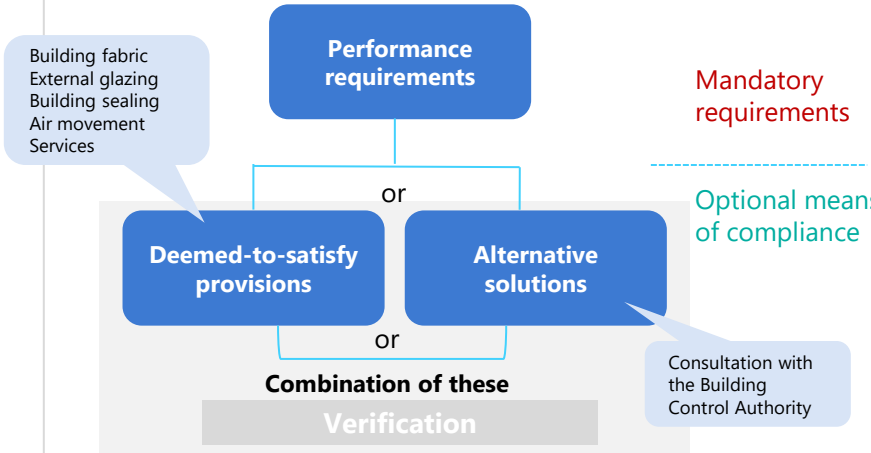
Regulation: Building Energy Code

Building Code of Australia (BCA)

2003: Energy efficiency provisions for houses were introduced were enhanced in 2005: Measures for multi-residential buildings were introduced
2006: Measures for public and commercial buildings were then introduced;
Amendment for residential buildings increased the range of options for complying with the requirements
2009: Stringency of energy efficiency requirements for both residential and commercial buildings were increased
2019: Stringency of energy efficiency provisions for commercial buildings by up to 30 %
2021: Further updates for energy efficiency requirements for residential buildings towards low-energy homes

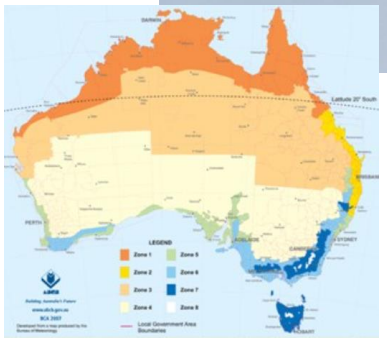


Flexibility of compliance paths within BCA



Mandatory requirements

Optional means of compliance



8 climate zones

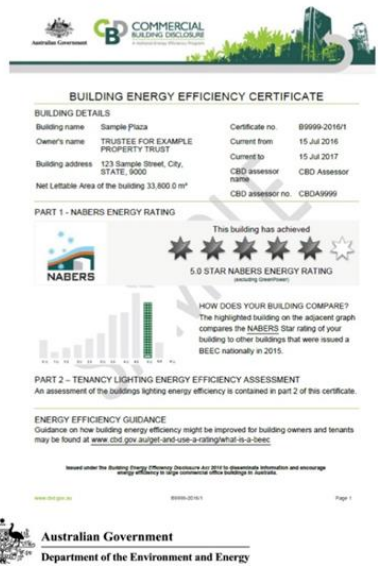
Specific energy efficiency requirements vary depending on the use of the building and the climate zone in which it is located

Regulation & information: mandatory disclosure, certification & labelling

National Australian Built Environment Rating System (NABERS)

COMMERCIAL BUILDING DISCLOSURE

Sample BEEC



BUILDING ENERGY EFFICIENCY CERTIFICATE

BUILDING DETAILS

Building name	Sample Plaza	Certificate no.	B9999-2016/1
Owner's name	TRUSTEE FOR EXAMPLE PROPERTY TRUST	Current from	15 Jul 2016
		Current to	15 Jul 2017
Building address	123 Sample Street, City, STATE, 9000	CBD assessor name	CBD Assessor
Net Lettable Area of the building	33,800.0 m²	CBD assessor no.	CBDA9999

PART 1 - NABERS ENERGY RATING

This building has achieved

5.0 STAR NABERS ENERGY RATING

(excluding GreenPower)

HOW DOES YOUR BUILDING COMPARE?
The highlighted building on the adjacent graph compares the NABERS Star rating of your building to other buildings that were issued a BEEC nationally in 2015.

PART 2 – TENANCY LIGHTING ENERGY EFFICIENCY ASSESSMENT
An assessment of the buildings lighting energy efficiency is contained in part 2 of this certificate.

ENERGY EFFICIENCY GUIDANCE
Guidance on how building energy efficiency might be improved for building owners and tenants may be found at www.cbd.gov.au/get-and-use-a-rating/what-is-a-beec

Issued under the Building Energy Efficiency Disclosure Act 2010 to disseminate information and encourage energy efficiency to align commercial office buildings in Australia.

PART 1 – NABERS* ENERGY RATING

BUILDING DETAILS

Building address	123 Sample Street, CITY, STA 9000	NABERS rating no.	N99999
		Certified date	15 Jul 2016
		Current to	15 Jul 2017

NABERS ENERGY RATING

This building has achieved

5.0 STAR NABERS ENERGY RATING**

(excluding GreenPower)

Rating scope	Base Building
Rated area	30,735.2 m²
Rated hours	52.9

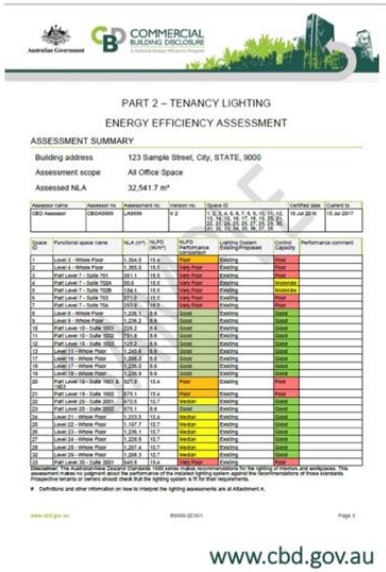
BUILDING CONSUMPTION & EMISSION DETAILS

Annual emissions	2,005,964 kg CO^2-e per year
Annual emissions intensity	65.3 kg CO^2-e/m² per year
Annual consumption	12,908,784 MJ per year

NABERS ASSESSOR DETAILS
Assessor name Joe Citizen
Assessor number CBDA9999

ABOUT NABERS ENERGY RATINGS
0 Very poor
1 Poor
2 Below average
2.5 to 3 Average
4 Good
5 Excellent
6 Market leading

* National Australian Built Environment Rating System is a joint initiative of the Australian, State and Territory governments.
** This rating must be used in an advertising.



PART 2 – TENANCY LIGHTING
ENERGY EFFICIENCY ASSESSMENT

ASSESSMENT SUMMARY

Building address	123 Sample Street, City, STATE, 9000
Assessment scope	All Office Space
Assessed NLA	32,541.7 m²

Assessor name	Assessor no.	Assessment no.	Version no.	Space ID	Certified date	Current to
CBD Assessor	CBDA9999	LA9999	V 2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38	15 Jul 2016	15 Jul 2017

Space ID	Functional space name	NLA (m²)	NLPD (W/m²)	NLPD Performance Assessment	Lighting System Existing/Proposed	Control Capacity	Performance comment
1	Level 2 - Whole Floor	1,354.0	15.4	Poor	Existing	Poor	
2	Level 4 - Whole Floor	1,365.8	16.0	Very Poor	Existing	Poor	
3	Part Level 7 - Suite 701	351.1	16.5	Very Poor	Existing	Poor	
4	Part Level 7 - Suite 702A	60.8	16.5	Very Poor	Existing	Wonderful	
5	Part Level 7 - Suite 702B	134.1	16.5	Very Poor	Existing	Wonderful	
6	Part Level 7 - Suite 703	372.0	16.5	Very Poor	Existing	Poor	
7	Part Level 7 - Suite 704	3573.9	16.5	Very Poor	Existing	Poor	
8	Level 8 - Whole Floor	1,235.1	8.6	Good	Existing	Good	
9	Level 9 - Whole Floor	1,234.2	8.6	Good	Existing	Good	
10	Part Level 10 - Suite 1001	224.3	8.6	Good	Existing	Good	
11	Part Level 10 - Suite 1002	781.9	8.6	Good	Existing	Good	
12	Part Level 10 - Suite 1003	137.2	8.6	Good	Existing	Good	
13	Level 11 - Whole Floor	1,240.6	8.6	Good	Existing	Good	
14	Level 14 - Whole Floor	1,256.2	8.6	Good	Existing	Good	
15	Level 17 - Whole Floor	1,234.3	8.6	Good	Existing	Good	
16	Level 18 - Whole Floor	1,230.9	8.6	Good	Existing	Good	
20	Part Level 19 - Suite 1900 & 1907	1077.8	15.4	Poor	Existing	Poor	
21	Part Level 19 - Suite 1909	1073.1	15.4	Poor	Existing	Poor	
22	Part Level 20 - Suite 2001	1073.1	10.7	Medium	Existing	Good	
23	Part Level 20 - Suite 2002	1073.1	8.6	Good	Existing	Good	
24	Level 21 - Whole Floor	1,233.5	12.4	Medium	Existing	Good	
25	Level 22 - Whole Floor	1,157.7	10.7	Medium	Existing	Good	
26	Level 23 - Whole Floor	1,236.1	10.7	Medium	Existing	Good	
27	Level 24 - Whole Floor	1,225.5	10.7	Medium	Existing	Good	
28	Level 25 - Whole Floor	1,267.4	10.7	Medium	Existing	Good	
32	Level 29 - Whole Floor	1,268.3	10.7	Medium	Existing	Good	
33	Part Level 30 - Suite 3001	545.5	19.4	Very Poor	Existing	Poor	

Disclaimer: This Australian Government Standards Total Lighting Power recommendations for the lighting of interiors and workplaces. This assessment makes no judgment about the performance of the installed lighting system against the recommendations of those standards. Prospective tenants or owners should check that the lighting system is fit for their requirements.

Definitions and other information on how to interpret the lighting assessments are at Attachment A.

www.cbd.gov.au

Australian Government
Department of the Environment and Energy

NABERS offers a package of policies – a proven effective combination of regulatory and information instruments

Regulation & information: mandatory disclosure, certification & labelling

OBJECTIVE

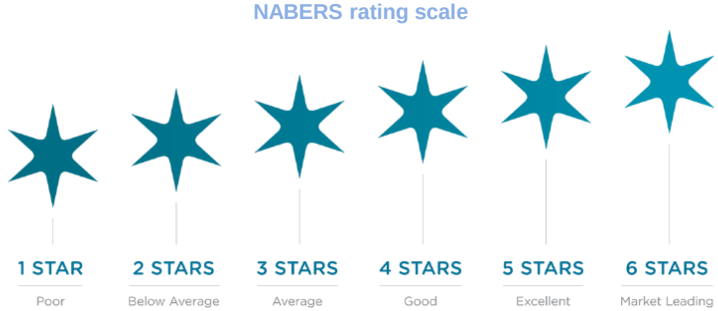
Require sellers and lessors to disclose information regarding energy efficiency of commercial buildings with over 1,000 m² of floor area, improving transparency on real estate transactions. Not all buildings are affected, requiring accredited assessors for compliance requirements.

BACKGROUND

The **Commercial Building Disclosure (CBD)** came to force in 2010, requiring commercial buildings to **have a Building Energy Efficiency Certificate (BEEC)**, being the BEEC necessarily provided to potential buyers or lessees when requested at the time of sale, lease or sublease. **Such certificates are composed by two parts**: (i) a star-score from a national rating system that measures the environmental performance of buildings, tenancies and homes, called **National Australian Built Environment Rating System (NABERS),** and (ii) a Tenancy Lighting Assessment, which measures the power density of the installed general lighting systems and its performance level. **BEEC's must be issued every 12 months**, ensuring compatibility to the latest energy efficiency improvements.

ACTIVITIES AND RESULTS

- **7,773 BEEC's had been issued** until 2018, with 2,162 unique buildings certified;
- The initial threshold was 2,000 m², which led to an average of 200 new buildings acquiring the BEEC yearly. In 2017-2018, when the threshold was lowered to 1,000 m², **312 buildings obtained a BEEC**;
- On the NABERS scale from 0 to 6, buildings, **CBD participants score an average of 3.7**. Larger buildings generally present higher scores.



Government 4.5 star office lease requirement (government purchasing power)

Disclosure program for commercial buildings (CBD) based on EE certificates (BEEC) which have a score from 0 to 6 stars based on their performance (NABERS)

Regulation: NABERS-based minimum energy performance standards

Energy Efficiency in Government Operation (EEGO)

EEGO policy includes energy intensity targets and minimum energy performance standards (MEPS) to ensure departments and agencies progressively improve their energy performance and consider energy use when purchasing or leasing buildings and appliances

MEPS apply to government office buildings that:

- are new
- have undergone major refurbishment (affecting their energy performance)
- have been leased for more than 2 years

Additional instruments:

- Green lease requirements
- Energy management plan
- Annual energy consumption reporting

EEGO policy requires agencies to report their energy consumption against core performance indicators to their portfolio minister

Element	>= 2000 m2 net lettable area			< 2000 m2 net lettable area
	100% of total building area	50% to 99% of total building area	< 50% of total building area	
Base building	>= 4.5 stars NABERS Energy, or equivalent, level of energy efficiency for whole building	>= 4.5 stars NABERS Energy, or equivalent, level of energy efficiency	No requirement	No requirement
Tenanted area	>= 4.5 stars NABERS Energy, or equivalent, level of energy efficiency for whole building	>= 4.5 stars NABERS Energy, or equivalent, level of energy efficiency	>= 4.5 stars NABERS Energy, or equivalent, level of energy efficiency	Separate digital metering and max 8W/m2 for lighting
Lease	To include a Green Lease Schedule	To include a Green Lease Schedule	To include a Green Lease Schedule	No requirement
Appliances	US EPA 'Energy Star' compliant with power management features enabled at the time of supply			

Source: https://www.energy.gov.au/government-priorities/buildings/government-buildings

Information: certification & labelling for residential buildings

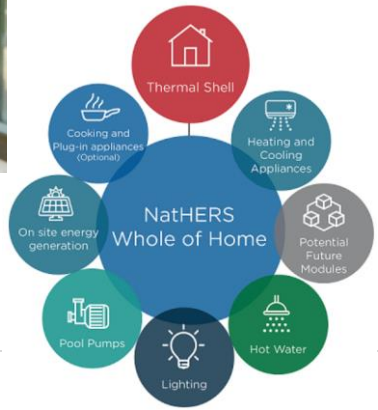
Nationwide House Energy Rating Scheme (NatHERS)

'In home' assessment of thermal performance based on BCA
NatHERS measures a home's energy efficiency to generate a star rating since 1993
NatHERS Assessors currently use the house plans and building specifications of a home to measures the home's thermal performance with an accredited software tool.
NatHERS tools estimate the amount of heat that needs to be added or removed to keep that home comfortable and generate a star rating out of 10 and a Certificate.

For construction of new homes there are 7 Star house free-to-download designs showcasing the use of sustainable design principles and construction techniques for a range of climate zones across Australia.

Rating is used in the requirements of BCA to set min.requirements

Work is underway to expand NatHERS to assess and rate the energy performance of the whole home, including appliances and equipment, which will result in a number of benefits



Nationwide House Energy Rating Scheme
NatHERS Certificate No. 0004466397
Generated on 22 Feb 2020 using CSIRO AccuRate Sustainability V2.4.3.13

6.0
NATIONWIDE HOUSE ENERGY RATING SCHEME
119.0 MJ/m²
www.nathers.gov.au

Property
Address: Unit 1, 37 Graham Road , Highett , VIC , 3190
Lot/DP: Lot gf DP 442528, loy Y
NCC Class*: 1a
Type: New Home

Plans
Main Plan: rtr
Prepared by: d

Construction and environment
Assessed floor area (m²)*
Conditioned*: 250.0
Unconditioned*: 0.0
Total: 250.0
Garage
Exposure Type: Suburban
NatHERS climate zone: 62

Thermal performance
Heating: 106.7 MJ/m²
Cooling: 12.3 MJ/m²

Accredited assessor
Name: John Smith
Business name: NA
Email: john.smith@na.com.au
Phone: 03 955 5555
Accreditation No.: 3333
Assessor Accrediting Organisation: HERA
Declaration of interest: Yes - managed

About the rating
NatHERS software models the expected thermal energy loads using information about the design and construction, climate and common patterns of household use. The software does not take into account appliances, apart from the airflow impacts from ceiling fans.

Verification
To verify this certificate, scan the QR code or visit hstar.com.au/QR/Generate?p=BrHnboVGP.
When using either link, ensure you are visiting hstar.com.au

National Construction Code (NCC) requirements
The NCC's requirements for NatHERS-rated houses are detailed in 3.12.0(a)(i) and 3.12.5 of the NCC Volume Two. For apartments the requirements are detailed in J0.2 and J5 to J8 of the NCC Volume One.
In NCC 2019, these requirements include minimum star ratings and separate heating and cooling load limits that need to be met by buildings and apartments through the NatHERS assessment. Requirements additional to the NatHERS assessment that must also be satisfied include, but are not limited to: insulation installation methods, thermal breaks, building sealing, water heating and pumping, and artificial lighting requirements. The NCC and NatHERS Heating and Cooling Load Limits (Australian Building Codes Board Standard) are available at www.abcb.gov.au.
State and territory variations and additions to the NCC may also apply.

* Refer to glossary.
Generated on 22 Feb 2020 using CSIRO AccuRate Sustainability V2.4.3.13 for Unit 1, 37 Graham Road , Highett , VIC , 3190
Page 1 of 6

Source: https://www.nathers.gov.au/

Incentives: variety of national, state and city programs

The Retailer Energy Productivity Scheme (REPS) supports households and businesses in South Australia to reduce their energy costs while improving energy efficiency in buildings.
Households and businesses may be able to receive free or discounted energy efficiency and energy productivity activities from energy retailers participating in the REPS.
Typical activities include installing energy efficient lighting, water efficient shower heads, helping save water heating costs.

Sustainability Incentive Scheme
The City of Adelaide provides financial incentives for sustainable technology installation in apartments, houses and commercial buildings, to improve energy and water performance

Rebates for commercial properties and apartments:
•Up to $5,000 for **commercial solar systems**
•Up to $20,000 per site ($500 per premise) for **shared solar** systems that provide electricity to multiple spaces
•Up to $5000 for **electric vehicle charging** equipment (cars and bikes)
•Up to $10,000 available for advanced electric vehicle charging technology providing virtual power plant capability
•Up to $5,000 for greenhouse gas inventory (plus additional up to $2,500 for other steps) towards **carbon neutral certification** for organisations, precincts, buildings or events
•Up to $5,000 for **NABERS** or **Green Star Ratings**
•Up to $500 for smart **electricity management systems** that optimise solar power or access 'off peak' tariffs.

The Energy Savings Scheme
The scheme can assist eligible NSW businesses with incentives to reduce energy use in office buildings. The incentives are available for office buildings that expect to get a NABERS energy rating of:
•at least 0.5 star higher than that of average office building stock, or
•at least 1 star higher than the building's historical NABERS energy rating
Incentives are site specific and depend on the size of your building and your NABERS star rating.

Rebates & training for 7-star homes
Rebates of $4,000 per home are available for builders to develop 7-star NatHERS rated homes in Victoria
Builders can collaborate with Sustainability Victoria to build up-to four new homes, with the rebate available per home built. Only 80 rebates available under the scheme.
In addition to 7-star NatHERS requirement a whole-of-home assessment to the program criteria is being introduced

A number of incentive programs are linked to NABERS or NatHERs and capacity buildings creating policy package synergies

Policy package for buildings

	New buildings	Existing buildings
Incentives	Financial incentives to develop buildings with higher ratings	Financial incentives to for energy efficiency upgrades, equipment and appliances
Information	Certification and labelling for residential (NatHERS) and non-residential (NABERS)buildings Capacity building programmes and accreditation for assessors	Certification and labelling for residential (NatHERS) and non-residential (NABERS)buildings Capacity building programmes and accreditation for assessors
Regulations	Building Energy Code and standards Mandatory disclosure of energy performance	Building Energy Code and standards – requirements vary by state MEPS, green lease and reporting requirements for government buildings Mandatory disclosure of energy performance

Enabling institutional framework and governance

- Long-term plans
- Capacity
- Financing
- Digitalisation

Think from the policy package point of view

- **Is the package effective? Why do you think so?**
- **Is there something missing?**
- **What instruments in this package would work well and not so well in your country? Why do think so?**

Session Activity

International Energy Agency

Activity - Energy efficiency policy package

With the information you have on your country and based on the analysis you have done in the previous exercises, identify important policies that have drive the improvement of energy efficiency in buildings. Would they be the same or different for new and existing buildings?

Policy Instruments		
	New buildings	Existing buildings
Regulations		
Information		
Incentives		

Present your work at ECEEE in Paris this summer!! All expenses paid!

In memory of Kathleen Gaffney

Preference will be given to female candidates from the Global South.

To apply for this prize, please submit a 250-word summary of your work to kathleengaffneyprize@gmail.com, explaining why you believe it is important to share your research with the global energy efficiency community.

The application deadline is March 31, 2024.

Buildings

AGENDA

International Energy Agency

Indicators and Evaluation

AGENDA

Industry

AGENDA

Transport

AGENDA

Appliances and Equipment

AGENDA

International Energy Agency

Energy Efficiency Training Week

Africa Energy Efficiency Policy in Emerging Economies Training Week

Buildings

Nairobi

18-22 March 2024

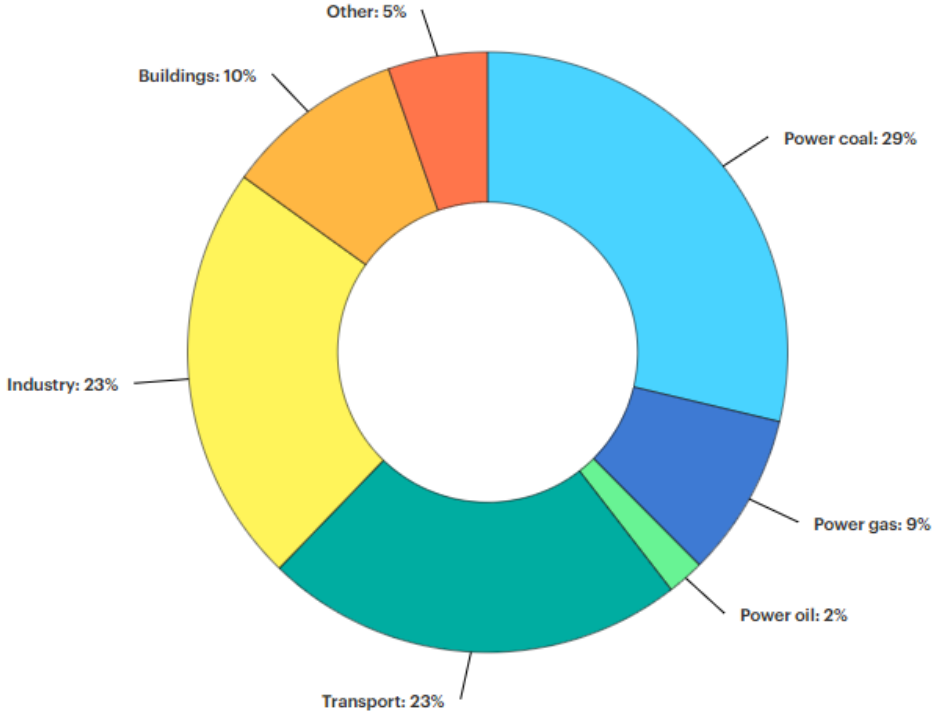
https://www.iea-events.org/energy-efficiency-training-week-nairobi

International Energy Agency

Energy Efficiency Training Week - Buildings – Day 2: 9. Efficient grid-interactive buildings

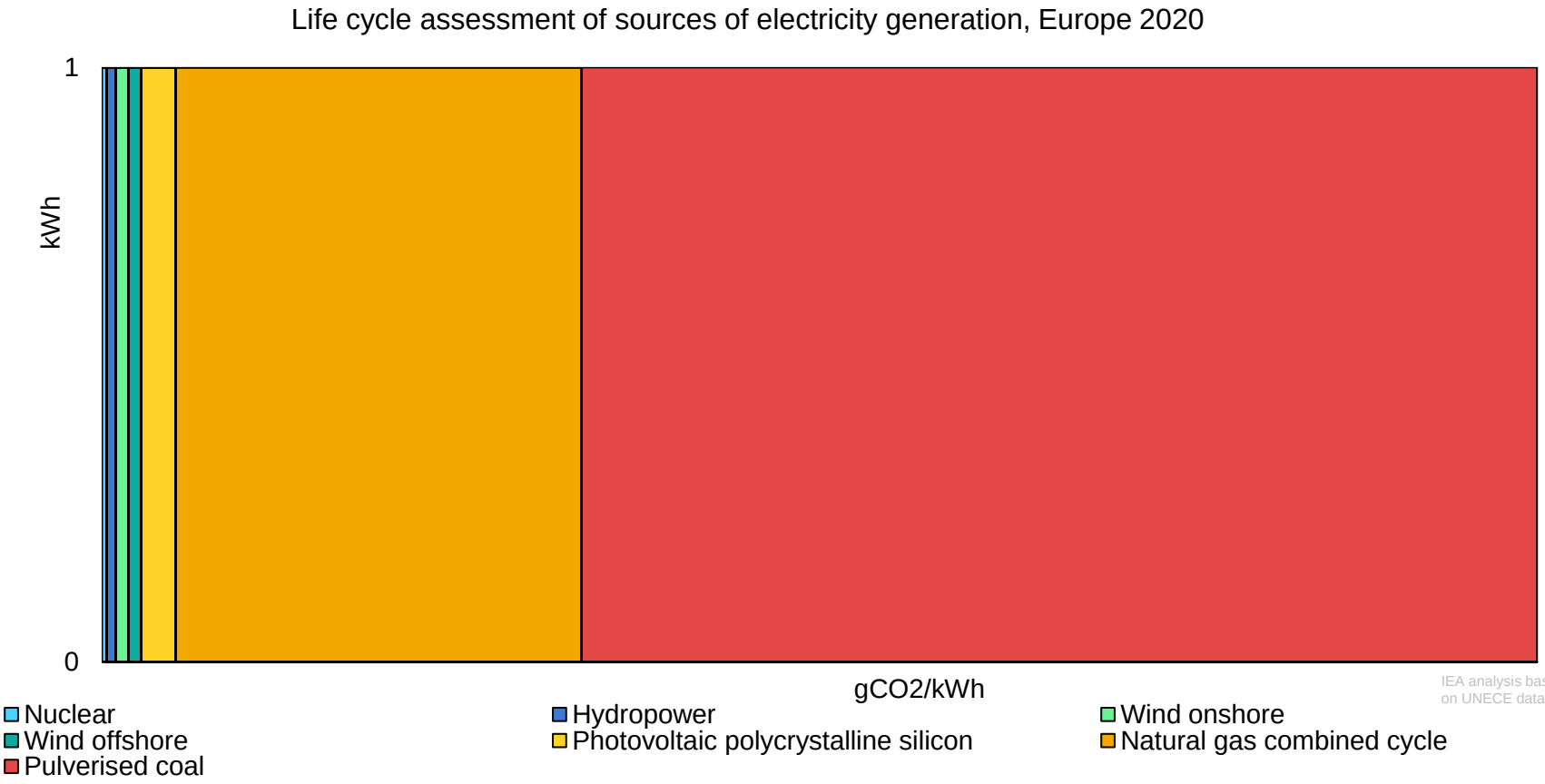
The importance of electricity

Global energy-related CO2 emissions by sector



Electricity has the biggest share of emissions, but the most to offer

Coal by far the largest source of emissions

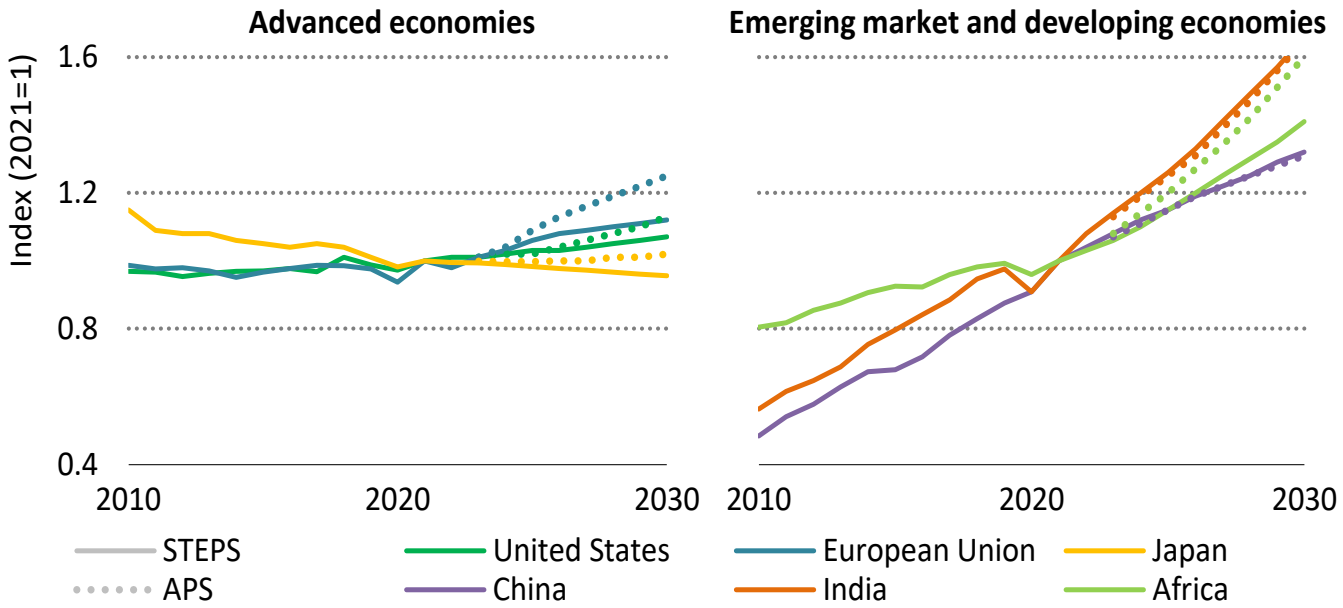


Electrify everything and reduce global primary energy demand by half

S Griffith – Rewiring America

Electricity is in high demand

Electricity demand in key regions by scenario, 2010-2030



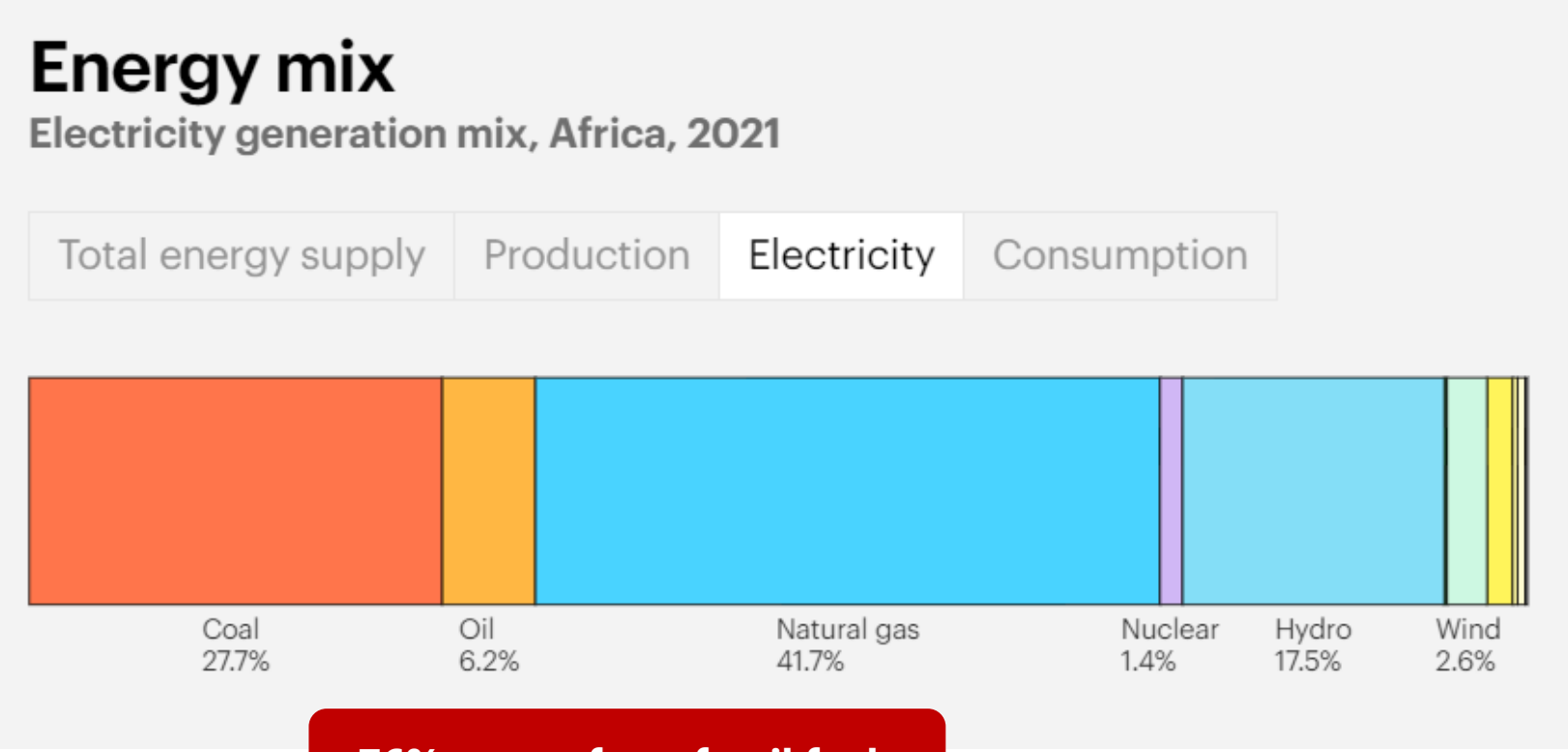
Demand almost flat in advanced economies but climbs skyward elsewhere

How is electricity produced in Africa?

What is % of fossil fuels in the generation mix?

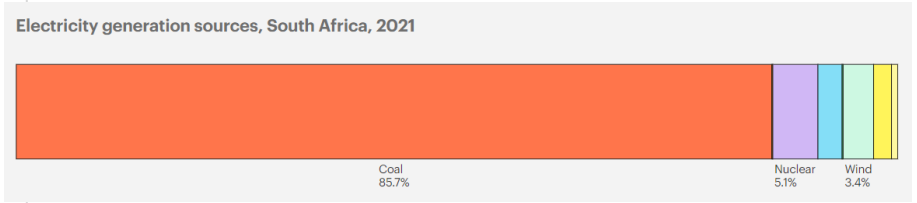
S Griffith – Rewiring America

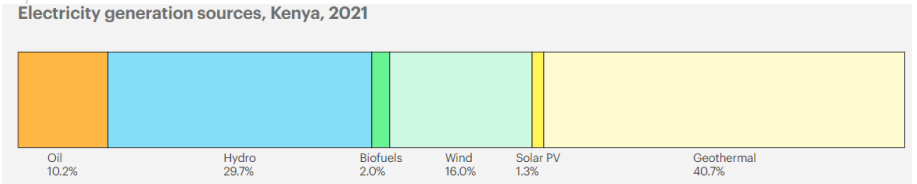
Electricity generation mix in Africa

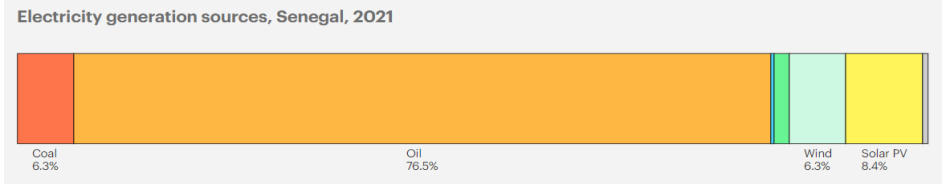


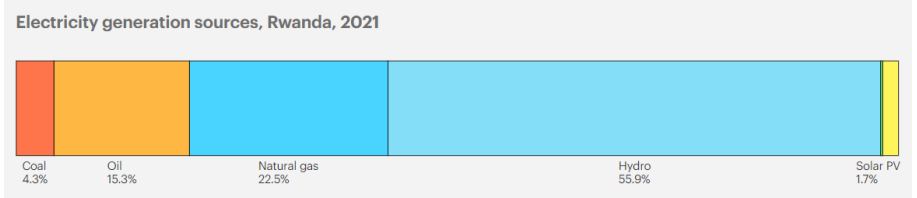
76% comes from fossil fuels

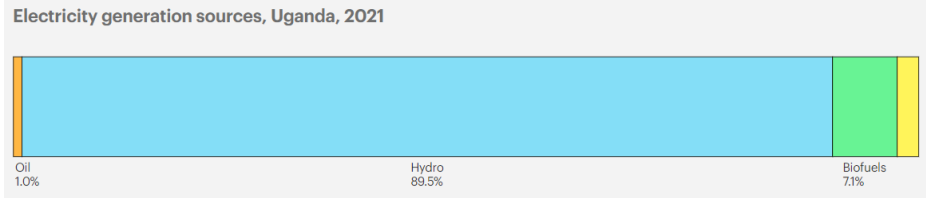
Electricity generation mix in selected countries in Africa







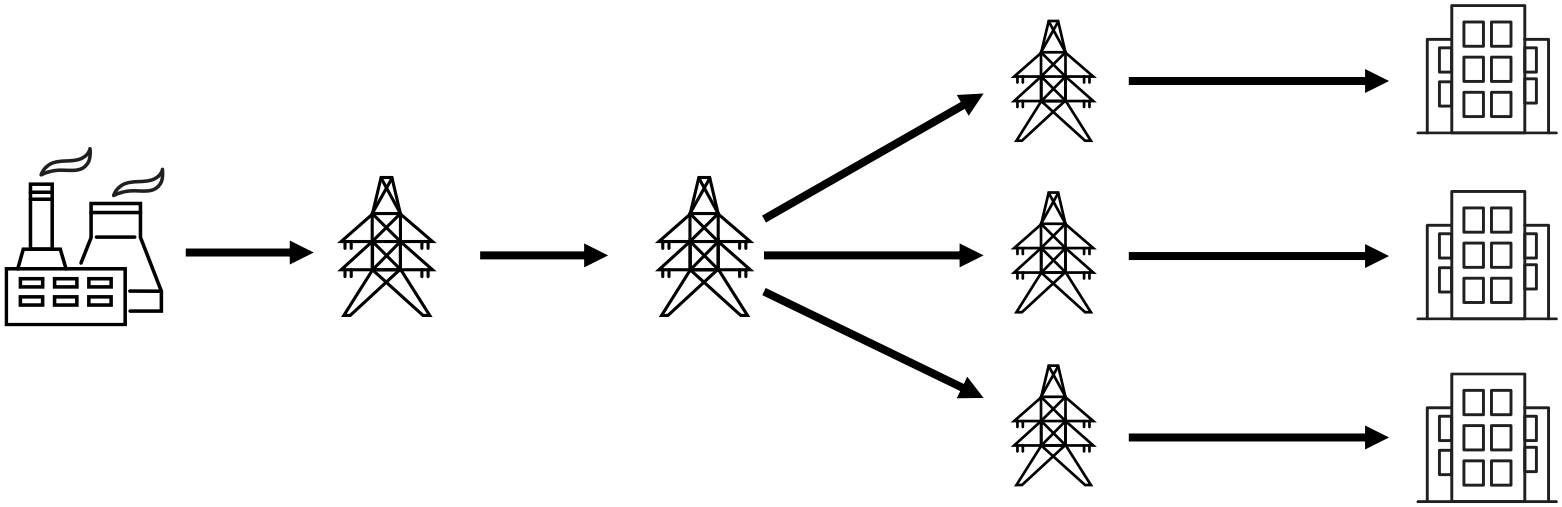




https://www.iea.org/regions/africa

Traditional electricity systems

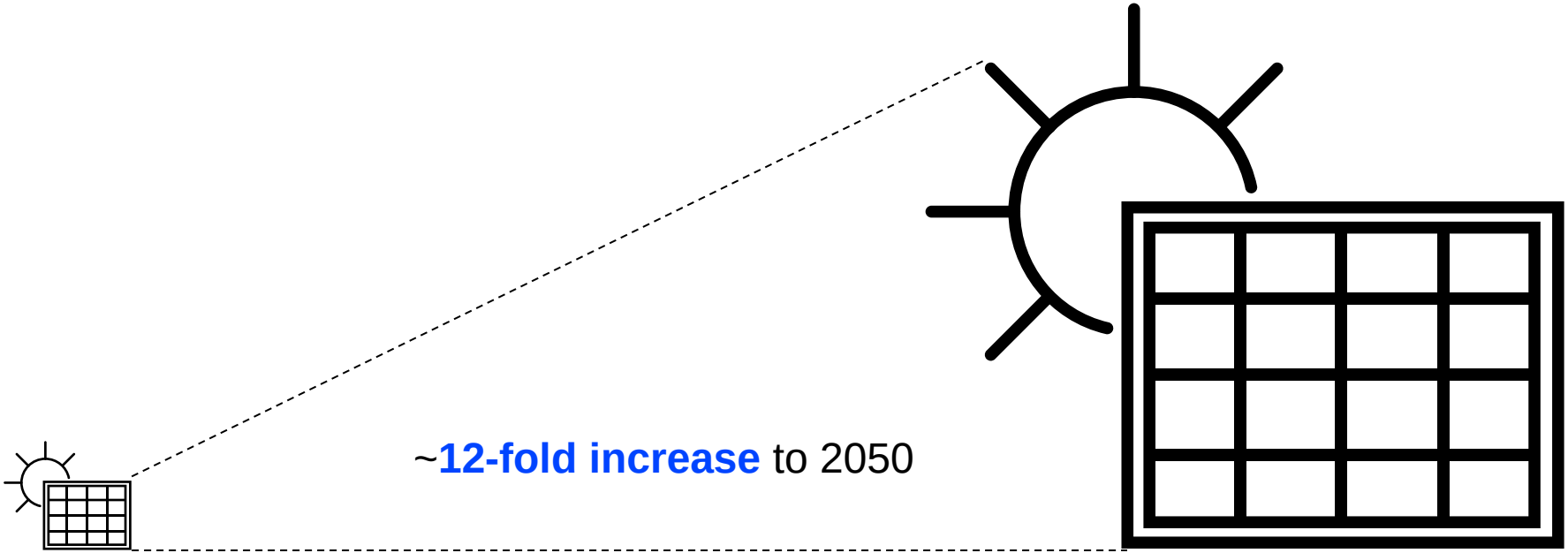
One-way dispatchable



Electricity flows one way from generation through transmission and distribution system to source of demand

Solar becomes increasingly important, but not without challenges

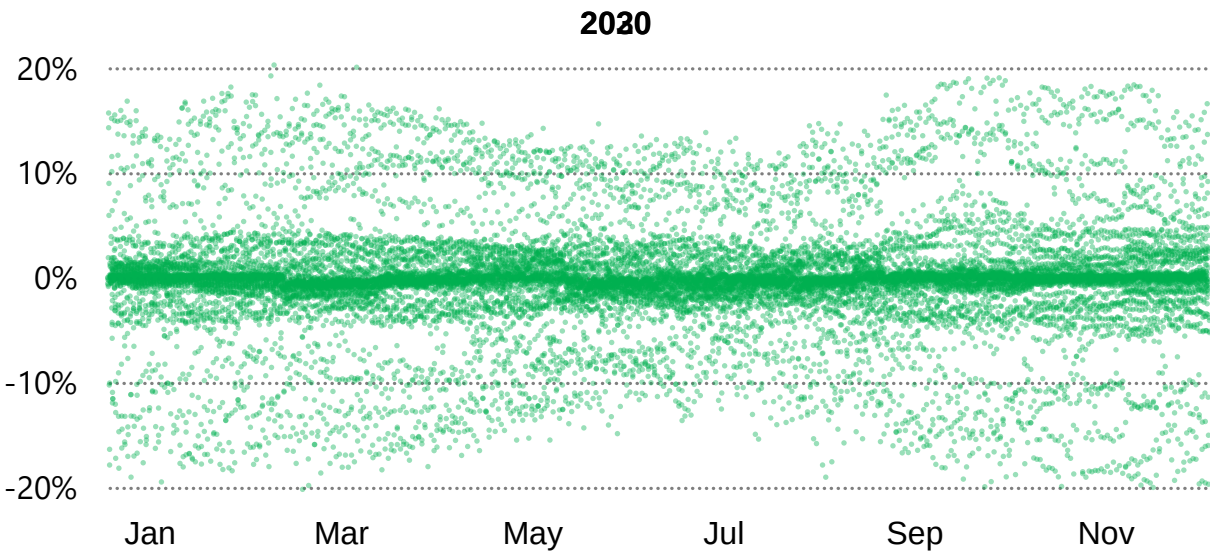
Solar supply 2050 (APS)



The location, visibility, and controllability are key considerations

Flexibility is becoming key to power system's stability

Hour-to-hour adjustments required in power systems due to variability in wind and solar in India in the STEPS



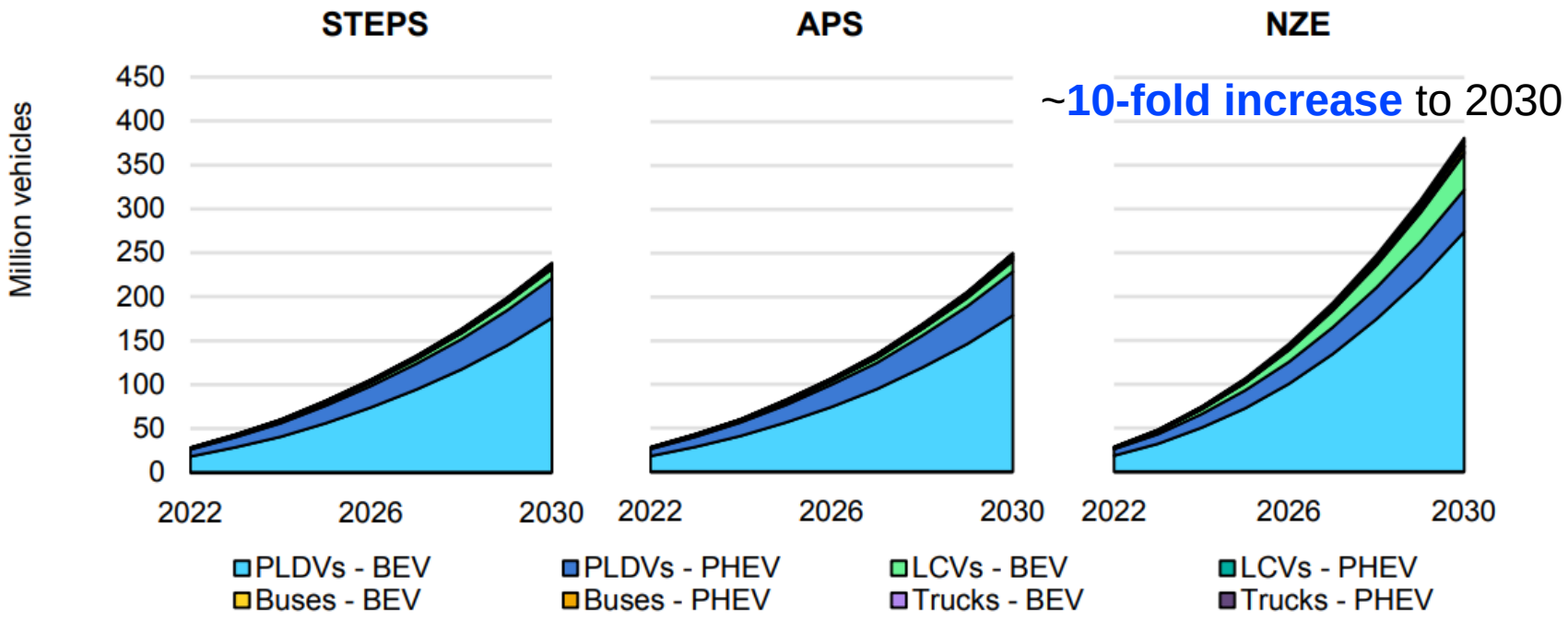
By 2030:
40% total installed capacity
25% of total generation

Hourly variations in the renewable sources increase more than threefold by 2030

An AC-induced early evening peak in power demand, alongside much greater variability in supply, puts a huge premium on robust grids & all forms of flexibility:
India ahead of all other countries in its total requirement for flexibility

Deployment of EVs is speeding up putting pressure on the grids

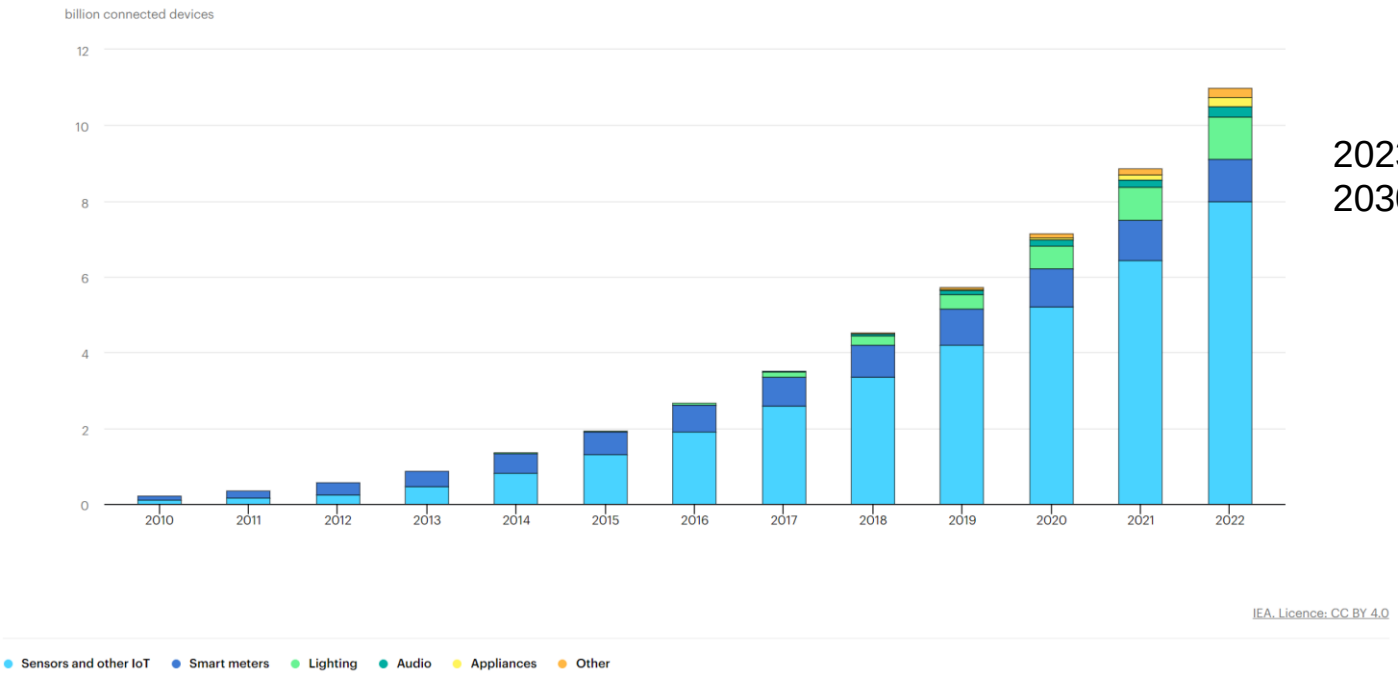
Global electric vehicle stock by mode and scenario, 2022-2030



Number of electric vehicles is expected to increase exponentially with 90% of charging taking place in buildings

Deployment of connected devices continues to grow

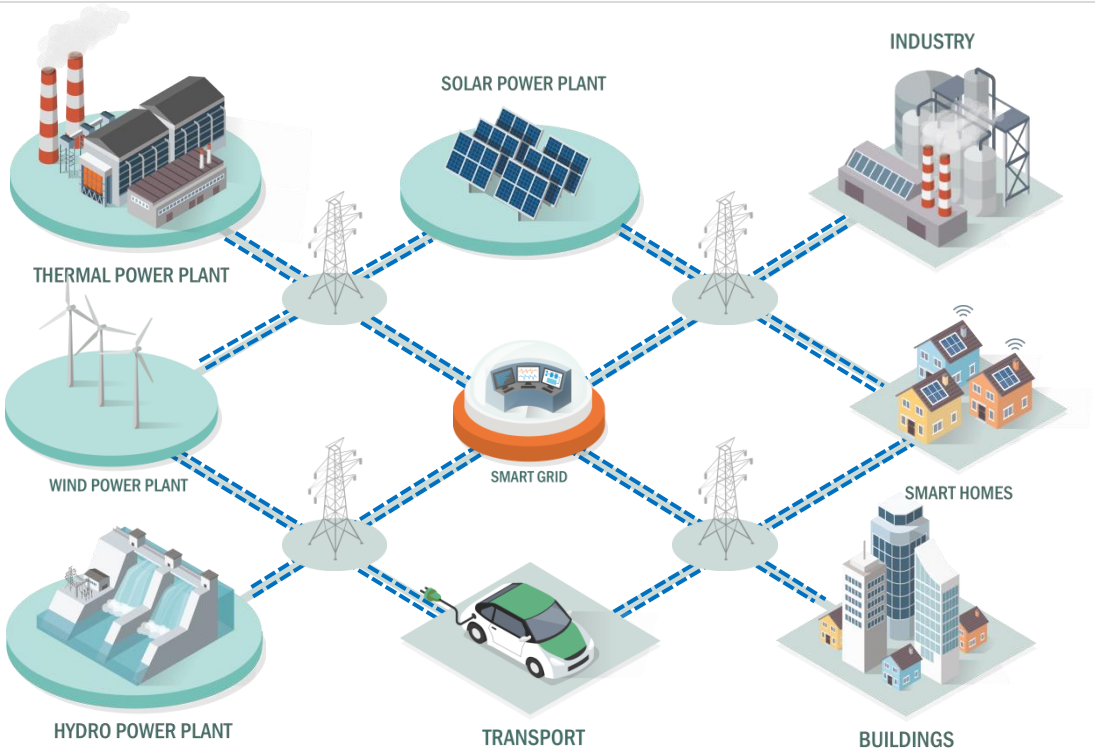
Global stock of digitally enabled automated devices, 2010-2021



~**double** by 2030

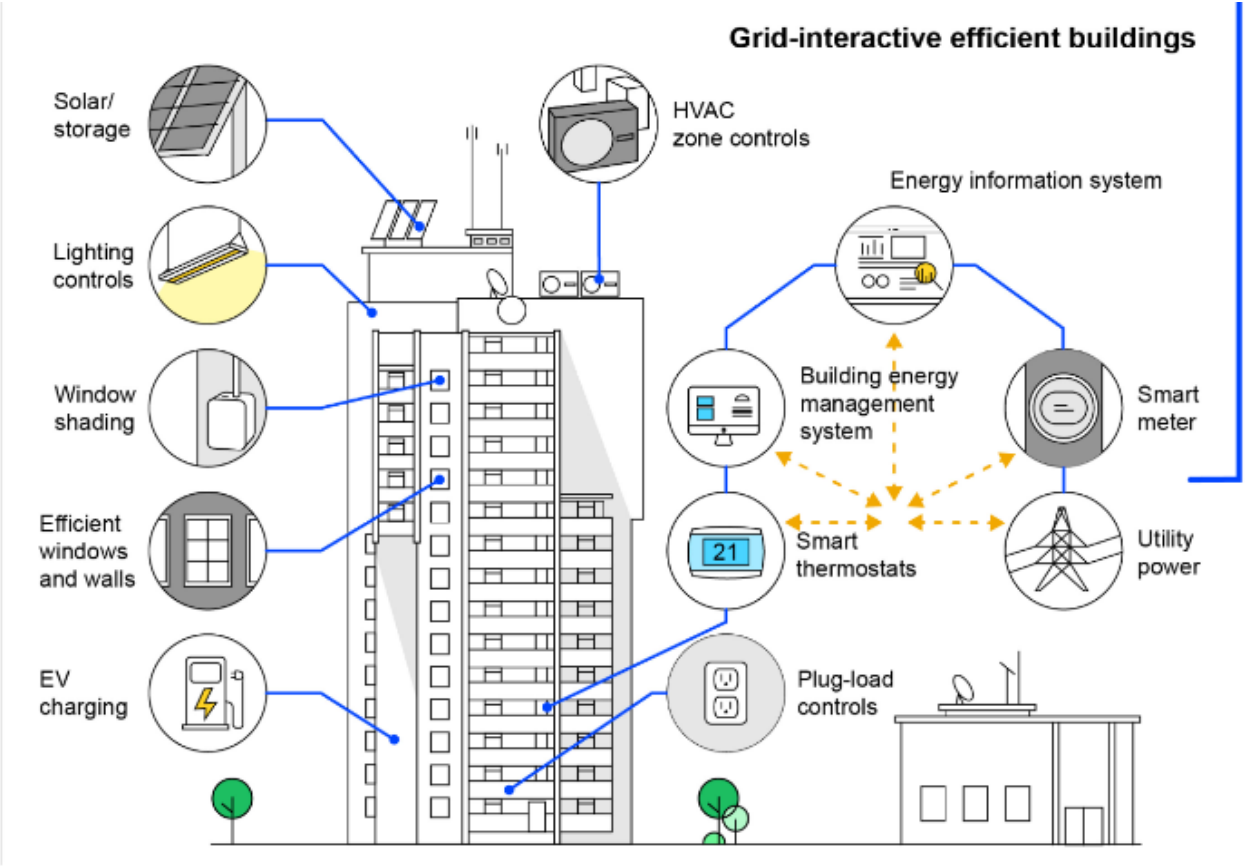
2023 – 13 billion
2030 – more than 25 billion

The digital transformation of the energy system

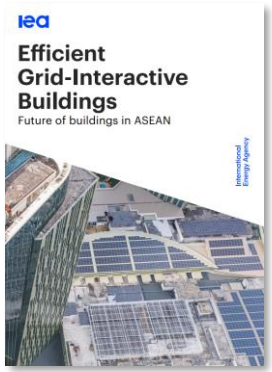


Pre-digital energy systems are defined by unidirectional flows and distinct roles, digital technologies enable a multi-directional and highly integrated energy system

Grid-interactive buildings – provide efficiency and flexibility



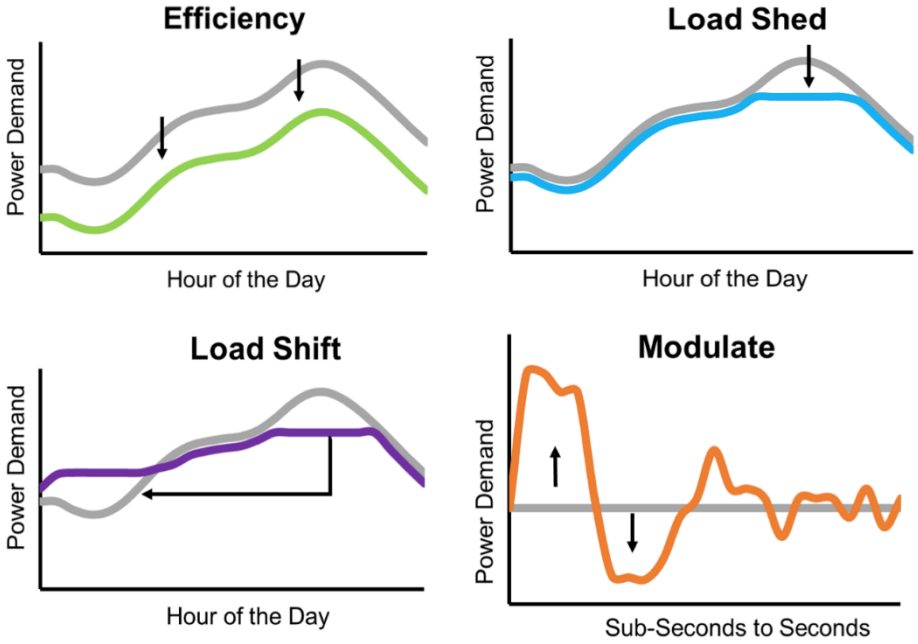
Efficient grid-interactive buildings are energy efficient buildings with smart technologies characterized by the active use of distributed energy resources (DERs) to optimize energy use for grid services, occupant needs and preferences, and cost reductions in a continuous and integrated way



Report launched in October 2023

Grid services of efficient grid-Interactive buildings

- **Efficiency**: the ongoing reduction in energy use while providing the same or improved level of building function.
- **Load Shed**: the ability to reduce electricity use for a short time period and typically on short notice.
- **Load Shift**: the ability to change the timing of electricity use. In some situations, a shift may lead to changing the amount of electricity that is consumed.
- **Modulate**: the ability to balance power supply/demand or reactive power draw/supply autonomously in response to a signal from the grid operator during the dispatch period.
- **Generate**: the ability to generate electricity for on-site consumption and even dispatch electricity to the grid in response to a signal from the grid.

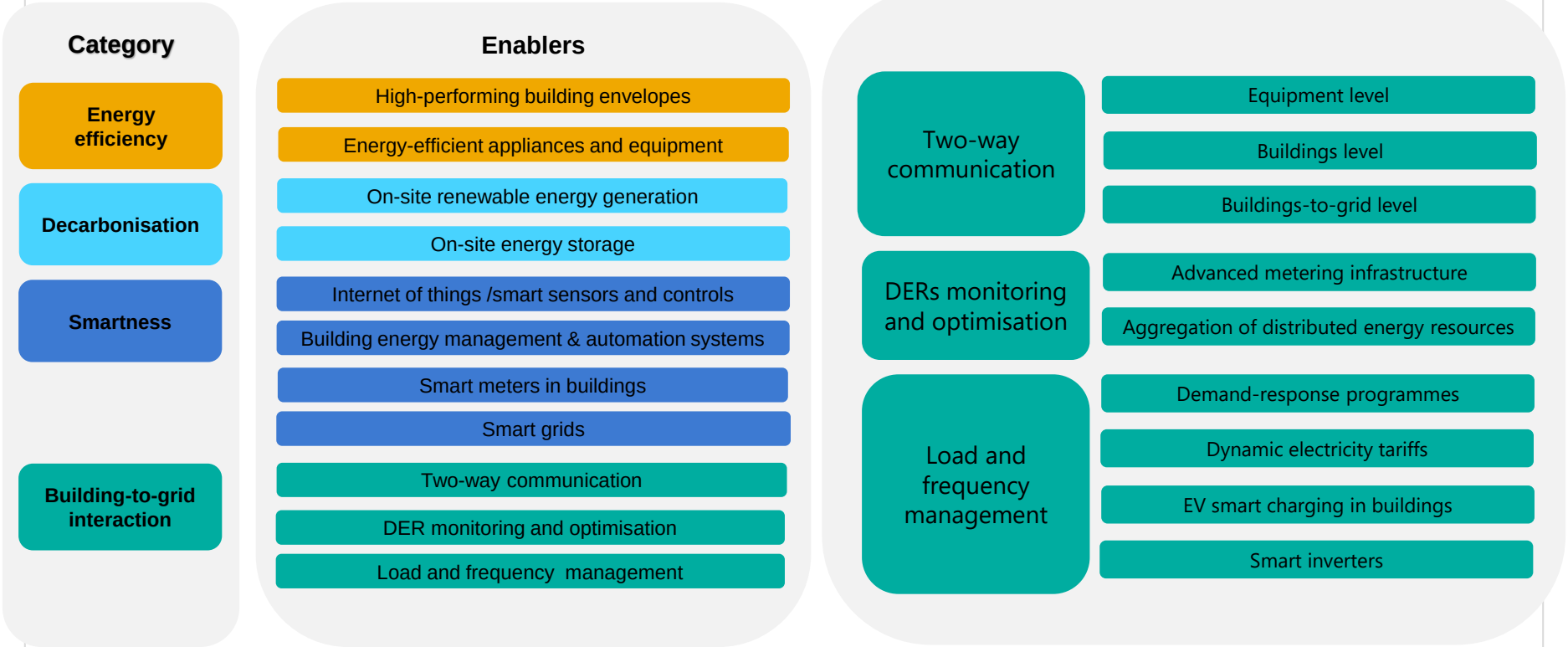


Source

Interesting fact

From 2010 to 2017, over 250 TWh of variable renewable electricity was curtailed globally, (~180 Mt CO2 emissions) equivalent to Spain's annual electricity demand

Enablers for building-to-grid interaction



https://www.iea.org/reports/efficient-grid-interactive-buildings

Two-way communication = need for interoperability

Level of integration	Technology example	Interoperability standards
 Building-to-grid level	• Automated demand response integrated with efficient appliances to reduce or shift electricity consumption • Aggregation of DERs such as peer-to-peer (P2P) energy trading and virtual power plants (VPP)	• OpenADR for automated demand response • IEEE 2030: Smart Grid Interoperability
 Building level	• Building energy management system (BEMS) • Home energy management system (HEMS) for residential settings • DERs like solar rooftop • Energy storage system integrated with building's energy system • Advanced HVAC control system	• BACnet, LonWorks: For building control
 Equipment level	• Smart appliances (e.g., smart AC, smart refrigerators, daylighting with sensors & controls) • Programmable thermostats • Smart lighting systems • Variable frequency drivers for HVAC	• Zigbee, Z-Wave: Communication protocols for home automation • Modbus: Communication protocol for industrial electronic devices

Ensuring interoperability means taking actions to develop standards and facilitate data exchange

Some related interoperability standards for EGIB

Zigbee or Z-Wave		BACnet, Modbus, LonWorks	OpenADR
Both Z-Wave and Zigbee are wireless technology used to connect smart home devices to each other and the internet		Communication protocols that play vital roles in building automation and control systems, allowing different devices and systems to communicate with each other	OpenADR is an open and standardized communication protocol that supports the automation of demand-side management services, particularly demand response (DR).
Frequencies	2.4 GHz and 915 MHz	An example of utilising these protocols is in a building management system that oversees HVAC, lighting, security, and fire safety. These protocols enable integration among systems and devices from different manufacturers, facilitating unified monitoring, control, and energy savings.	OpenADR is automated, interoperable, and scalable. An example of its implementation is peak load shaving in commercial buildings. OpenADR enables buildings to automatically respond to demand response requests, facilitating peak shaving through reduced energy demand.
Speed	40 Kbps – 250 Kbps		
Compatibility	2820 – 3000+ devices		
Interference	WiFi (Zigbee), 900 MHz (Zwave)		

Case study: OpenADR in Thailand's demand-response programme

The Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA) are looking to integrate OpenADR standards into their demand-response operation.

Timeline of demand response programme in Thailand

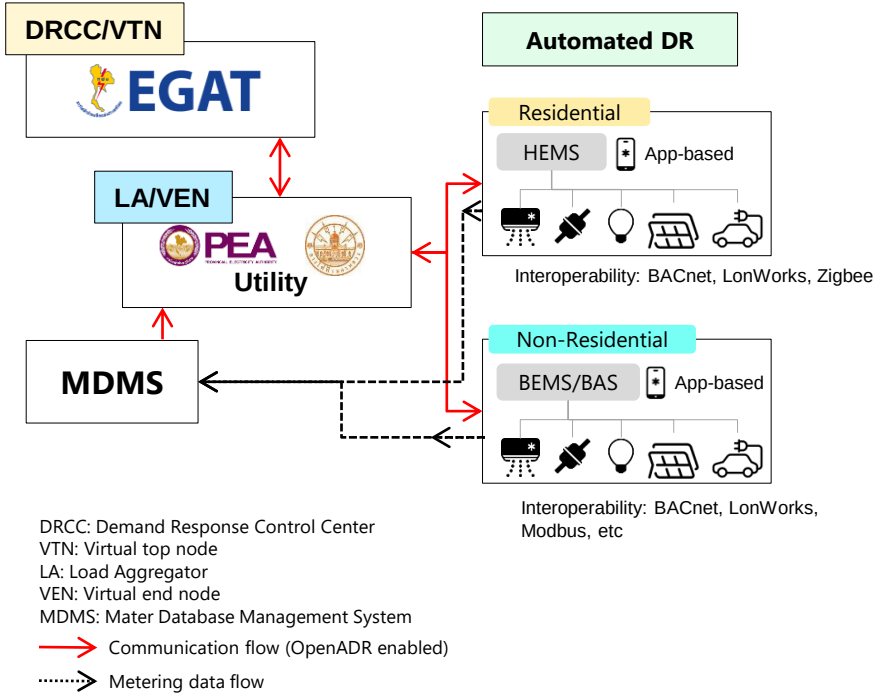
2013
Manual demand response was introduced in Thailand in 2013 to reduce peak demand during the 2013 – 2015 period in response to the gas supply shortage.

1st Trial
The first pilot demand response programme in 2014 achieved an actual reduction of 130 MW from the 200 MW expected target load. The participants were from the industry and residential sectors from all areas of the country.

2nd Trial
The second trial was for the Southern region of the country. The incentive scheme was enhanced, resulting in a higher reduction of 202 MW from the 250 MW target load.

2015
An incentive-based DR programme was piloted in 2015. The peak demand was reduced to 500 MW from an expected load of 561 MW. The demand response programme was a combination of implicit and explicit programmes.

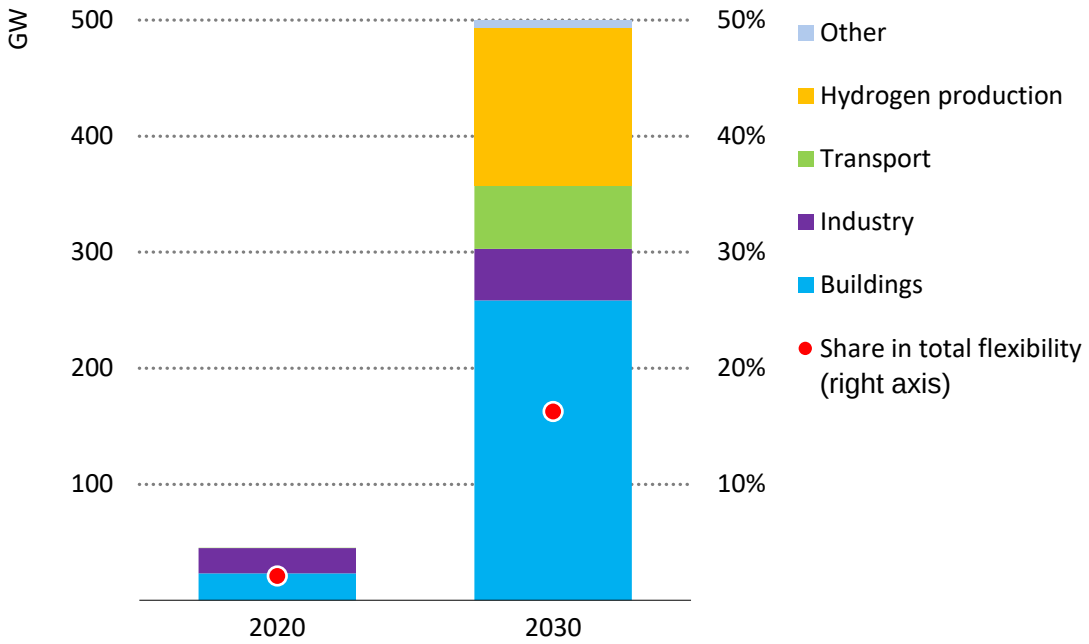
Proposed Automated DR implementation for Thailand (simplified)



Source: Sonsaard et al., (2022)

Demand-response availability increases tenfold by 2030, mostly coming from buildings

Demand response availability at times of highest flexibility needs and share in total flexibility provision in the Net Zero Scenario, 2020 and 2030

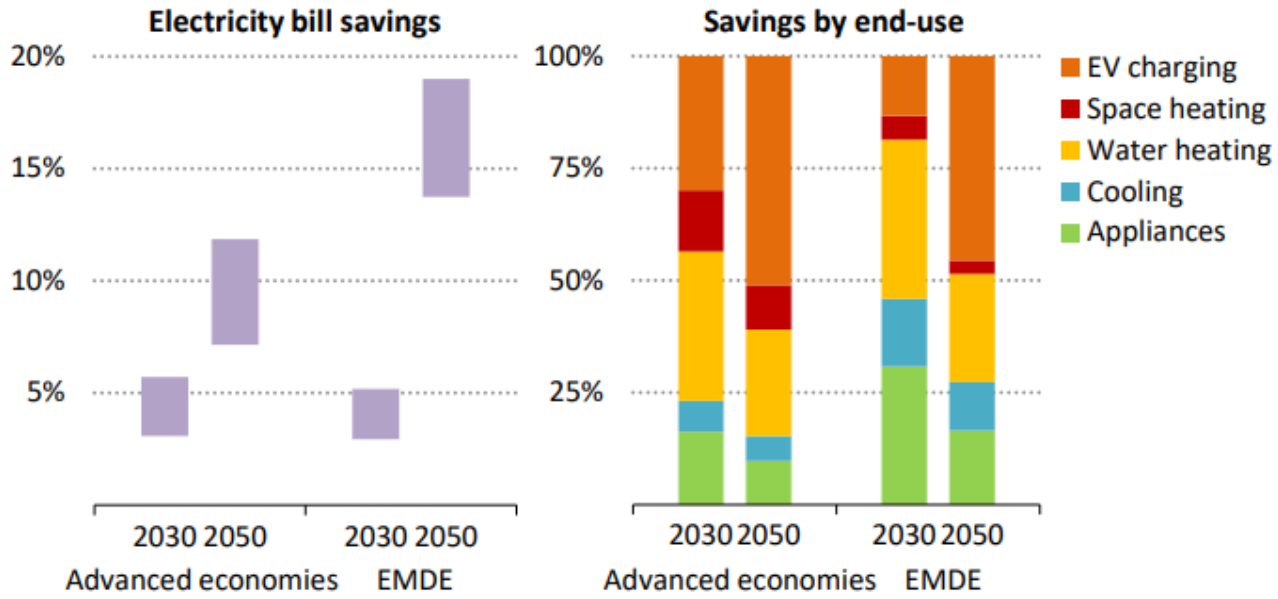


Actions taken in this decade to open markets to demand-side participation, encourage new business models and establish controllability standards for equipment and appliances

https://www.iea.org/reports/demand-response

Demand-side response as a tool to cut energy demand & bills

Electricity bill savings from demand response for households and by end-use in the NZE Scenario, 2030 and 2050



Demand-side response measures can help consumers cut energy bills by up to nearly 20% by 2050 in particular by shifting EV charging and water heating patterns

Source: IEA (2023), World Energy Outlook

Case Study: Washington House Bills 1444 for CTA-2045

Washington House Bill 1444 States…

An electric storage water heater, if manufactured on or after January 1, 2022, may not be installed, sold, or offered for sale, lease, or rent in the state **unless it complies with the following design requirement:**

a) The product must have a modular demand response communications port compliant with:

   i. The March 2018 version of the ANSI/CTA–2045-A communication interface standard, or equivalent and

   ii. The March 2018 version of the ANSI/CTA-2045-A application layer requirements."

Source

CTA-2045

ANSI/CTA-2045 specifies a modular communications interface (MCI) to facilitate communications with residential devices for applications such as energy management.

- **This is not a device, but a protocol**
- Makes it possible for appliances to participate collectively in ADR

CTA-2045 Appliance Family

Hot Water Heaters

Pool Pumps

EV Chargers

Heat Pump HVAC Mini-Splits

Packaged Terminal Air Conditioner

Source

Case Study: California Buildings Standards

The 2022 California Building Energy Code strongly incentivizes all-electric construction

focuses on four key areas in newly constructed homes and businesses:

- **Encouraging electric heat pump technology** for space and water heating, which consumes less energy and produces fewer emissions than gas-powered units; new homes to be wired in ways that ease and encourage use of electricity for heating and other appliances.
- **Establishing electric-ready requirements** for single-family homes to position owners to use cleaner electric heating, cooking and electric vehicle (EV) charging options whenever they choose to adopt those technologies.
- **Expanding solar photovoltaic (PV) system and battery storage standards** to make clean energy available onsite and complement the state's progress toward a 100 percent clean electricity grid;
- to include solar power and battery storage in many new and renovated commercial structures as well as high-rise residential projects
- **Strengthening ventilation standards** to improve indoor air quality
- **Requiring to install demand response automation** technology: thermostats, HVAC systems, networked lighting controllers, BASs must have two-way communication and be demand responsive using OpenADR, a common open industry led standard.

40 YEARS
OF ENERGY EFFICIENCY STANDARDS FOR BUILDINGS AND APPLIANCES HAVE SAVED CALIFORNIANS MORE THAN
$100 BILLION

Virtual Power Plant (VPP)

Aggregators bundle DERs to engage as a single entity – a virtual power plant (VPP) – that could participate in power or service markets

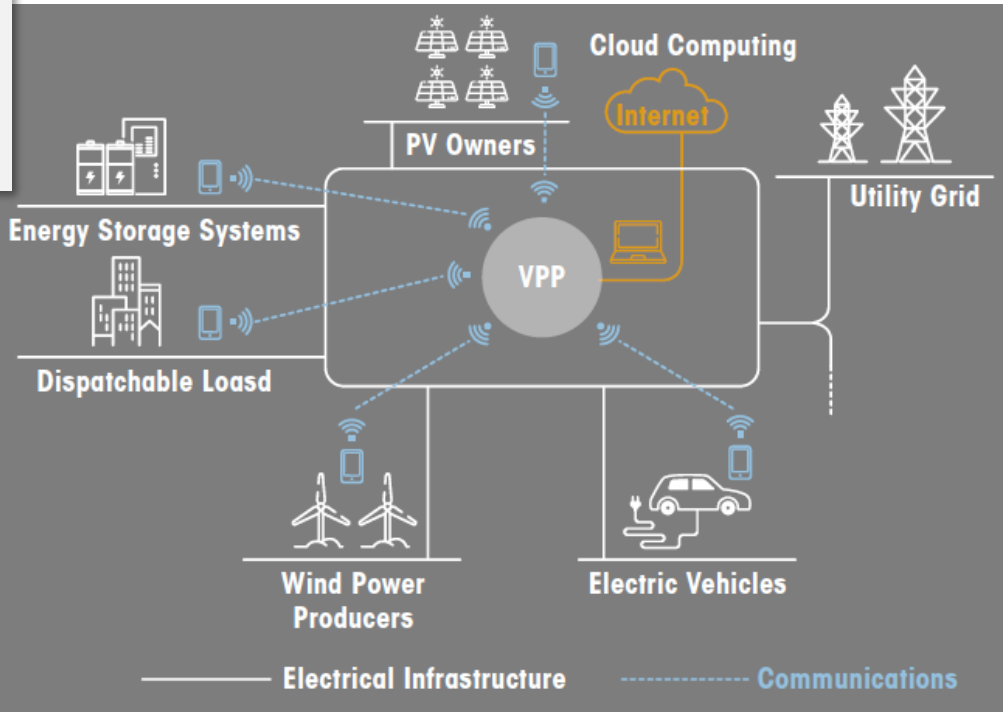
A VPP is a system that relies on software and a smart grid to remotely and automatically dispatch and optimise the distributed energy resources

Aggregators use a centralised IT system to remotely control the DERs and optimise their operation.

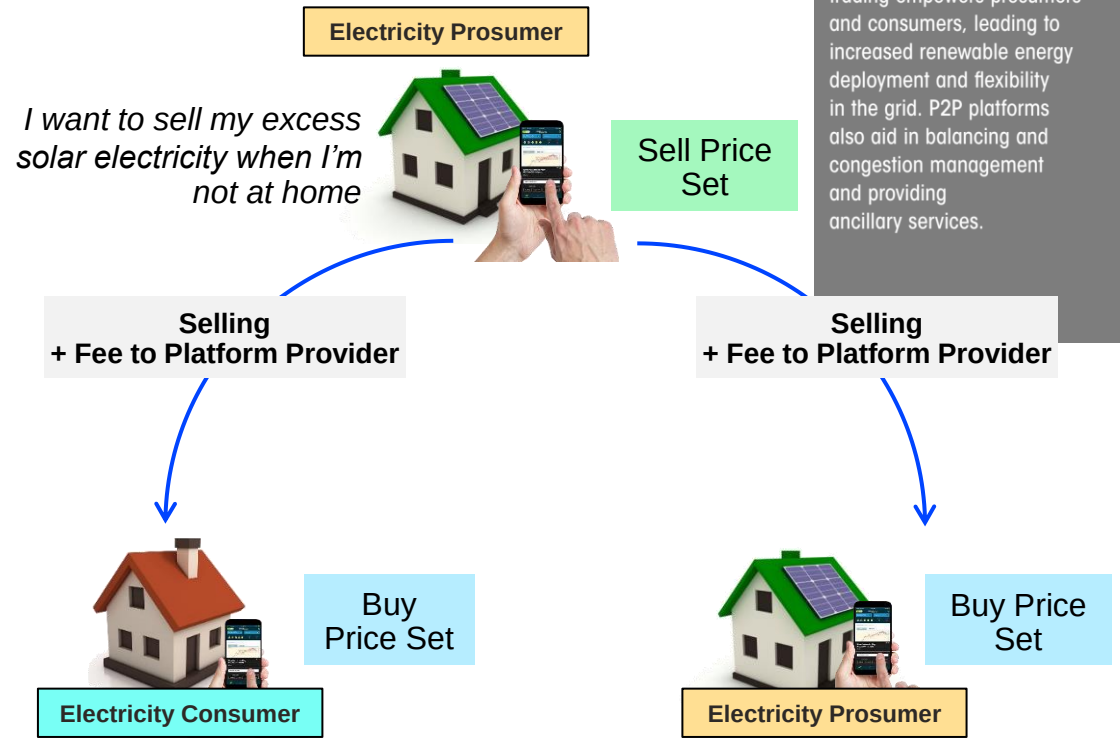
They can provide:

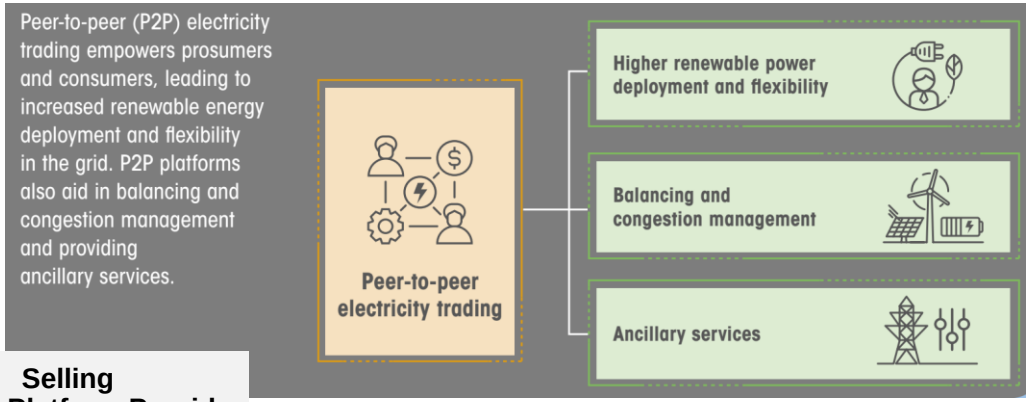
- ➜ Load shifting
- ➜ Balancing services to TSOs
- ➜ Local flexibility to DSOs

Source: IRENA (2019)



Peer-to-Peer (P2P) [renewable] electricity trading





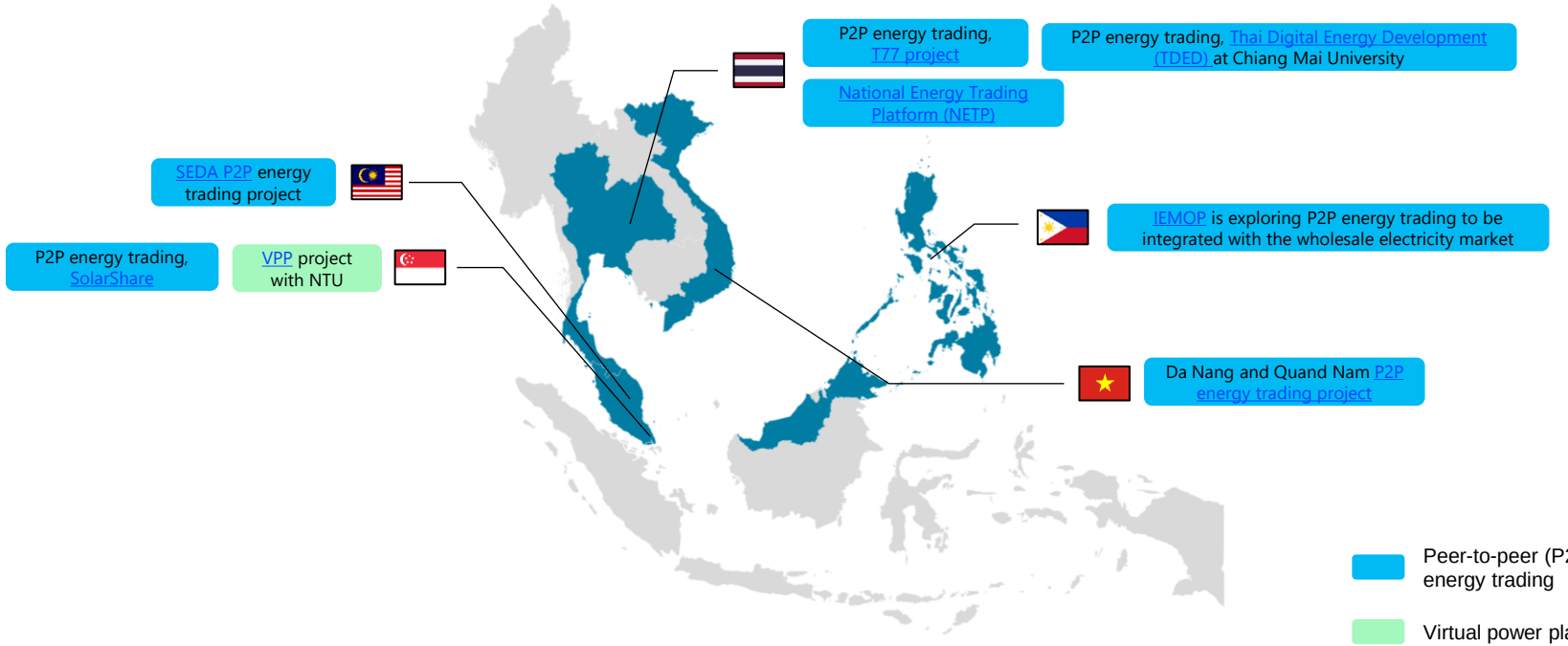
Source: IRENA (2020)

Interesting fact

P2P electricity trading platform can serve as a virtual power plant and provide services to the main grid

Aggregation of DERs in the ASEAN region

Pilot projects are demonstrating benefits of aggregating distributed energy resources (DERs)



A promising trend in the region is the integration of Distributed Energy Resources (DER) through the implementation of peer-to-peer (P2P) energy trading and virtual power plant (VPP) projects. Many of these initiatives have been supported by regulatory sandboxes, allowing them to test and implement new and innovative technologies.

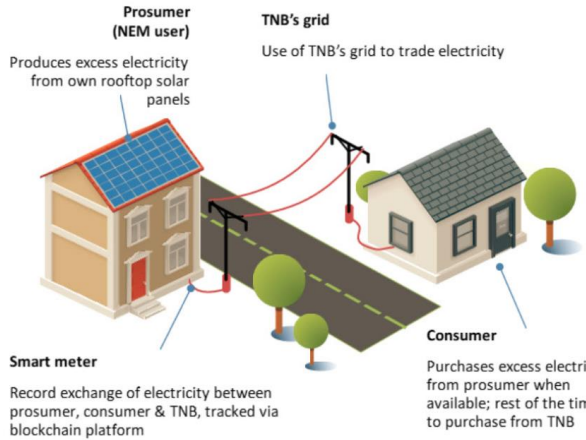
Malaysia's 1st pilot run of P2P energy trading

Project details

P2P platform was developed under the regulatory sandbox framework

A Regulatory Sandbox is defined as a 'safe place' where a predetermined set of rules allow innovators to test their products, services, business models and delivery mechanisms in a live environment with relaxations on all or specific regulatory requirements.

- The P2P platform was provided by PowerLedger and involved four prosumers and eight consumers, with a total installed solar PV capacity of 4 031 kWp.
- TNB purchased electricity from the prosumers at a rate 10% higher than the medium voltage industrial tariff and sold it to consumers at a rate 11% cheaper than the residential tariff.
- During the eight-month operating period from June 2020, a total of 680 MWh of energy was exported by the prosumers, and 470 MWh of energy was traded between participants in the P2P energy project.



Source: SEDA

Session Activity

International Energy Agency

Activity: Efficient grid-interactive buildings & digitalisation

Select 3-4 the most important enablers for your country and specify what technologies and policy instruments could support their implementation

Category	Enablers		
Energy efficiency	High-performing building envelopes		
	Energy-efficient appliances and equipment		
Decarbonisation	On-site renewable energy generation		
	On-site energy storage		
Smartness	Internet of things /smart sensors and controls		
	Building energy management & automation systems		
	Smart meters in buildings		
	Smart grids		
Building-to-grid interaction	Two-way communication	Two-way communication	Equipment level
			Buildings level
			Buildings-to-grid level
	DER monitoring and optimisation	DERs monitoring and optimisation	Advanced metering infrastructure
			Aggregation of distributed energy resources
	Load and frequency management	Load and frequency management	Demand-response programmes
			Dynamic electricity tariffs
			EV smart charging in buildings
			Smart inverters

International Energy Agency

Energy Efficiency Training Week

Africa Energy Efficiency Policy in Emerging Economies Training Week

Nairobi

18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

Deep dive on passive design and cooling in buildings

Nairobi

18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

Overview of session

1. Recap of session 1
2. Case Study 1: Norrsken Kigali House, Rwanda
3. Case study 3: Earth Enable (rural low-income homes)
4. Case study 2: Kepler Higher Education Buildings, Kigali, Rwanda

Audience Question

How many people are at high risk due to a lack of access to cooling across Latic America and the Caribbean, Africa, Asia and the Middle East?

A. 1.55 million people

B. 50 million people

C. 1.12 billion people

D. 6 billion people

Audience Question

What are some passive cooling strategies that can be used to protect the most vulnerable from heat exposure and lower energy demand for active cooling?

Recap

Passive cooling measures can reduce global cooling capacity by 24% (UNEP, 2023) and a vital for reducing heat exposure for the most vulnerable populations.

Passive cooling measures includes:

- Solar shading
- Natural ventilation
- ‘Cool’ Roofs
- Thermal mass
- Nature-based solutions, e.g. trees and vegetation

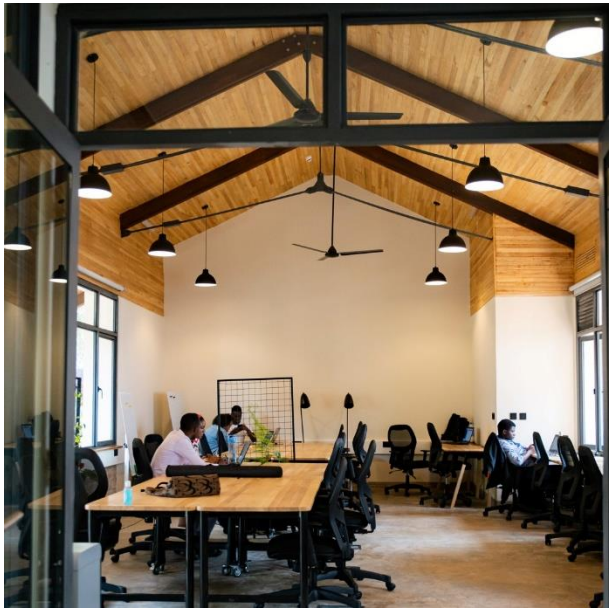
Policies and actions: Building code, voluntary standards, government leading by example, awareness campaigns, training and capacity building etc…

Case Study 1: Norrsken Kigali House, Rwanda

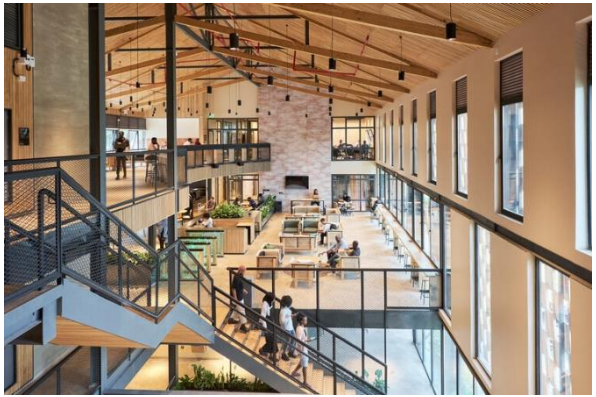
Photo credit: Chris Schwagga

MASS.

Case Study 1: Norrsken Kigali House, Rwanda



Natural ventilation + ceiling fans for adaptive comfort.

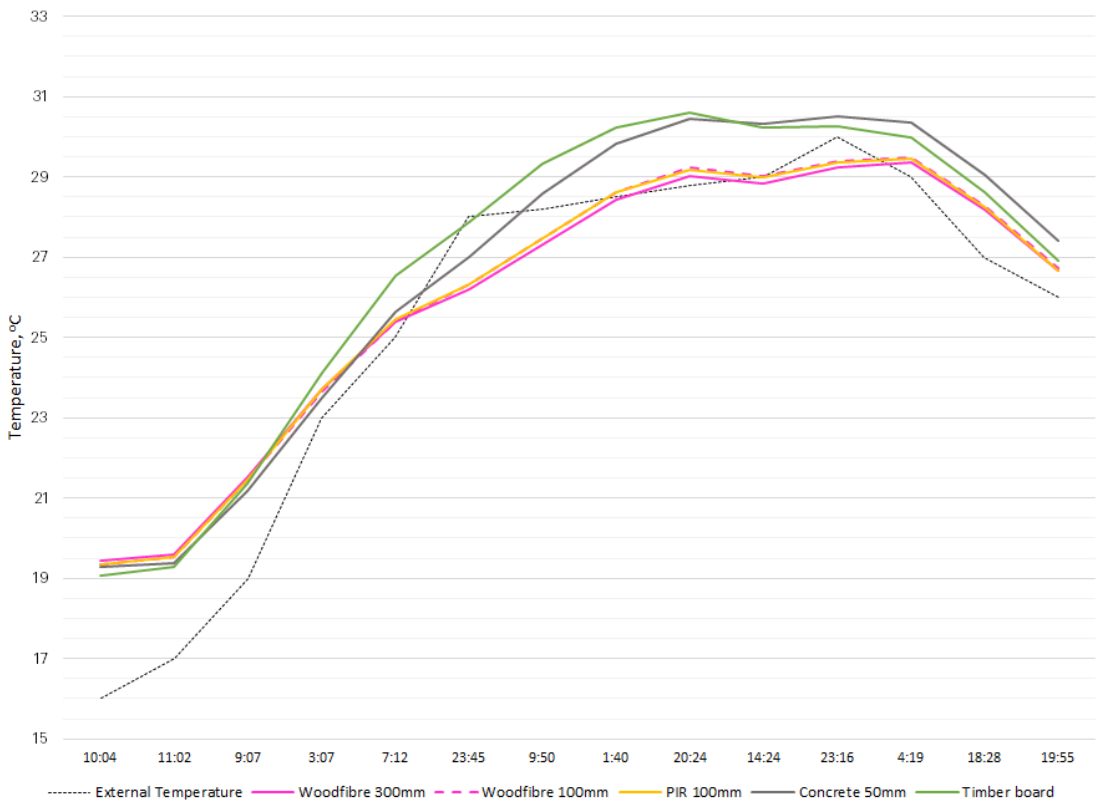


Wood fibre insulation in the roof build up

Atrium space with low level and high-level opening for stack ventilation.

Clay tile shading & high-performance glazing for west facing façade.

Case Study 1: Norrsken Kigali House, Rwanda

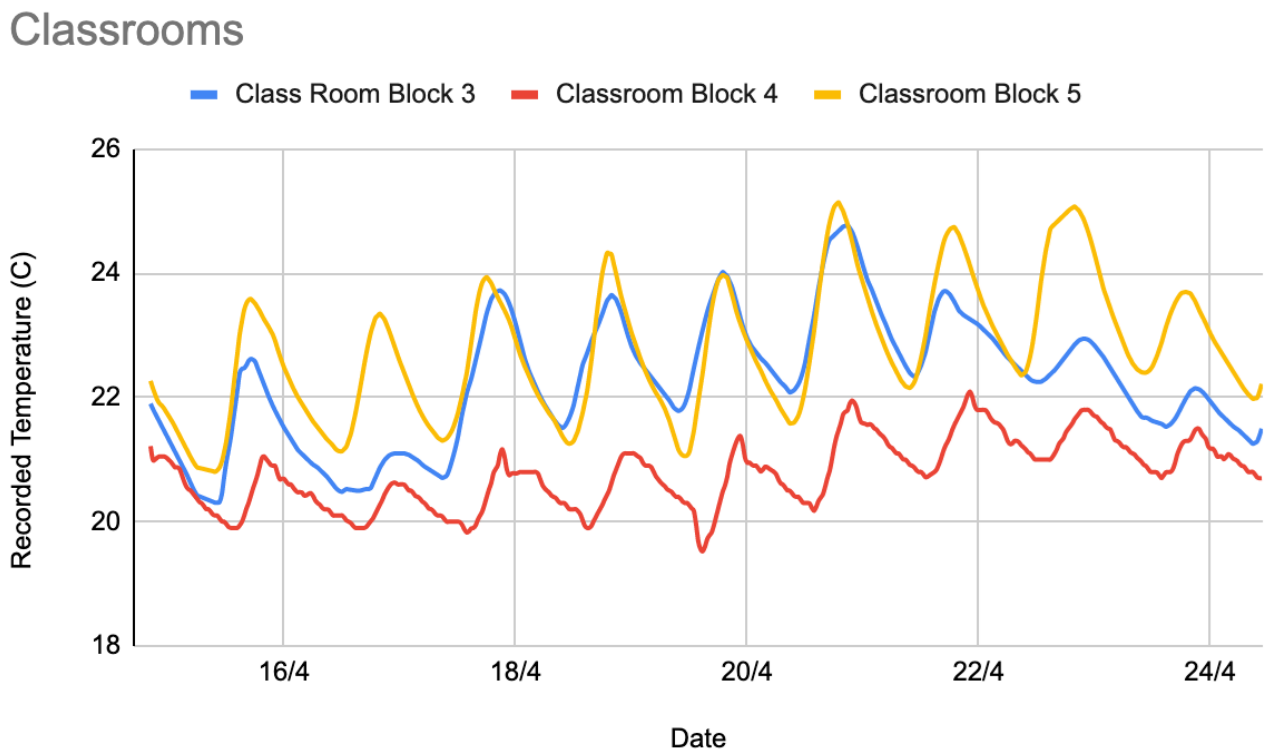


Design simulations for renovated spaces

During the design we predicted that we could keep the internal at or below external temperatures with wood fibre insulation in the roof.

Other roof build ups resulted in higher internal temperatures.

Case Study 1: Norrsken Kigali House, Rwanda



Actual measurements post-occupancy for renovated spaces

Weekly external temperatures

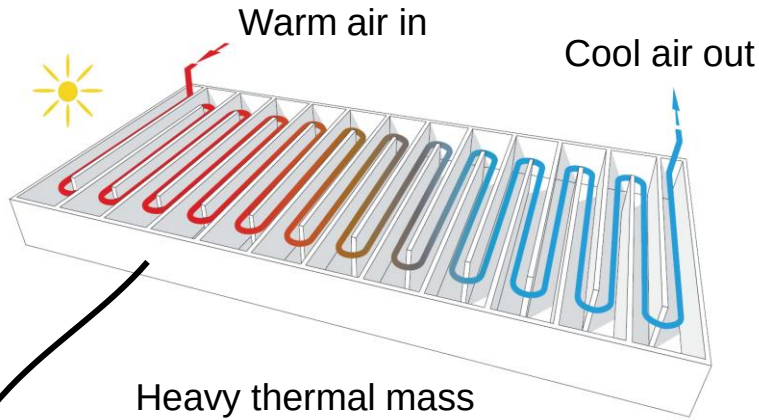
Max: 27ºC
Average 21ºC
Low: 17ºC

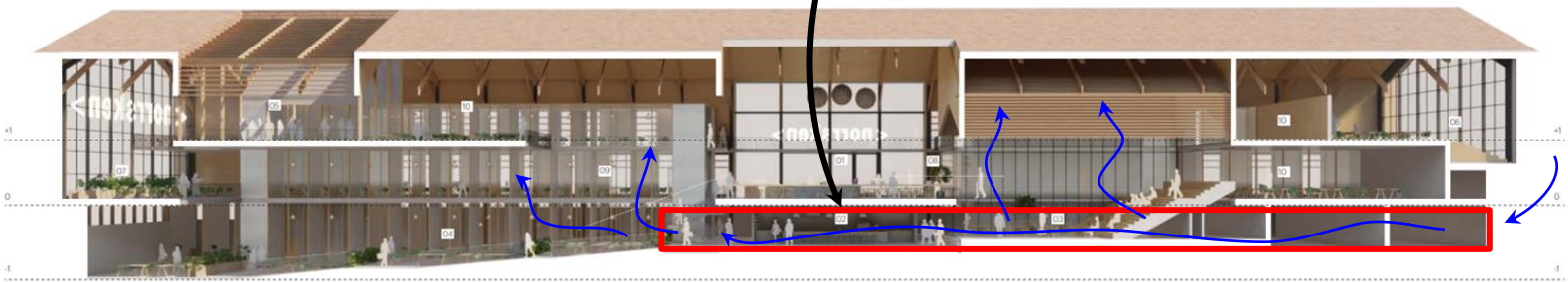
Internal temperaures below outdoor peak temperatures

Case Study 2: Kepler Higher Education Facility, Kigali, Rwanda

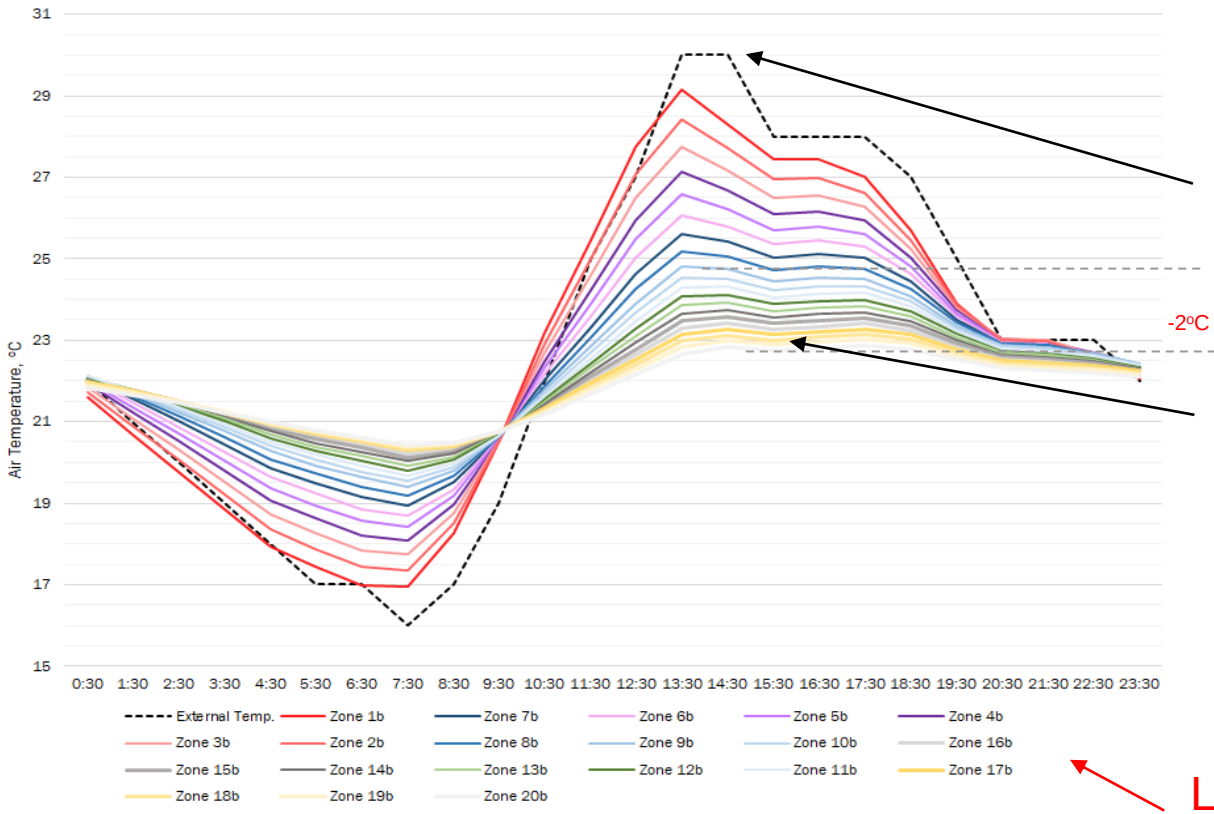
Thermal labyrinth ventilation & cooling system

- Passive cooling (no refrigerants) driven by mechanical fan
- Daytime: Warm outdoor air passes through a below-building ‘labyrinth’ made of concrete blocks that absorb heat and cool the air before it’s delivered to the building.
- Nighttime: Heat is purged from the labyrinth construction materials by driving cool nighttime air through it





Case Study 1: Norrsken Kigali House, Rwanda



Design simulations for thermal labyrinth cooling

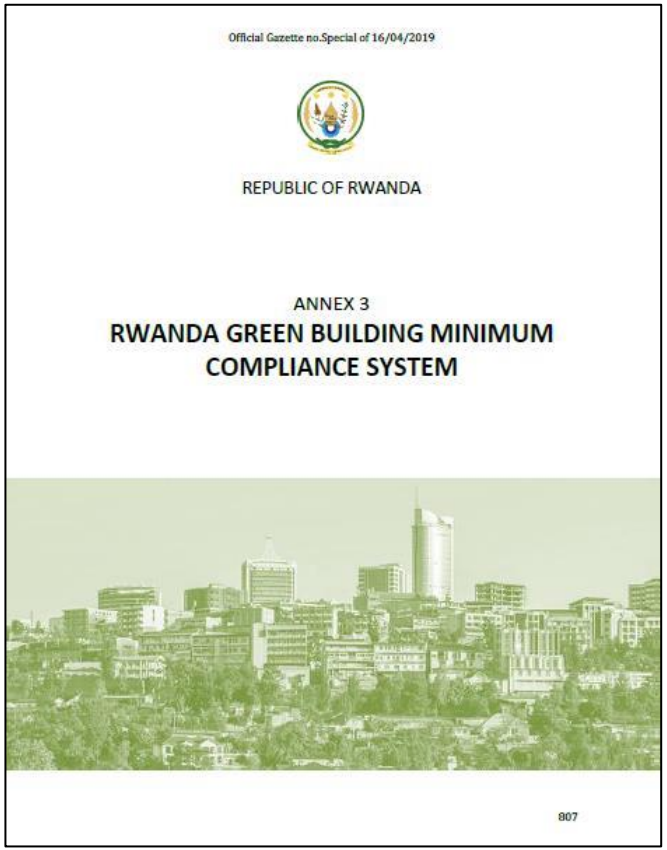
Peak outdoor air temperature: 30°C

Supply air temperature to building: < 23°C

(1000 litres/ second Continuous ventilation)

Labyrinth zones each 6m in length

Case Study 1: Norrsken Kigali House, Rwanda


Official Gazette no.Special of 16/04/2019

REPUBLIC OF RWANDA

ANNEX 3

RWANDA GREEN BUILDING MINIMUM COMPLIANCE SYSTEM

807

Excellence In Design For Greater Efficiencies

Edge

CERTIFIED GREEN ▸ ADVANCED

20%	40%	100%
LEVEL 1: EDGE Certified	LEVEL 2: EDGE Advanced (Zero Carbon Ready)	LEVEL 3: Zero Carbon

Case Study 1: Norrsken Kigali House, Rwanda

Key Takeaways

- It’s possible to design beautiful, energy efficiency, comfortable work-spaces that maximise the use of passive design and cooling!
- The occupied building doesn't always function as designed
- Testing and commissioning, hand-over, building operator understanding is key
- Monitoring and evaluation is helpful to tweak and improve sytems

Case Study 3: Earth Enable, Low-income homes, East Africa

EarthEnable develops ultra-affordable, extremely sustainable, and high-quality earthen housing products and construction techniques in our design lab.

EarthEnable identifies masons to become micro- franchisees and trains them to

EarthEnable's ongoing role can be replicated by others, which will catalyze an affordable healthy housing industry.

Case Study 3: Earth Enable, Low-income homes, East Africa

2014 Floors

2019 Plaster

2022 New geographies

2023 R&D on whole housing

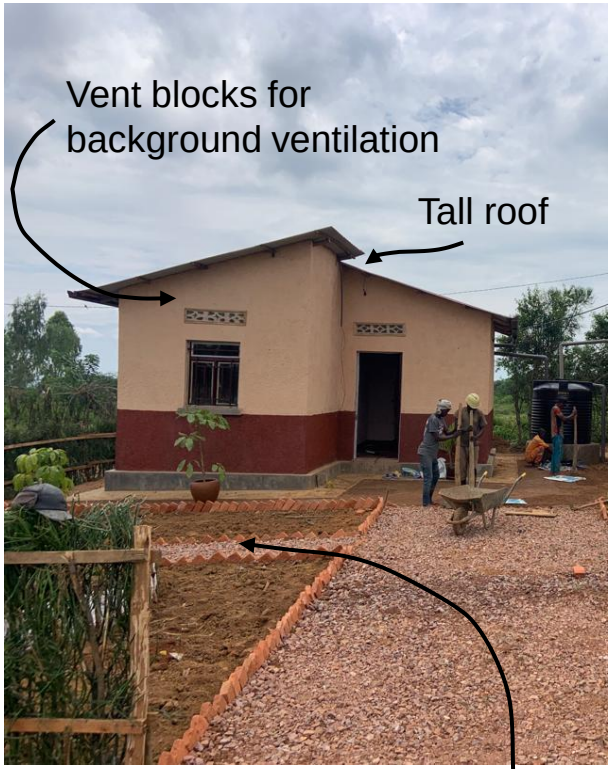
EARTH ENABLE

RWANDA HOUSING AUTHORITY REVISED GUIDELINES ON USING ADOBE BRICKS

Case Study 3: Earth Enable, Low-income homes, East Africa

Clerestory vents encourage stack ventilation

Exposed earthen floor and earth walls offer excellent thermal mass



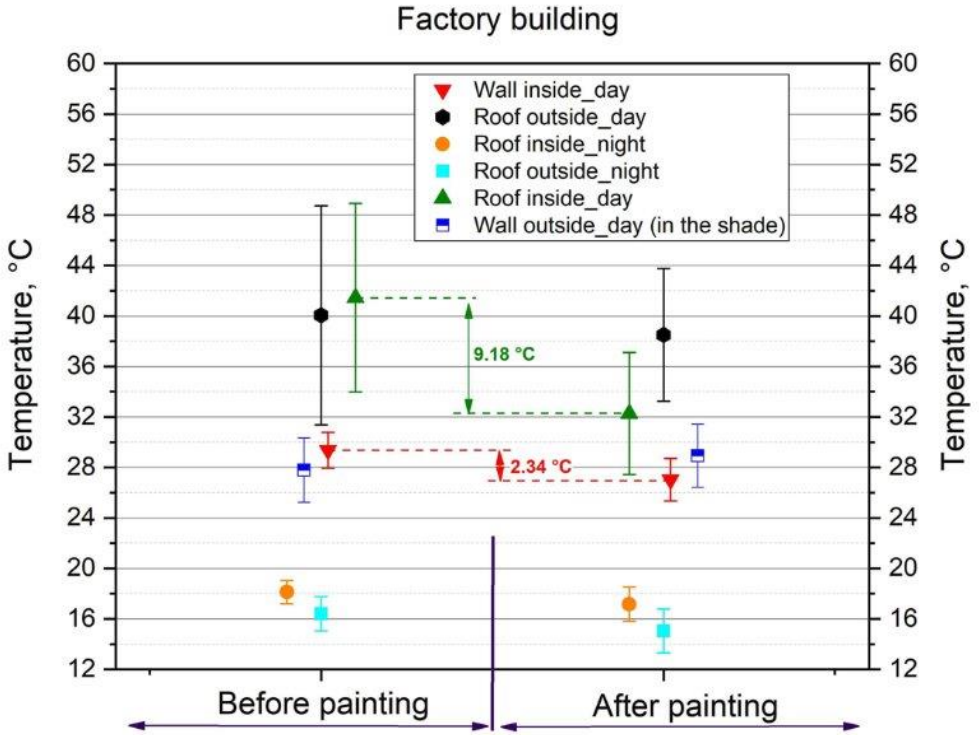
Vegetation & trees

Case Study 3: Earth Enable, Low-income homes, East Africa

Future research & development

- Paint a roof white
- Monitor & compare homes
- Train micro franchises to be ‘master’ painters?

Actual data from GIZ (German government international aid agency) ‘Cool White’ project in Rwanda →



Case Study 3: Earth Enable, Low-income homes, East Africa

Future research & development

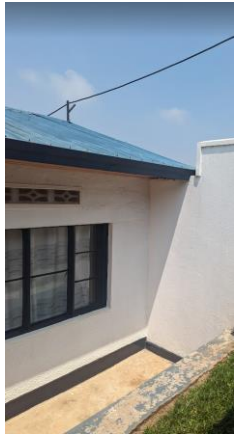
- Thicker abode walls to increase thermal mass?

"***increasing the wall thermal mass improved both the daytime and nighttime*** *indoor thermal conditions. By changing the wall thickness* ***from 200 to 400 mm****, the percentage of operative temperatures outside the adaptive comfort zone was reduced by 15.6% and 72.8% for the daytime and nighttime hours, respectively."*

Holistic Approach towards a Sustainable Urban Renewal: Thermal Comfort Perspective of Urban Housing in Kigali, Rwanda" (Irakoze et al., 2023)

Case Study 3: Kepler University, Kigali, Classroom Renovations

Photo: https://kepler.org/elementor-8715/



Students complained about thermal comfort – it often feel uncomfortable hot, which makes it difficult to concentrate and work.

Case Study 3: Kepler University, Kigali, Classroom Renovations

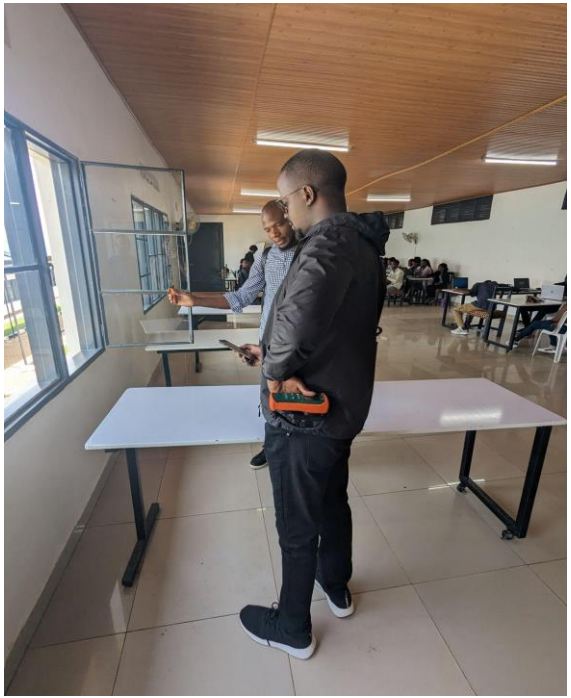
Site Investigations

- Radiant (infrared) temperature measurements

External wall:22ºC

Roof: 52.5ºC!

Ceiling: 33.1ºC



Window: 28ºC

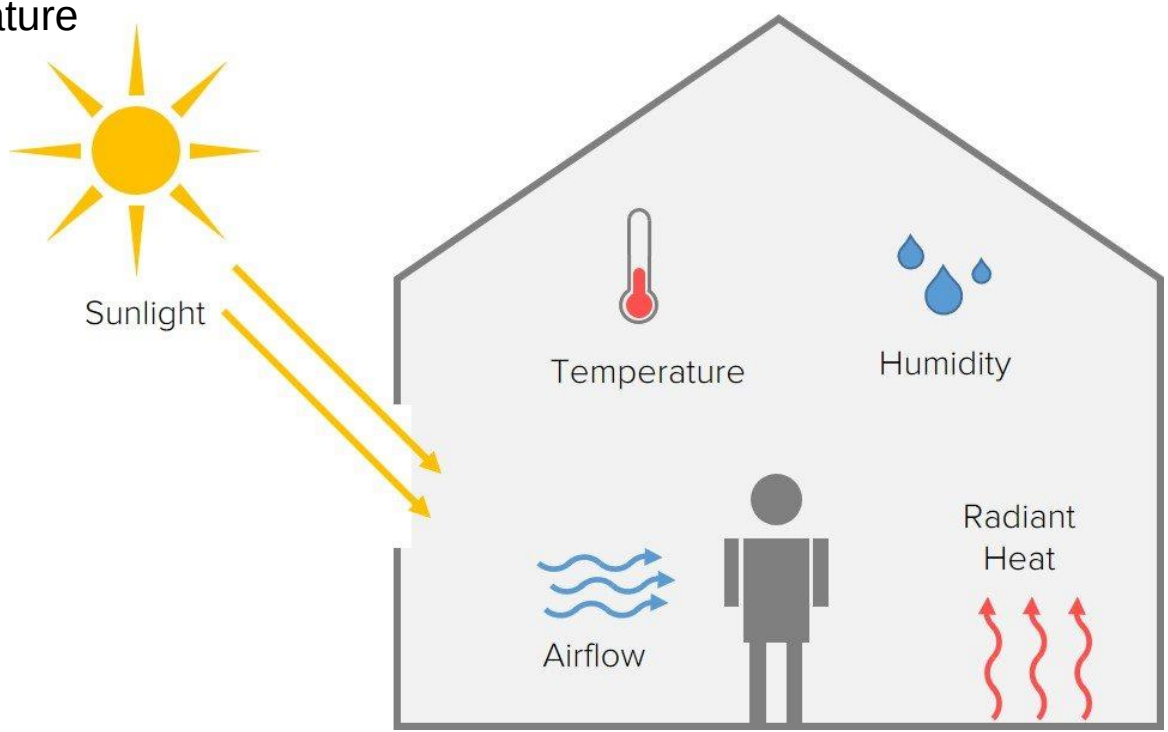
Internal wall: 23.7ºC

Internal floor: 24.5ºC

Case Study 3: Kepler University, Kigali, Classroom Renovations

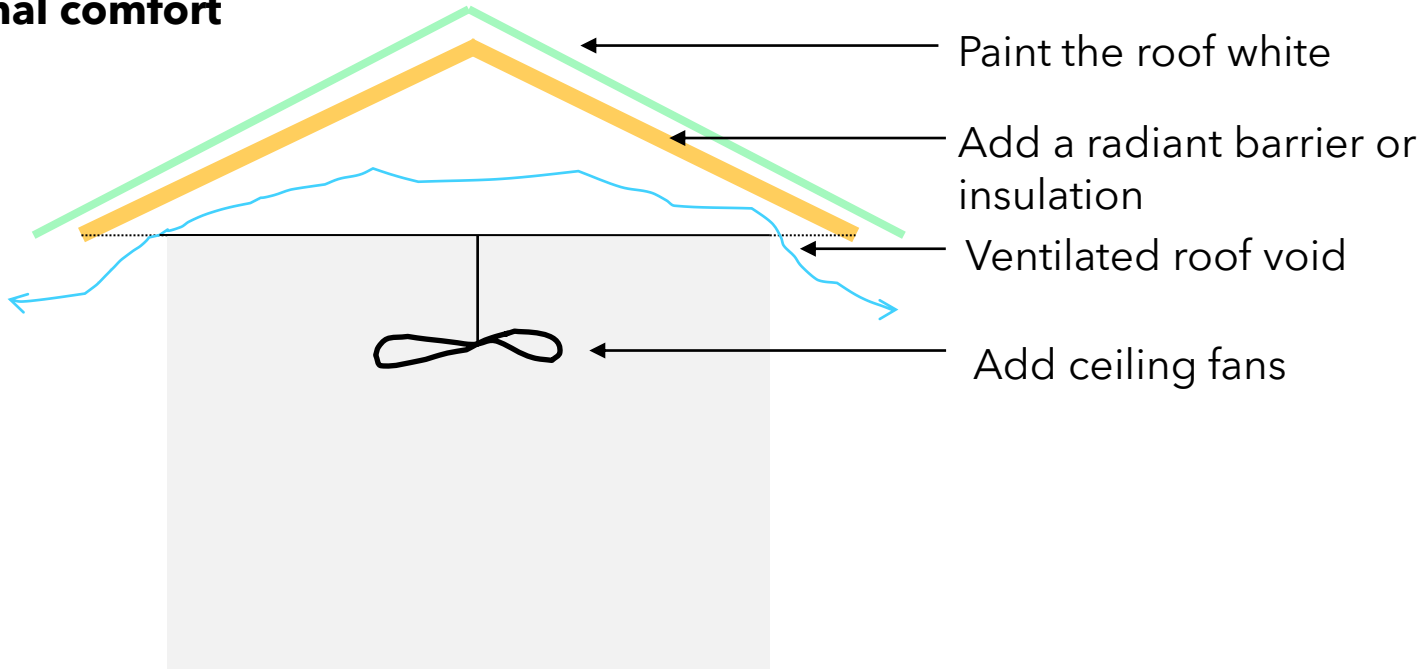
Site Investigations

- Radiant (infrared) temperature measurements



Case Study 3: Kepler University, Kigali, Classroom Renovations

Recommended low-intervention improvements to reduce heat gain & improve thermal comfort



Africa Energy Efficiency Policy in Emerging Economies Training Week

Buildings

Nairobi

18-22 March 2024

https://www.iea-events.org/energy-efficiency-training-week-nairobi

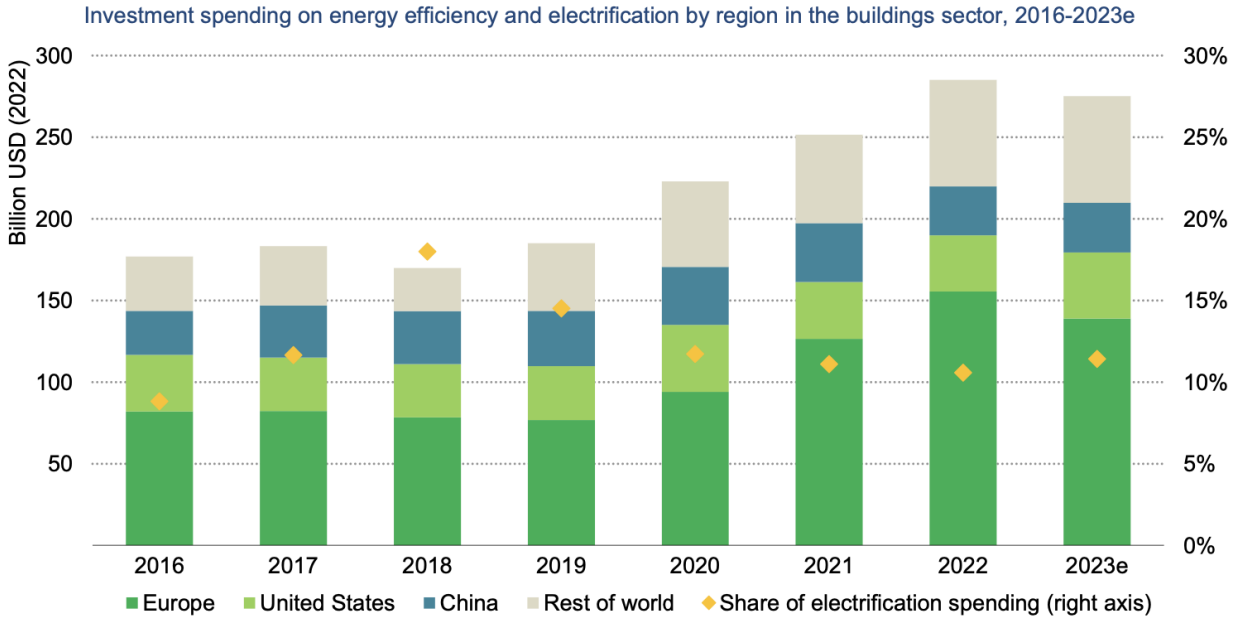
Energy Efficiency Training Week – Buildings – Day 2: 11. Enabling investment in energy efficiency buildings

Introduction

Global investment in energy efficiency in 2022

- In 2022 energy efficiency investment in the global buildings sector **increased by around 14% on 2021 levels**, continuing the strong growth trend of the past few years.
- The total investment of around **USD 285 billion in 2022** marks a strong increase in efficiency spending and electrification from the previous year
- Spending on efficiency is **projected to fall back in 2023** as the effects of increased borrowing costs and economic uncertainty reduce market activity
- The increased efficiency investment in 2022 was the result of sustained spending in major markets such as the United States, Germany and Italy.
- Over **USD 33 billion was spent in the United States** through the continued funding of the Department. of Energy efficiency programmes or utility demand-side management.

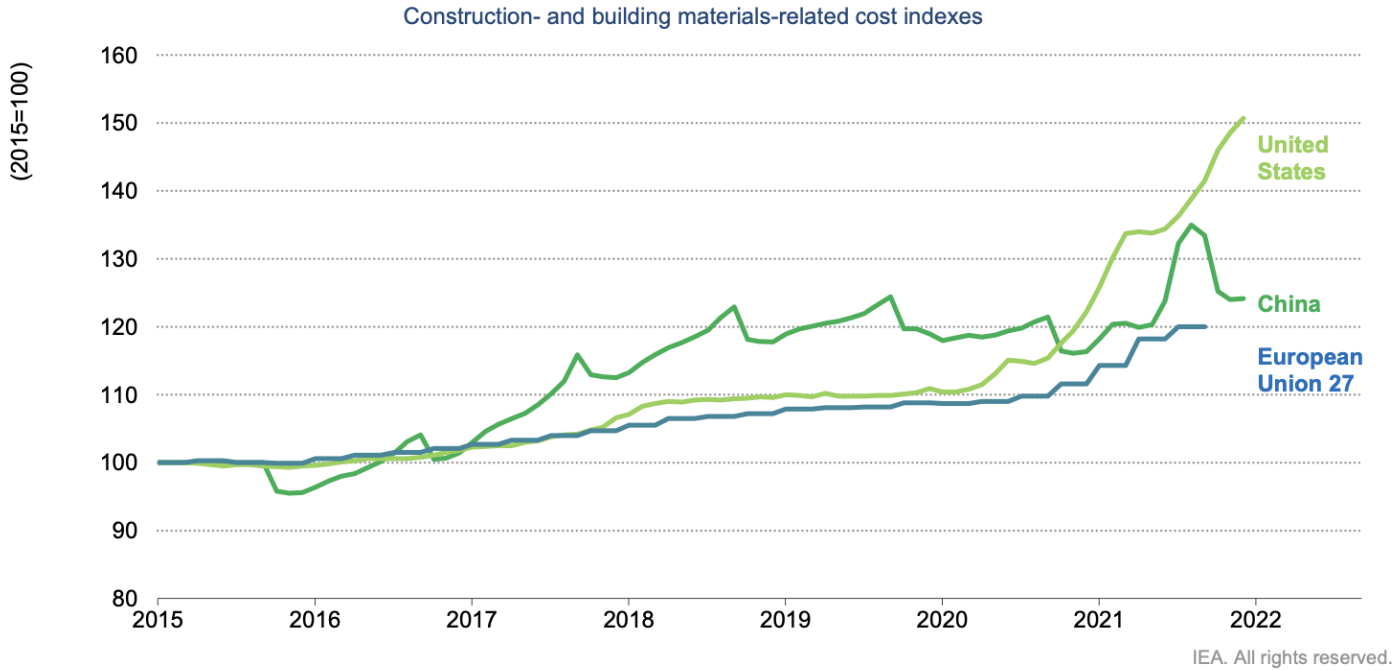
Global investment in energy efficiency



Notes: Spending on electrification (e.g., Heat pumps) is included in the total spending, and represented as a share of total spending on the right axis; 2023e = estimated values for 2023

Energy efficiency spending on buildings rose in 2022, but the ongoing cost-of-living crisis and economic uncertainty could reduce investment in 2023

Global investment in energy efficiency



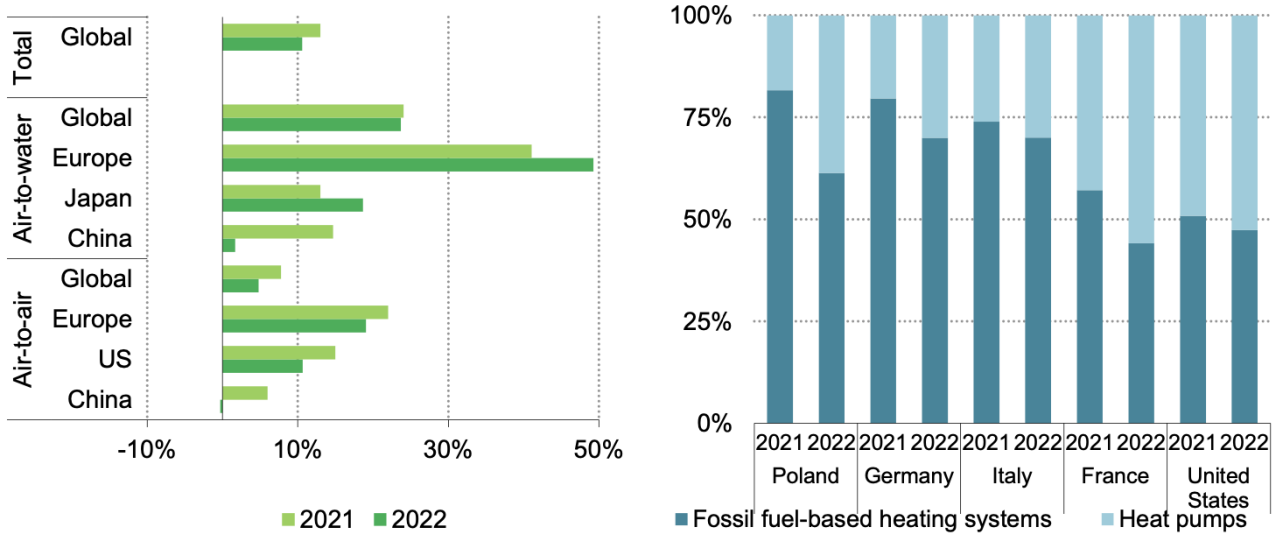
Notes: China = Producer price index – Building materials industry non-seasonally adjusted; US = Producer price index – Materials and components for construction seasonally adjusted; EU27 = Construction cost index seasonally adjusted.

Sources: IEA calculations based on Bloomberg terminal (2022); Eurostat (2022); NBS (2022).

Construction and material costs have increased and have reached an all time high in 2022

Global investment in energy efficiency

Rate of growth of heat pump sales in 2021 and 2022 (left) and market share of heat pumps in global heating system sales (right)



IEA. CC BY 4.0.

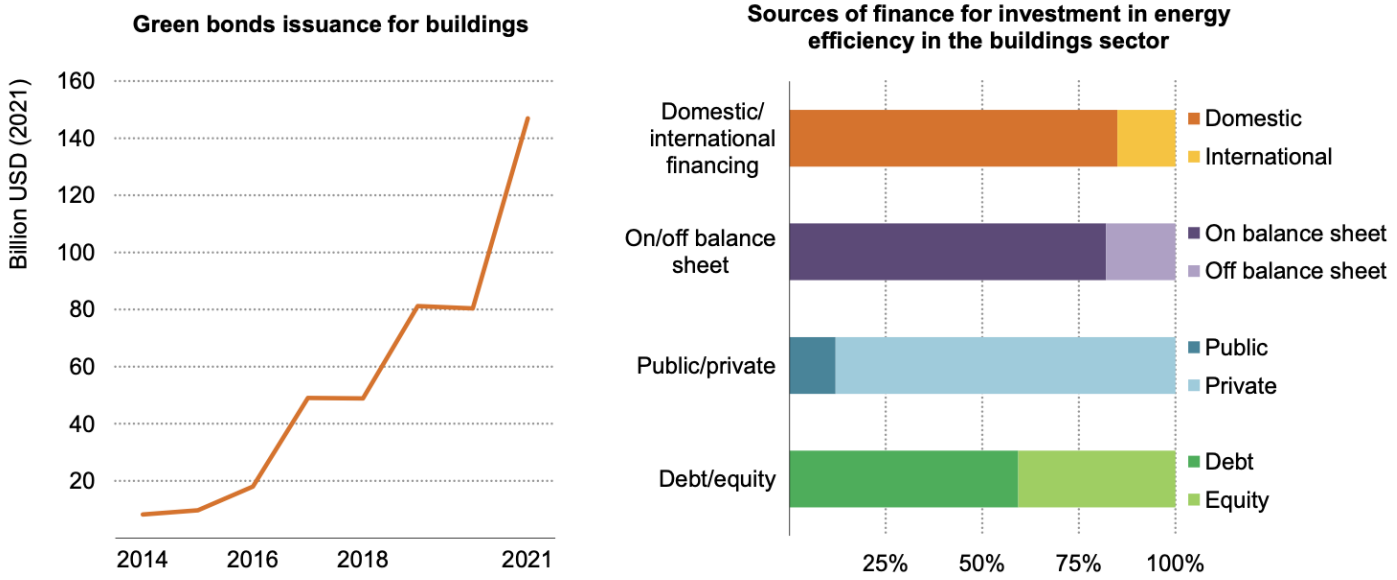
Notes: Air-to-water units include heat pump water heaters; total also includes ground- and water-source heat pumps.

Sources: IEA (2023), Global heat pump sales continue double-digit growth, based on data from AHRI, Assoclima, Assotermica, BDH, CHPA, ChinaIOL, EHPA, JRAIA, SPIUG and Uniclima.

Heat pump sales experienced double-digit growth for a second year in a row in many areas as they start to replace fossil fuel-based heating systems

Global investment in energy efficiency

Green bonds earmarked for the buildings sector, 2014-2021, and sources of finance, 2021

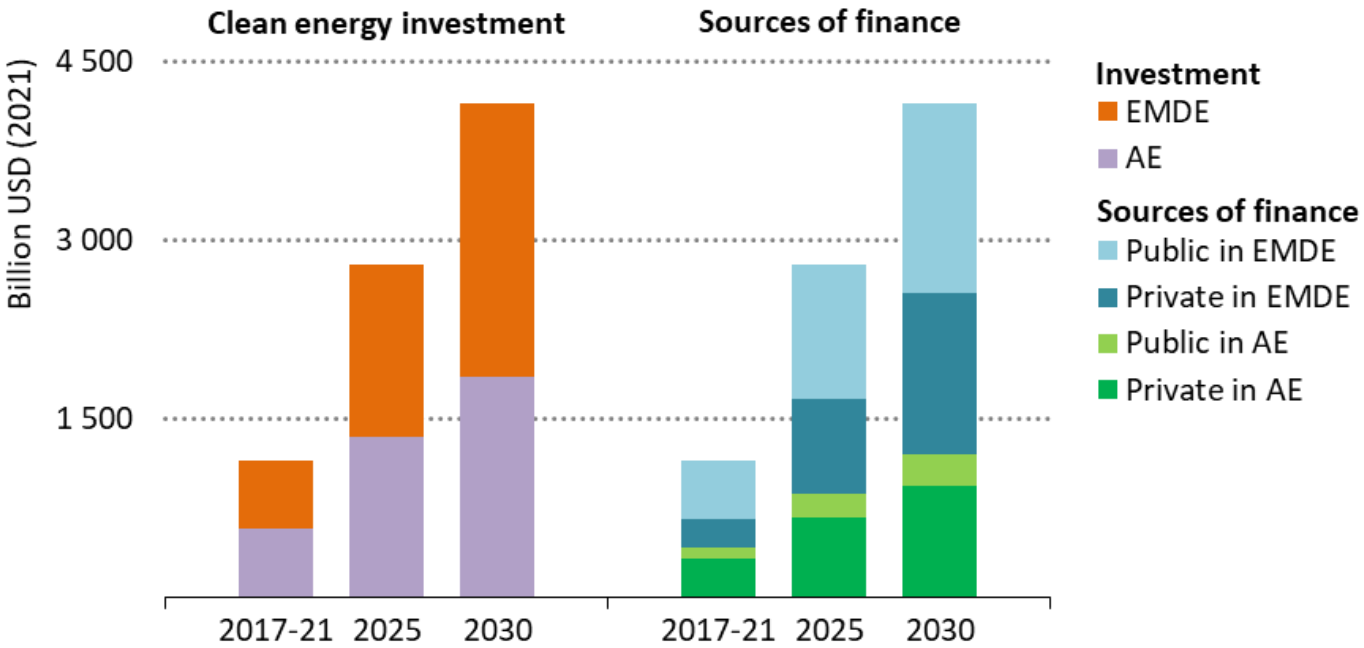


Note: Left graph shows data for bonds that identify energy efficiency in the buildings sector as one of the intended uses of proceeds.
Source: IEA calculations based on Climate Bonds Initiative.

Green debt financing for energy efficiency investment in buildings is on the rise, with record green bond issuances in the sector in 2021

Higher levels of private finance are needed

Clean energy investment and sources of finance in the NZE Scenario to 2030



Reaching the NZE Scenario investment levels requires a larger contribution from private finance than seen today, particularly in emerging market and developing economies

Critical considerations for energy efficiency investment & financing

- **Investment vs financing**: What's the difference?

- **What are the biggest challenges?**

Technical capacity	Heterogeneous projects	Small project scale	Payback periods
Complexity	Upfront investment	Business model (cost savings vs revenues)	Split incentives

- **Which risks can be involved and why does it matter?**

Technology	Regulatory	Physical	Organisational
Energy Market	Economic	Behavioural	Financial

Financing EE: De-risking instruments

Partial Credit Guarantee Schemes: Credit enhancement mechanisms for debt instruments (bonds and loans)

- Offered by many MDBs, GCF, GEF etc.

- **Example: Partial Risk Sharing Facility for EE** (PRSF) India:
  - Component 1: Risk sharing facility
  - Component 2: Technical assistance, capacity building and operations support
  - 29 PRSF guarantees of USD 17.2 million issued, leveraging total investment of USD 55.7 million (February 2021)
  - http://prsf.sidbi.in

- **Example China: Utility-based Energy Efficiency Finance Programme** (CHUEE)

Local currency loans: e.g. offered by IFC to mitigate the risk for companies to face losses from currency mismatches of assets and liabilities in developing countries.

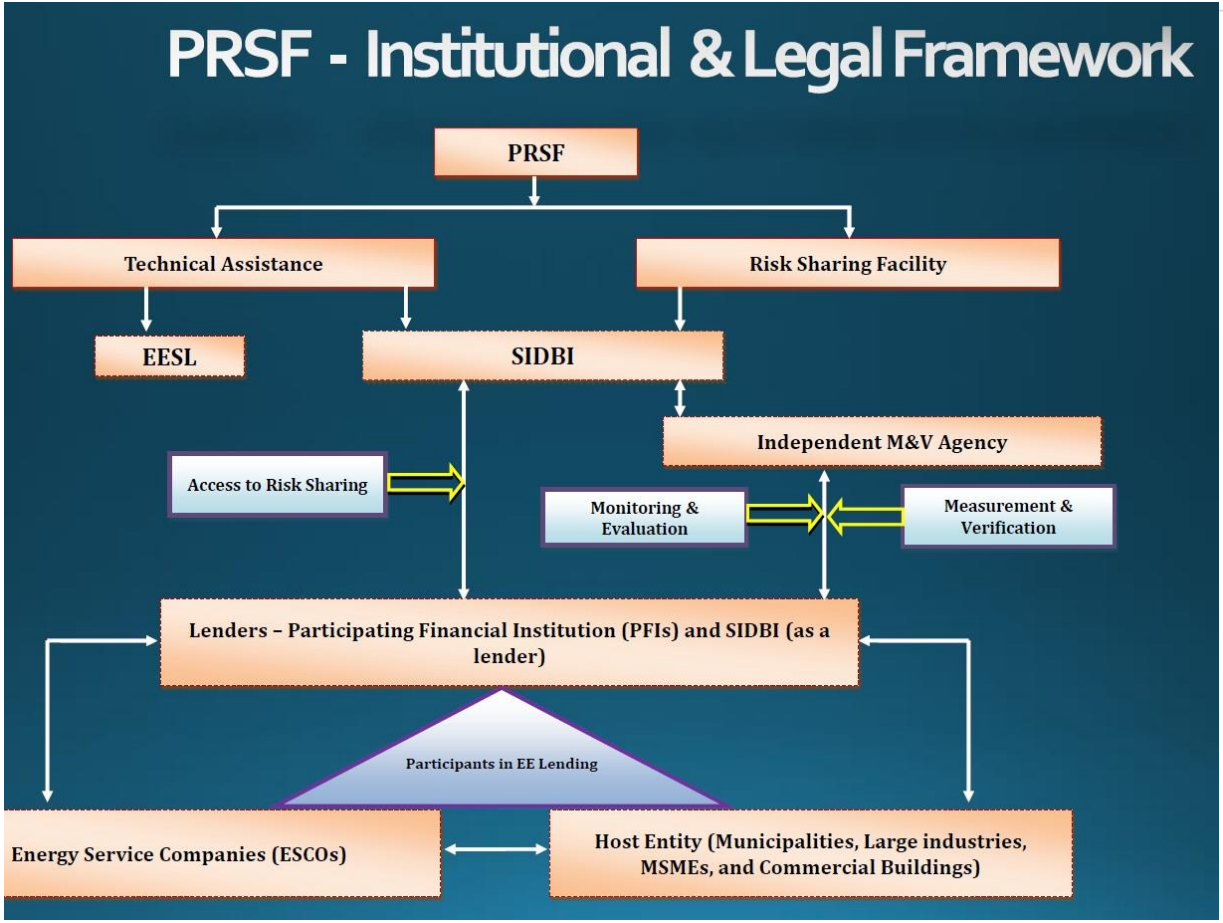
Partial Risk Sharing Facility for EE (PRSF) India

How PRSF Works

Financial Institutions :SIDBI, YES Bank, Corporation Bank, Tata Cleantech, Electronical Finance.

This project consists of two components. The Project has a total outlay of USD 43 million consisting of the "Partial Risk Sharing Facility for Energy Efficiency" component of USD 37 million and technical assistance component of USD 6 million.

Partial Risk Sharing Facility for EE (PRSF) India



The extent of guarantee cover as a proportion to the guaranteed loan expected to be 40%-75% (the full range initially will be 20% to 75%).

Financing EE construction and retrofits: Concessional loans

Green Mortgages: to build a new home with sustainability rating or to invest in renovating an existing unit to high sustainability standards.

Banks typically offer lower interest rates or increase the loan amount available to borrowers, as green buildings represent a lower risk investment

Benefits: concessional finance; unlocks private sector capital for renovation; adds mortgage banks as a new market player; comes at a time when renovation decisions are typically made

Examples

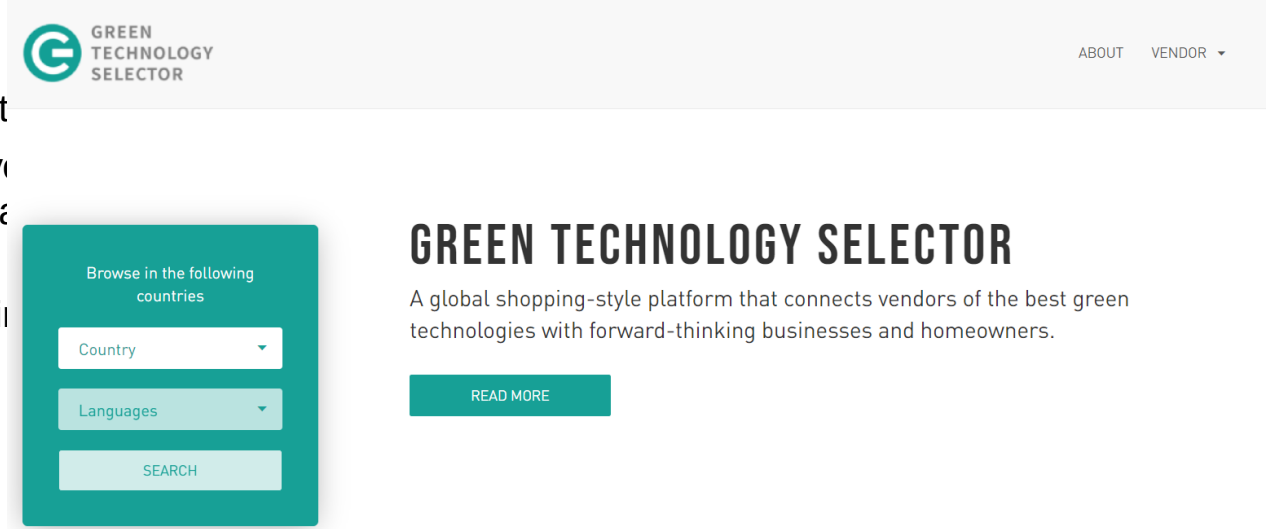
- Energy Efficient Mortgages Initiative: EU
- UK Green mortgage market: over 50 products
- Mexico, Colombia and Péru: Green mortgage schemes
- South Africa: Absa Eco Home Loan

Energy Technology Lists can qualify efficient products for financing

- **Energy Technology List:** list of pre-assessed and pre-approved energy efficient appliances and equipment that can automatically qualify for subsidies or funding
  - Procurement tool
  - De-risking instrument through independently measured and verified energy performance
  - Regular reviews of criteria as well as of technologies and products that qualify for inclusion

- UK Energy Technology List - Government list of energy efficient plant and machinery that meets specified energy savings criteria

- EBRD Green Technology Selector: vendors that offer high-performing t
  - Pre-assessed and pre-approv through a participating financia per equipment)
  - Regular adjustments of baseli



Energy Performance Contracting: The case of ESCOs

- An energy performance contract commits an energy service company to install energy efficient equipment, provides a performance guarantee and establishes the terms of any payments.

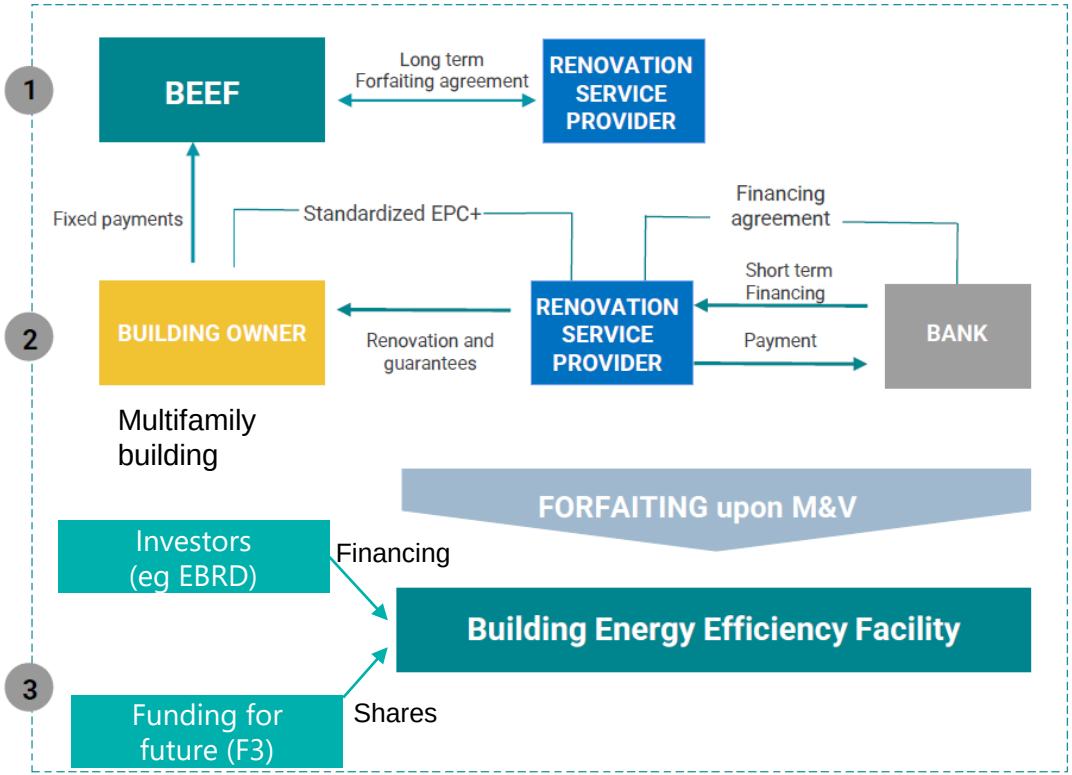
- **Common types**:
  - Shared savings

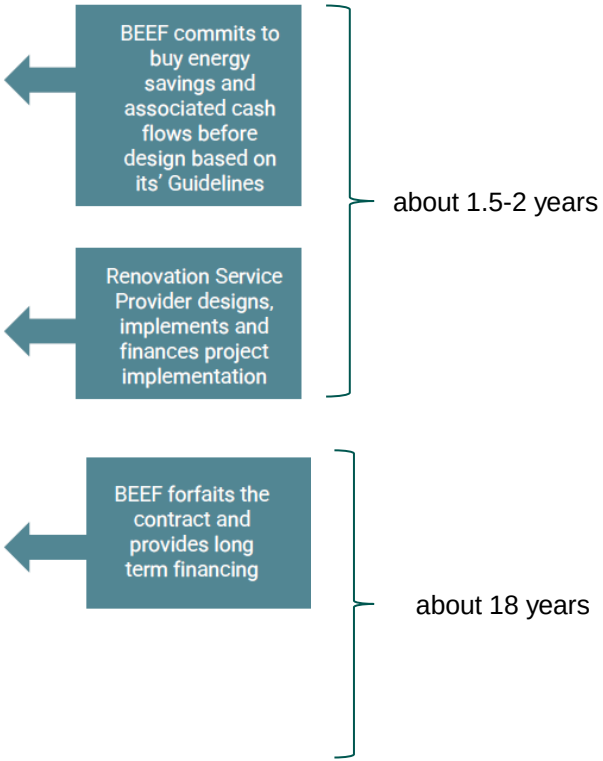
- Guaranteed savings

- Possible risk mitigation instruments include
  - Energy savings insurance models
  - Credit risk guarantees

Financing EE retrofits: (Latvian) Building Energy Efficiency Facility

(LA)BEEF operations scheme





Adapted from: Funding for Future, 2022

Indian SuperESCO EESL & Moroccan Super ESCO SIE

EESL Selected Programmes

UJALA
Unnat Jyoti by Affordable LEDs for All

E-MOBILITY
A green and ecofriendly transportation mode for sustainable development.

BUILDING ENERGY
Building Energy Efficiency Programme

NMRP
National Motor Replacement Program (NMRP)

SLNP
Street Lighting National Programme

SOLAR STUDY LAMP
70 lakh Solar Study Lamp Scheme

SIE Selected Programmes

Green Mosques Programme

- Upgrade and maintain over 50,000 mosques

Street Lighting Refurbishment Programme (Marrakech)

- Reduce by at least 40% the annual energy consumption of street lighting

Energy Savings Insurance Scheme

- Mobilise financing for EE improvements in SMEs

Energy Efficiency as a service

Pay-per-use model

Client

- No upfront investment
- Pays for services received
- Lower life-cycle equipment costs and access to BAT

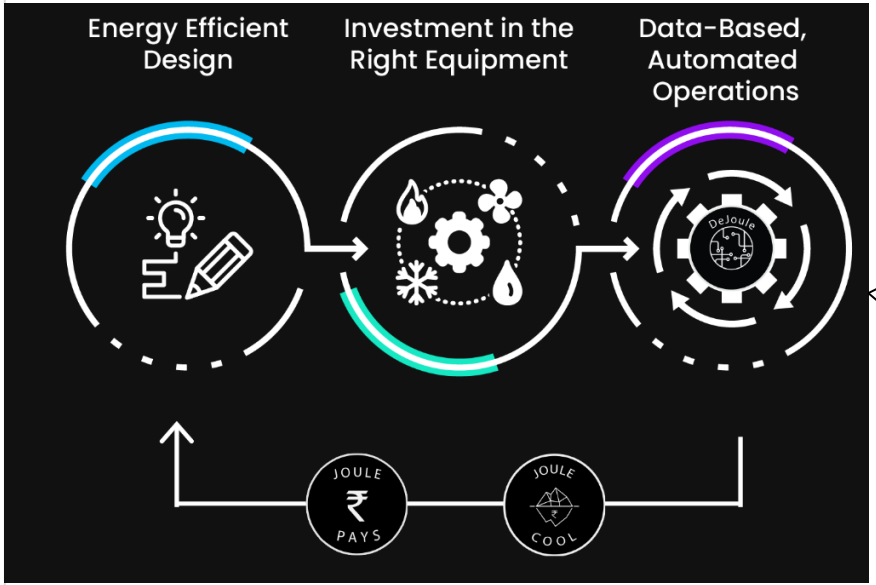
Technology provider

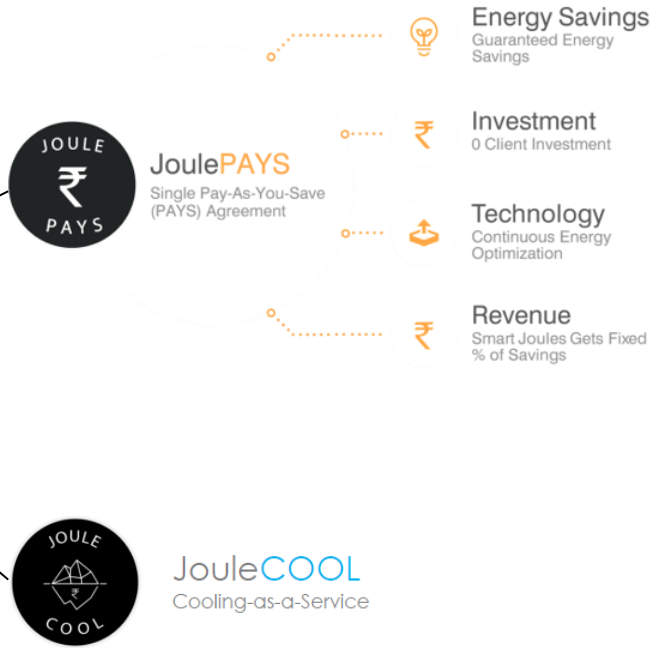
- Invests in and owns the equipment
- Bears costs of operations and maintenance
- Long-term revenue stream and new clients

Investor

- Purchases equipment and leases it back to the provider (monthly payments)
- Collateral: equipment, contract provider-client, default guarantee

PAYS business model example: Smart Joules, India





Adapted from Smart Joules, 2022

What can we learn from past programmes?

- **Address regulatory barriers**
  - Consider removing or simplifying unnecessary red-tape to support fast rollout of green building programmes and ease investment.
- **Consider shovel-ready options**
  - Deep retrofits of government buildings can deliver improvements to hospitals, schools, social housing and offices.
- **Evaluate and leverage effective existing programmes**
  - Supercharging existing programmes and leveraging their administration, contracts, guidelines and delivery partners.
- **Standardise**
  - Standard contracts, designs, or lists of approved technologies reduce costs and risks and enhance understanding and trust.
- **Set the right level of ambition**
  - Don’t let perfect be the enemy of the good – set the energy efficiency requirements as high as possible while remaining realistic about considerations such as price, supply and demand side constraints.
- **Get the level of incentive right**
  - Find the right balance between a high enough incentive to drive uptake without introducing significant programme risks or creating boom-bust cycles.
- **Turn short-term impacts into long-term transformations**
  - Harness the investment from stimulus programmes to lock-in changes through improvements to building energy efficiency codes.
- **Collaborate with important multipliers**
- **Develop a good communication and promotion strategy**

Session Activity

International Energy Agency

Activity - Enabling investment with energy efficiency policies

Which policies and financing mechanisms would you as a policy maker like to put in place to address the barriers to access for financing and improve financing conditions?
Which stakeholders would you seek cooperation with for addressing those barriers?

International Energy Agency

International Energy Agency

Energy Efficiency Training Week

Buildings of the FUTURE

Sustainable, Resilient, Hyper-efficient, People-centric

Speaker Name
Speaker Title
Month 00, 202X

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The world of your building

Forecasts project a recovery in 2021, with the total building stock estimated to grow to

124.7 billion m^2

in 2029 from 102.9 billion m^2.

Source: Global Building Stock Database 2Q20

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The world of your building

~40%

of the world's CO_2 emission comes from buildings[1]

>350

natural + man-made disasters in the world in 2019[2]

>30%

of the energy is wasted in buildings[3]

~90%

of our time is spent indoors[4]

Source:
[1] Architecture 2030, 2020
[2] Facts + Statistics: Global catastrophes, Insurance Information Institute, 2020
[3] U.S. Environmental Protection Agency, 2020
[4] Joseph G. Allen, Healthy Buildings Program, Harvard University, 2019

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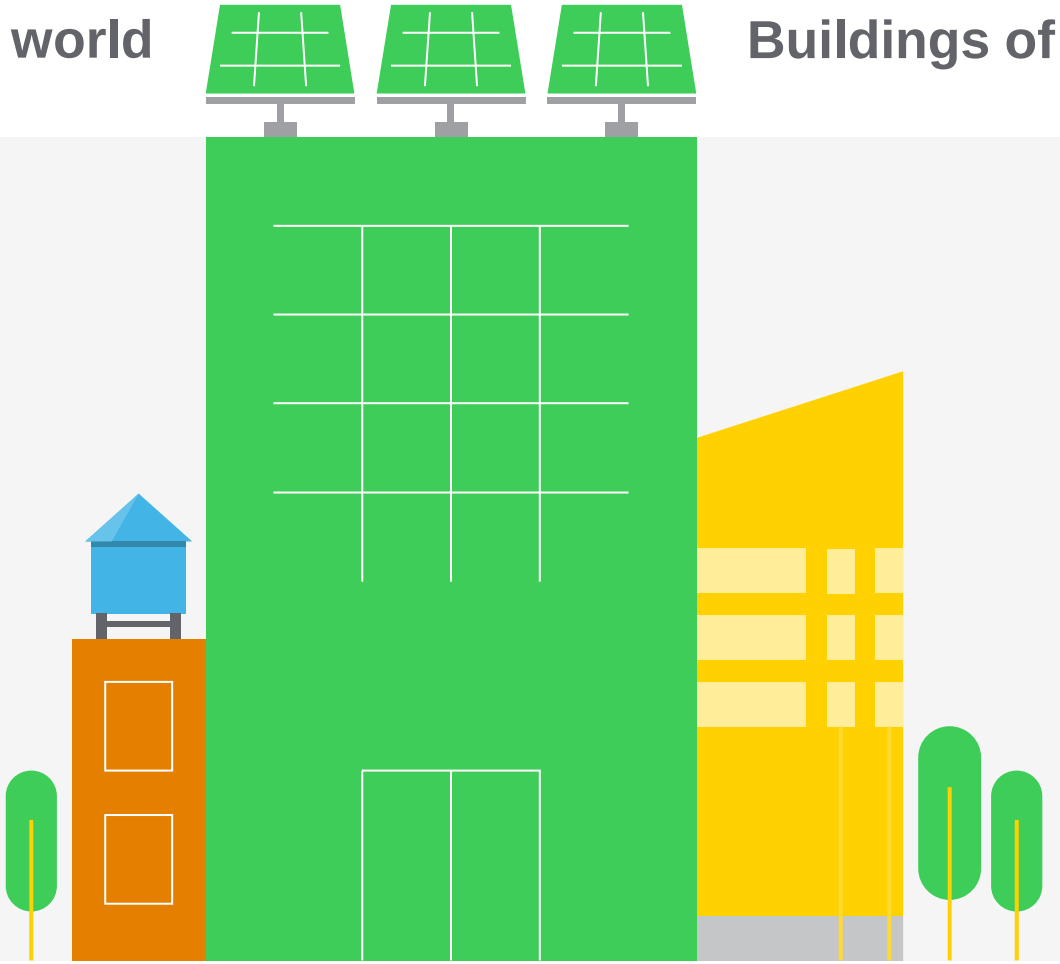
Two major transitions already underway

All-digital, all-electric world

Buildings of the future



Digitization

IoT **10x** more new connected devices than individuals
Source: GSMA 2019

Big Data **x5** 81 bn GB in 2017, 403 bn GB in 2021
Source: IDC, 2018

AI **x6** increase in AI expenditures between 2017 and 2022
Source: International Data Corporation, 2020

Electrification

50% of energy production will be solar or wind-driven by 2050
Bloomberg New Energy Finance, New Energy Outlook 2019

30% of vehicle stocks will become electric by 2040
Source: Bloomberg New Energy Finance, New Energy Outlook 2019

x2 Electricity consumption doubles until 2050
Source: Global Energy Perspective 2019, McKinsey, 2019

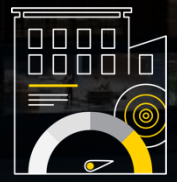
The foundation of buildings of the future

Sustainable

Equipped with flexible energy assets and various electric sources

Resilient

Recover quickly and bounce back



Hyper-efficient

Seamlessly controlled by end-to-end digital platform

People-centric

Designed to be responsive to people

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Sustainable

Buildings today

- 30% of the **world's energy**
  (Source: IEA, 2020)
- 40% of global **greenhouse emissions**
  (Source: IEA, 2020)
- Rely on **non-renewable energy resources**

Buildings tomorrow

- **60% reduction** of carbon emissions by 2040
- At least **40% green, renewable electricity**
- **Influential to decarbonization** of other industries

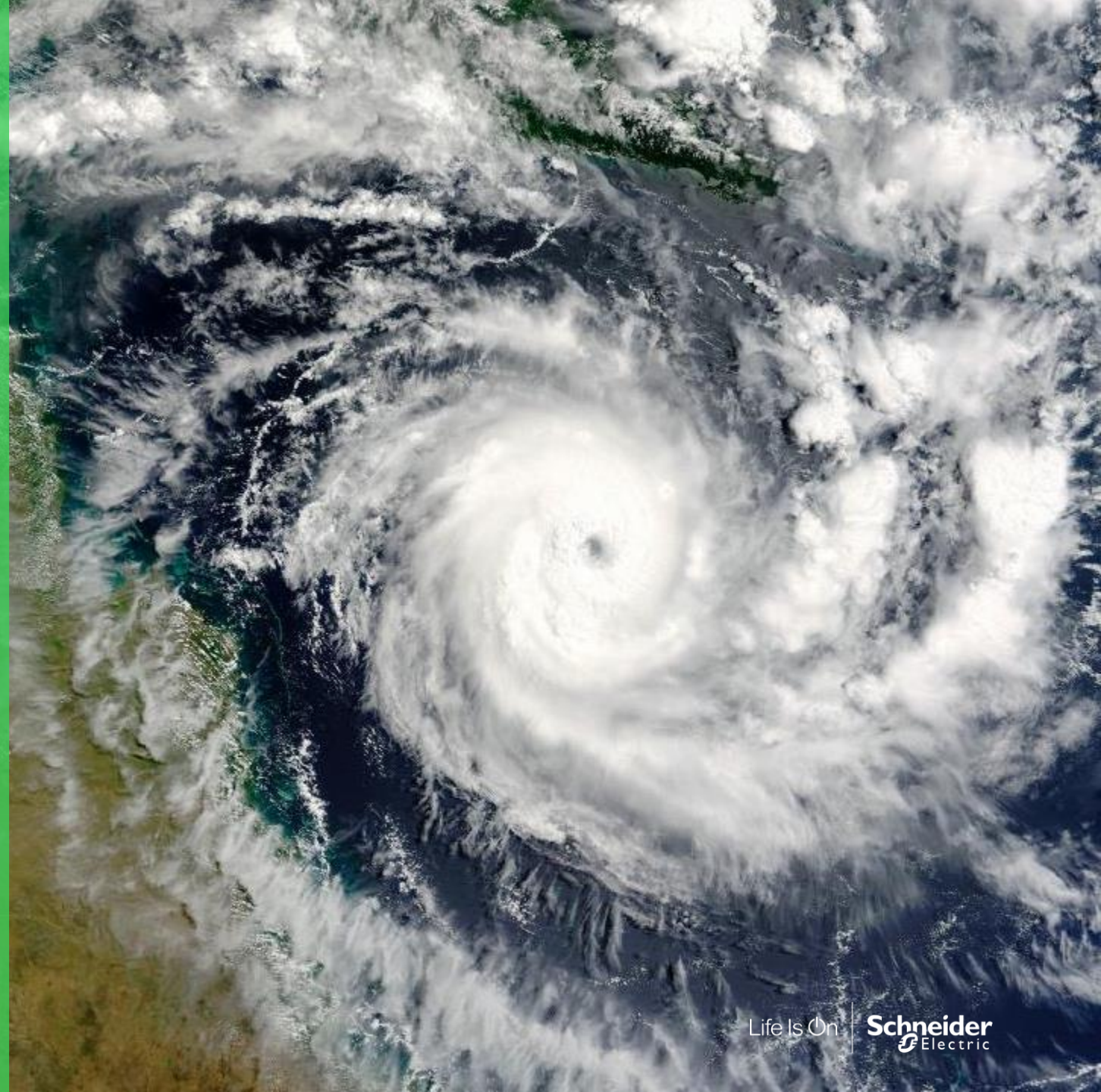
Resilient

Buildings today

- Only as good as their **weakest** link
- **Threatened** by weather, cybersecurity, health and outages
- Face peak **highs and lows** for utilization

Buildings tomorrow

- More than 70% of operations **performed remotely**
- **Automation** and **predictive analytics** to minimize outages and failures
- **Cybersecurity protocols** to minimize risk level



Hyper-efficient

Buildings today

- ~30% of construction cost is **rework**
  (source: Procore, 2018)
- **Disconnected**, disparate systems
- **Under-utilized** assets and space
- **Reactive** maintenance

Buildings tomorrow

- **Digital twin** leveraged from design to build, into the operation and maintenance phases
- **Energy and building automation integrated** by converging IT and OT systems
- Systems that are **connected to each other and to the cloud**

People-centric

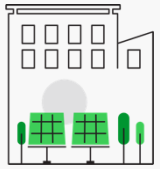
Buildings today

- **Required to implement** new health and safety guidelines
- **Challenged to improve** occupant experience
- **React to demands** for safe and productive environment

Buildings tomorrow

- **Monitoring** of occupant levels and health indicators
- Significantly improved **occupant experiences**
- **Semi-autonomously identify** issues and take actions

Enabling buildings of the future



Sustainable

Equipped with flexible energy assets and various electric sources

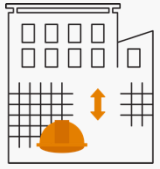
- Maximizing electrification
- Active energy management
- Positive energy buildings
- Resource-efficient design leveraging software
- Sustainable retrofits

Hyper-efficient

Seamlessly controlled by end-to-end digital platform

Better decision making, impacting:

- People needs
- Space resources
- Asset efficiency
- Energy cost



Resilient

Recover quickly and bounce back

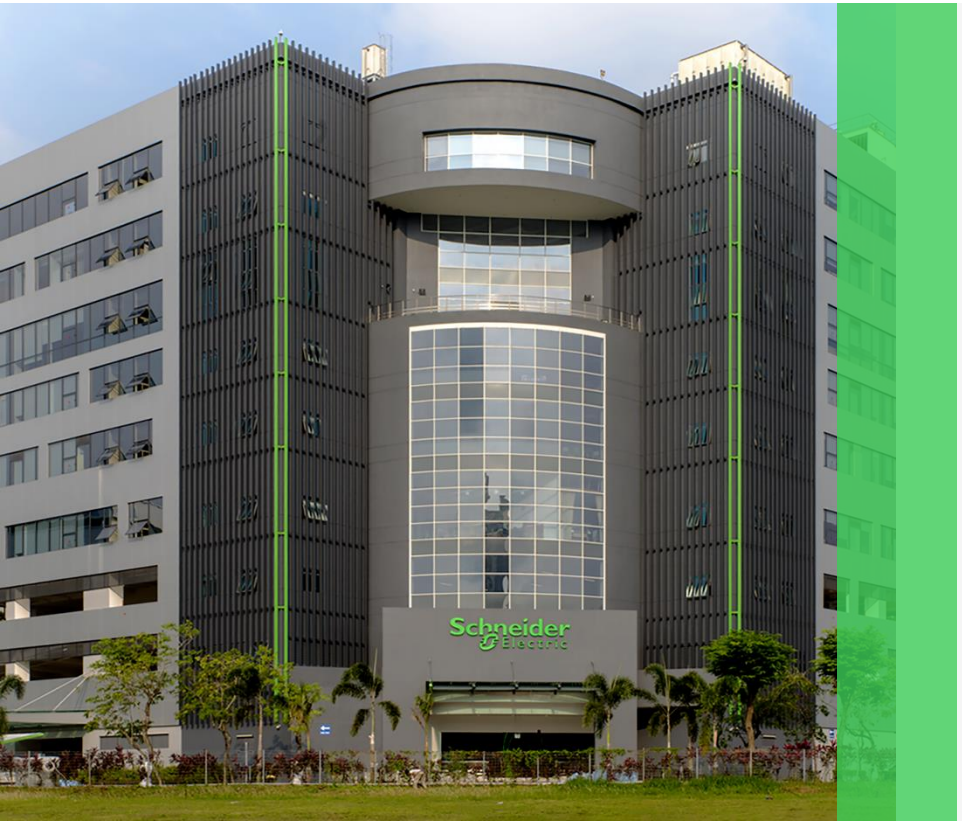
- Remote operations
- Power reliability
- Cybersecurity
- Critical infrastructure and asset protection
- Flexible buildings

People-centric

Designed to be responsive to people

- Safer buildings
- Healthy buildings
- Comforts and experience

Enabling our own
Buildings of the Future



Kallang Pulse

Schneider Electric
East Asia & Japan HQ

Building age: **25 years**
Total gross floor area: **18,500 m²**
Objective: **achieve 100% CO_2 neutrality by 2020**

Software and Analytics
Building Advisor, Power Advisor, Resource Advisor, Asset Advisor Power, Asset Advisor IT, Workplace Advisor, MicroGrid Advisor, Augmented Operator Advisor

Edge Control
Power Monitoring Expert, Building Management System (BMS), Security Expert, Facility Expert

IoT-enabled Connected Products

Over 5000 connected products

- Power Logic, Power Tag, MTZ
- BTU, Water Meter, PAHU, Chiller Plant (data exchange with BCA Portal through Web Service)
- Motion Sensors, CO_2 Sensor, Env Sensor, lighting control KNX/Dali, UPS, InRow, CCTV, Card Access
- Conext Solar/ Battery Monitoring / Battery Energy Storage Solution (BESS)
- Elink(Kone lift), Data exchange with offsite solar energy retailers

Sustainable rooftop

Kallang Pulse

Schneider Electric
East Asia & Japan HQ

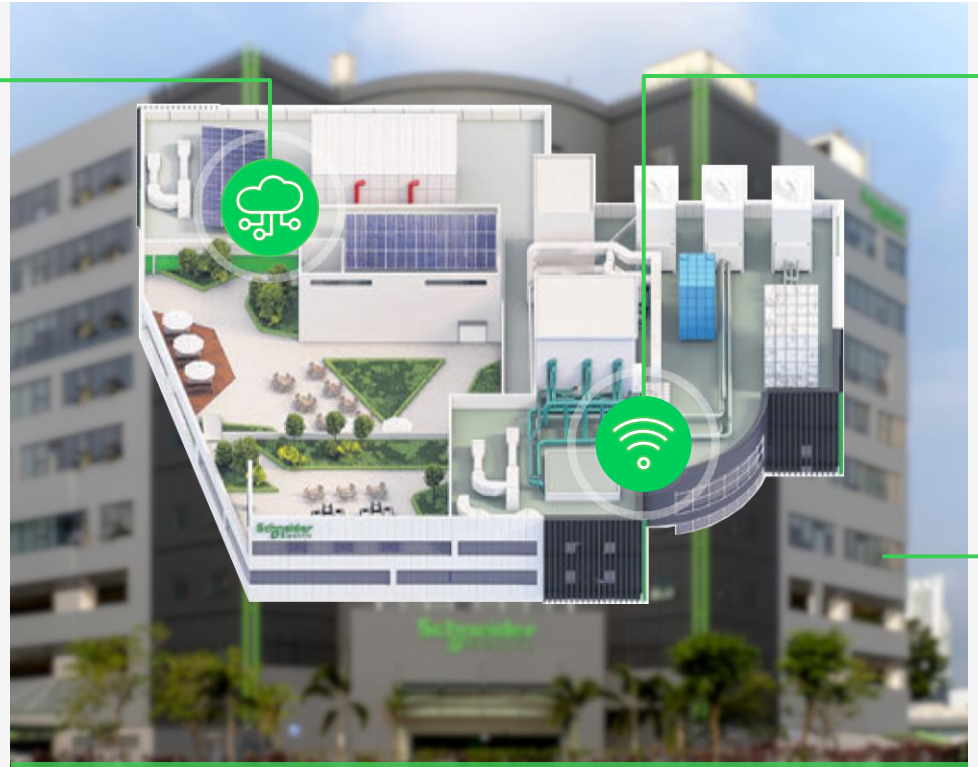
Building age: **25 years**
Total gross floor area: **18,500 m^2**
Objective: **achieve 100% CO_2 neutrality by 2020**

80 solar panels on the rooftop

The building runs on 100% renewable (solar) energy in the daytime (9.30am to 4.30pm). Accompanied with offsite solar energy, this accounts for 47% of the building's monthly energy consumption (220Mwh).

The BMS is linked to **meteorological weather forecast** to improve **energy efficiency** and **system performance**.

- On a hot day, the pump will regulate the pumping of the VSD
- On a cold day, the chiller plant will be set at a lower speed to regulate the temperature at optimum levels.



Integrated with Real Time Data at the IBMS Level

Magnetic bearing chiller with VSD

A chiller plant also acts as a centralized cooling system, providing a portion of air conditioning in the building's HVAC systems. The magnetic bearing chiller with VSD regulates the speed according to the demand. This helps to achieve higher efficiency rating.

Window panels

The design of the building facade and window panels meet the Envelope Thermal Transfer Value (ETTV) to enhance energy performance.

Renewable energy

Kallang Pulse
Schneider Electric
East Asia & Japan HQ

Building age: **25 years**
Total gross floor area: **18,500 m^2**
Objective: **achieve 100% CO_2 neutrality by 2020**

Renewable energy usage

- More than 10 solar panels on car park rooftops and in the gardens
- Electric Vehicle charger stations powered by solar energy
- Landscape lightings and koi pond are powered by harvested solar energy on site
- Battery Energy Storage System (BESS) stores conserved solar energy for nighttime use

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Smart office

Kallang Pulse
Schneider Electric
East Asia & Japan HQ

Building age: **25 years**
Total gross floor area: **18,500 m²**
Objective: **achieve 100% CO_2 neutrality by 2020**

Space management

EcoStruxure™ Workplace Advisor

- Ensure safe distancing
- Monitor occupancy levels
- Adapt office layout

Occupant well-being

EcoStruxure Workplace Advisor

- Adaptive lighting & temperature adjustment
- Confirm optimal humidity
- Check air circulation
- Monitor rise of VOC

Operational efficiency

EcoStruxure Building Advisor

- Smarter cleaning
- Optimize building management and power systems
- Better manage amenities

Occupant engagement

EcoStruxure Engage Enterprise

- Communicate effectively
- Simplify access to IT tools
- Enable occupants to easily navigate the new office

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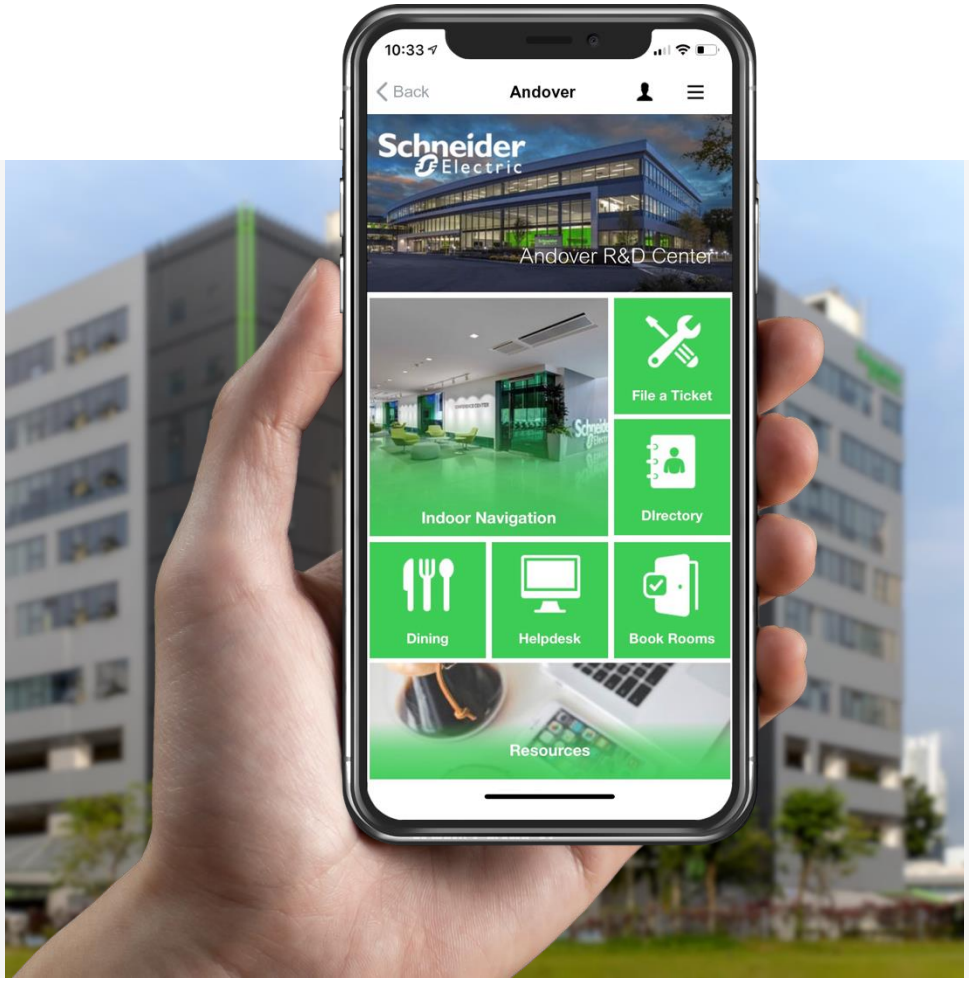
Putting control in the hands of users



Occupant engagement

EcoStruxure™ Engage Enterprise

- Room booking
- Helpdesk
- Company directory
- Dining
- Indoor navigation
- Access control
- File maintenance ticket
- Comfort control

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Tenant’s happiness index

Participants

81% Spend more than **30 hours** in the office

71% Aged **31 to 50** years old

Air Quality

Reduced stuffiness and odor: **54%**

Reduced humidity: **65%**

Air movement: **65%**

Workspace

with amount of workspace despite reduced floor space **79%**

satisfied or very satisfied

69%
Overall Indoor Satisfaction

Data is based on survey taken in 2019 from 298 employees in comparison to the old Schneider Electric Building in 2017.

Outcomes

45% reduction in electricity consumption

- Re-designed building to be **people-centric** and **resilient** by utilizing technologies and engineering solutions, reducing consumption in electricity
- Proactive EcoStruxure Solutions provide analytics-based service to optimize energy performance and create a **hyper-efficient** building

1253 tons p.a. carbon emissions

- Reduced carbon emissions are equivalent to removing 358 cars (2.0cc) from roadways, increasing the **sustainability** of the building
- 100% solar powered during the day
- Reduced carbon footprint with solar blended power supply and Microgrid Advisor

Achievements

- Awarded BCA Green Mark Platinum (Version 2017) building
- Awarded Leadership in Sustainability & Performance by SGBC-BCA (2019)
- Increased brand recognition and improved on Corporate Social Responsibility (CSR)

Buildings of the future across the life cycle

Leveraging the **all-digital, all-electric world**
for new and existing buildings

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