



Energy efficiency and benchmarking analysis for G20 countries and beyond

Brian Motherway

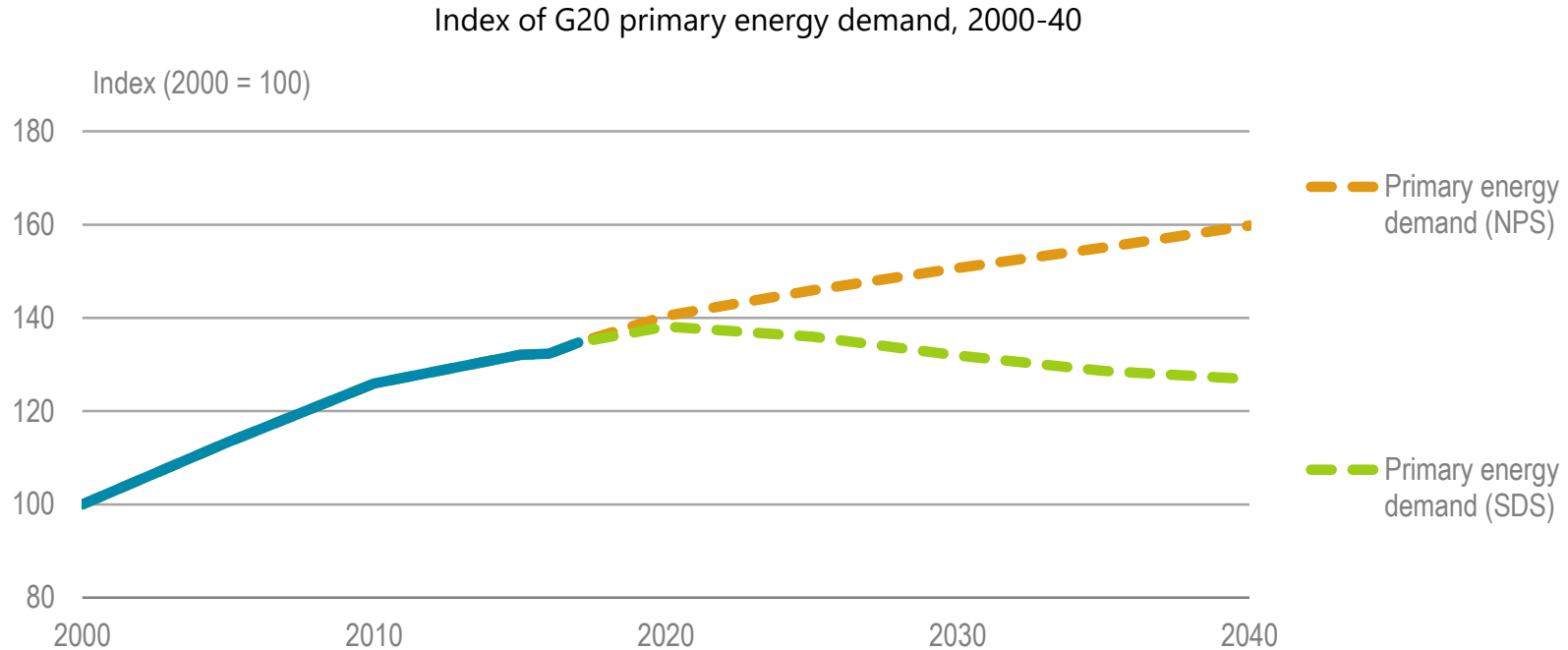
Head of Energy Efficiency, International Energy Agency

Context

- New analysis was prepared at the request of Japan for its G20 presidency looking at efficiency trends and opportunities for gains.
- All G20 countries have made notable progress on energy efficiency, but potential remains for considerable further gains
- Analysis seeks to highlight the potential that exists to improve energy efficiency.
- Preliminary benchmarking analysis prepared to highlight the potential benefits of such analysis and the importance of data collection

Potential for efficiency gains in G20 countries

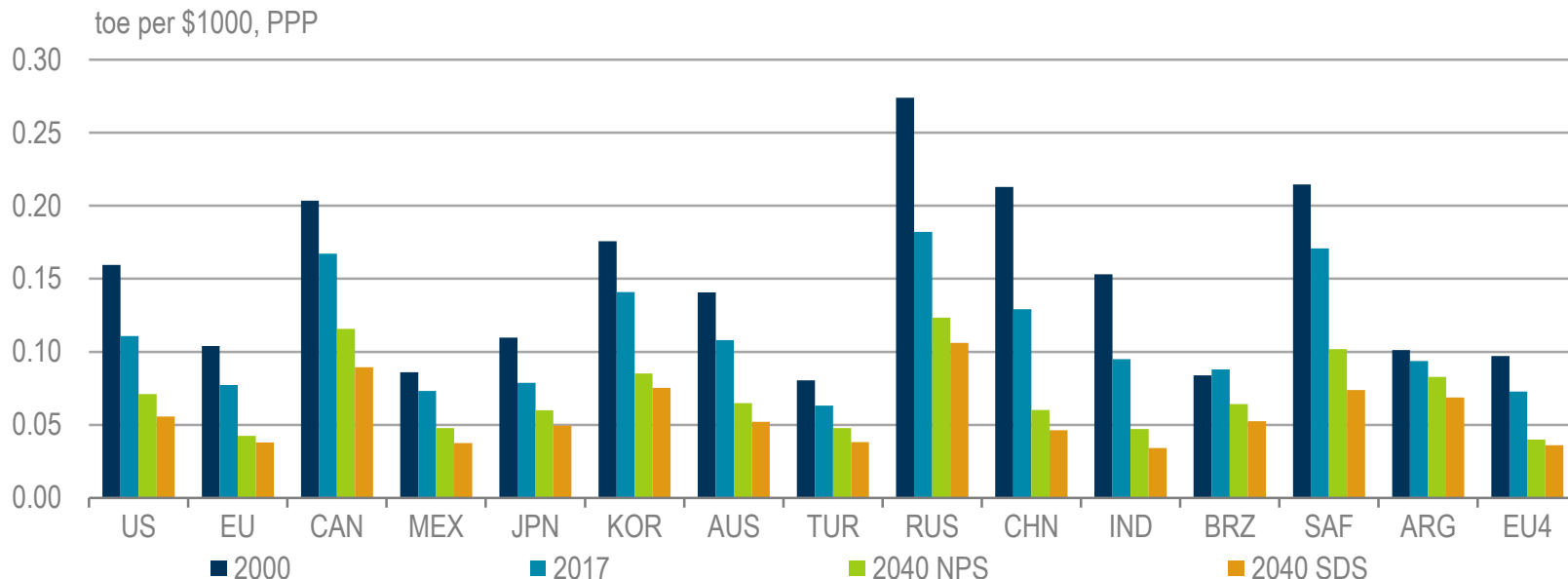
Trends in primary energy demand in G20 countries



Greater efforts on efficiency and renewable energy, as described by the IEA's Sustainable Development Scenario (SDS), could see primary energy demand in G20 countries follow a different path.

Changes in primary energy intensity in G20 countries

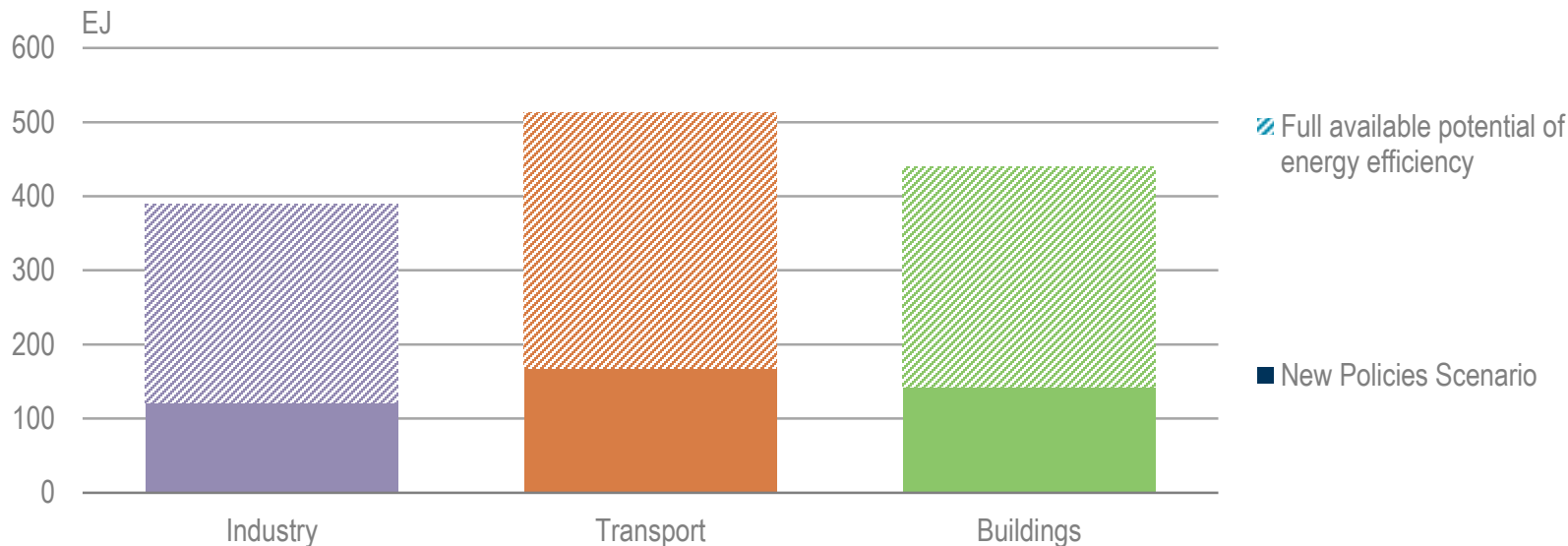
Primary energy intensity in G20 countries, 2000-40



All G20 countries have the opportunity to continue to improve energy intensity, extracting more value from each unit of energy.

There is significant cost-effective savings potential in every sector

Potential energy savings from the implementation of cost-effective energy efficiency measures to 2040

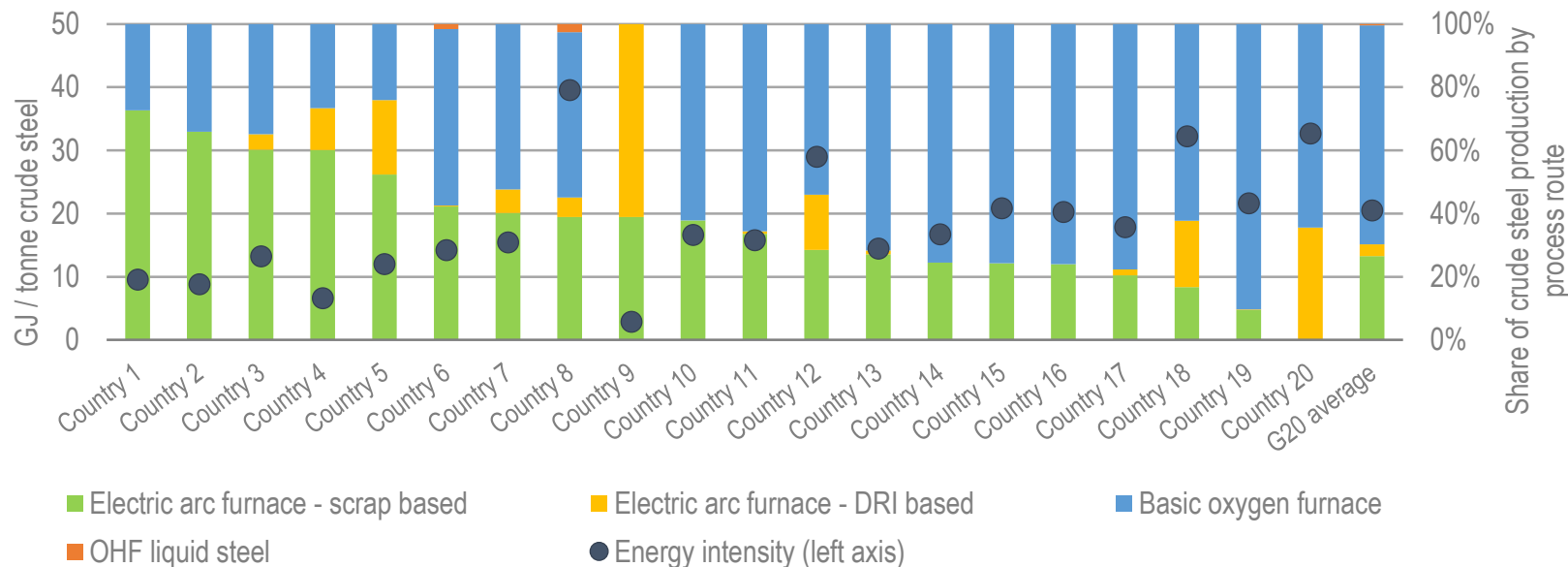


Only one third of the potential cumulative energy savings from efficiency gains by 2040 are realised in the NPS. Better analysis can help prioritise policy action in key sub-sectors and for key technologies.

Preliminary benchmarking analysis

Industrial efficiency varies depending on a range of factors

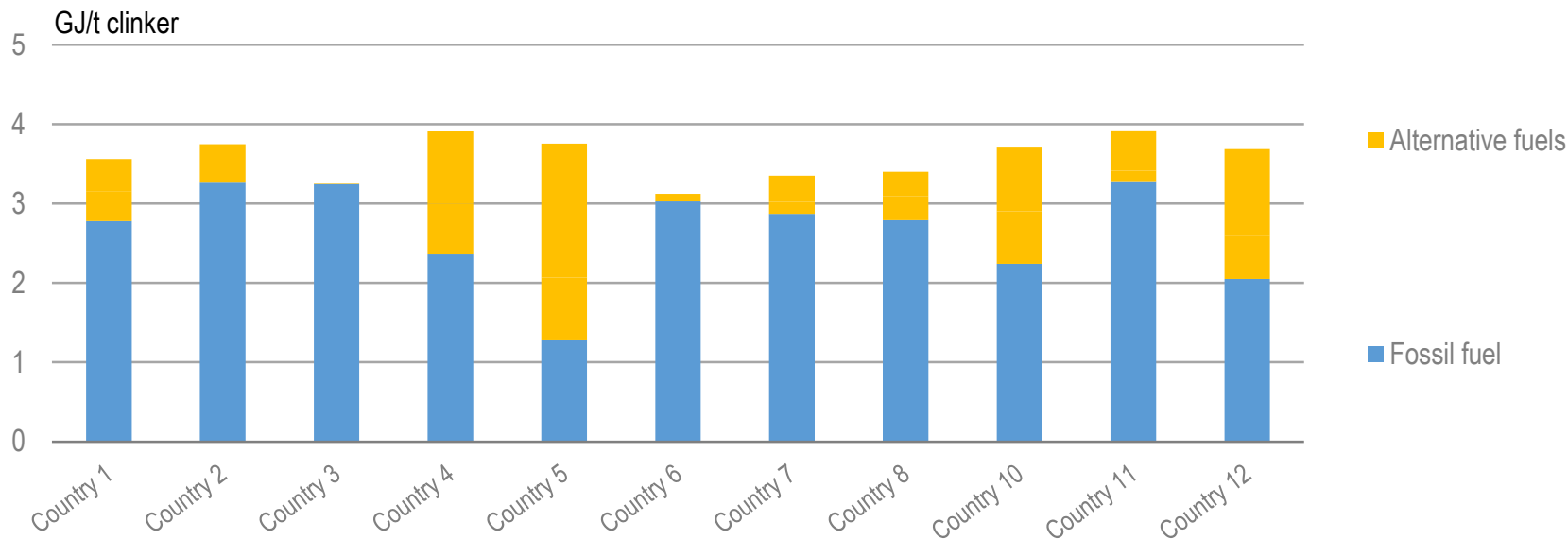
Final energy use per tonne of crude steel and share of steel production by process route in 2016



The energy intensity of steel production varies across all G20 countries, as a result of different production routes. Efficiency gains can come from technology, recycling and energy management.

Variation is also observed in the cement industry

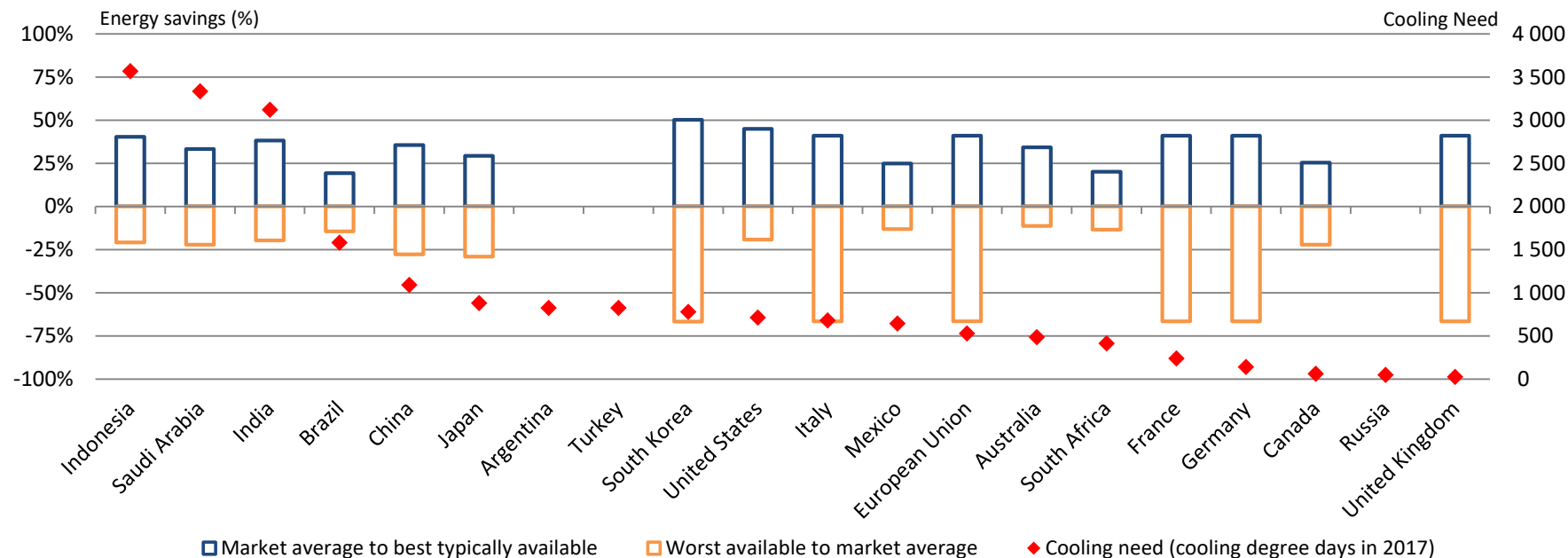
Thermal energy per tonne of clinker in 2016



Thermal energy intensity of cement production varies across countries depending on the raw materials and the quality of data available.

Air conditioning is a growing source of efficiency gains

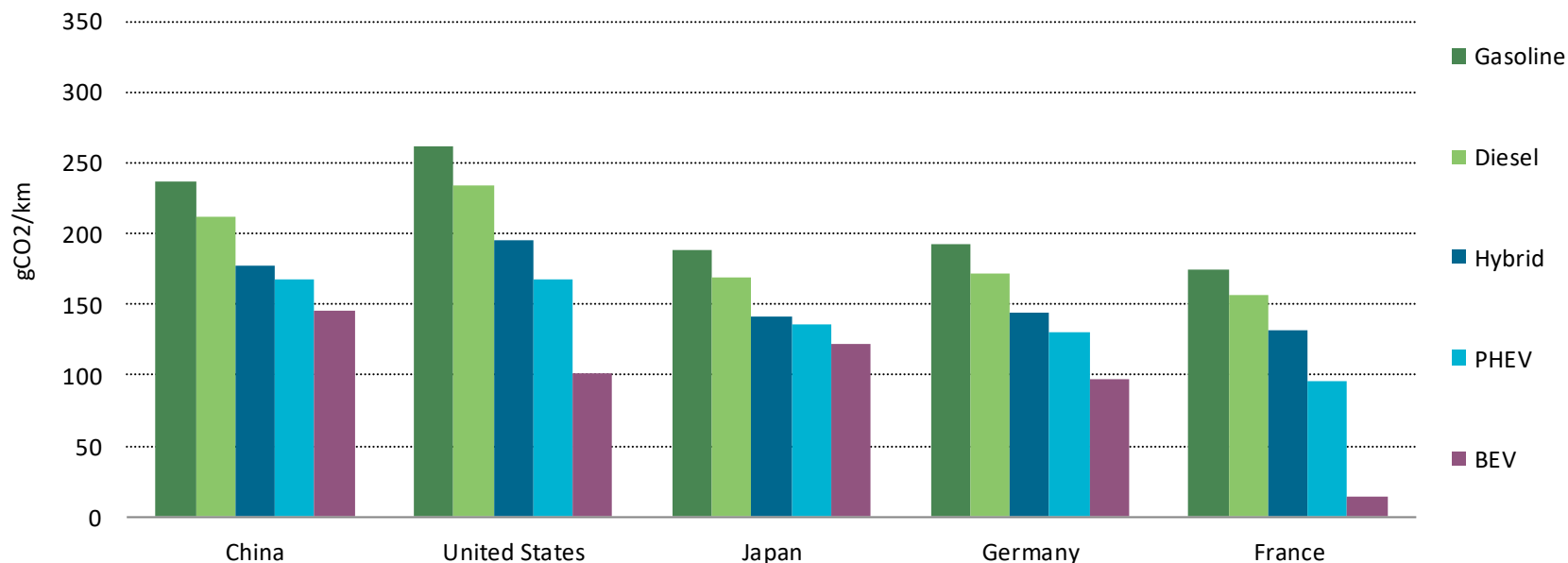
Potential energy savings from adoption of more efficient air conditioners



Energy savings of nearly 40% are possible in most G20 countries through pushing markets towards more efficient ACs that are already available.

Electrification presents opportunities for transport

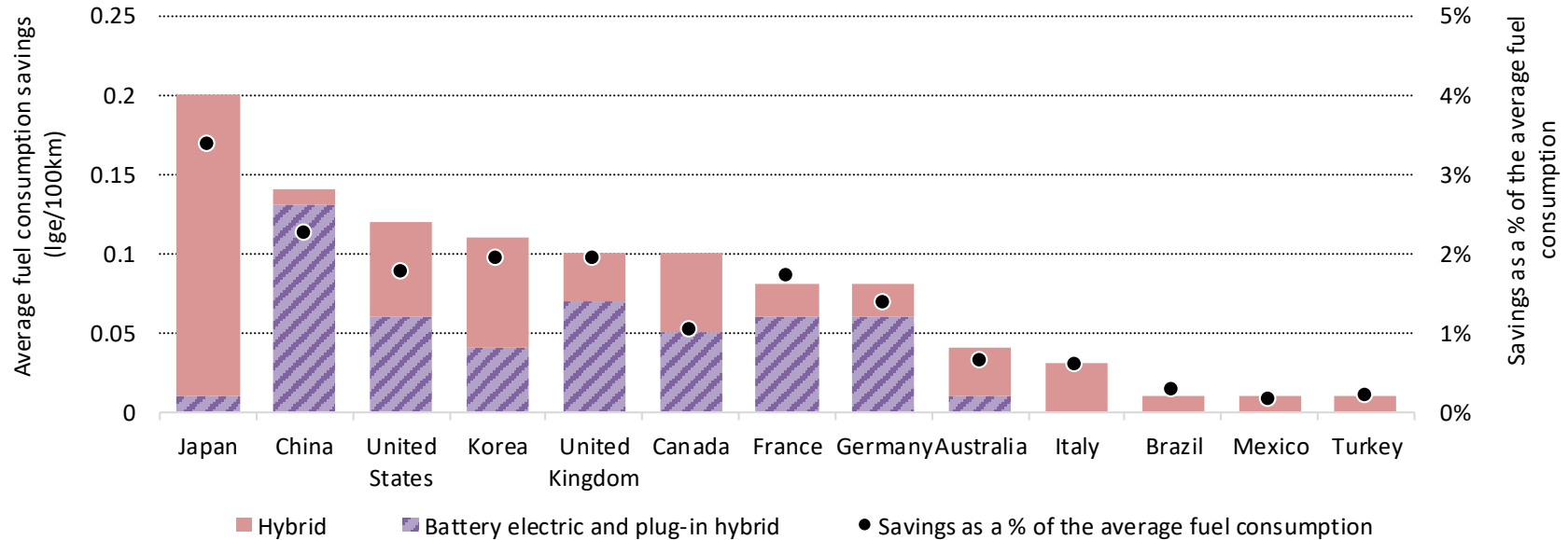
Well-to-wheel CO₂ emissions from similar-sized cars in selected G20 countries, 2017



Electrification of vehicles, coupled with decarbonisation of electricity supply, will improve the efficiency and reduce the environmental impact of transport.

Transport energy savings are driven by different vehicle types

Contribution to the fuel consumption savings from electrified vehicles, 2017



Adoption of hybrid, plug-in hybrid and battery electric vehicles are driving transport energy savings. Data reveals which electric vehicles are most prevalent in G20 countries and the impact they are having.

Why benchmarking

- The preliminary analysis performed by the IEA shows that benchmarking, when developed and used properly, can be beneficial
- Discussion amongst G20 countries during year revealed that countries were interested in benchmarking analysis to understand current levels of energy efficiency and opportunities for gain.
- However, it was also acknowledged that there remain issues with both data availability and sensitivity, which are currently limiting the scope and level of detail in benchmarking analysis.
- Therefore, to be effective and meaningful, benchmarking analysis requires data collection and analysis to be improved and expanded.
- The IEA is continuing to work with Japan on benchmarking, following today's workshop:
 - A discussion on benchmarking to be held with specialists in data collection and reporting
 - Planned in November during G20 energy end-use data and energy efficiency metric initiative

Closing remarks

- G20 has made strong progress on energy efficiency, while there remains considerable cost-effective potential to improve energy efficiency
- Detailed data analysis can help identify this potential and best policy opportunities, and this can apply well beyond the G20 group
- We encourage collaboration among countries on energy efficiency data collection and sharing
- One very important emerging aspect is the opportunities created by digitalisation, and the policy responses governments may consider
- IEA is working with Japan and with countries to more fully analyse efficiency opportunities in key sectors

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Energy efficiency indicators data collection

Roberta Quadrelli | IEA Energy Data Centre

Head, Energy balances, prices, emissions, RDD and efficiency

18th September 2019

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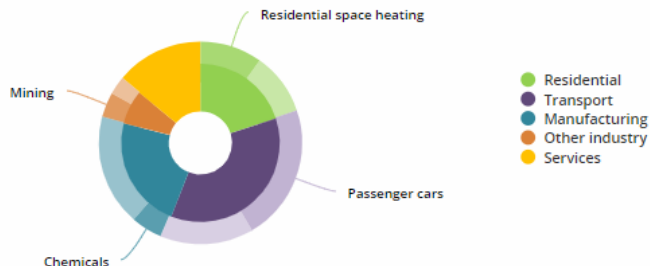
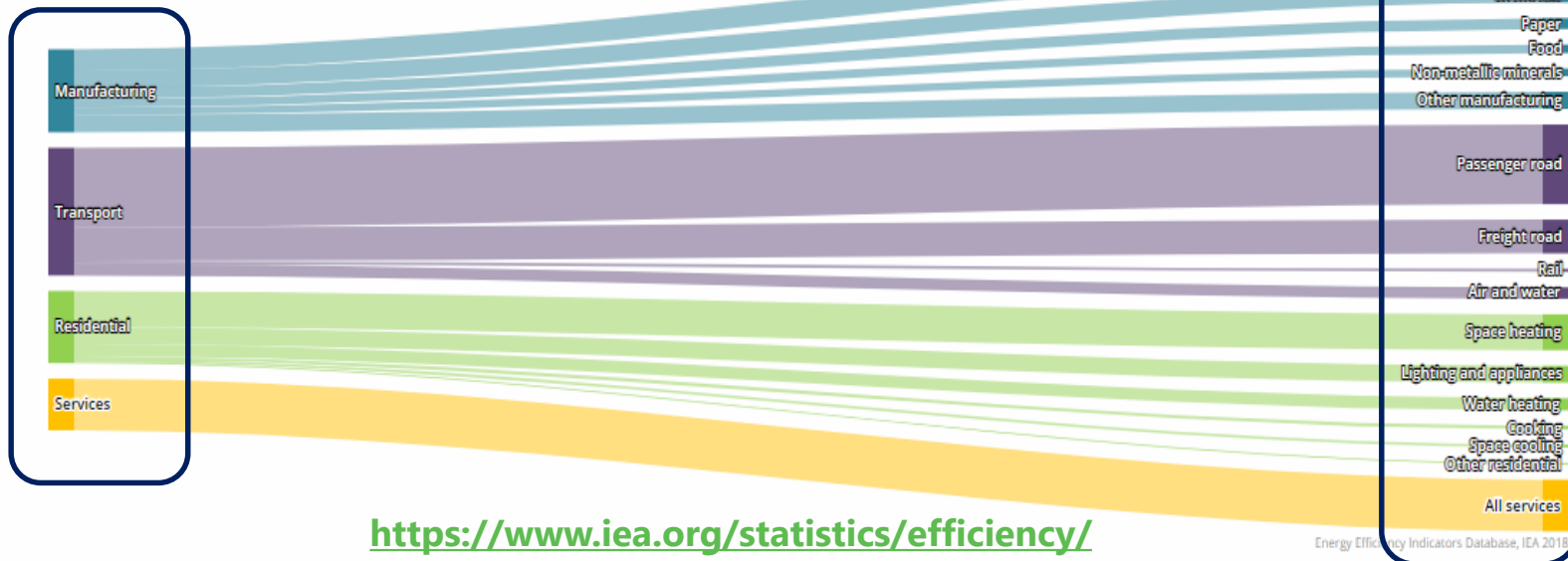
- Introduction to the IEA efficiency data collection
- What data do we collect for the industry sector?
- Summary of reporting status from member countries
- Opportunities for development

IEA energy efficiency indicators work: focus on energy demand

The key sectors for tracking energy efficiency progress are transport, services, manufacturing and the residential sector.

Across IEA countries, the transport sector accounted for the highest share of final energy consumption in 2016 (36%), followed by manufacturing industry (23%), the residential sector (20%) and finally the services sector (14%).

Largest energy end-uses in IEA 2016



End-use data are key to understand efficiency progress

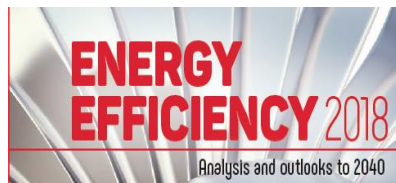
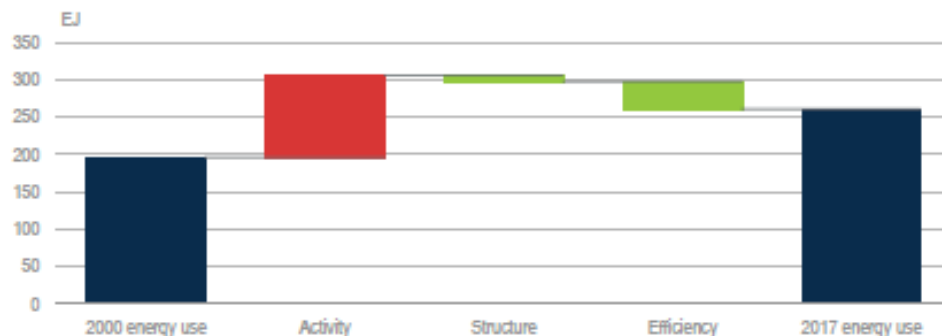


Figure 1.6 Decomposition of final energy use in IEA countries and other major economies



Note: Countries covered are IEA countries plus China, India, Brazil, Indonesia, Russian Federation, South Africa and Argentina. "Energy use" covers the residential, industry and services, passenger and freight transport sectors. It excludes non-energy use (i.e. feedstocks), energy supply and US freight transport (see Chapter 2).

Sources: Adapted from IEA (2018g), *Energy Efficiency Indicators 2018* (database); IEA (2018c) *World Energy Balances 2018* (database); IEA (2018h), *Energy Technology Perspectives* (Buildings model); IEA (2018i), *Mobility Model* (database); Timmer et al. (2015), *World Input Output Database* (database); IBGE (2018), *Quarterly National Accounts* (database); National Bureau of Statistics of China (2018), *National Accounts* (database); Reserve Bank of India (2018), *The India KLEMS Database* (database); Statistics Indonesia (2018), *Gross Domestic Product* (database); INEGI (2018), *GDP - Activity of Goods and Services* (database); StatsSA (2018), *Gross Domestic Product (GDP), 4th Quarter 2017* (database); Quantec (2018), *Industry Service - RSA Standard Industry - Input Structure at basic prices* (database); INDEC, Republic Argentina (2018), *Macroeconomic aggregates (GDP)* (database); World KLEMS Data (2018), *Russia* (database).

IEA Members recognize the value of end-use data

- Data collection agreed by member countries in 2009 (**IEA Ministerial**)
- **Developed with international community of experts**, (Odyssee, LBNL, etc.)
- A user-friendly **Excel questionnaire** (available online)
- Collects **energy consumption** and **activity** data
- Covers **four sectors**: residential, services, industry, transport
- **Publication** and **database** : <https://www.iea.org/statistics/efficiency/>

The screenshot shows the 'Energy Efficiency Indicators Template' Excel questionnaire. The header is blue with the IEA logo and the text 'Energy Efficiency Indicators Template country name'. Below the header, there are several sections with colored backgrounds: 'COUNTRY DATA SECTION (to be reviewed and updated)' in blue, 'INDUSTRY' in orange, 'SERVICES' in orange, 'RESIDENTIAL' in orange, 'TRANSPORT' in orange, 'IEA DATA and AGGREGATE INDICATORS' in orange, 'ELECTRICITY CONSUMPTION' in orange, 'SUPPORT TOOLS' in green, 'INDICATORS' in green, 'DATA COVERAGE' in green, 'SINGLE INDICATOR GRAPHING' in green, 'MULTIPLE INDICATOR GRAPHING' in green, and 'CONSISTENCY CHECKS' in green. Each section contains a list of indicators and their descriptions. At the bottom, there is a 'START' button and a link to the IEA website.



IEA resources : methodologies on indicators and data collection

➤ Fundamentals on statistics:

- Conceptual indicators framework and data collection methods

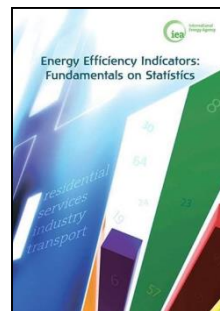
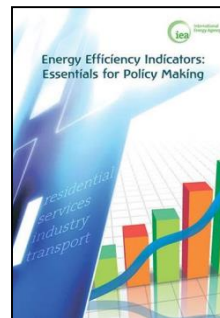
<https://webstore.iea.org/energy-efficiency-indicators-fundamentals-on-statistics>

➤ Essentials for policy makers:

- Guidance to develop and interpret indicators

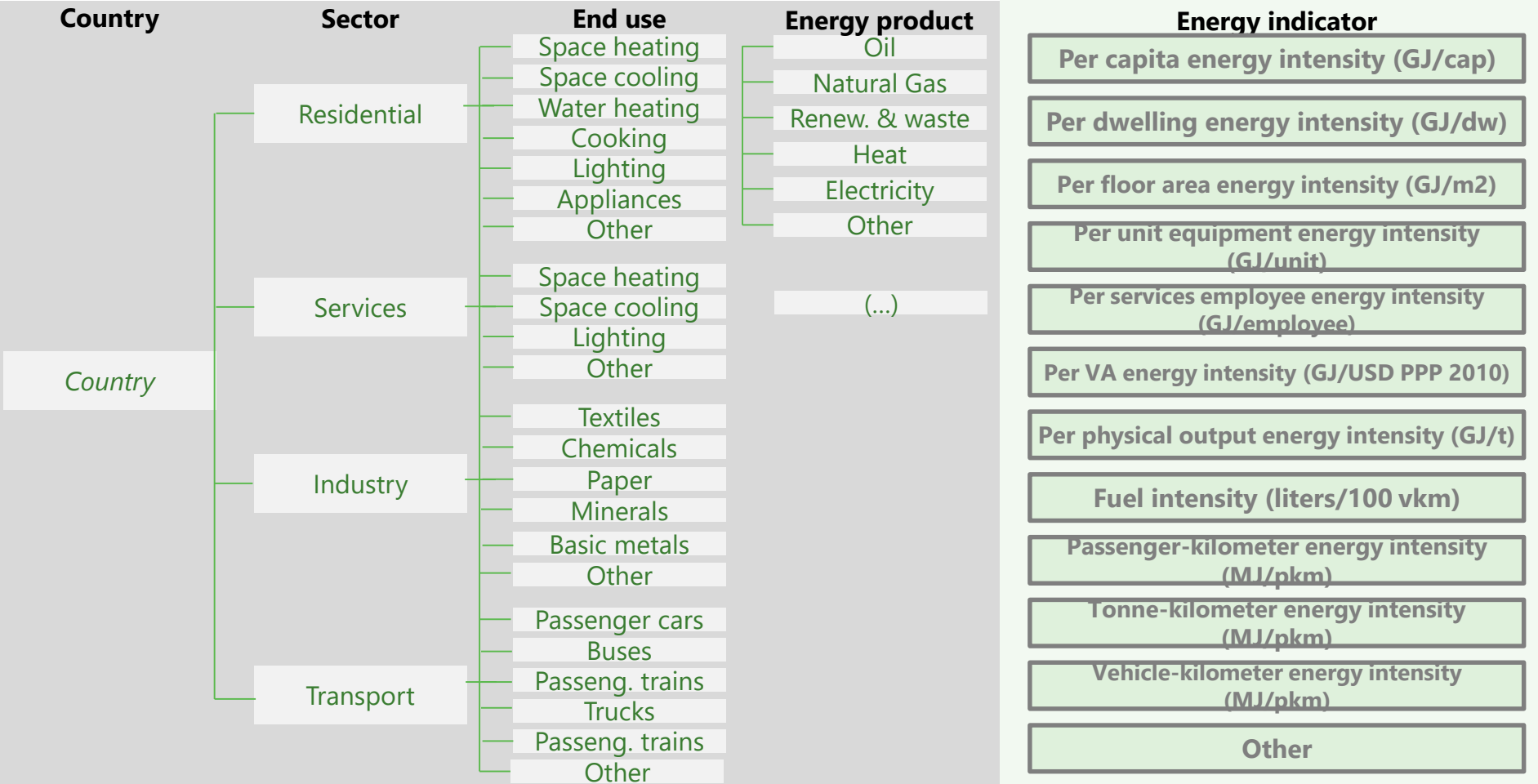
<https://webstore.iea.org/energy-efficiency-indicators-essentials-for-policy-making>

- Downloadable online as pdf
- Both translated into several languages (Spanish, Chinese, Russian, French)
- Also available as online training platform



International guidelines are key to ensure comparability of data and indicators across countries

The overall structure of the IEA efficiency database



Focus on industry: what energy data are collected?

- **Sub-sectors:** same as in energy balances

With increased detail for energy-intensive sectors, in some cases up to product type

- **Products:** more aggregated than in fuel questionnaires (coal, oil products, etc.)
- Covers **energy use** (excludes non-energy)
- **Units:** energy (NCV)

INDUSTRY		units	2000
Legend	Check all/none	Add remarks	
19: Manufacture of coke and refined petroleum products			
Oil & Petroleum Products		PJ	0
Natural Gas		PJ	0
Coal & Coal Products		PJ	0
Combust. Renewables & Waste		PJ	0
Heat		PJ	0
Electricity		PJ	0
Other		PJ	0
Total Energy Use		PJ	0
20 - 21: Manufacture of chemicals and chemical products & base			
Oil & Petroleum Products		PJ	0
Natural Gas		PJ	0
Coal & Coal Products		PJ	0
Combust. Renewables & Waste		PJ	0
Heat		PJ	0
Electricity		PJ	0
Other		PJ	0
Total Energy Use		PJ	0
22: Manufacture of rubber and plastics products			
Oil & Petroleum Products		PJ	0
Natural Gas		PJ	0
Coal & Coal Products		PJ	0
Combust. Renewables & Waste		PJ	0
Heat		PJ	0
Electricity		PJ	0
Other		PJ	0
Total Energy Use		PJ	0
23: Manufacture of other non-metallic mineral products			
Oil & Petroleum Products		PJ	0
Natural Gas		PJ	0
Coal & Coal Products		PJ	0
Combust. Renewables & Waste		PJ	0
Heat		PJ	0
Electricity		PJ	0

Sub-sectoral disaggregation for industry energy data

10 - 12	10 - 12: Manufacture of food products, beverages, tobacco products
13 - 15	13 - 15: Manufacture of textiles, wearing apparel, leather and related products
16	16: Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles
17	17: Manufacture of paper and paper products
	Of which pulp
	Of which paper
18	18: Printing and reproduction of recorded media
19	19: Manufacture of coke and refined petroleum products
20 - 21	20 - 21: Manufacture of chemicals and chemical products & basic pharmaceutical products and pharm
22	22: Manufacture of rubber and plastics products
23	23: Manufacture of other non-metallic mineral products
	Of which cement
	Of which clinker
24	24: Manufacture of basic metals
	Class 2410+2431: Manufacture + Casting of iron and steel
	Of which BOF (Basic Oxygen Furnace)
	Of which EAF (Electric Arc Furnace)
	Class 2420+2432: Manufacture + Casting of precious and non-ferrous metals
	Of which aluminium
25 - 28	25 - 28: Manufacture of fabricated metal products, machinery and equipment
29 - 30	29 - 30: Manufacture of motor vehicles, trailers, other transport equipment
31 - 32	31 - 32: Manufacture of furniture & Other manufacturing
	Manufacturing Not Elsewhere Specified
35 - 36	35 -36: Electricity, gas, steam, air conditioning, and water supply
41 - 43	41 - 43: Construction

What activity data do we collect for industry?

- **Value added:** same disaggregation as energy

Value-added in USD PPP 2005 \$ (at the price levels and PPPs of 2005)	
ISIC Rev.4 Division	
01 - 03: Agriculture, forestry and fishing	
05 - 09: Mining and quarrying	
10 - 32: Manufacturing	
10 - 12: Manufacture of food products, beverages, tobacco products	
13 - 15: Manufacture of textiles, wearing apparel, leather and related products	
16: Manufacture of wood and of products of wood and cork, except furniture; manufacture of other products of wood and cork	
17: Manufacture of paper and paper products	
18: Printing and reproduction of recorded media	
17 - 18: Paper & Printing	
19: Manufacture of coke and refined petroleum products	
20 - 21: Manufacture of chemicals and chemical products & basic pharmaceutical products	
22: Manufacture of rubber and plastics products	
23: Manufacture of other non-metallic mineral products	
24: Manufacture of basic metals	
Class 2410+2431: Manufacture + Casting of iron and steel	
Class 2420+2432: Manufacture + Casting of precious and non-ferrous metals	
25 - 28: Manufacture of fabricated metal products, machinery and equipment	
29 - 30: Manufacture of motor vehicles, trailers, other transport equipment	
31 - 32: Manufacture of furniture & Other manufacturing	
35 - 36: Electricity, gas, steam, air conditioning, and water supply	
41 - 43: Construction	
33 - 99: Services	
Total gross value added at basic prices	

- **Physical production:** more detail

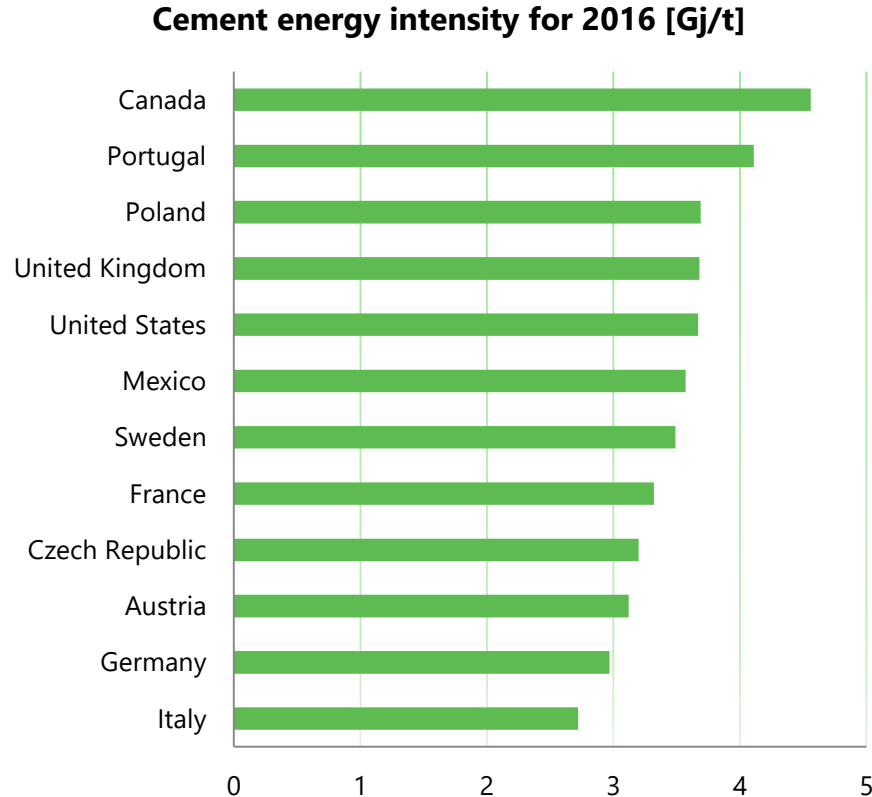
Production of commodities based on ISIC Rev.4 Division	
17	17: Manufacture of paper and paper products
✓	Pulp
✓	Chemical pulp
✓	Mechanical pulp
✓	Recovered Paper
✓	Inked
✓	De-inked
✓	Paper and paperboard
✓	Household + Sanitary Paper
✓	Newsprint
✓	Printing + Writing Paper
✓	Wrapping + Packaging Paper + Paperboard
✓	Other
20 - 21	20 - 21: Manufacture of chemicals and chemical products
✓	Ethylene
✓	Propylene
✓	BTX
✓	Ammonia (NH3)
✓	Butadiene
✓	Caustic Soda
23	23: Manufacture of other non-metallic mineral products
✓	Cement
✓	Clinker production
✓	Cement production
24	24: Manufacture of basic metals
✓	Crude Steel
✓	Basic Oxygen Furnace production
✓	Electric Arc Furnace production
✓	Direct Reduced Iron
✓	Bauxite
✓	Alumina refining
✓	Aluminium
✓	Primary production
✓	Recycled production

Collected either through submission or from secondary sources

Reporting status of energy use in selected industry subsectors for IEA member countries

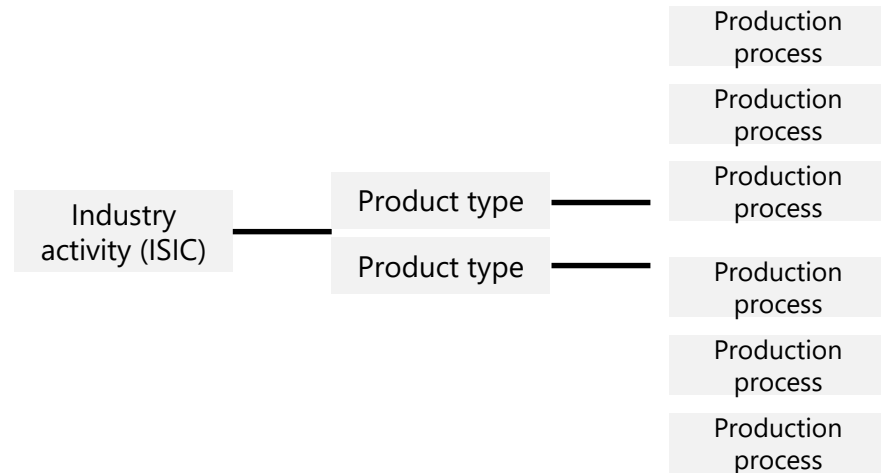
Industry subsector	Countries reporting (28)	Industry subsector	Countries reporting (28)
Paper, Pulp & Print [ISIC 17-18]	28	Basic Metals [ISIC 24]	28
Paper and Pulp [ISIC 17]	9	Ferrous Metals [ISIC 2410+2431]	28
Printing [ISIC 18]	9	of which: BOF (Basic Oxygen Furnace)	0
<u>of which: pulp</u>	2	of which: EAF (Electric Arc Furnace)	0
of which: paper	2	Non-Ferrous Metals [ISIC 2420+2432]	28
Rubber and Plastics [ISIC 22]	13	of which: Aluminium	5
Non-Metallic Minerals [ISIC 23]	28	Vehicles & Transport Equipment [ISIC 29-30]	25
<u>of which: cement</u>	13		
of which: clinker	1		

Example of indicators derived from IEA data collection



A few remarks

- Detailed end-use and activity data - and indicators - are vital for energy demand policy and planning, across sectors and end-uses.
- Ideally energy intensities should be considered at product/process level.
- Constraints in collecting energy use at the same level of detail as physical production
- Development of more detailed data collection should generally be targeted at filling more relevant gaps at a more aggregated level first, ideally following a tree structure:



The IEA is committed to facilitate the national work with a view to strengthening long-term institutional collaboration

Opportunities to further develop end use data beyond Members

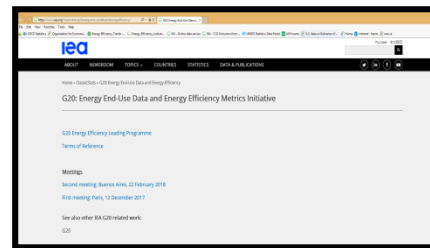
- **G20 fora** are a privileged context to identify priorities for further data needs across key players, be it for benchmarking, new policy interests, etc...

G20: Energy End-Use Data and Energy Efficiency Metrics Initiative

Discussion forum for countries to share knowledge, methodologies and experience in collecting and using energy demand and energy efficiency data for policy making. **Upcoming workshop: 21-22 November, IEA, Paris**



- Need for prioritization of data collection and proper allocation of resources at national level
- The IEA is keen to assist as possible, for example by providing technical support, and to raise data needs among national counterparts as appropriate



Benchmarking work programs to go hand in hand with data collection efforts

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Energy efficiency benchmarking in industry

Peter Levi

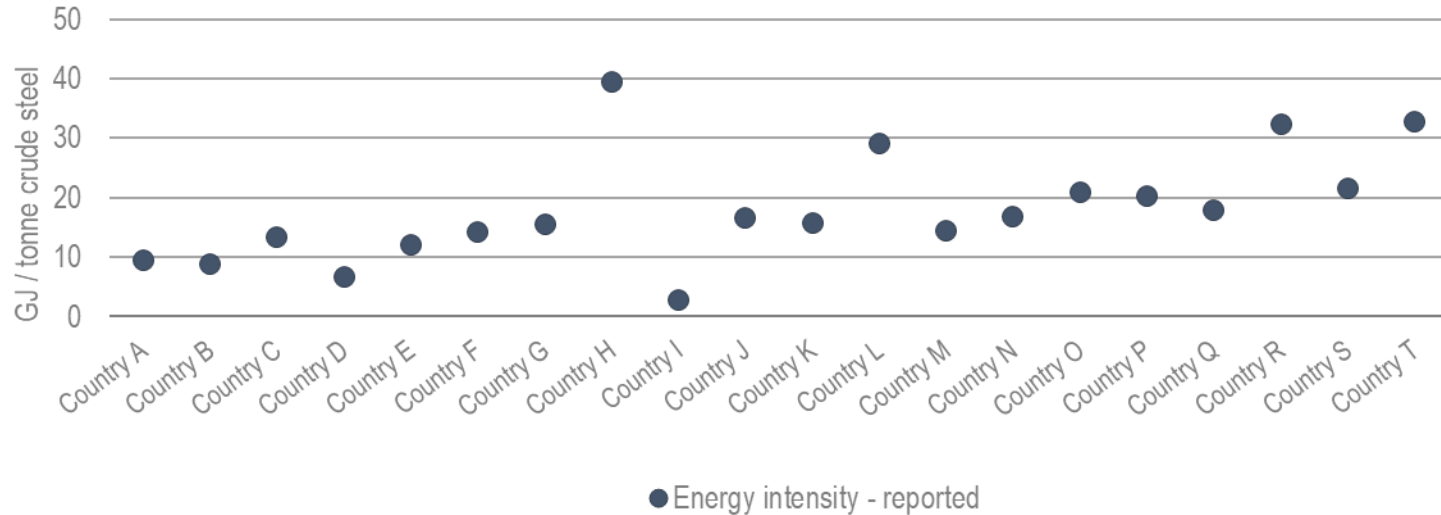
Paris, 18 September 2019

Outline

1. What data on industrial energy efficiency do we have available today?
2. What data would we ideally like?
3. Why would these data be useful?
4. How could we get better data in the future?

The IEA energy balance provides sectoral energy data...

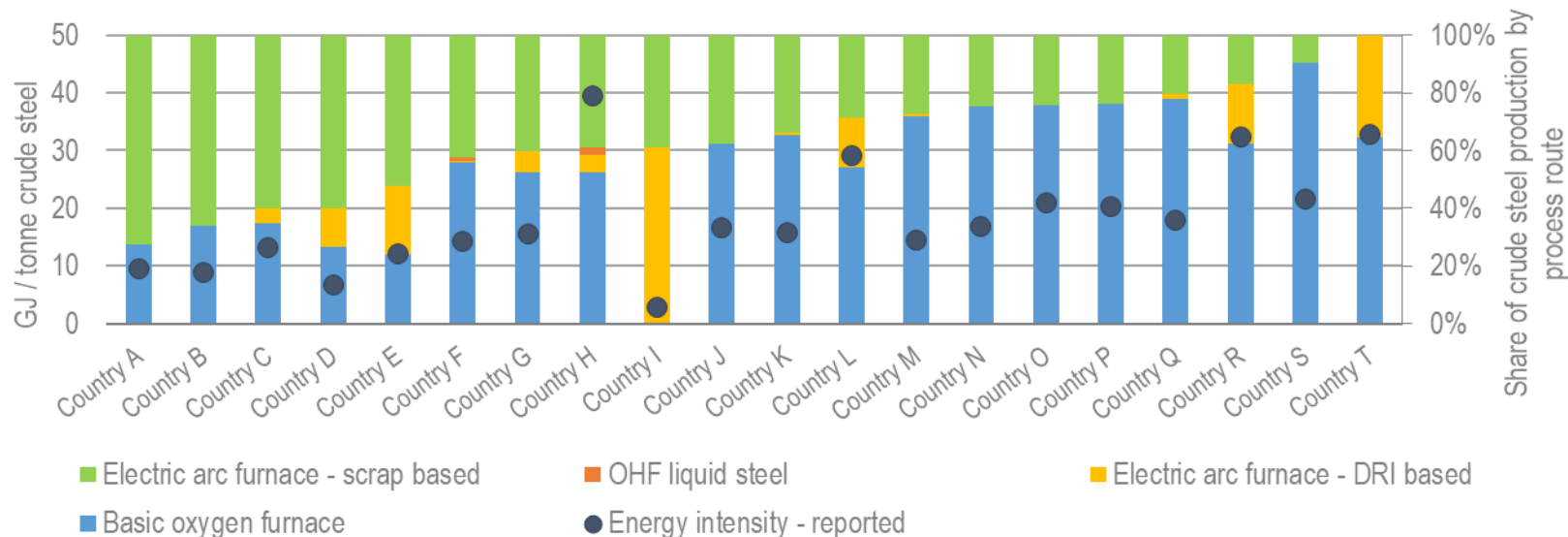
Final energy use per tonne of crude steel in 2016



The IEA energy balance enables us to see how broad sectors perform in energy terms. But due to the complex nature of industrial production, more detailed data is needed to assess energy efficiency.

...but more detailed data provides a fuller picture

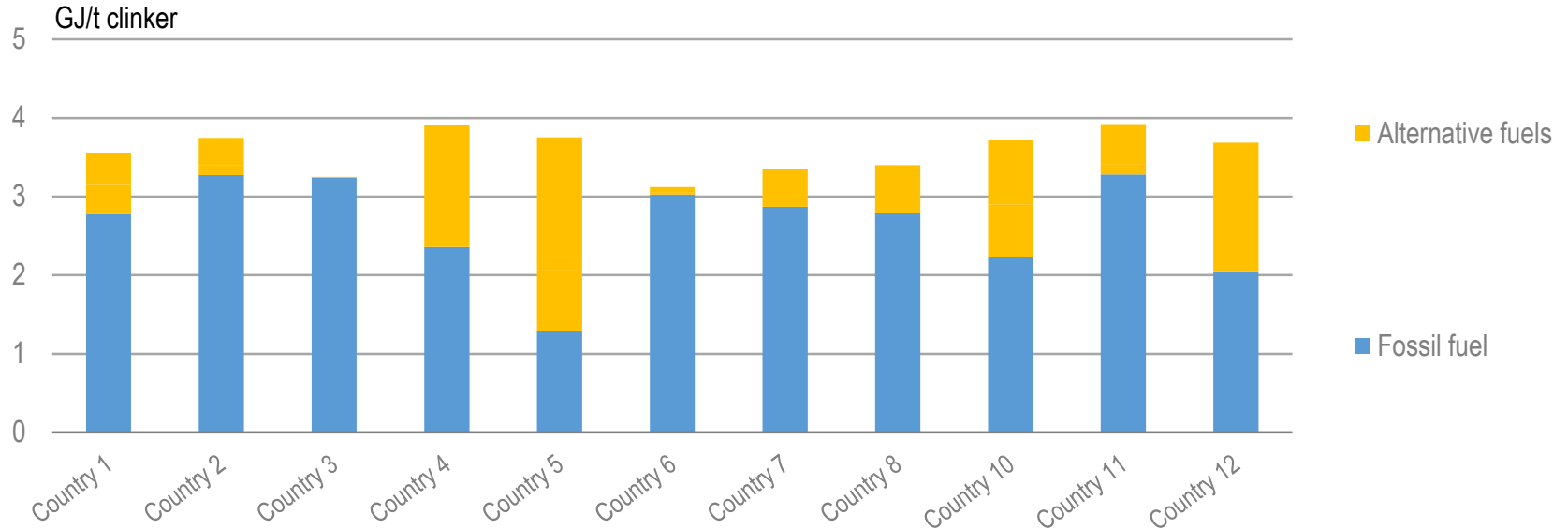
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External data sources can provide additional details...

Thermal energy per tonne of clinker in 2016



Using data from other data sources can provide more detail. However, for industry there are often limitations with this data as well.

...but this data also has limitations.

GNR Project Reporting CO2



Region / Country	Year	Nb companies	Nb plants	GNR Cement production	Total cement production	Coverage
World	2017	48	879	822078249	4224782640	19%
Geographical	2017	48	877	821586586	4224782640	19%
Austria	2017	6	7	4191141	5168731.56	81%
Brazil	2017	6	55	36514895	53540000	68%
Canada	2017	4	18	12917095	11930000	100%
Czech Republic	2017	4	6	4127572	4077000	100%
Egypt	2017	5	10	25993839	64300000	40%
France	2017	4	39	17311580	17039000	100%
Germany	2017	6	57	34736068	34428000	100%
India	2017	8	107	157261399	297680000	53%
Italy	2017	5	45	15906238	19549000	81%
Philippines	2017	4	15	19978334	26000000	77%
Poland	2017	7	14	17356873	15667900	100%
Spain	2017	6	29	10433912	21118000	49%
Thailand	2017	3	12	37178139	35670000	100%
United Kingdom	2017	4	13	8688637	9280000	94%
United States	2017	10	83	70706585	86560000	82%

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Better data could provide multiple benefits

- Improved energy efficiency benchmarking, which enables:
 - Identifying best performers and sharing best practices
 - Setting regulatory targets
 - Identifying opportunities for improvement and pushing for better performance
- Tracking progress
- Energy modelling and analysis, for understanding future CO2 trajectories

There are several possible paths to better data

- Collection directly from countries (for example, hosted by the IEA):
 - Could be incorporated into existing or new IEA data collection
- Better support from countries for reporting to industry associations:
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 - Could help resolve confidentiality concerns and enable more data to be made publicly available

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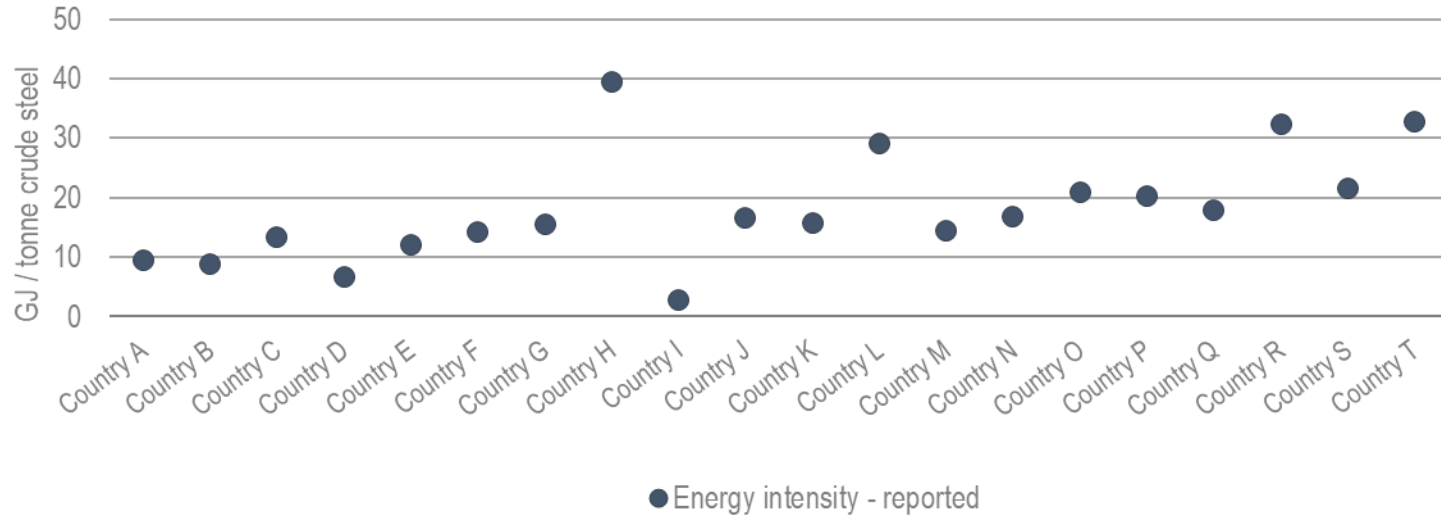
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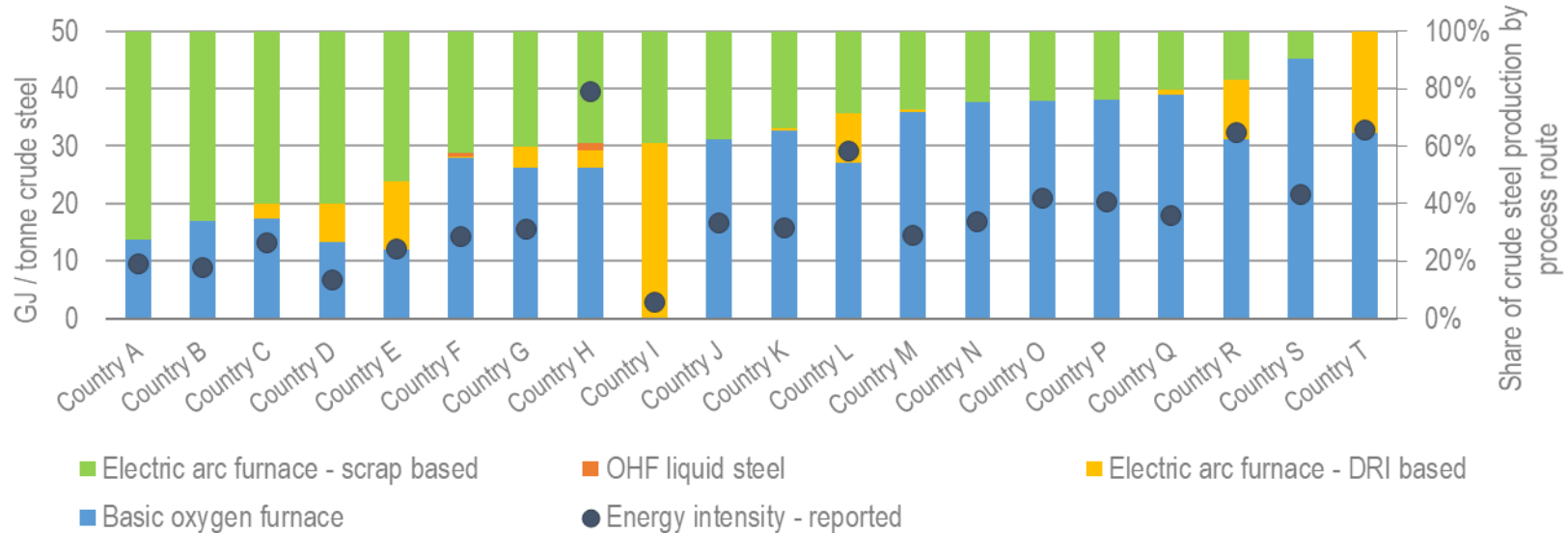
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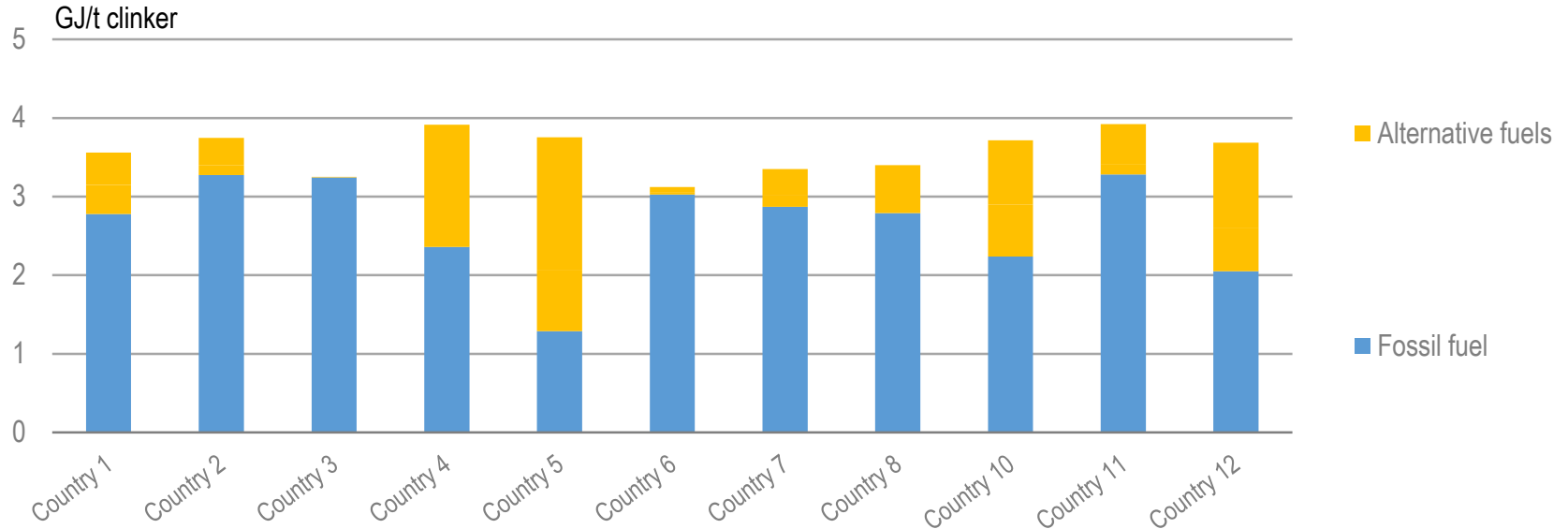
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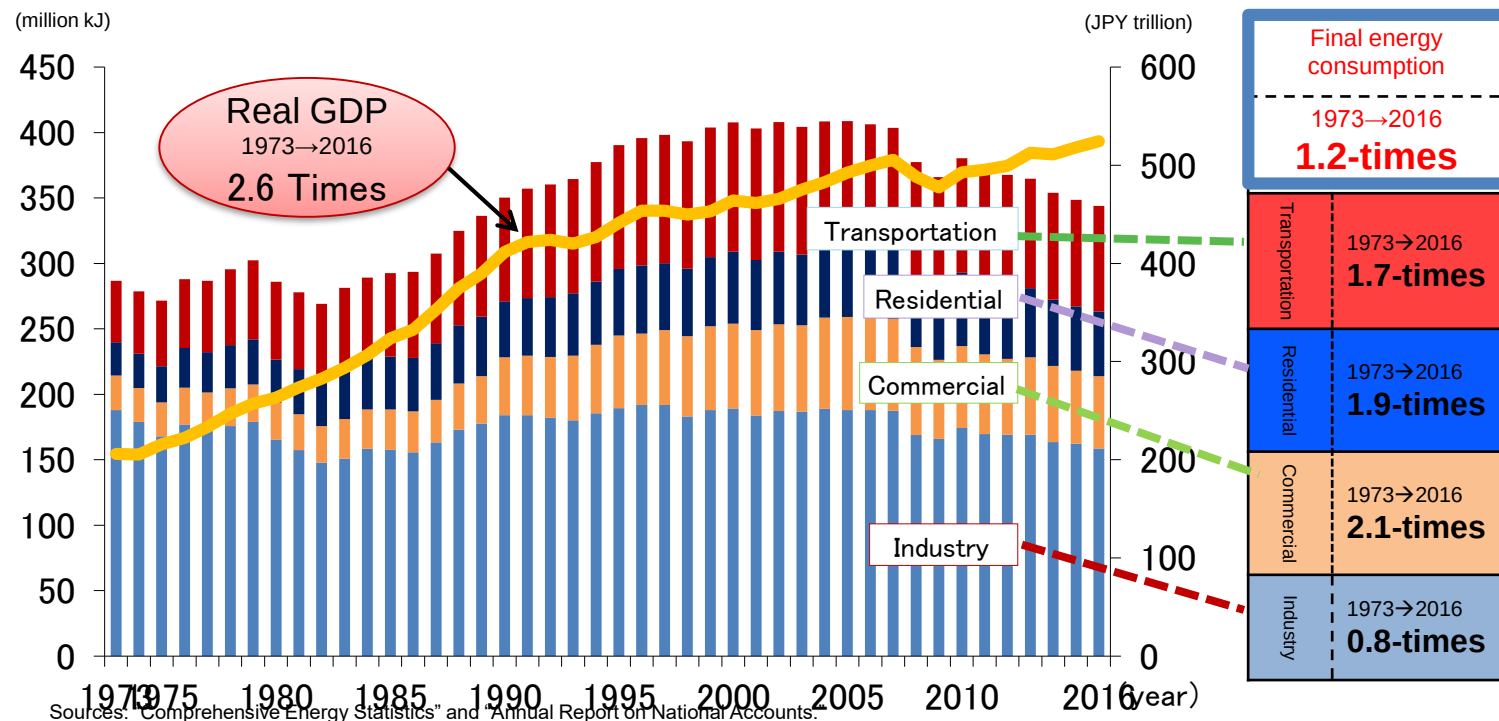
Energy Efficiency Benchmark Policy in Japan and Expectations for IEA's Global Energy Efficiency Benchmarking Work

Hiroya Gorai

Deputy Director, Energy Efficiency Division,

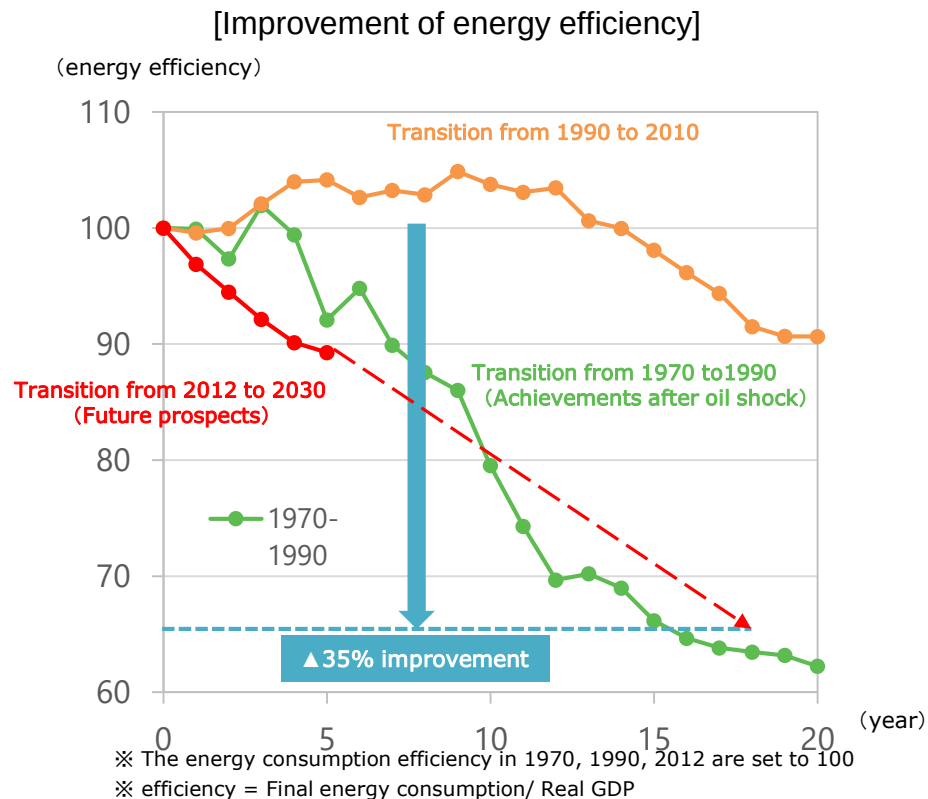
Ministry of Economy, Trade and Industry (METI)

Trends in Final Energy Consumption in Japan



Japan's target for ambitious energy efficiency

- 35% reduction in energy consumption per GDP toward 2030

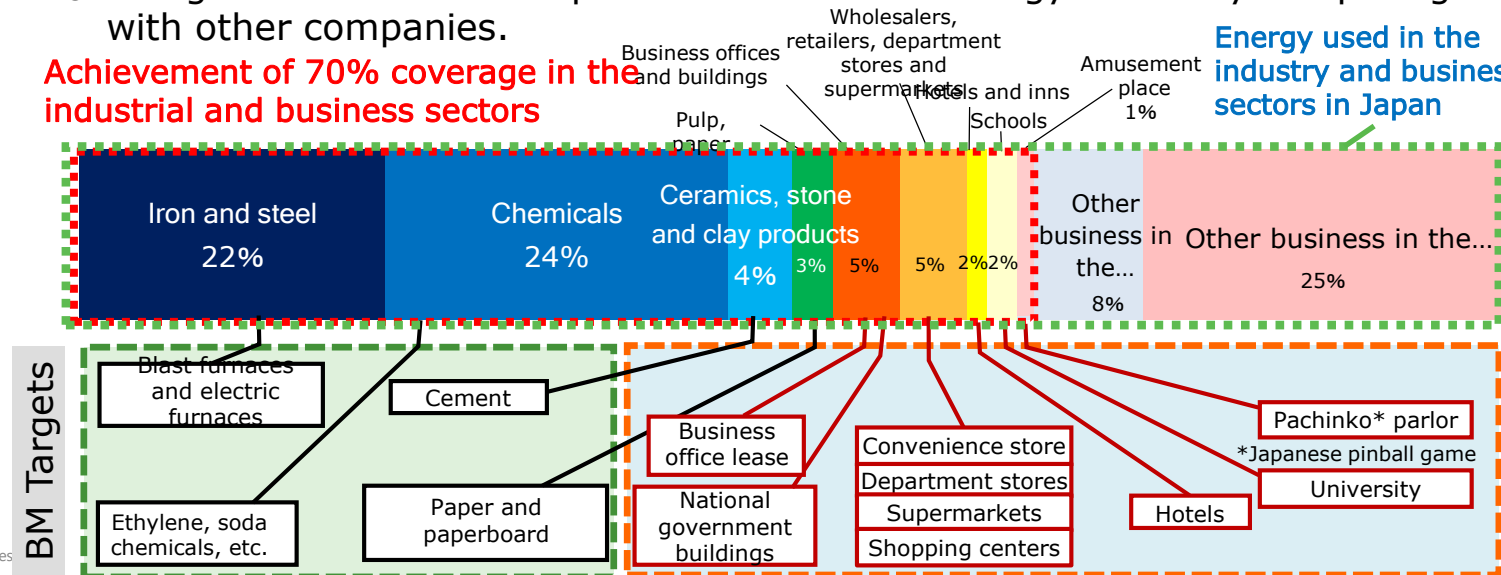


Energy Efficiency Benchmark Policy in Japan

- ⊖ The benchmark policy(BM) sets an energy consumption efficiency target for each sector which should be achieved by each company.
- ⊖ BM was introduced in 2008. Currently, the coverage of BM is 70% of energy consumption in the industrial and business sectors.
- ⊗ The government and companies can evaluate energy efficiency comparing with other companies.

Achievement of 70% coverage in the industrial and business sectors

Energy used in the industry and business sectors in Japan

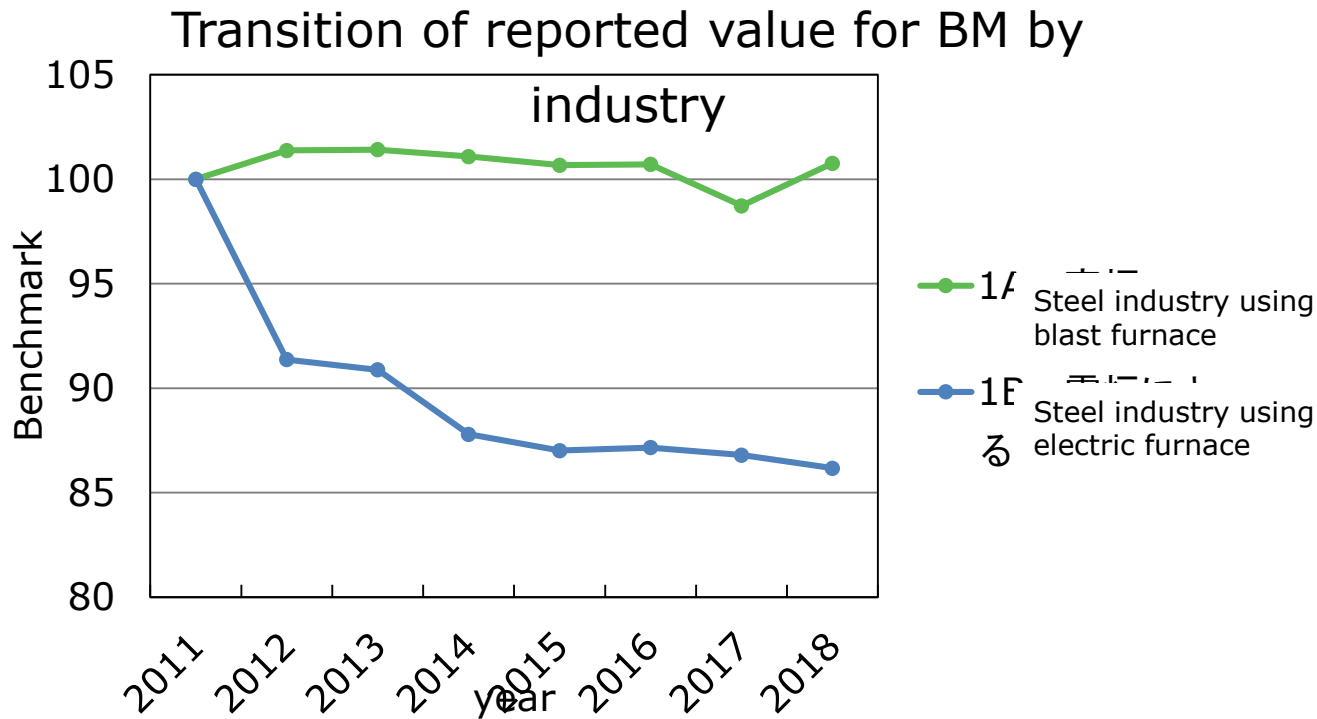


Energy Efficiency Benchmark Indicators and Targets

Category	Business	Benchmark Indicators (Summary)	Benchmark target	Year of introduction	Number of companies achieved in 2018 periodic reports
1 A	Steel industry using blast furnace	Energy consumption per crude steel production	0.531kloe/t or less	FY 2009	0 / 4 (0.0%)
1 B	Steel industry using electric furnaces	Sum of energy consumption of upper process per amount of crude steel and that of lower process per rolling amount	0.143kloe/t or less	FY 2009	6/31 (19.4%)
1 C	Special steel industry using electric furnaces	Sum of energy consumption of upper process per amount of crude steel and that of lower process per shipment	0.36kloe/t or less	FY 2009	4/18 (22.2%)
2	Electric power producing industry	Thermal power generation efficiency A index Thermal power generation efficiency B index	A:1.00 or more B:44.3% or more	FY 2009	32/79 (40.5%)
3	Cement industry	Sum of energy consumption per production volume or shipment volume in each process of raw material process, firing process, finishing process, and shipping process	3,739MJ/t or less	FY 2009	4/16 (25.0%)
4 A	Paper industry	Energy consumption per paper production in the paper manufacturing process	6,626MJ/t or less	FY 2010	3/18 (16.7%)
4 B	Paperboard industry	Energy consumption per paperboard production in the paperboard manufacturing process	4,944MJ/t or less	FY 2010	6/32 (18.8%)
5	Petroleum refining industry	Energy consumption per standard amount of oil used in the oil refining process	0.876 or less	FY 2010	4/10 (40.0%)
6 A	Basic petrochemicals manufacturing industry	Energy consumption of ethylene, propylene, butadiene and benzene per the production volume	11.9GJ/t or less	FY 2010	5/10 (50.0%)
6 B	Caustic soda industry	Sum of energy consumption per production volume and steam heat consumption per liquid caustic soda weight in concentration process	3.22GJ/t or less	FY 2010	6/22 (27.3%)

Reported value for Energy Efficiency Benchmark (Steel)

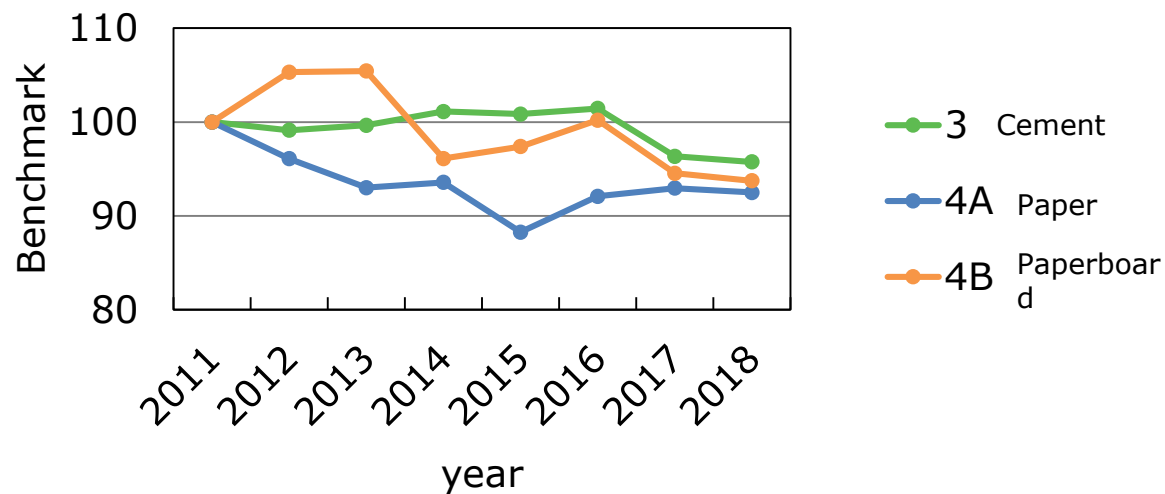
- Steel industry using electric furnace steadily improves efficiency



Reported value for Energy Efficiency Benchmark (Cement, Paper, Paperboard)

- ⊖ Reported value was improved in all three industries
- ⊖ The value changes by the amount of production

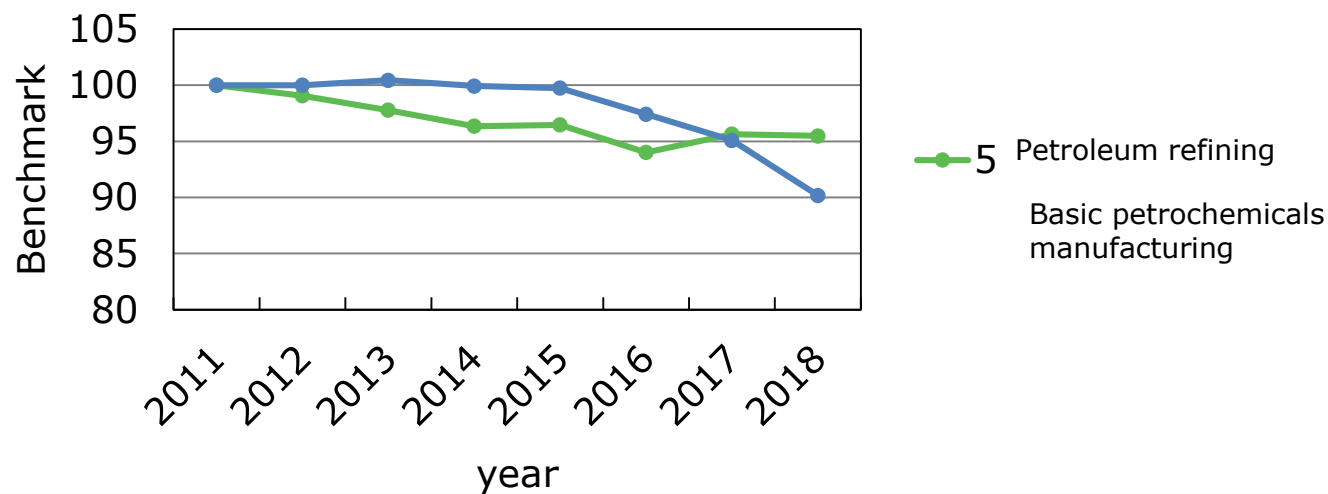
Transition of reported value for BM by industry



Reported value for Energy Efficiency Benchmark (Petroleum, petrochemicals)

- Both the petroleum refining and basic petrochemicals manufacturing industries steadily improved value

Transition of reported value for BM by
industry



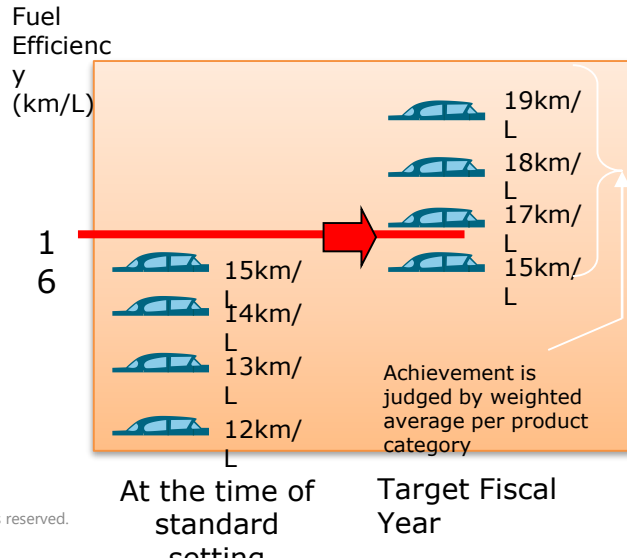
Reference: Benchmark Policies in G20 Members

	Benchmark system name	Setting method	Number of target industries	Steel	Cement	Pulp and paper	Chemistry
US	Energy Star (Energy benchmark)	25% or more	18	✓	✓	✓	—
EU	EU Emissions Trading System (CO2 benchmark)	Top 10% average	ETS covered industry	✓	✓	✓	✓
China	National recommended standards (Energy benchmark)	International standard reference	All industry	✓	✓	✓	✓
India	Perform Achieve and Trade (PAT) (Energy benchmark)	Adjustment by sector and company	11	✓	✓	✓	✓
Canada	Output-based pricing system (CO2 benchmark)	20-30% higher than the industry average	17	✓	✓	✓	✓
UK	Climate Change Agreement (CCA) (Negotiated Target)	Group or company negotiates with government	All industry	✓	✓	✓	✓
Korea	KETS (CO2 benchmark)	Industry average	23	—	✓	—	—
Saudi	Energy benchmark	Global top 1/4 level	3 Source: The Institute of Energy Economics, Japan	✓	✓	—	✓

"Top-Runner Program" for Equipment and Materials

- ⊖ The "Top-Runner Program" is a mandatory program.
- ⊖ The government set targets based on the most efficient performance of equipment on the market.
- ⊗ Companies need to achieve such targets in 3 to 10 years.

Example of Top Runner Program

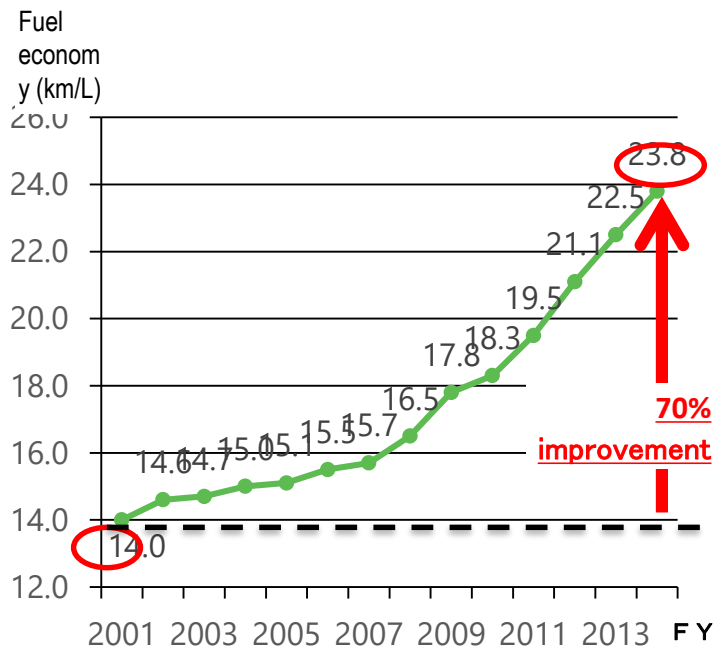


32 equipment and materials

- | | | |
|------------------------------|----------------------------|----------------------------|
| 1. Passenger vehicles | 11. Electrical freezers | 22. Routers |
| 2. Air conditioners | 12. Space heaters | 23. Switching units |
| 3. Lighting equipment | 13. Gas cooking appliances | 24. Multifunction devices |
| 4. TV sets | 14. Gas water heaters | 25. Printers |
| 5. Copying machines | 15. Oil water heaters | 26. Electric water heaters |
| 6. Computers | 16. Electric toilet seats | 27. AC motors |
| 7. Magnetic disk units | 17. Vending machines | 28. lamps |
| 8. Freight Vehicles | 18. Transformers | 29. Showcase |
| 9. Video cassette recorders | 19. Electric rice cookers | 30. Insulation materials |
| 10. Electrical refrigerators | 20. Microwave ovens | 31. Sashes |
| | 21. DVD recorders | 32. Multi-paned glazing |

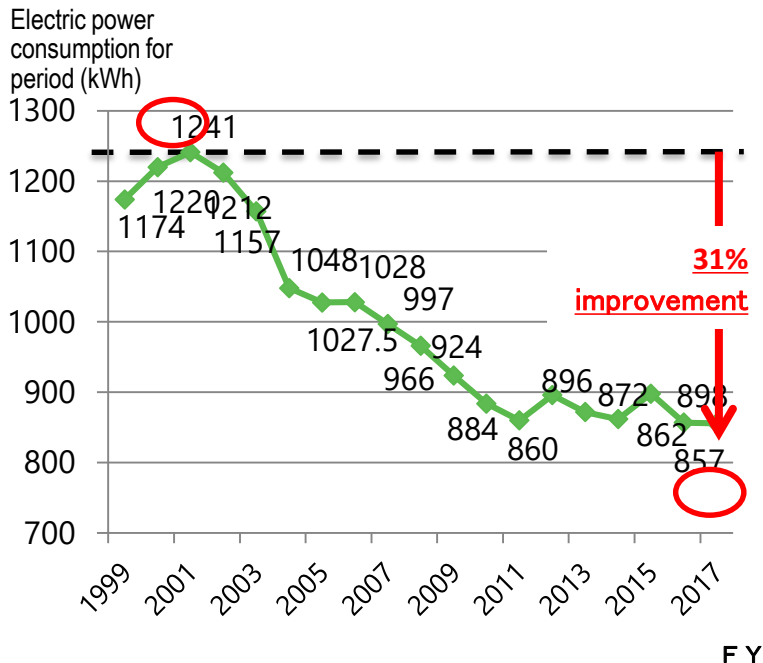
Improvements in Energy-Efficiency under “Top Runner Program”

[Passenger vehicles]



(Source) Ministry of Land, Infrastructure and Transport

[Air conditioners]



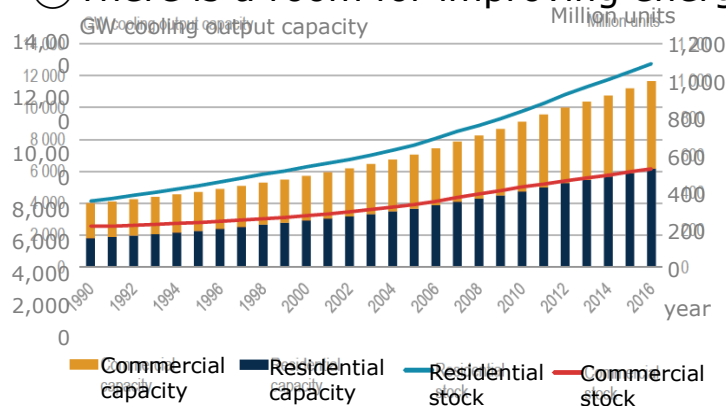
(Source) Created from “Energy Efficiency Performance Catalog”.

Air conditioner (Background)

- ⊖ The number of air conditioners(ACs) units is increasing worldwide (North America, Europe and Asia)
- ⊖ Energy demand for AC is increasing.
- ⊗ Energy efficiency is important to achieve the goals of the Paris Agreement.

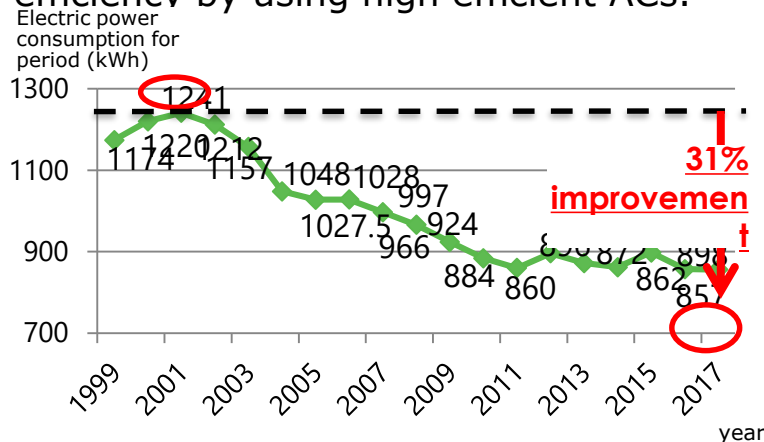
④ Energy efficiency of ACs are quite different by countries and manufacturers.

Worldwide stock and capacity of ACs by sector



Source: IEA(2018) The Future of Cooling Fig. 3.1

Improvement of energy efficiency of ACs in Japan



Source: Created from "Energy Efficiency Performance Catalog"

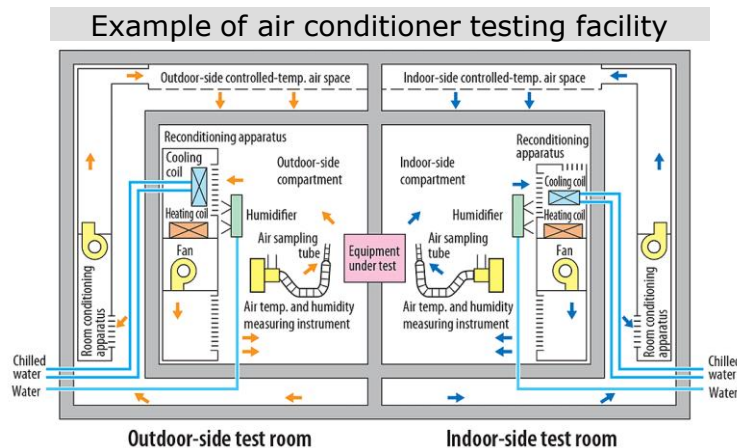
Air conditioner (Points to better analysis)

- ⊖ Differences of the test methods and energy efficiency performance calculation for AC in the world
(e.g. there are methods apply to neither ISO, US standard, nor EU standard)
- ⊖ Importance of accurate evaluation methods which can evaluate actual AC use
(e.g. partial output)
- ⊗ Reasonable and tighter regulation for AC efficiency in each country

Reference: Standard of energy efficiency of ACs in Japan

④ Potential of decreasing energy consumption by using energy efficient ACs

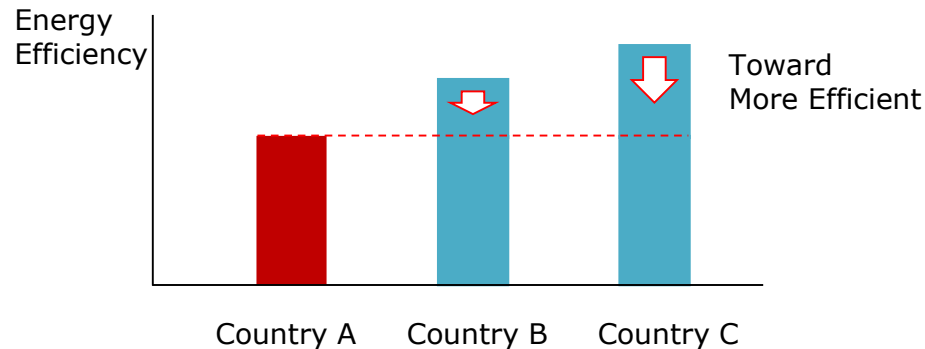
- Calculation method of is based on JIS(Japan Industrial Standards) C 9612:2013 (based on ISO 5151:2010)



(Source) Japan Air Conditioning and Refrigeration Testing Laboratory

Expectations for IEA's Global EE Benchmarking work

- By recognizing each country's position in the world, it is possible for each government to promote energy efficiency policies.
- We think it is appropriate to begin with case studies for the steel industry, the cement industry and air conditioners.
- However, we should note that the results of energy efficiency are affected by the differences of the process, climate and temperature, etc. in each industry. (Image of benchmarking)

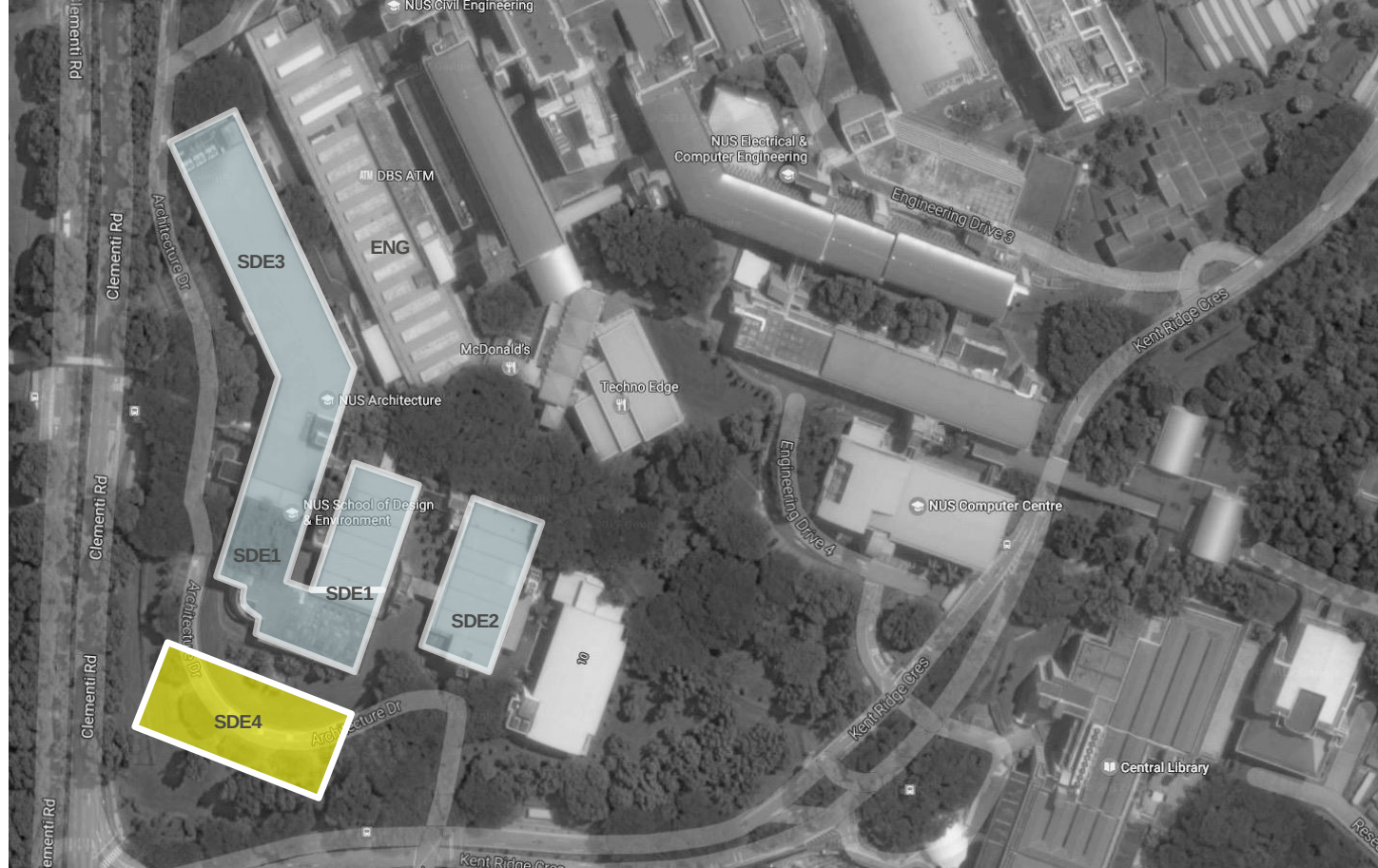




Thank you

Net-Zero Energy Building in the Tropics School of Design and Environment SDE 4





SDE4 | Longitudinal Section

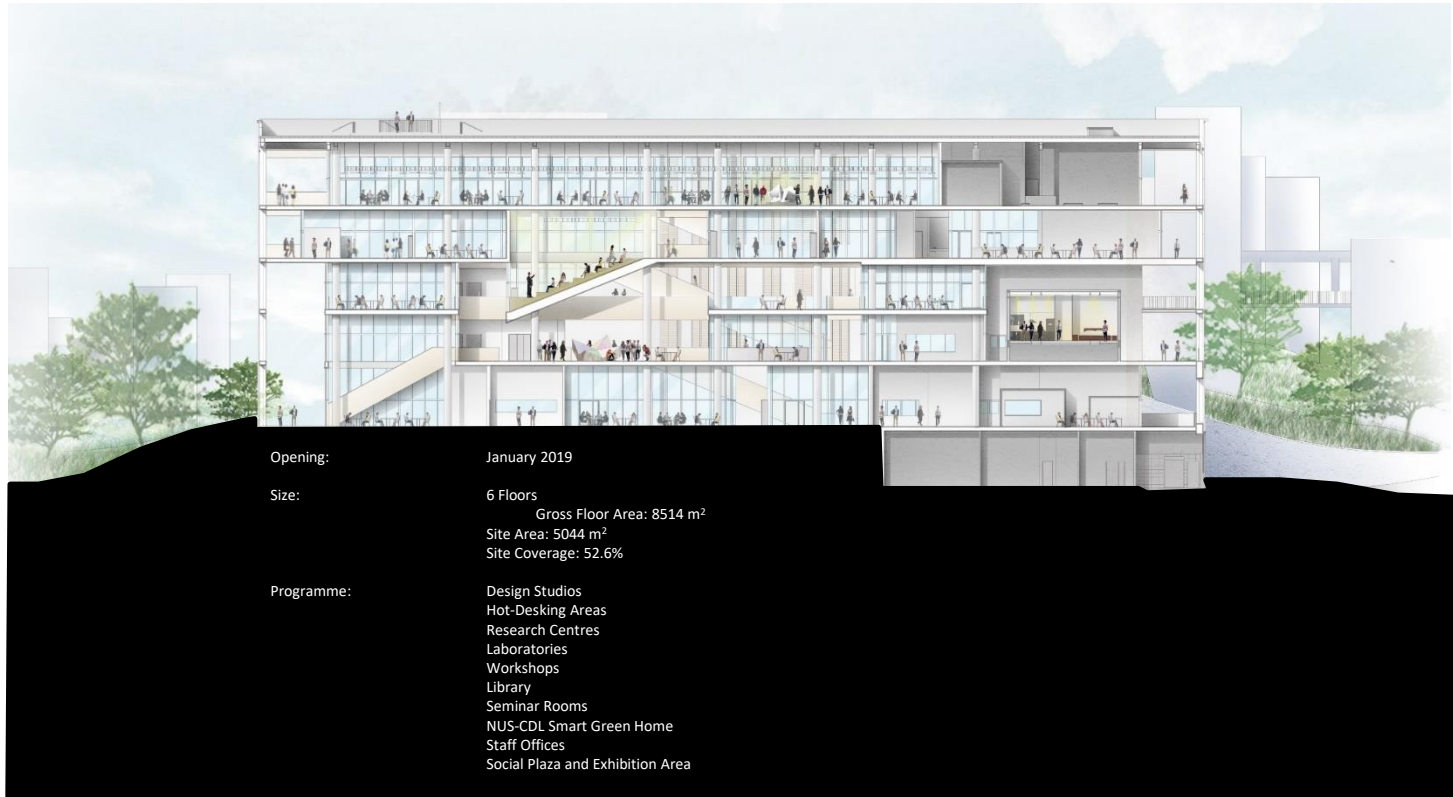


Image: Serie Architects

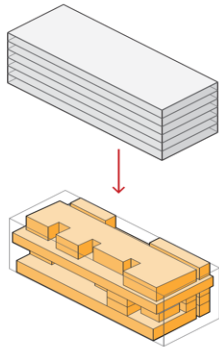
SDE4 | Longitudinal Section



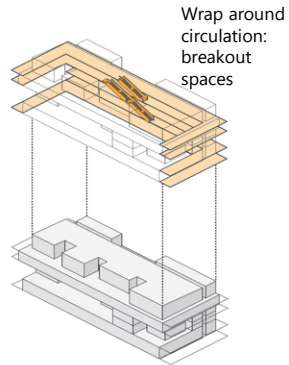
Image: Serie Architects

SDE4| SPACE AND FORM

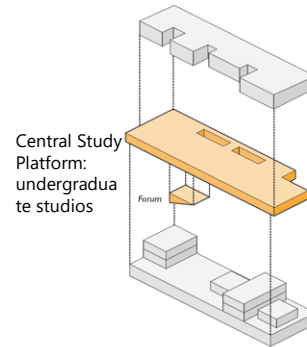
WELLNESS



EDUCATIONAL MODEL



FLEXIBILITY



COMMUNITY

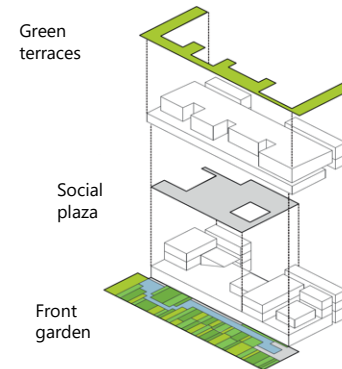


Image: Serie Architects

A net zero energy building is one in which the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created.

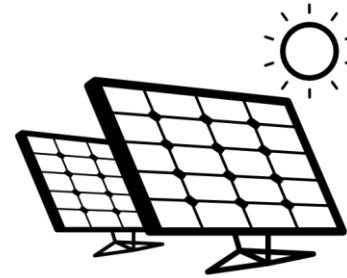
NZEB: Site Energy A, renewable energy collected within Site Boundary

Net Zero Source Energy
Net Zero Energy Costs
Net Zero Energy
Emissions

SDE 4 Net Zero Energy Building



$\geq$



Renewable Energy
Production over a YEAR

SDE4 | ENERGY REDUCTION STRATEGIES

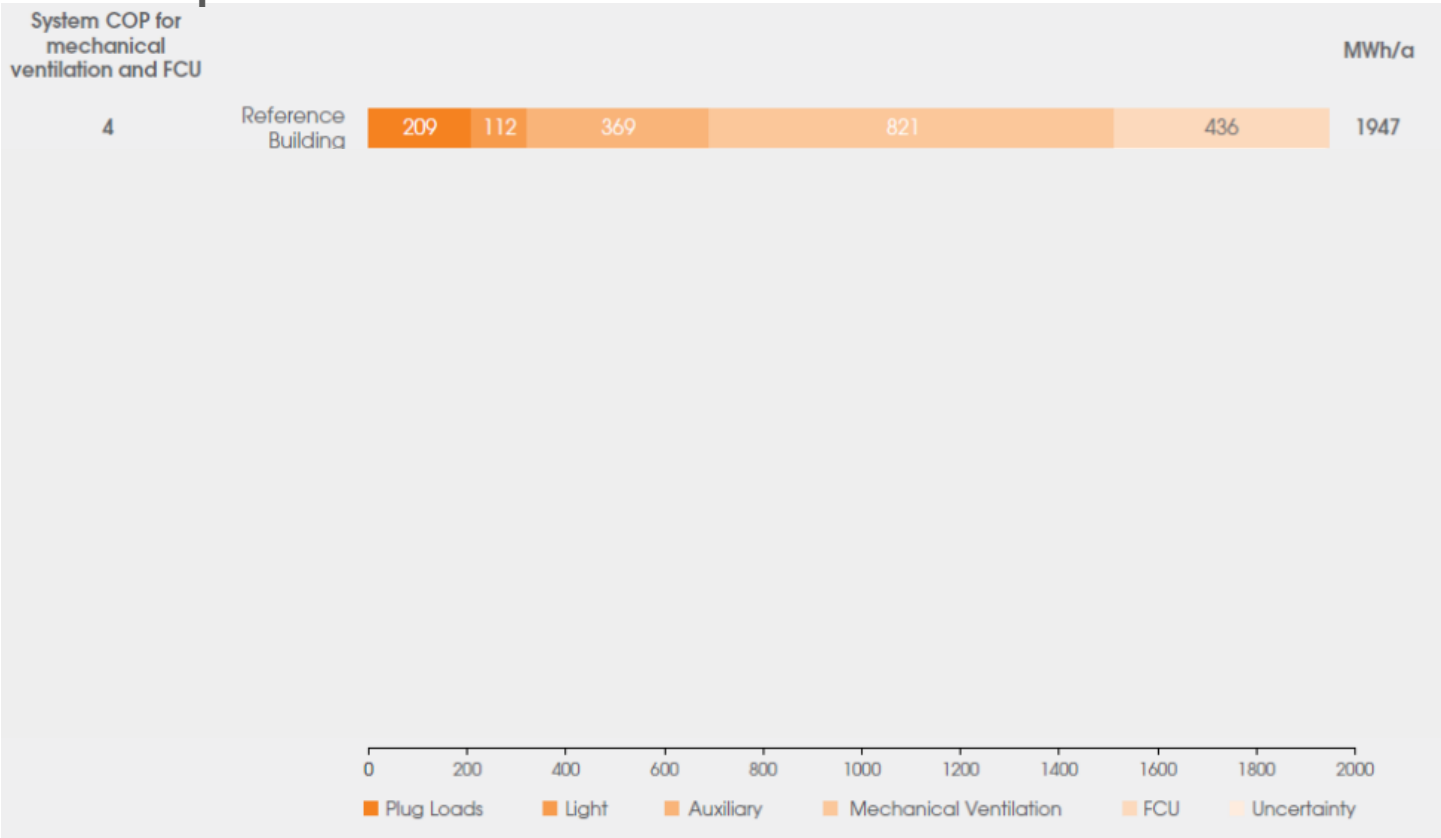


Image: Transsolar Klimaengineering

SDE4| RENEWABLE ENERGY

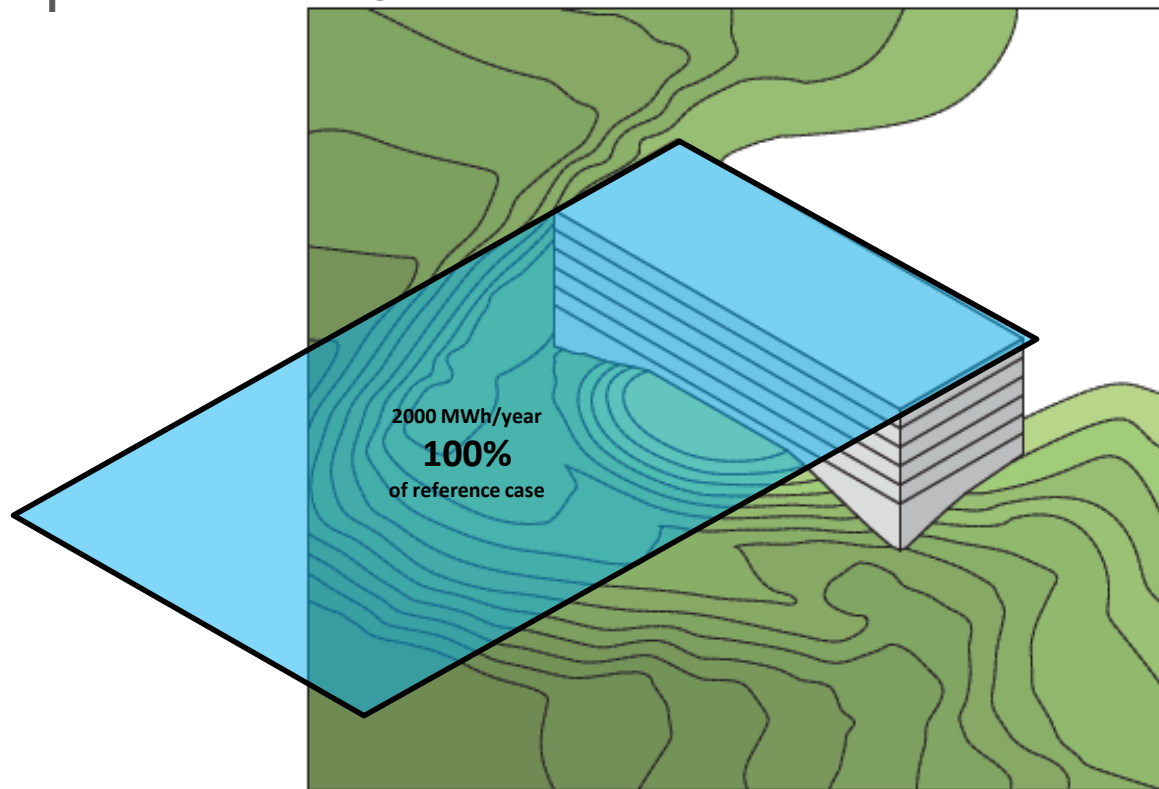
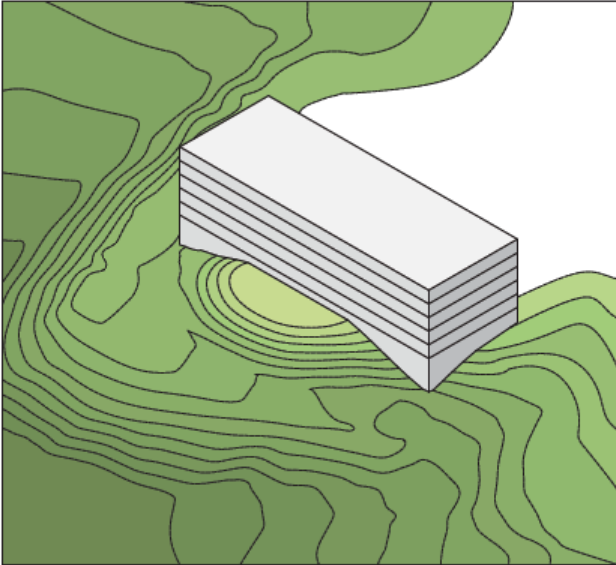


*Image: Serie
Architects*

SDE4| PASSIVE DESIGN, TROPICAL ARCHITECTURE

0. Base Case

The standard architectural form with emphasis on enclosure and architecture as object.



1. Enhancing Natural Ventilation

Loosely stacked planes
Occupant controlled glazing
Shallow composition depth
Optimal North, South opening

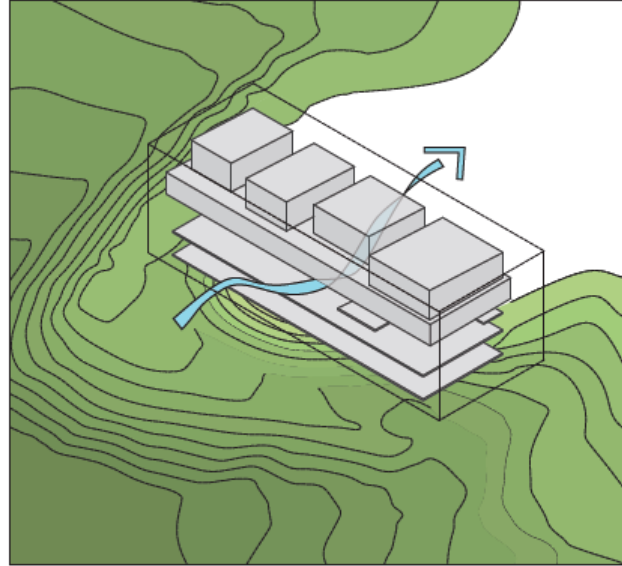
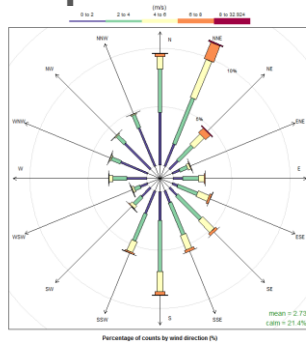


*Image: Serie
Architects*

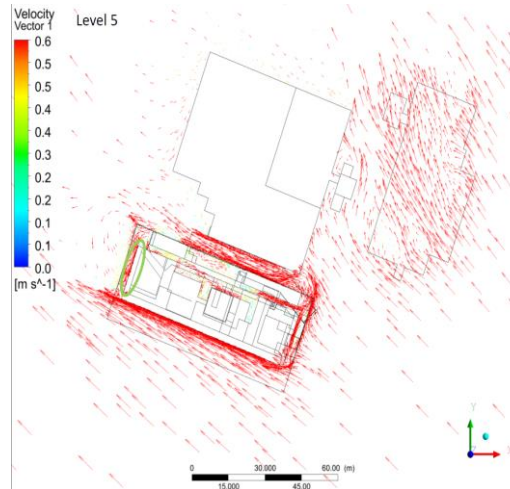
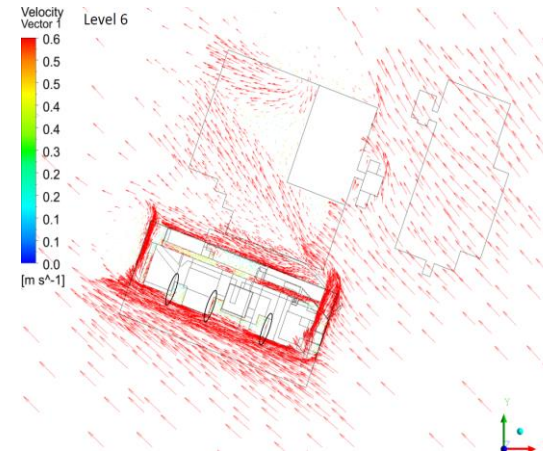
SDE4| NATURAL VENTILATION



Orientation



Design



Simulation

SDE4| SOLAR LOAD

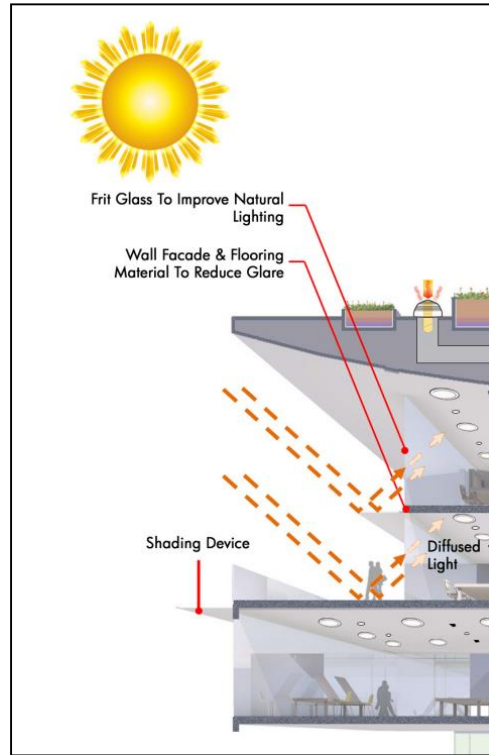
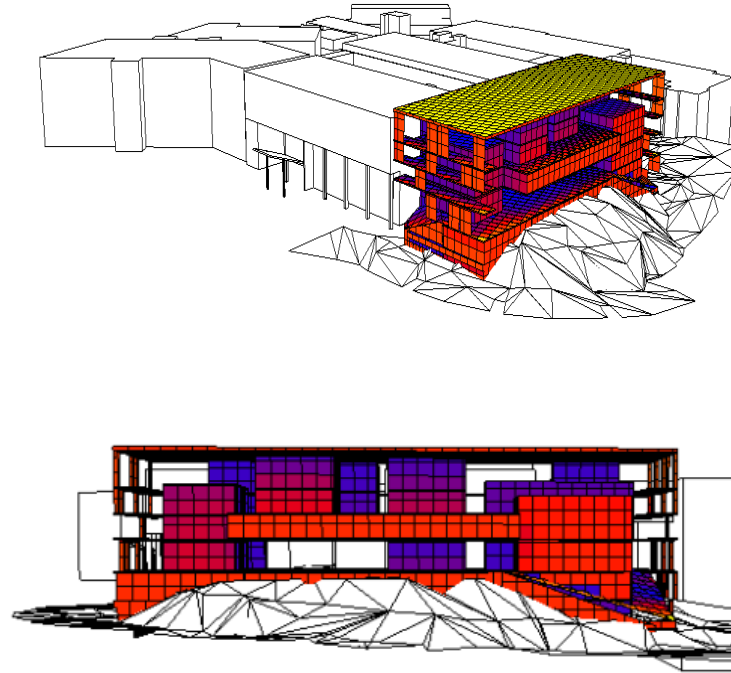
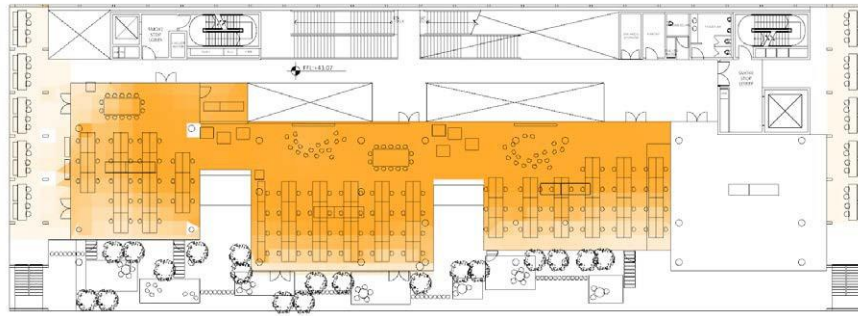
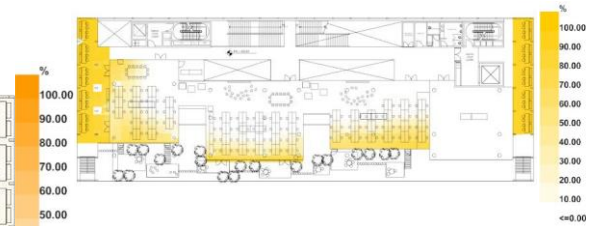


Image: Surbana Jurong + Serie M'Ply

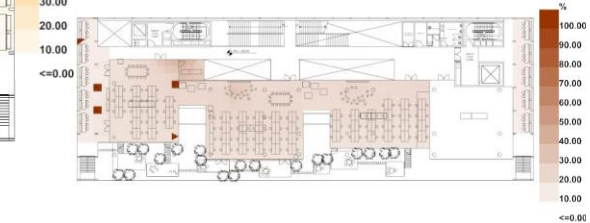
SDE4| DAYLIGHTING



UDI 300-2000lux



UDI >2000lux



UDI <300lux

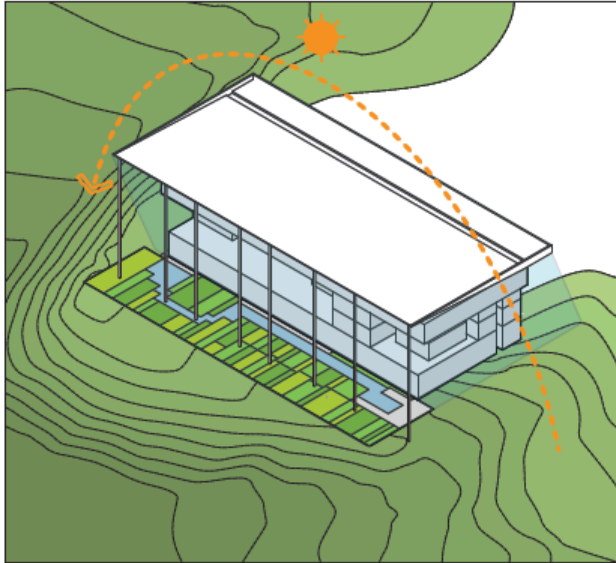
Useful Daylight Illuminance: Floor 6

Image: TRANSSOLAR KLIMAENGINEERING

SDE4| PASSIVE DESIGN, TROPICAL ARCHITECTURE

2. Over-sailing roof

Uniting the programmatic components is an over-sailing roof. This roof covers the entire plot and shades the whole composition.



3. Solar screens

Massive solar shading panels provide shade in the morning and the evening. These screens also complete the architectural form. The roof accommodates an array of PV cells which generate additional electricity for the building. Minimum East, West facing façade East, West ETTV optimized

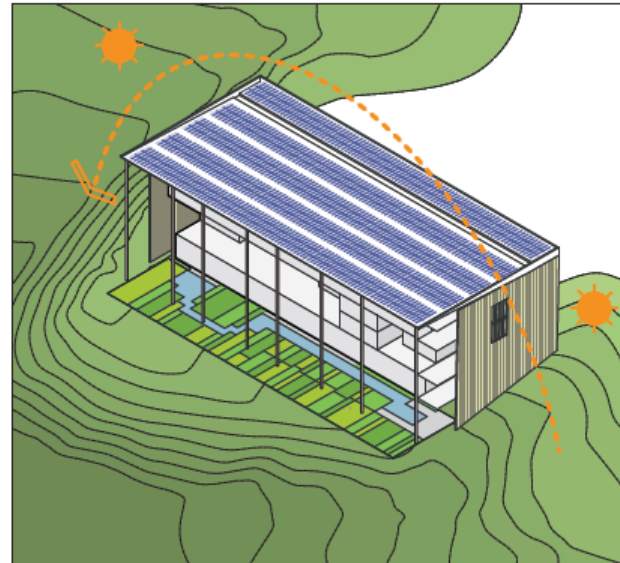


*Image: Serie
Architects*

SDE4 | ENERGY REDUCTION STRATEGIES

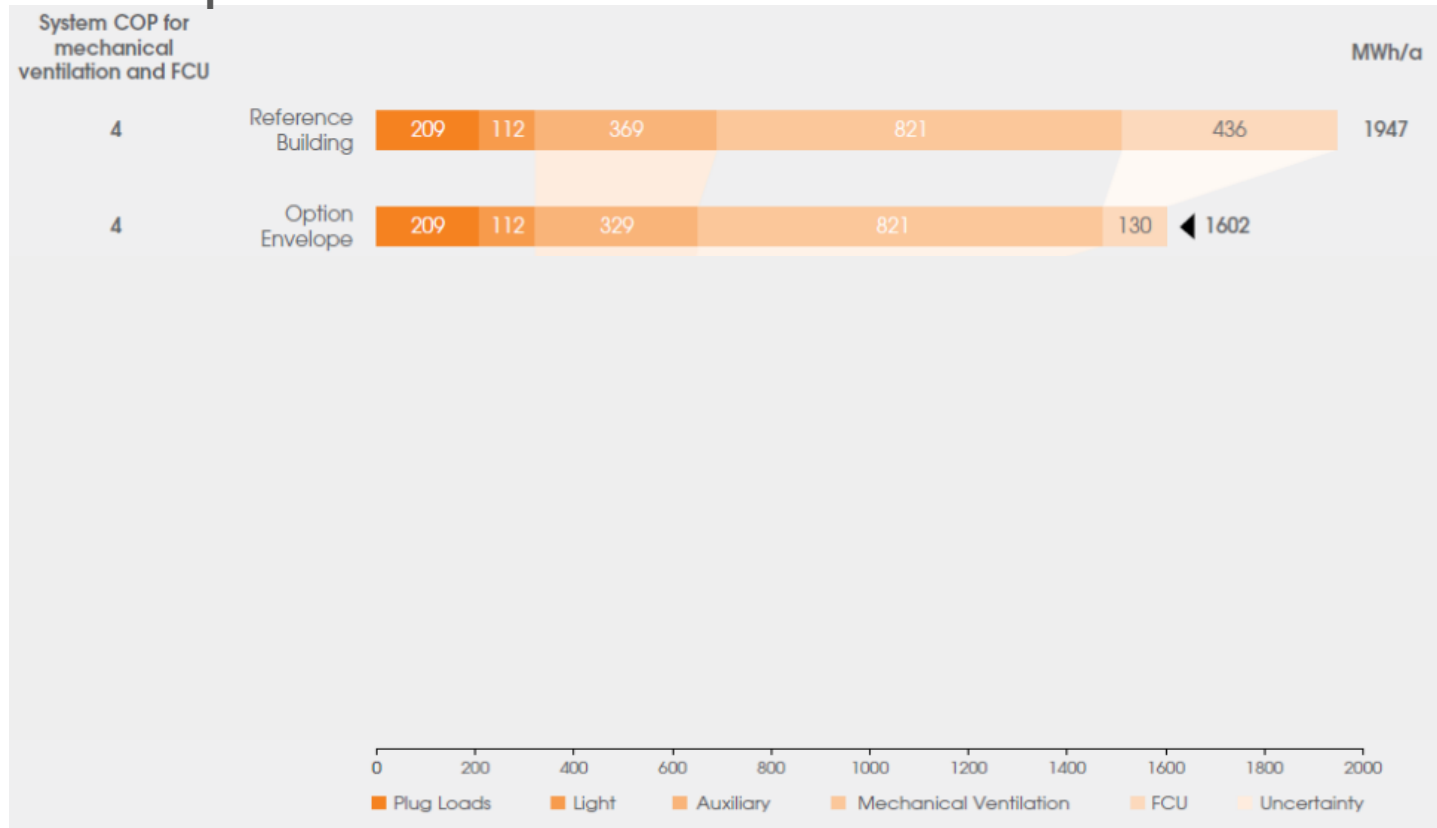


Image: Transsolar Klimaengineering

SDE4| RENEWABLE ENERGY

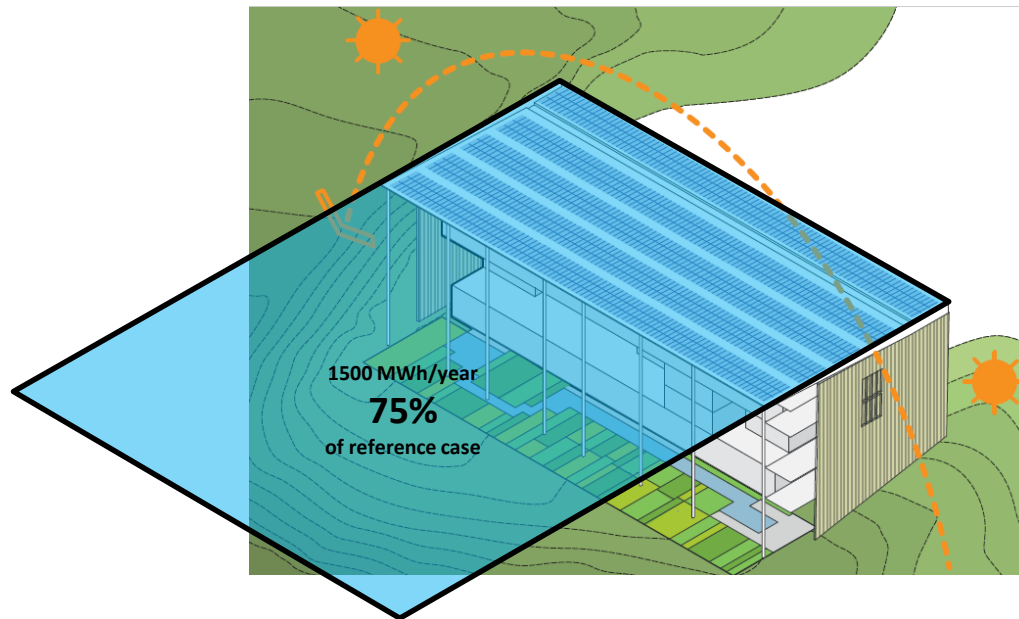


*Image: Serie
Architects*

SDE4 | ENERGY REDUCTION STRATEGIES

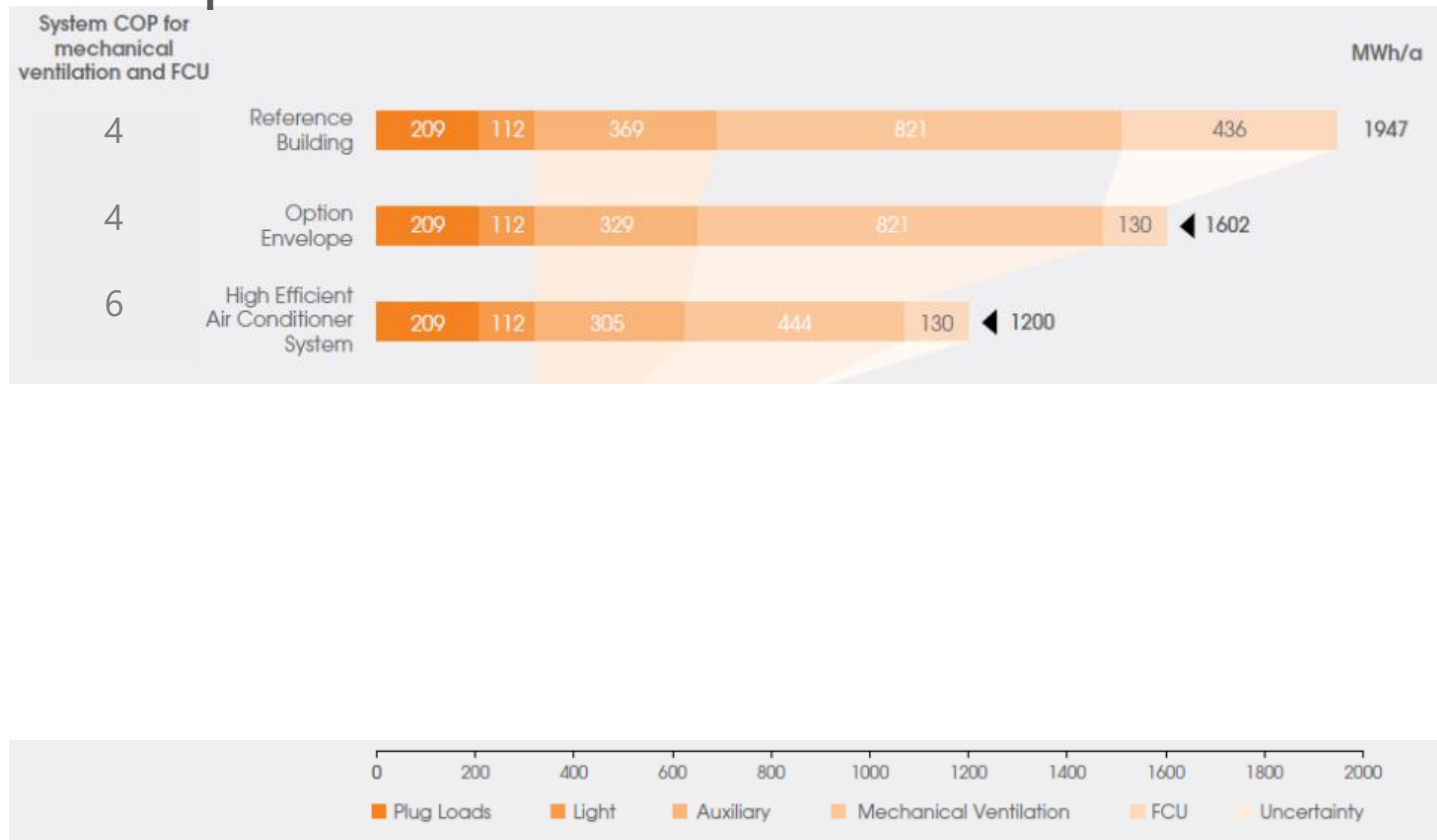


Image: Transsolar Klimaengineering

SDE4| RENEWABLE ENERGY

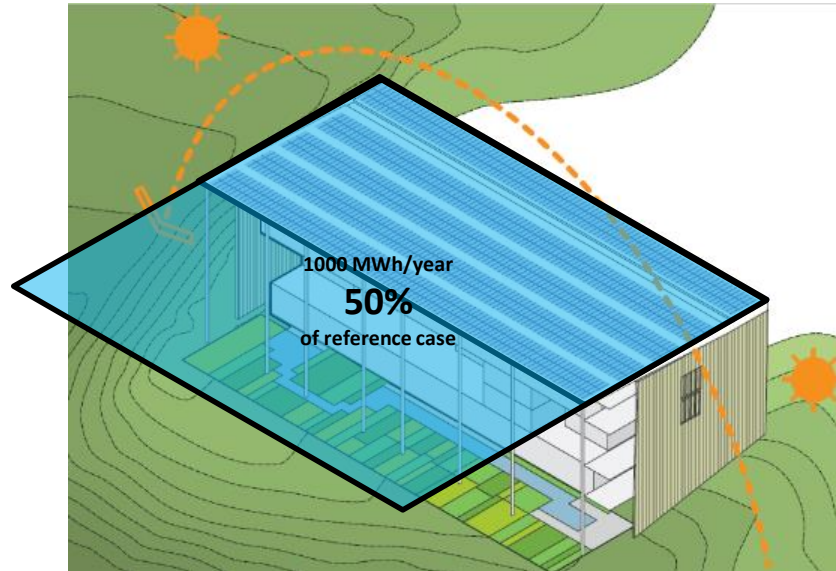


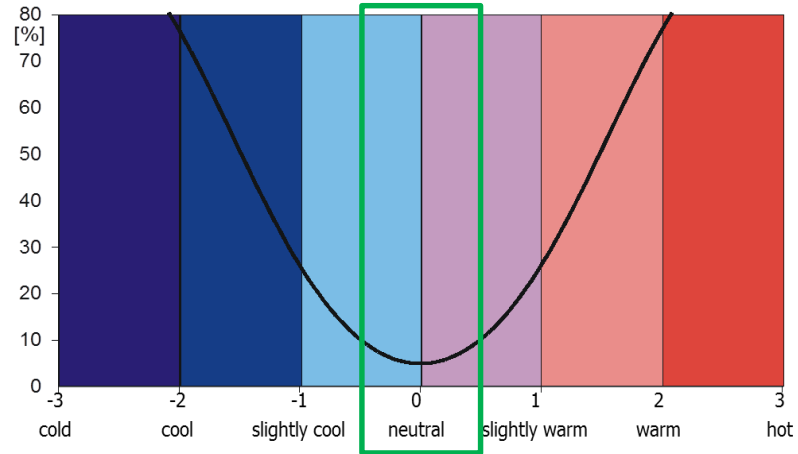
*Image: Serie
Architects*

SDE4| THERMAL COMFORT

Air temperature
Mean radiant temperature
Air humidity
Air speed
Clothing factor
Physical activity

PPD – Predicted
Percentage of Dissatisfied

PMV – Predicted Mean Vote and
7-point thermal sensation scale

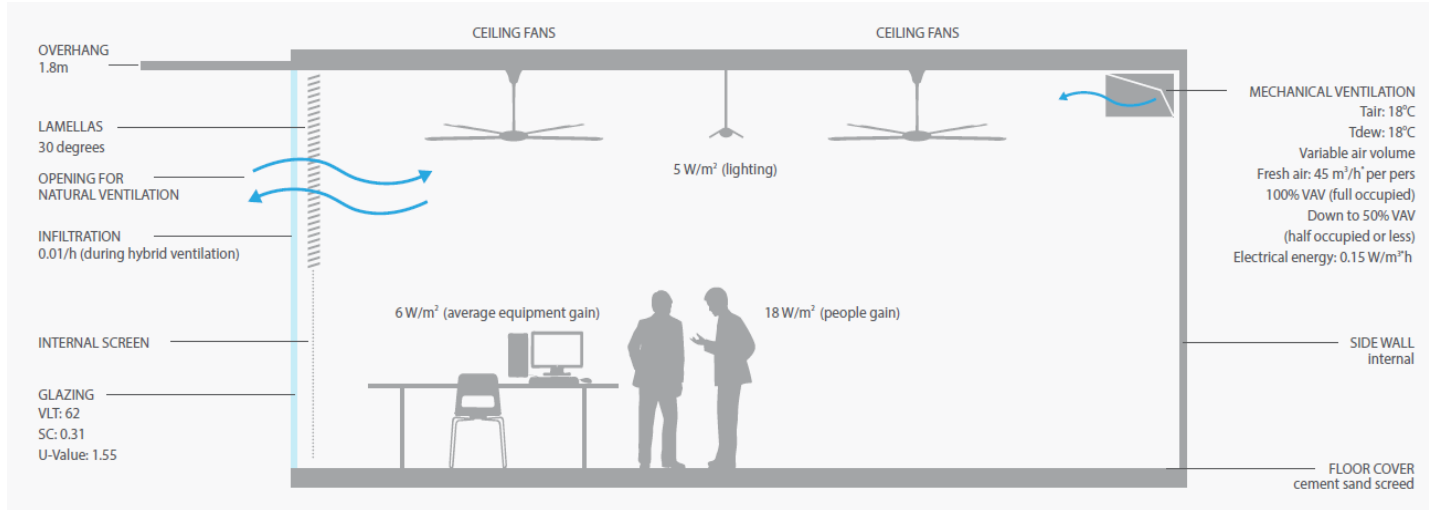


$PMV \pm 0.5 / PPD \leq 10 \%$

high comfort

ASHRAE Standard 55-2013

SDE4|HYBRID COOLING SYSTEM

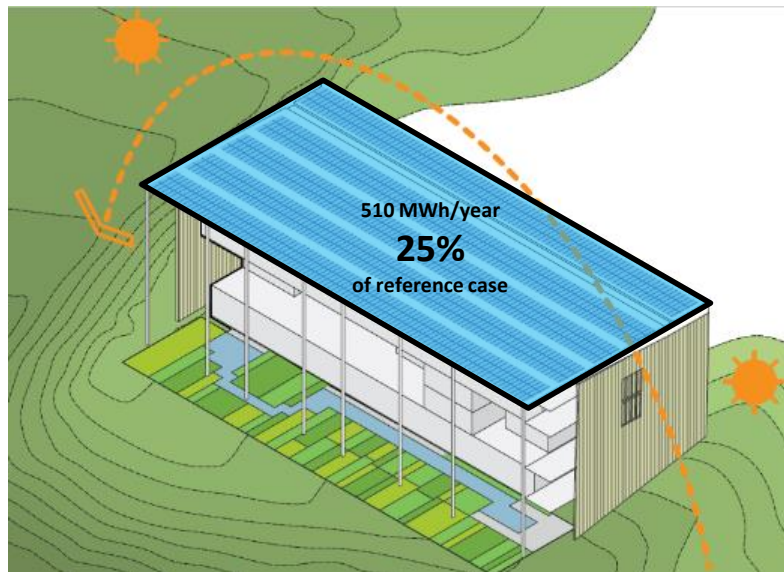


"...Elevated air speed has long been used in practice as a means to off-setting higher temperatures. Updated in 2013, the **ASHRAE Standard 55** includes a procedure for evaluating the **cooling effect of elevated air speed** using the PMV for elevated air speed (PMV_{eas}).

Rethinking Comfort; A Pathway to Low-energy Buildings
Wolfgang Kessling, Martin Engelhardt and Ina Maia,
Futurarc Magazine, Sept-Oct 2015

Image: TRANSSOLAR KLIMAENGINEERING

SDE4| RENEWABLE ENERGY



SDE4 | ENERGY REDUCTION STRATEGIES

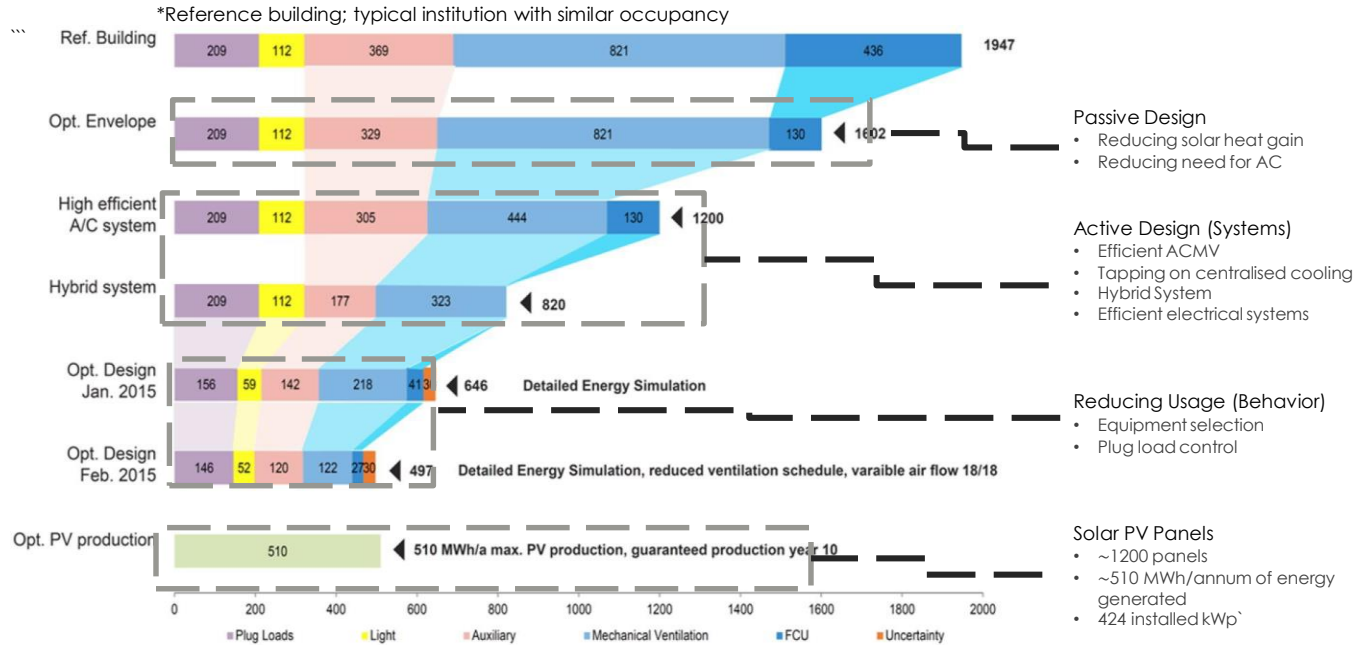


Image: Transsolar Klimaengineering

SDE4| SYNERGISTIC DESIGN SOLUTIONS

Daylight Utilisation

- Daylighting sensors
- Dedicated perimeter circuit
- Greater energy savings

Weather Responsiveness

- Energy savings suggestions communicated to occupants based on weather station data

Temp. & Air Quality Control

- Regulation via VAV boxes based on sensor feedback
- Further reducing cooling load



Smart Ceiling Fan

- >High Efficiency
- >IOT Enabled

LED Lighting

- >90% of lighting utilizes LED
- > 60% in energy savings
- > All Light controllable
 - Scenes
 - Dimming

Vacancy Detection

- Automatically switches off lighting when area is not in use

Receptacle Load Control

- Energy consumption meters for each zone
- KNX control over power supply to each zone

Photo by Rory Gardiner



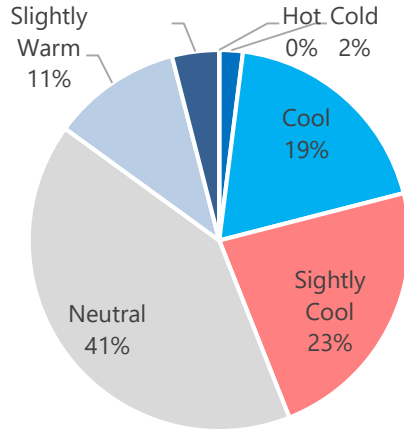
1225 PV Panels, Peak Power : 425 kWp

SDE4| FIELD MEASUREMENT

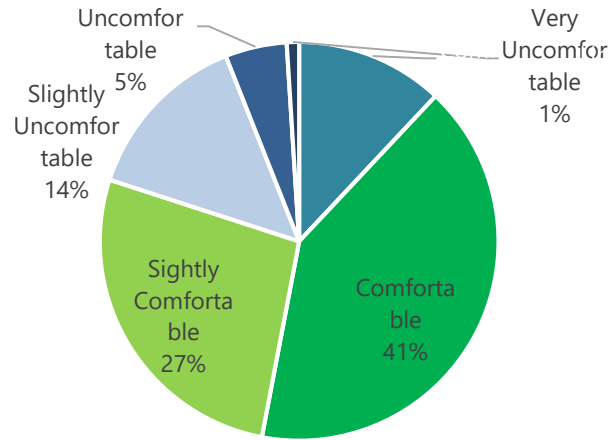


Image: Surbana Jurong

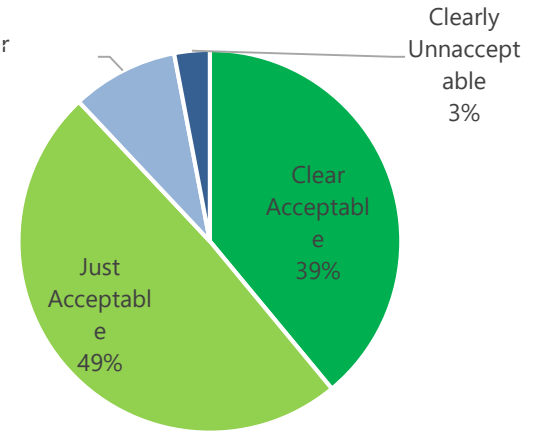
SDE4| POST OCCUPANCT SURVEY



Thermal Sensation
85% Cold to Neutral



Thermal Comfort
80% of Comfortable

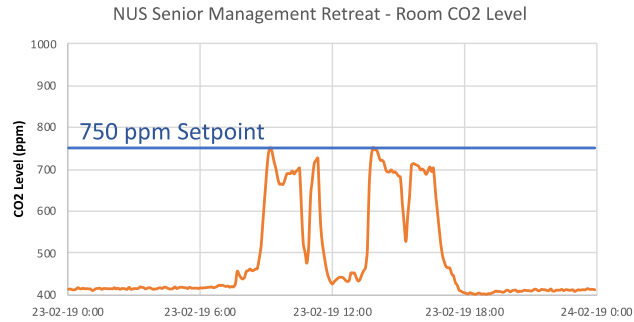
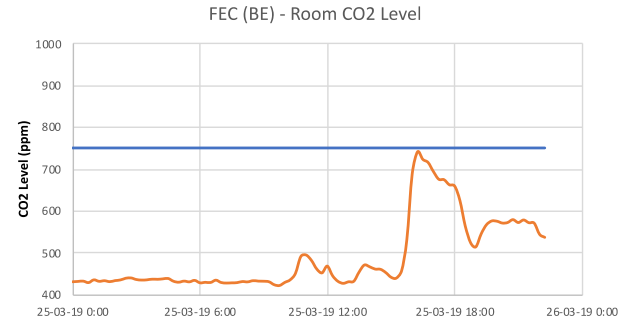
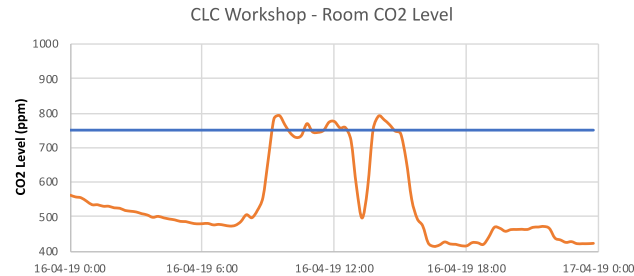


Thermal Acceptability
88% of Acceptable

Room Condition 26.3-27.3°C, 57-64% RH

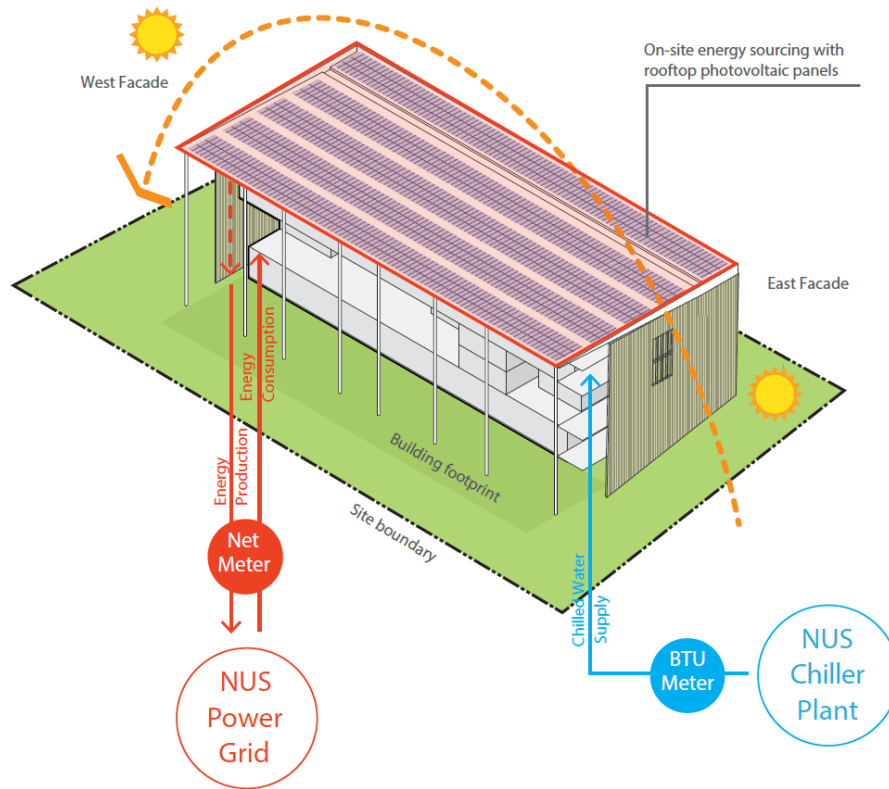
Credit: Kuniaki Mihara, NUS, PhD Student

SDE4 | IMPROVED INDOOR AIR QUALITY

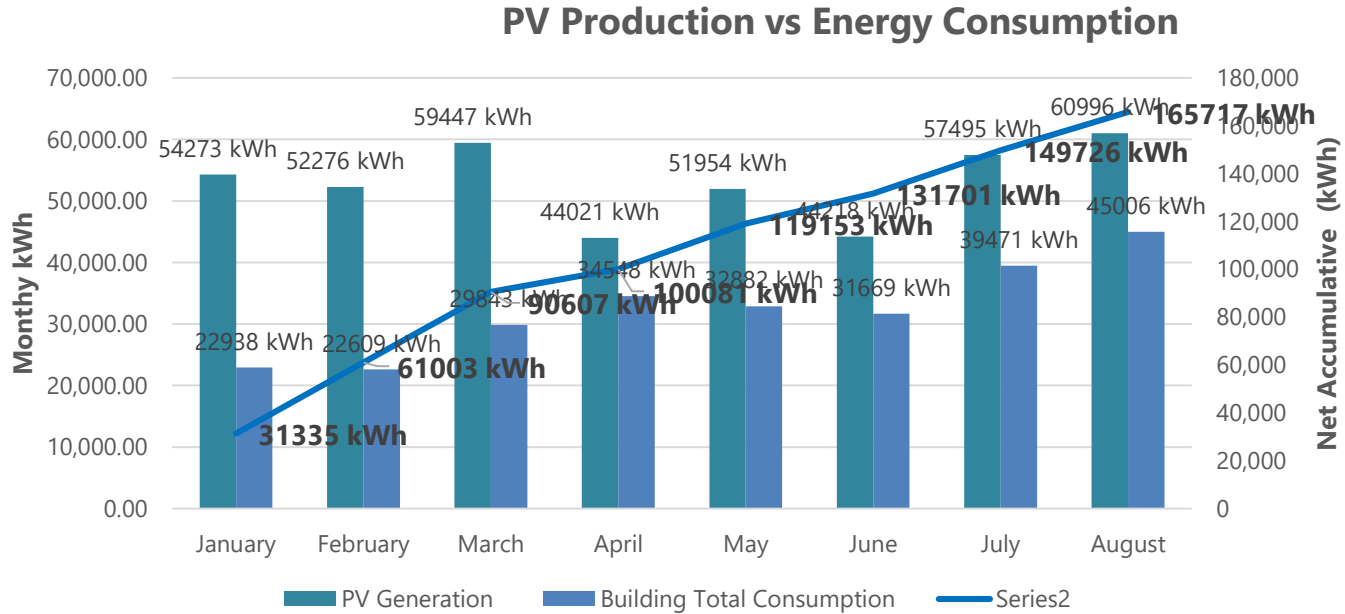


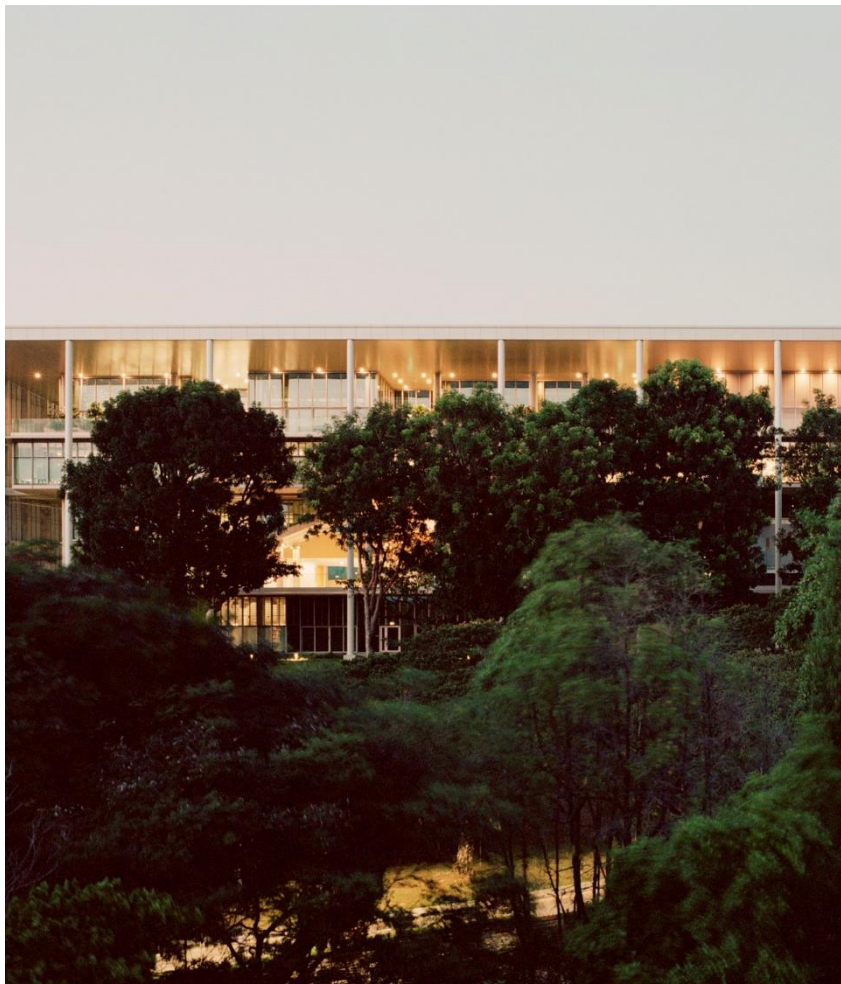
100% fresh air with demand control ventilation

SDE4| METERING



SDE4 | ENERGY PERFORMANCE











Holistic approach enabling high performances

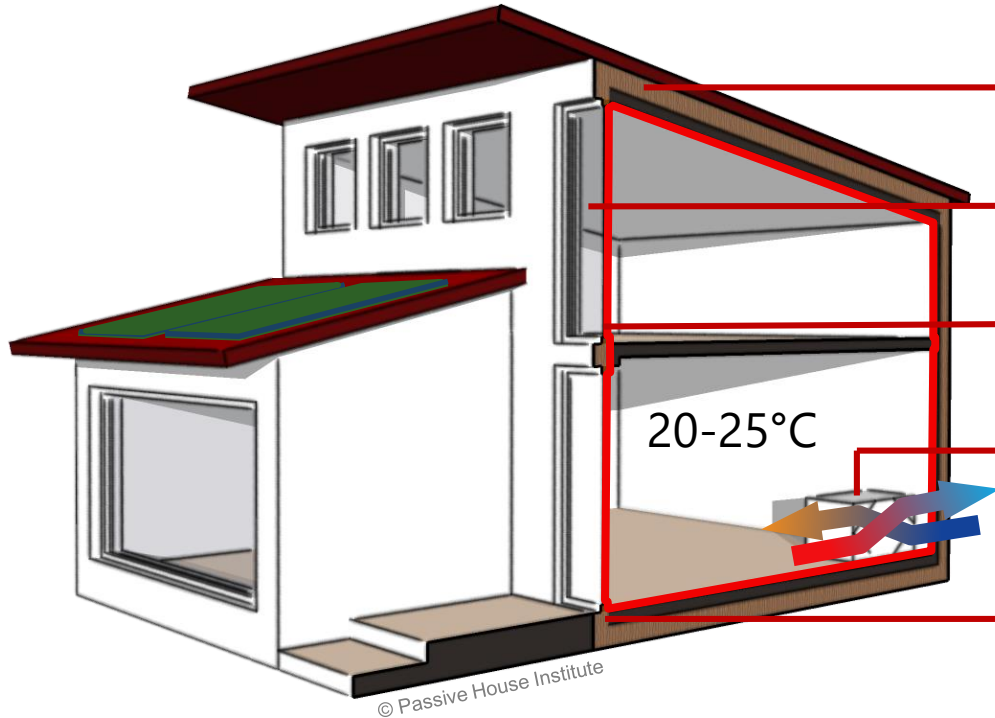
Joint workshop IEA and IPEEC
Paris, 18/09/2019

Low Energy Buildings and the Role of
Smart Management Systems - Building
Design

Camille Sifferlen
Project Manager
camille.sifferlen@passiv.de

Passive House Institute, Germany

5 Passive House Principles



Continuous insulation

Reduces heat losses/gains*

Passive House windows + shading

Enjoy/avoid* solar gain

Continuous airtightness

Prevents drafts + moisture problems

Ventilation unit

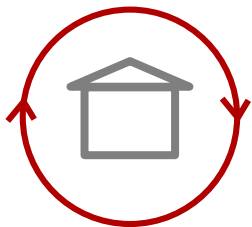
With heat/humidity recovery*

Provides fresh air 24/7!

No thermal bridges

Limit weak points

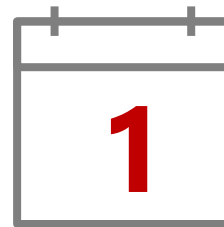
* Climate dependent



**Holistic
approach**



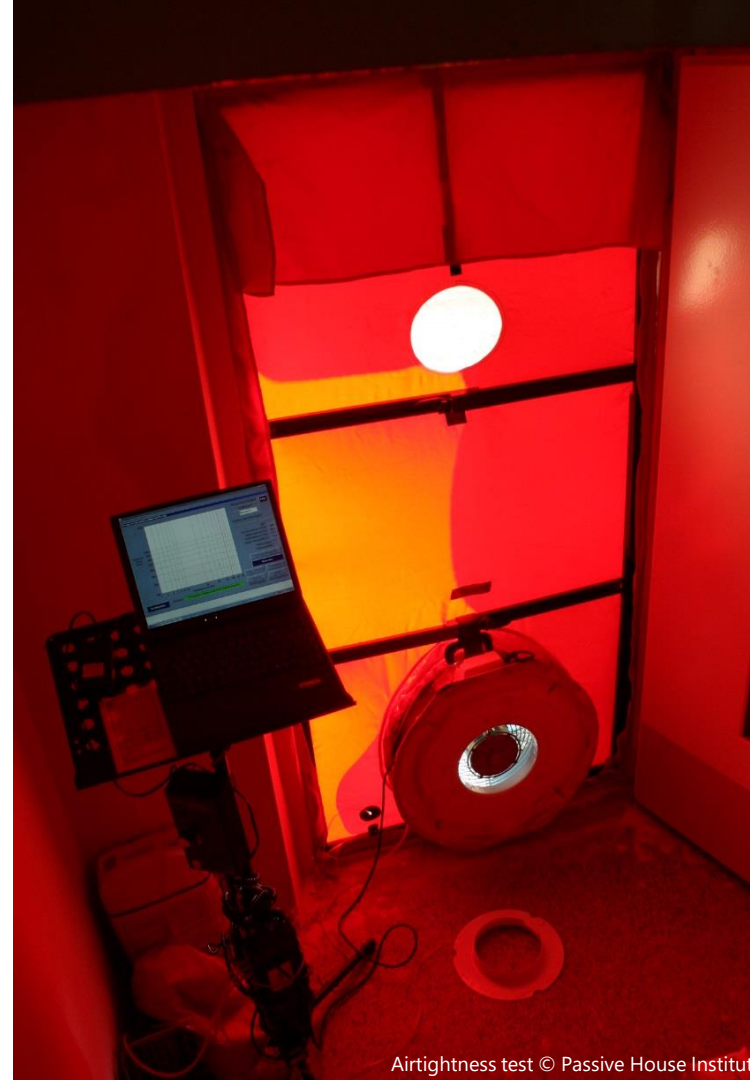
**High performance
based targets**



**Early design
integration**

Holistic approach

e.g. interaction between
airtightness and
ventilation or airtightness
and insulation





Cold composite

Frankfurt, Germany



Warm climate

Morelia, Mexico



Hot & humid climate

Colombo, Sri Lanka

High insulation levels

Triple glazing

Airtightness

Heat recovery ventilation

No thermal bridges

Low insulation levels

Single glazing

Airtightness

Extract air

ventilation

No thermal bridges

High insulation levels

Double solar protective glazing

Airtightness

Heat/humidity recovery

ventilation

No thermal bridges

Passive House **international building criteria**

Heating demand
 $\leq 15 \text{ kWh}/(\text{m}^2\text{a})$

OR
Heating load <
 $10\text{W}/\text{m}^2$

Primary Energy demand
 $\leq 120 \text{ kWh}/(\text{m}^2\text{a})$

Passive cooling
<10% overheating

Active cooling
Variable limit value
OR

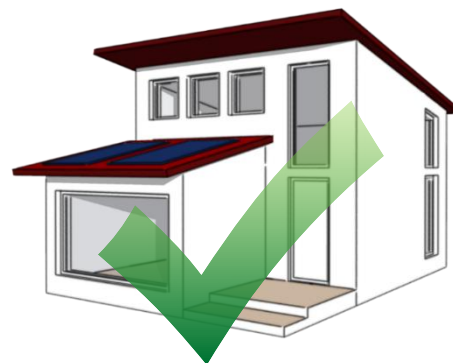
Cooling load <
 $10\text{W}/\text{m}^2$

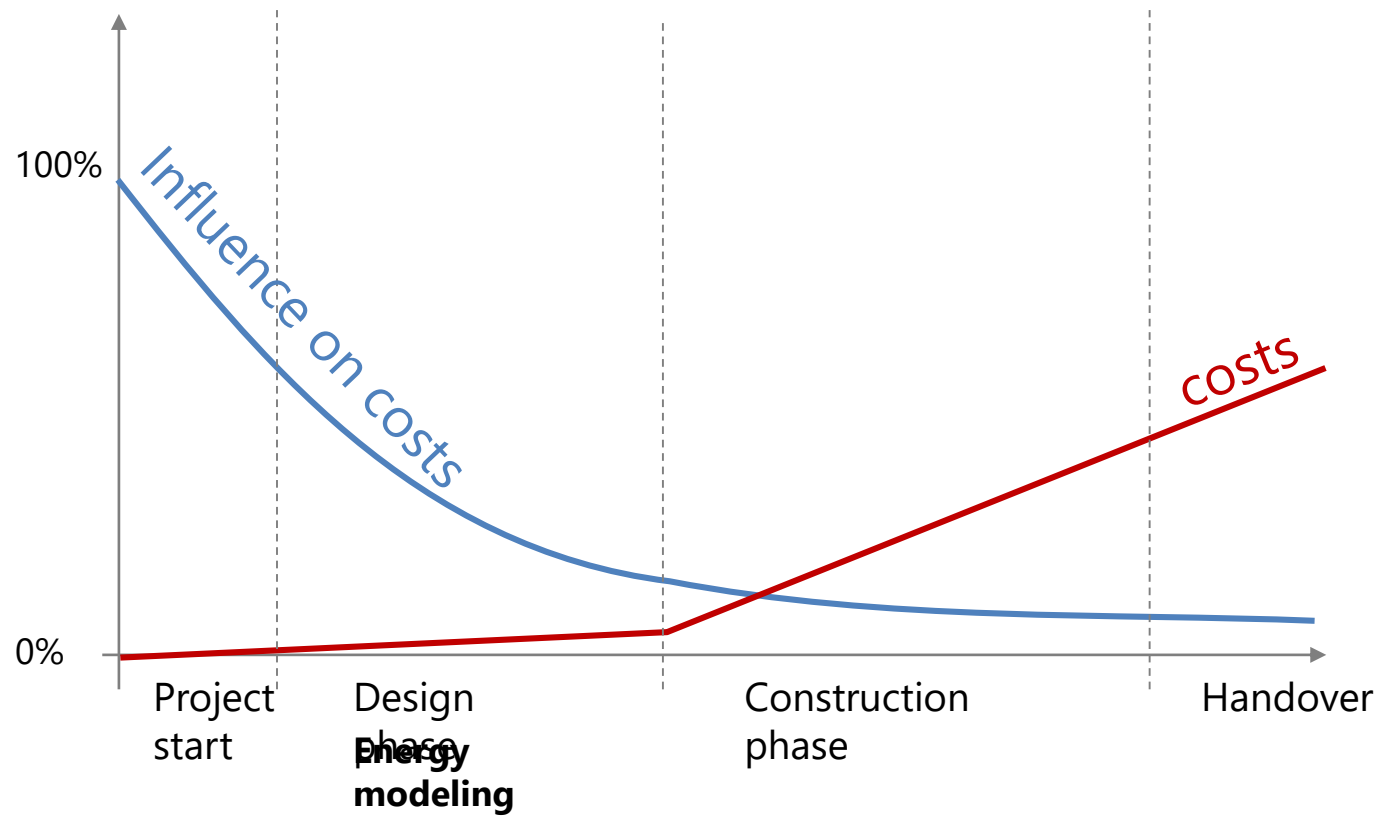
Airtightness
 $n_{50} \leq 0.6 \text{ h}^{-1}$

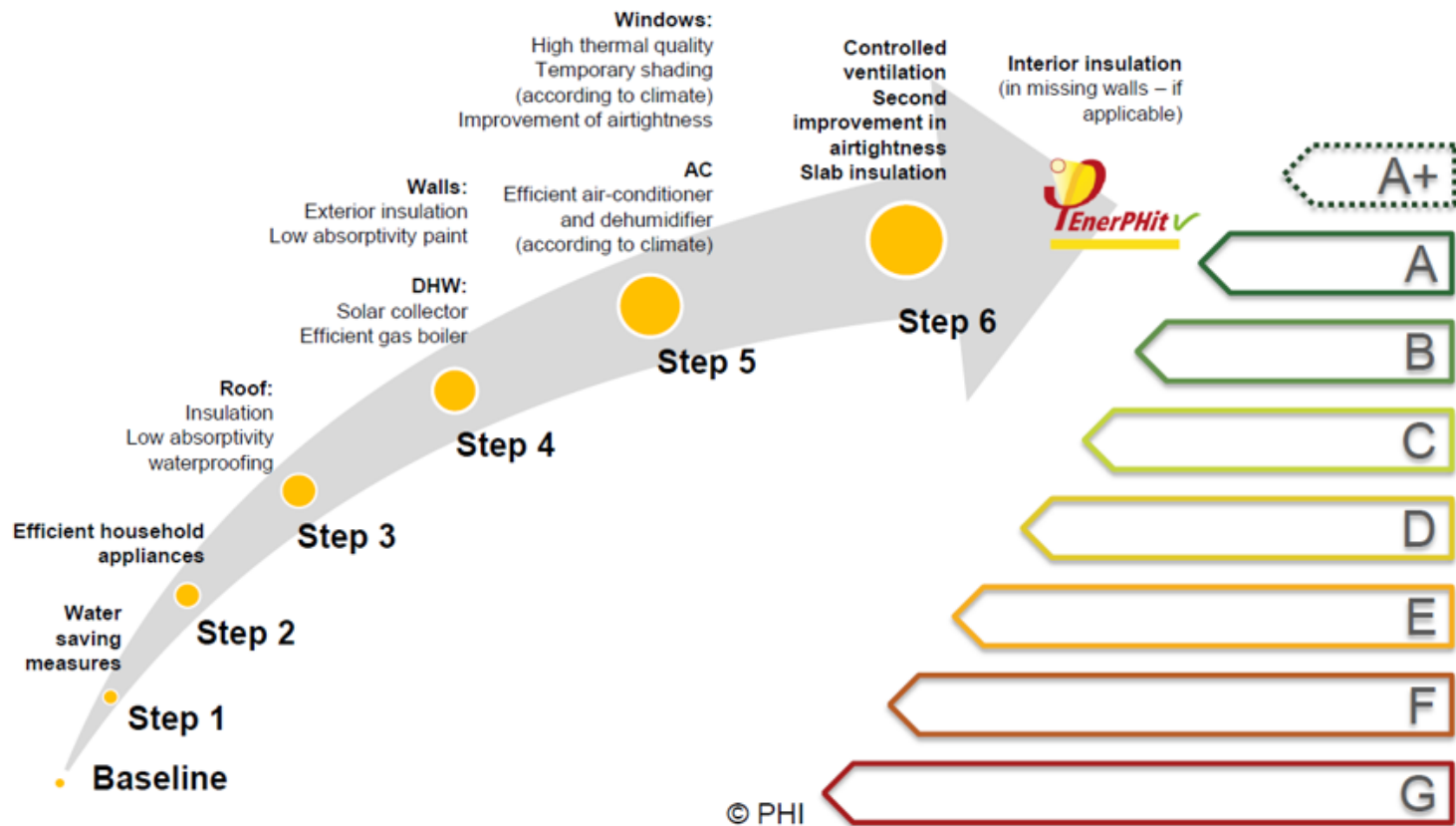
Down to

- **90%** heating

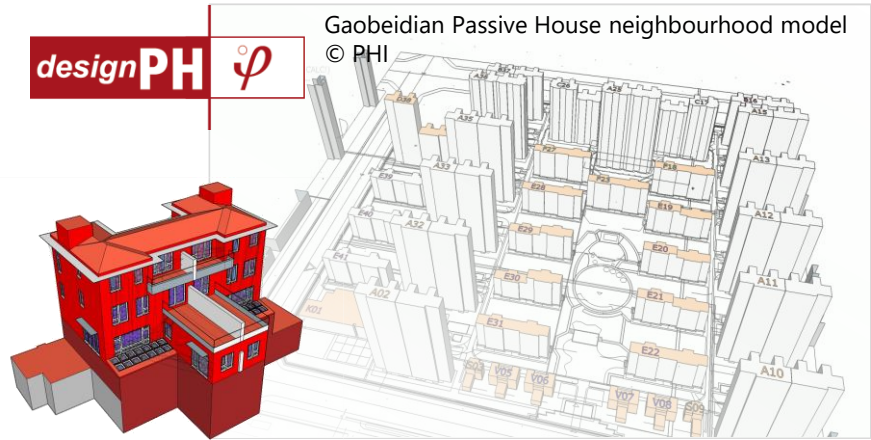
- **80%** cooling







Concept for the step-by-step implementation of energy efficiency measures in existing housing in Mexico. Source: NAMA Vivienda Existente; Authors: PHI, IzN Friedrichsdorf, GOPA Consultants; Review and supervision: CONAVI, Infonavit, GiZ

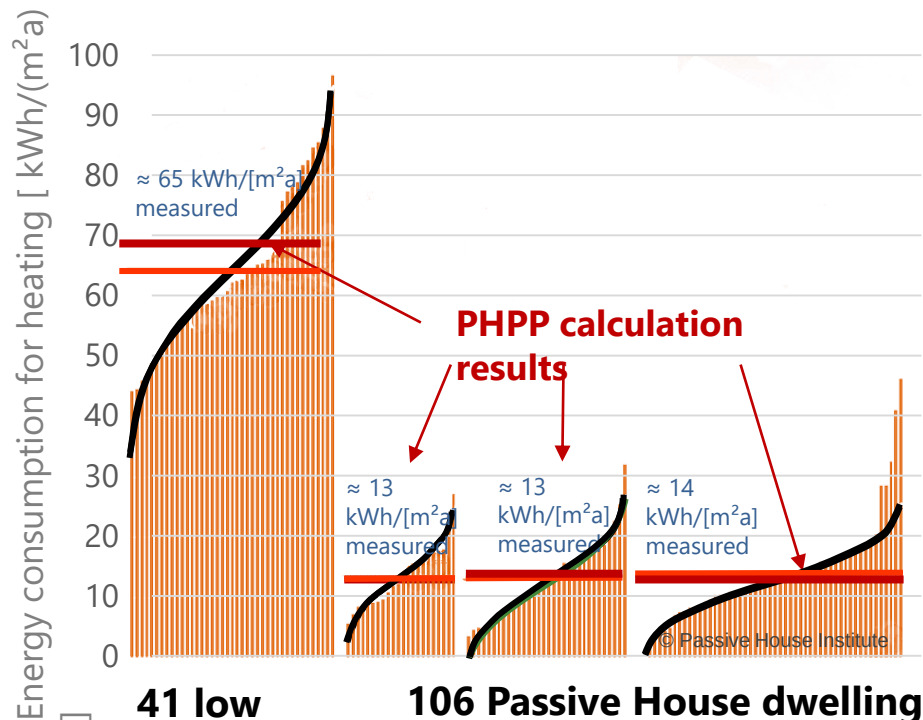


Passive House Planning Package

- Early design & optimisation
- International verification tool
- Validated with ASHRAE & monitoring
- 3D input (SketchUp & BIM)

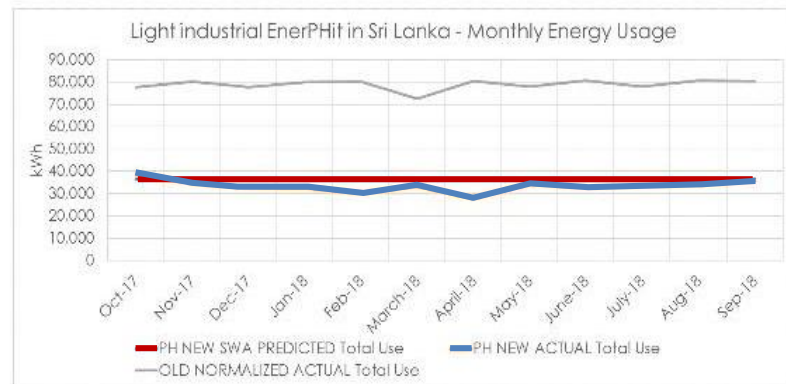


No detected performance gap!



41 low energy dwellings in Niederhause

106 Passive House dwellings in Wiesbaden | Hanover | Stuttgart



Source: <https://www.swinter.com/party-walls/the-first-certified-passive-house-in-southeast-asia-star-garments-innovation-center/?platform=hootsuite>

Holistic approach.
High performance based targets.
Early design integration.



Passive House Star Garment Innovation Center, Sri Lanka
© Ganidu Balasuraya

INDO-SWISS Building Energy Efficiency Project (BEEP)



Technical assistance for thermal comfort and energy efficient design

INDO-SWISS Building Energy Efficiency Project (BEEP)

- India's energy consumption is growing the fastest among all major economies
- Residential buildings consume ~25% of the total electricity
- By 2030 residential buildings are expected to consume 38% of electricity in India
- Projected residential building construction between 2018 and 2030 is >15 billion m²

Objective: Reduce energy consumption in new commercial, public and residential buildings in India through energy-efficient and comfortable



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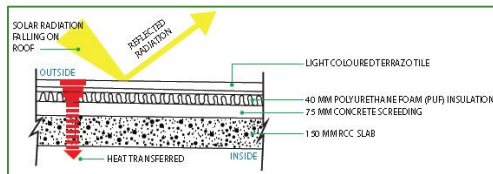
Swiss Agency for Development
and Cooperation SDC

CASE STUDY: OFFICE BUILDING – ARANYA BHAWAN, JAIPUR



Aranya Bhawan: Measures to Reduce Heat Gains

Roof insulation

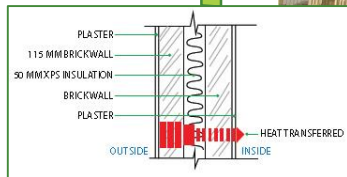


U-value: 0.6
 $\text{W/m}^2\cdot\text{K}$



Double-glazed windows

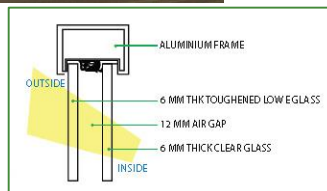
Reduction in glazed area and external shading



U-value: 0.5
 $\text{W/m}^2\cdot\text{K}$

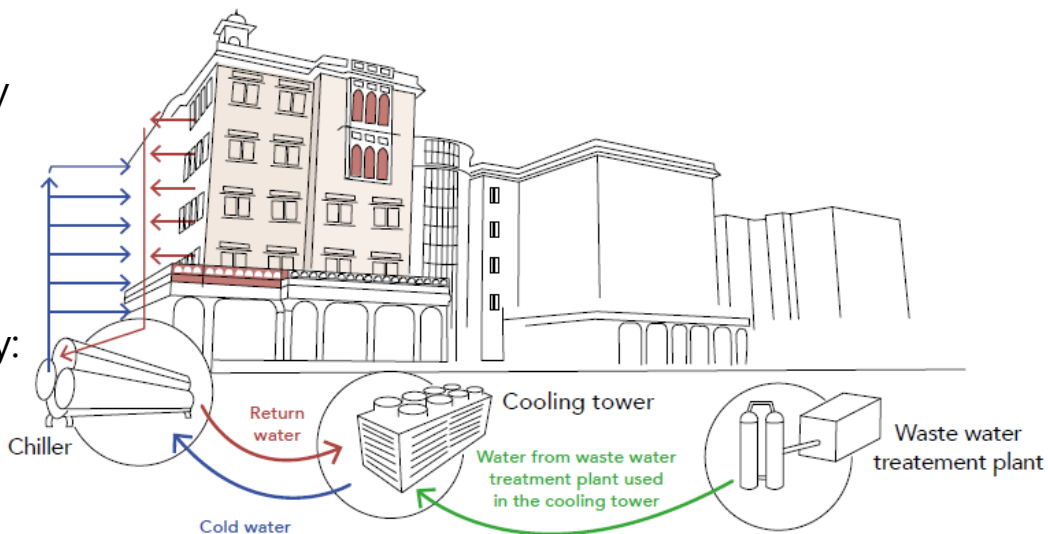
Wall insulation

U-value: 1.8
 $\text{W/m}^2\cdot\text{K}$
SHGC: 0.24
VLT: 36%



Aranya Bhawan: Energy Efficient Cooling System

- Centralised high efficiency water-cooled chiller
- Sewage treatment plant (capacity: 15 m³/d) to provide water for cooling towers

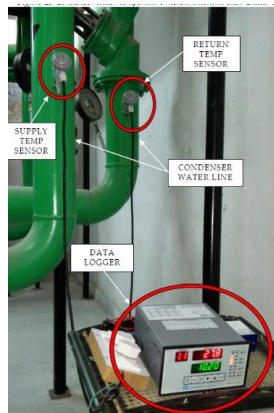
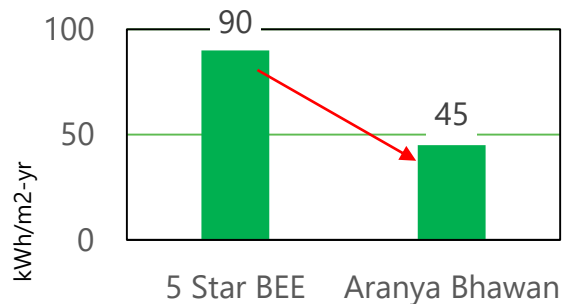


Aranya Bhawan: Renewable Electricity

- Rooftop 45 kW_p grid-connected Solar photovoltaic system (SPV) generating around 60,000 kWh per year (~20% of the annual electricity requirement)
- Additional 100 kW_p ground mounted SPV system planned



Aranya Bhawan: Energy Monitoring



➤ Measured Energy Performance Index of **43 kWh/m²/year.**

➤ ~ **50% lower** compared to

CASE STUDY: AFFORDABLE HOUSING – SMART GHAR-III, RAJKOT



Smart GHAR III: Project description



- Smart GHAR III (Green Homes at Affordable Rate) is a social housing project in Rajkot
- 1176 2-room apartments (33.6m²)
- Most families cannot afford air-conditioning

➤ **Aim:** Improve thermal comfort through building design

Smart GHAR III: Reducing heat gain through walls, roof and windows

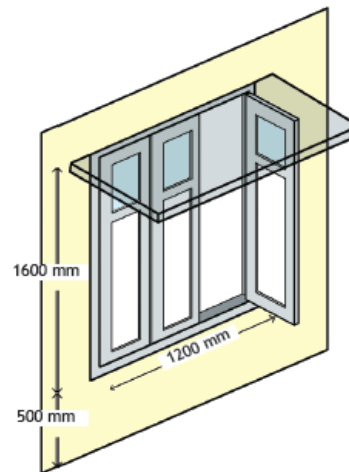
Walls & Roof

- 230mm Autoclaved Aerated Concrete Blocks (U-value of 0.8 W/m².K). AAC cavity walls on southern side (U-value 0.3 W/m².K)
- High-reflective glazed tile roof



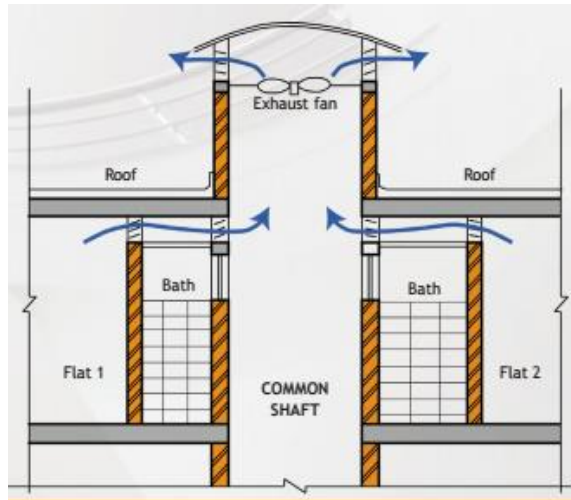
Windows

- Low Window to Wall Ratio
- Partly opaque windows/shutters
- Casement windows with large natural ventilation openings



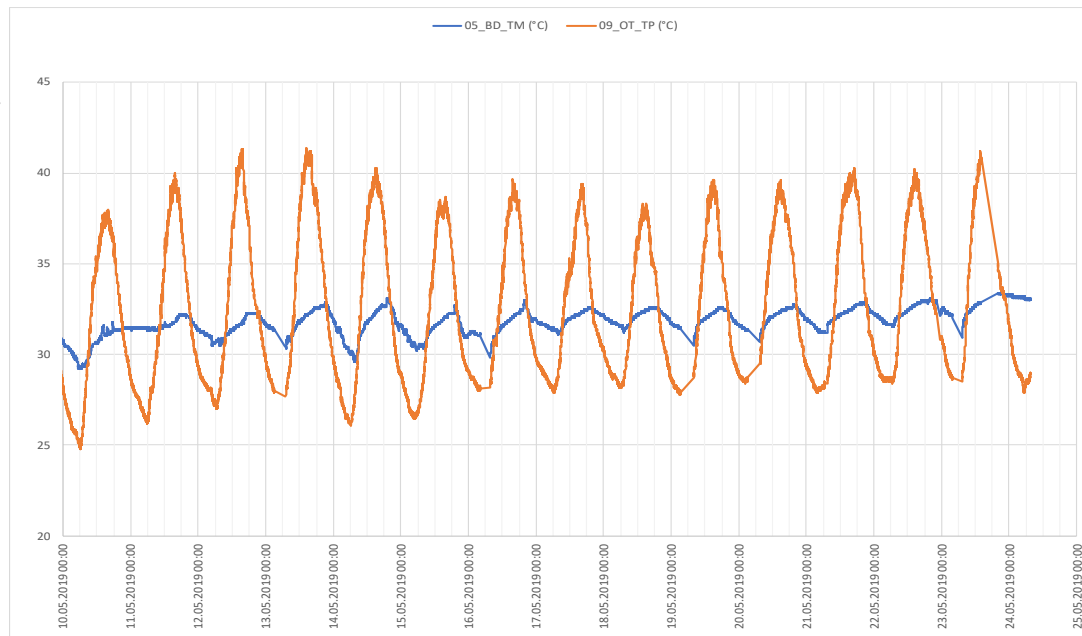
Smart GHAR III: Additional assisted ventilation to increase thermal comfort

- A fan on top of the service shaft provides additional ventilation when the ambient temperatures are low



Smart GHAR III: Monitoring of Apartment during Summer 2019

- During hot summer in Rajkot the daily ambient high temperature is $\sim 40^{\circ}\text{C}$
- Indoor room temperature in flats between $30\text{--}32^{\circ}\text{C} \rightarrow 8\text{--}9^{\circ}\text{C}$ below outside temperature without any cooling



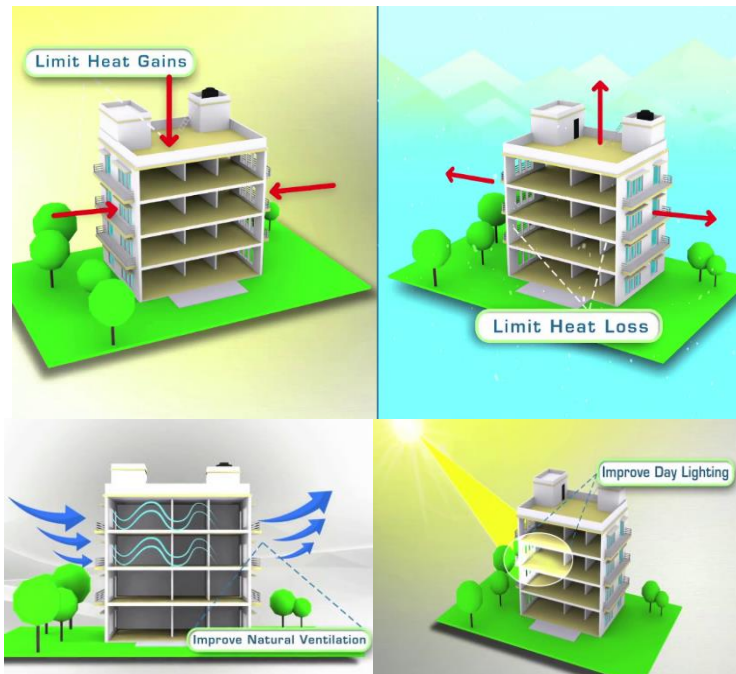
Development of the ECBC-R code

- Indo Swiss BEEP project provided technical support for development of new Energy Conservation Building Code for Residential Buildings
- BEEP is assisting BEE to disseminate ECBC-R to states and municipalities
 - Design of energy-efficient affordable housing projects
 - Amend the building regulations to include ECBC-R
 - Capacity building of officials and building sector professionals
 - Working with selected cities for the implementation

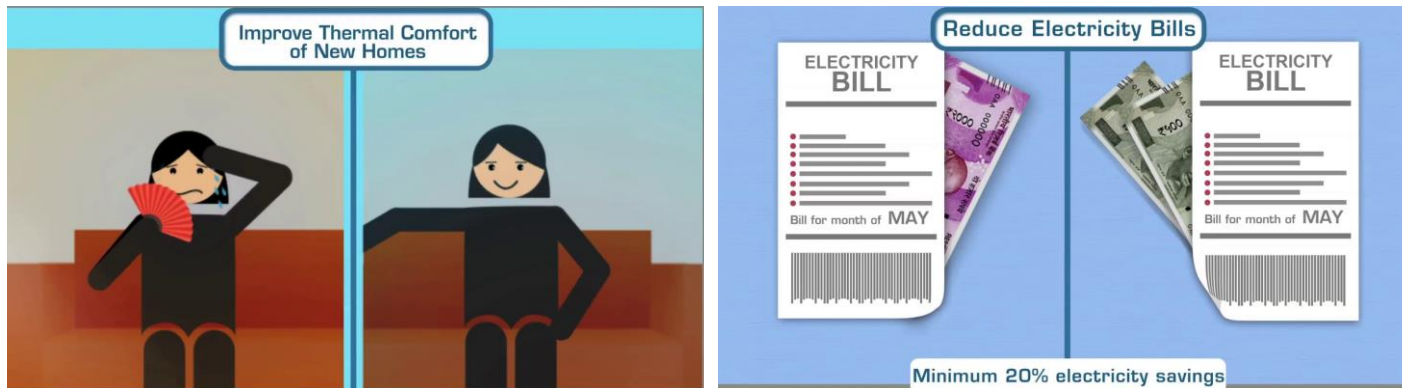


Features of the ECBC-R code

- Building envelope (roof, walls, windows and external openings)
- Sets minimum building envelope performance standards to
 - Limit heat gains / losses
 - Exploit adequate natural ventilation potential
 - Exploit adequate daylighting potential



Estimated Impacts of the ECBC-R code



- Estimated impact of ECBC-Residential during **2018-2030**
 - Minimum **20% energy savings** (in cooling) as compared to a typical building
 - **125 billion kWh** of electricity savings
 - **100 million tonnes** of **CO₂** equivalent abatement



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Thank you for your attention

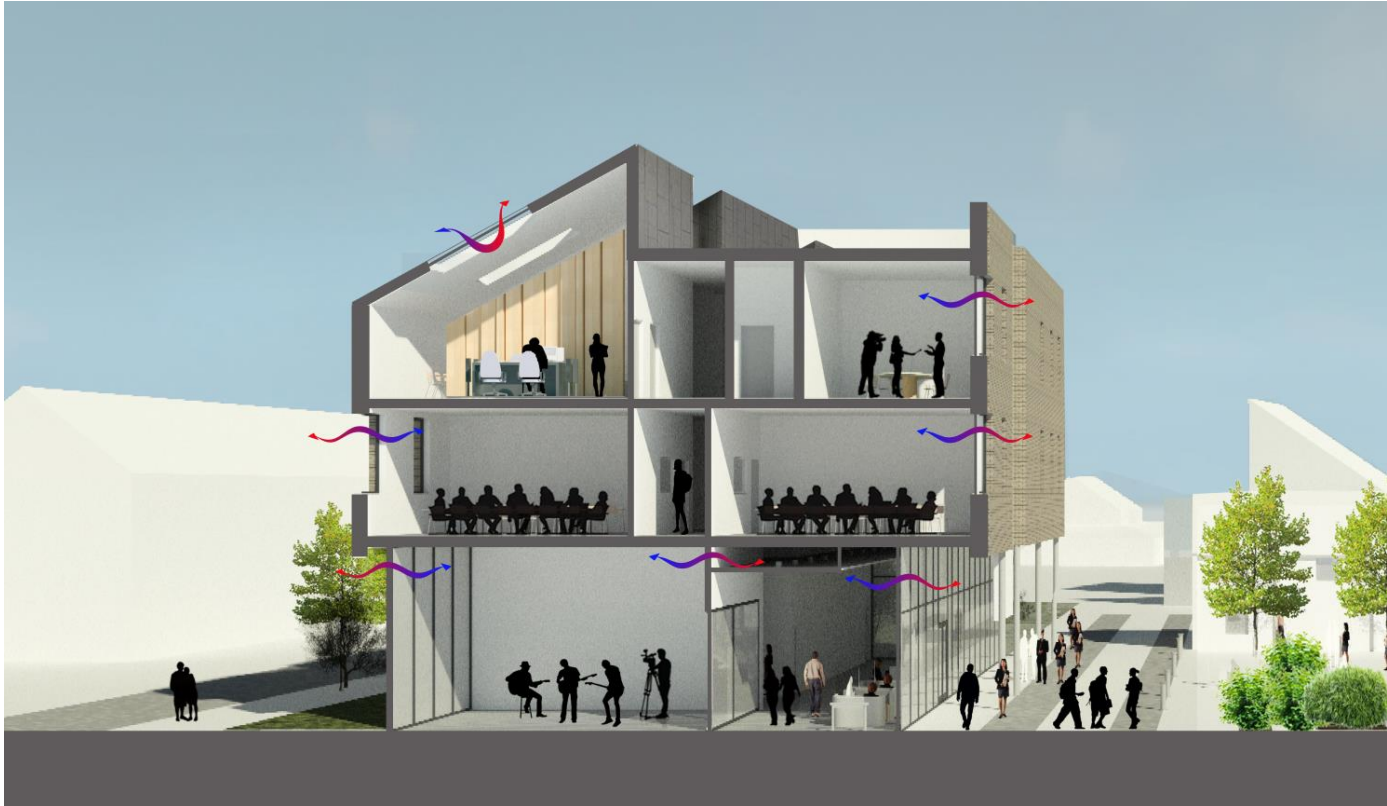
Low energy buildings vs low energy designs

Phil Armitage

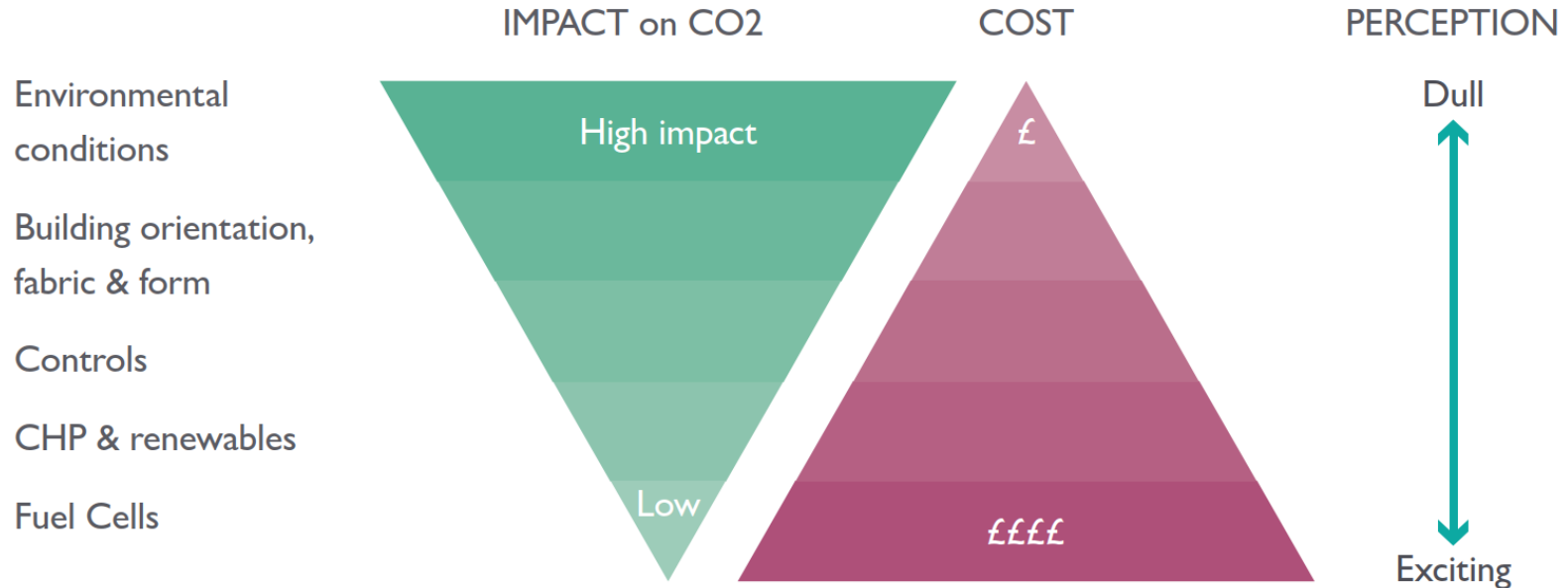
September 2019



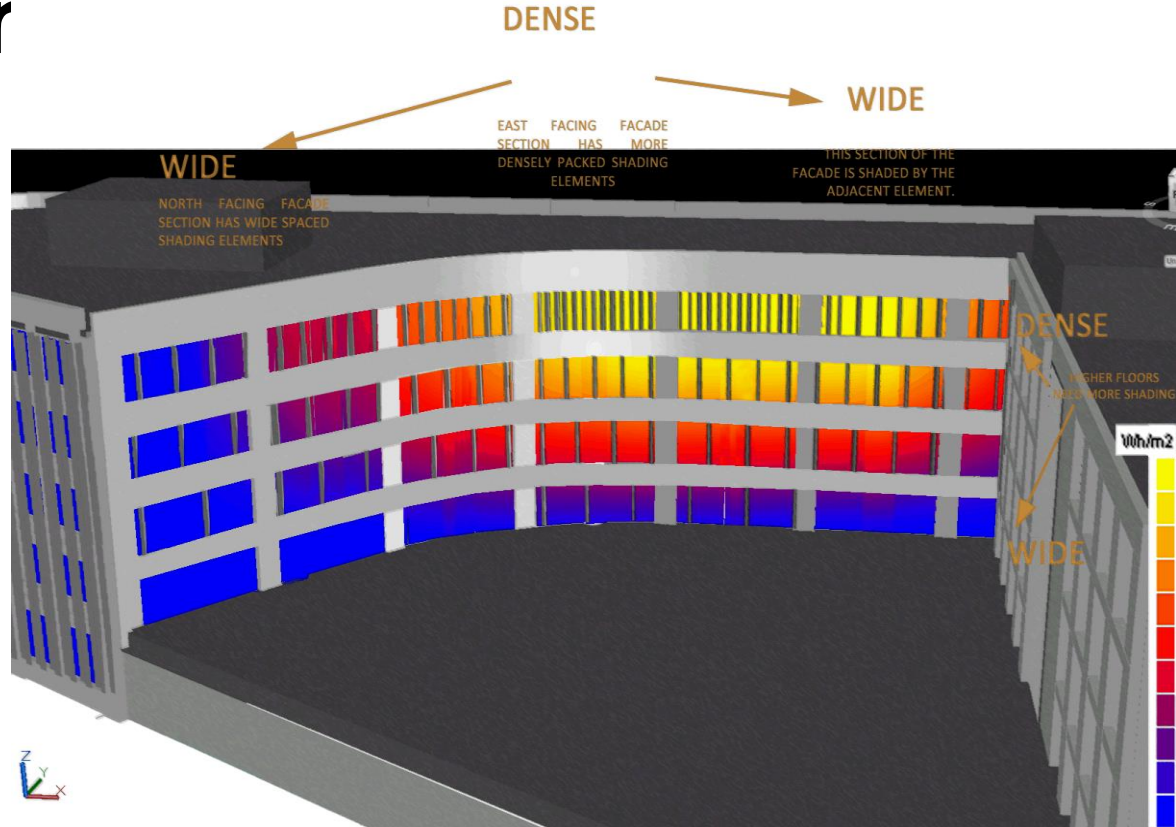
The problem



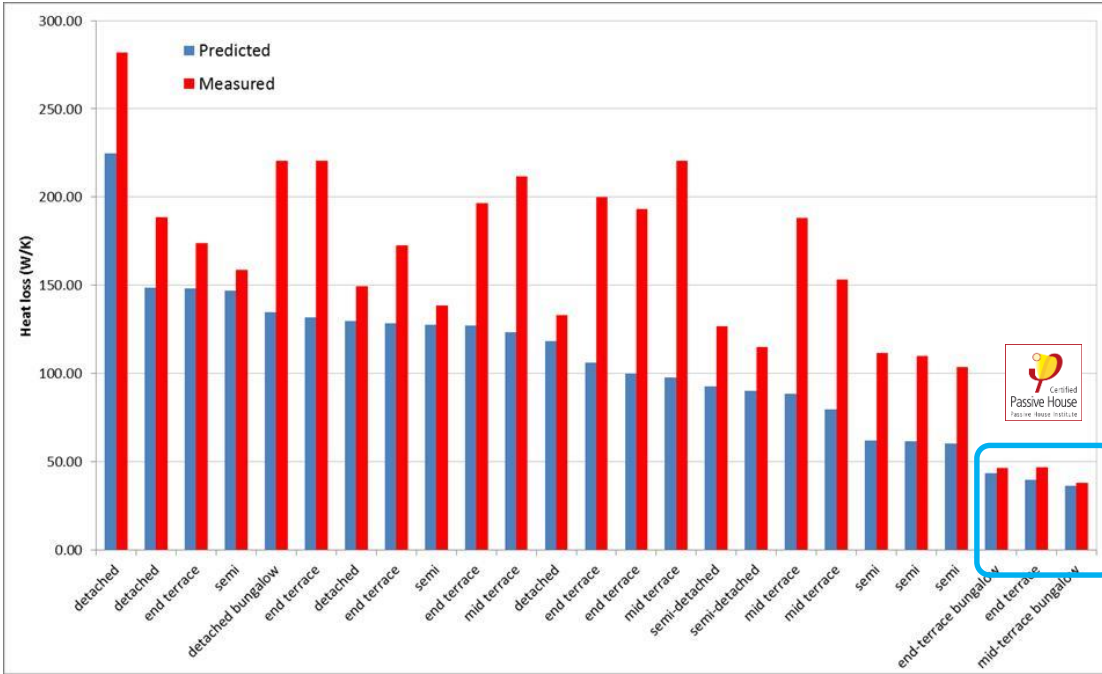
Low energy design – design hierarchy



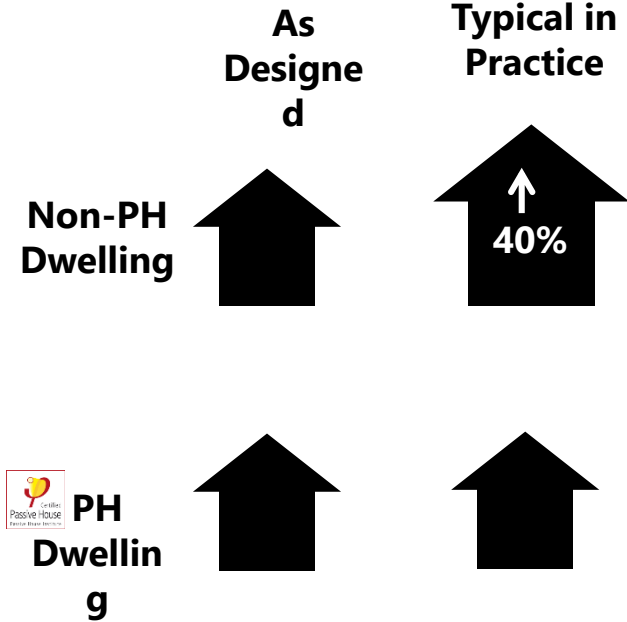
Low energy design – passive design



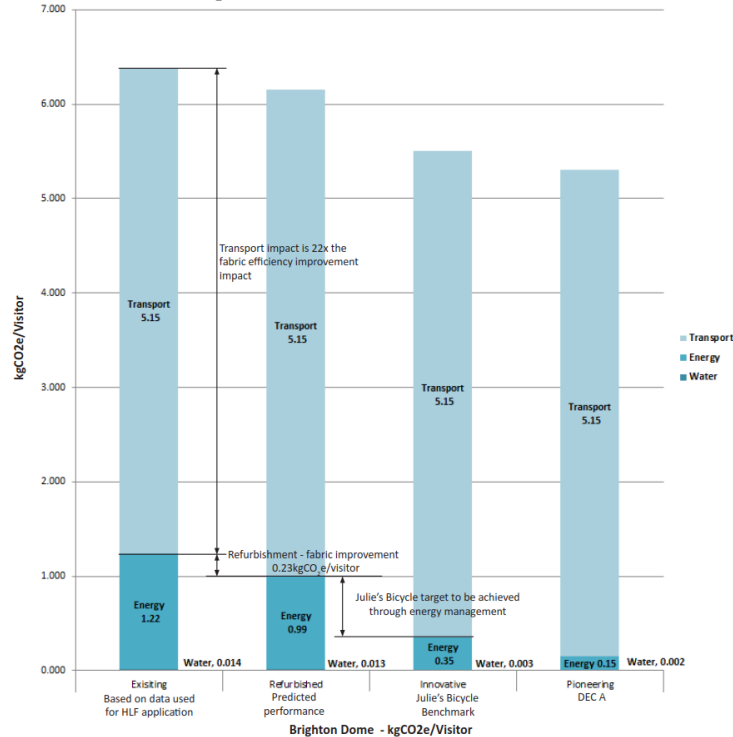
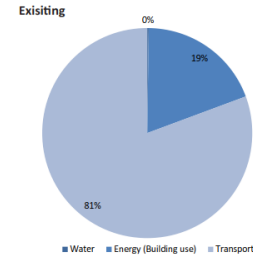
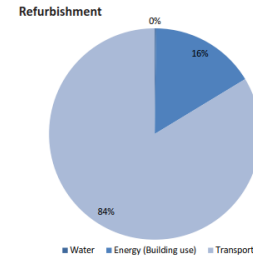
Low energy design – rigour



Heat loss

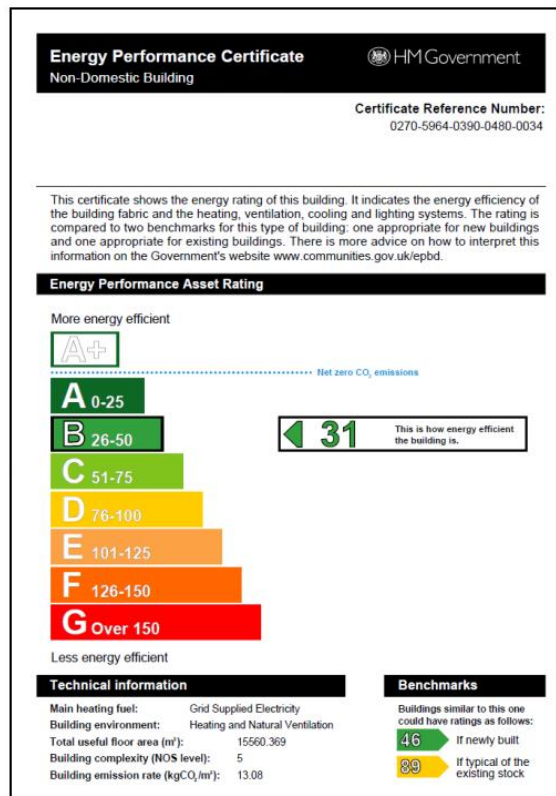
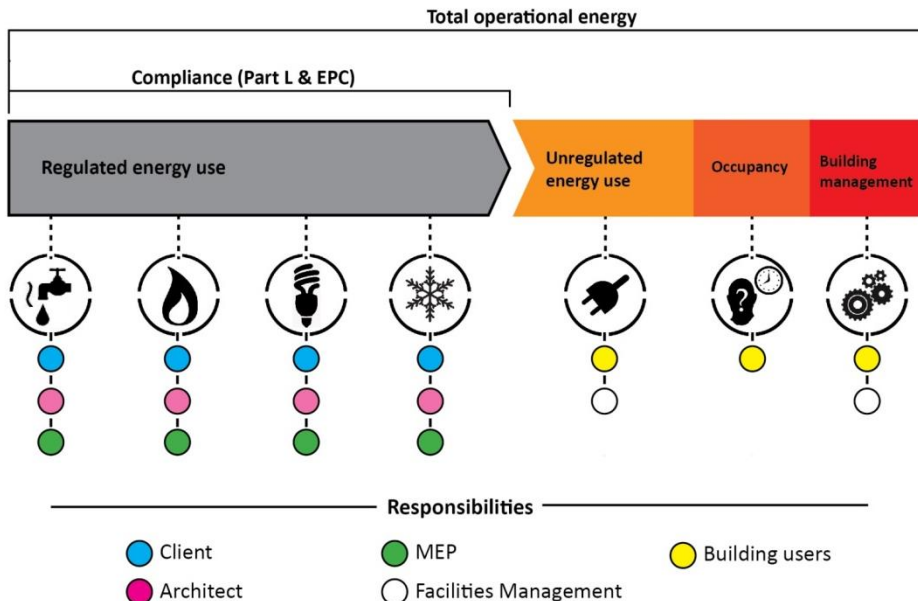


BRIGHTON DOME: PREDICTED CARBON IMPACT/VISITOR BREAKDOWN (kgCO₂e)

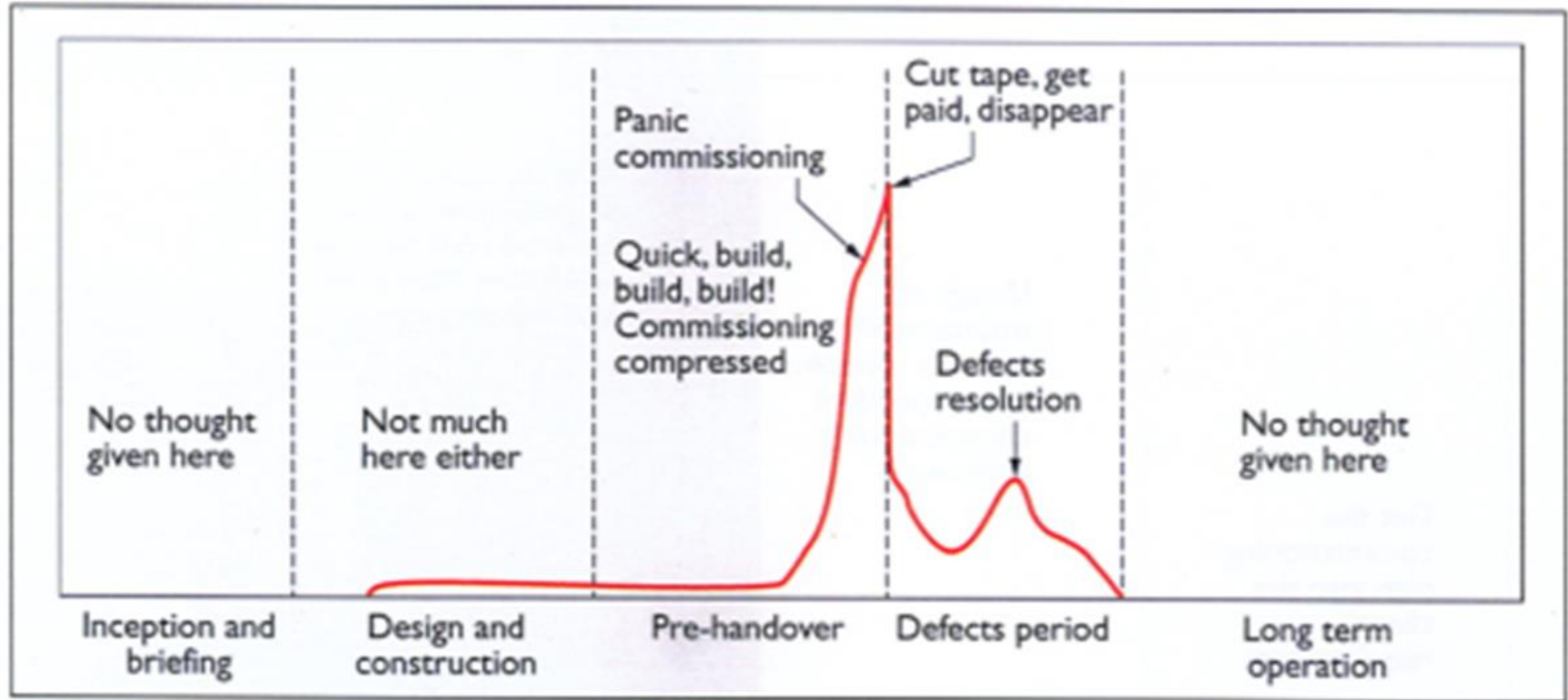


MAX FORDHAM

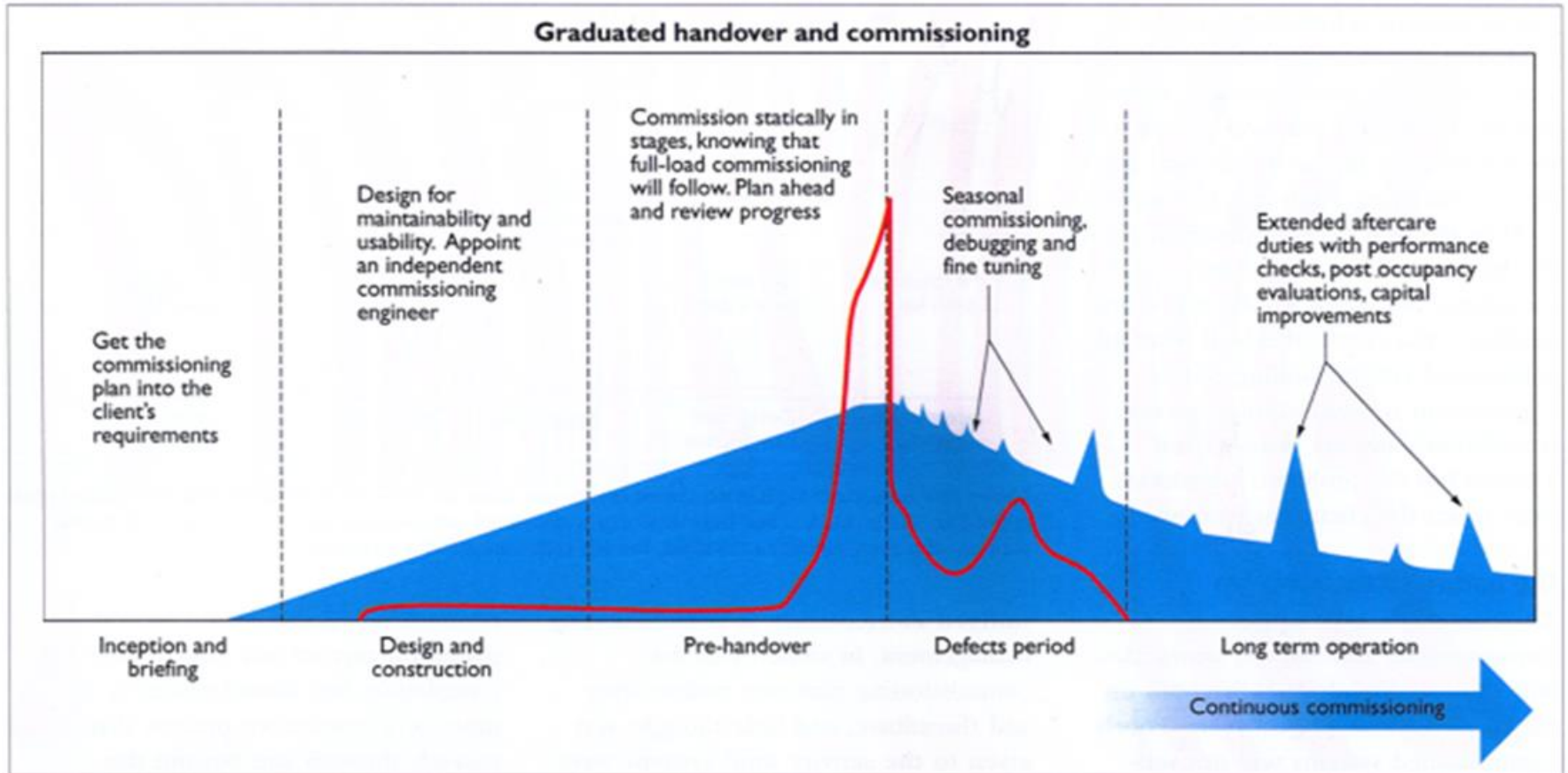
Regulation and compliance



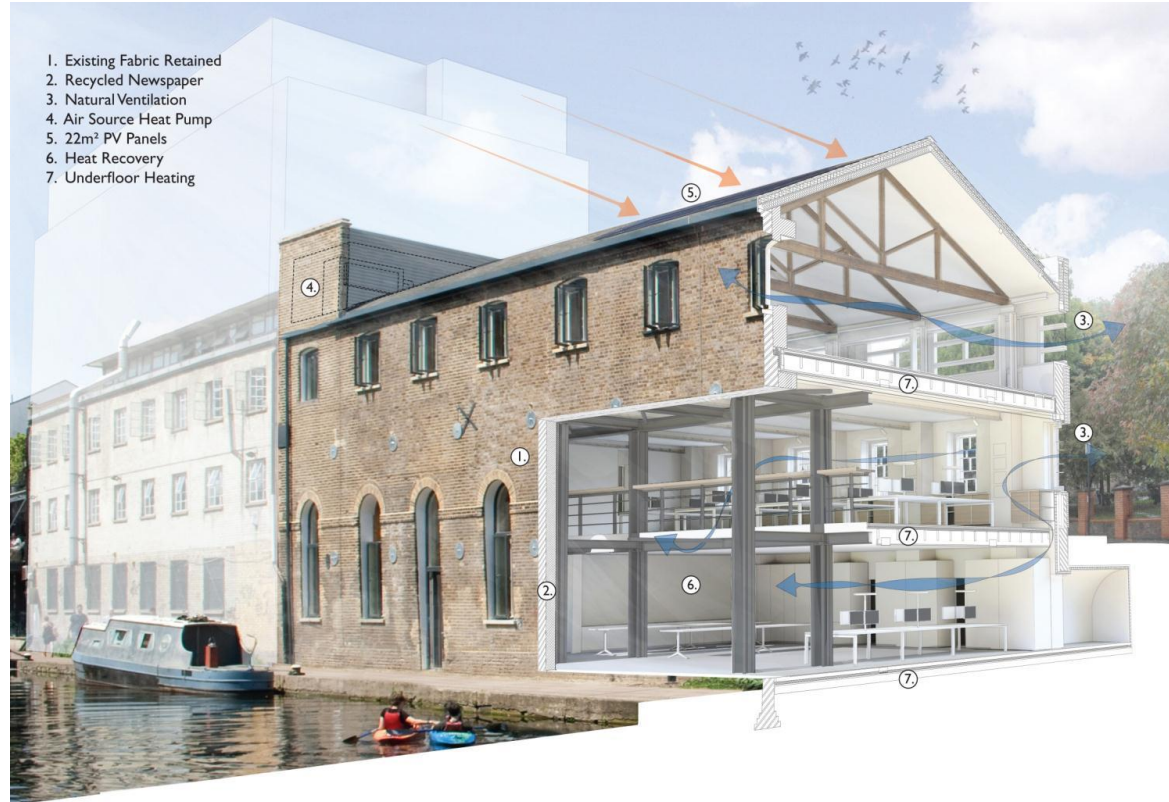
Procurement



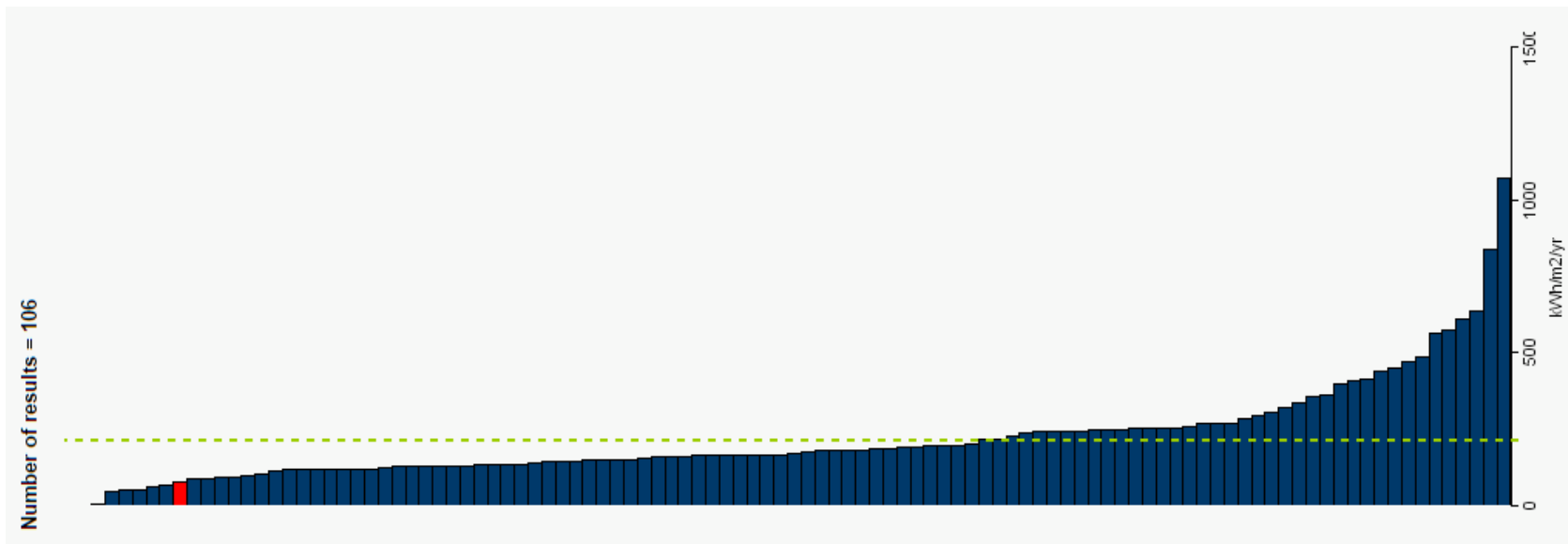
Procurement



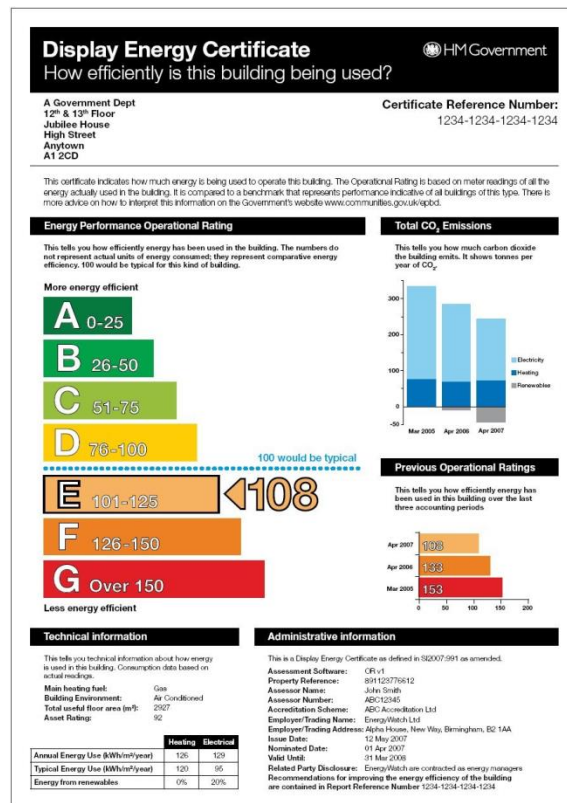
Influence of users commitment



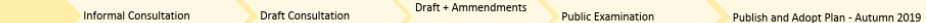
Influence of users commitment



Publicise in use data

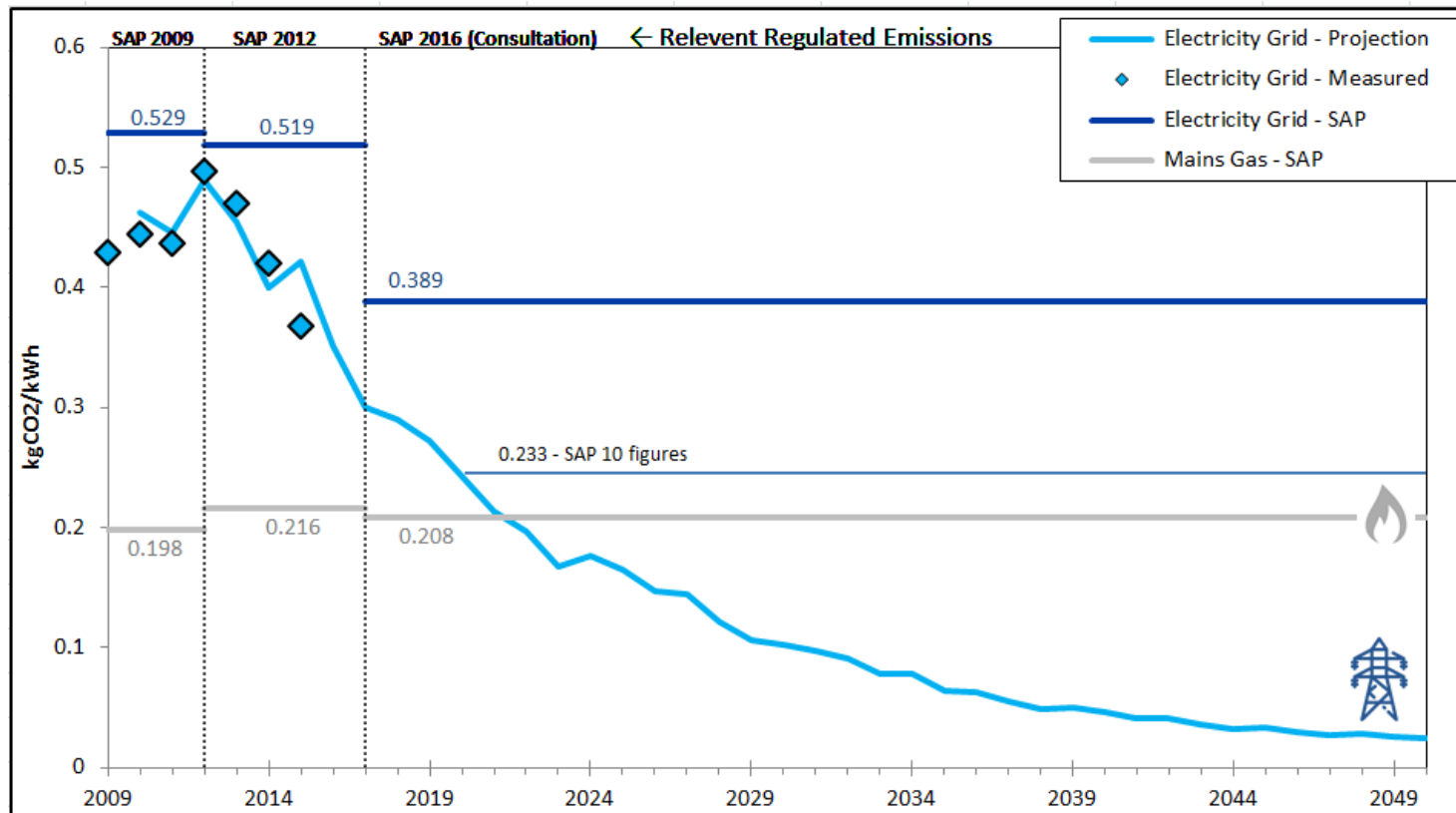


Future trends – energy policy

	TIME	2016	2017	2018	2019	2020	2021
National Strategy		2017 Clean Growth Strategy * Accelerating Green Growth: Green finance capabilities * Improve Business and Industry Efficiency: 25% of UK Emissions : Improve industry energy productivity by 20% by 2030. Improve energy efficiency of commercial buildings. Invest in carbon capture schemes. Phase out fossil fuel energy generation * Improving homes: 13% of UK emission: All homes to be EPC C by 2035. Strengthen energy performance standards. Install smart meters in all homes. Improve standards of new boilers					
		* Consultation on all new dwellings having access to electric car charging stations					
National Building Regulations (England)	New build non-residential	2014 (6th April 2014) * 9% CO ₂ emissions improvement from 2010 Part L2a baseline 				2019 Zero Carbon Non Domestic - Cancelled * Any building performance to go beyond that of Part L2A is Voluntary * Proposed zero carbon buildings - Now Voluntary	
						2019	2020
						* European Directive, EPBD2 - Public buildings to be 'nearly zero energy' (unknown if retained post-Brexit)	* European Directive, EPBD2 - All buildings to be 'nearly zero energy'
	New build residential	Part L1a 2014 Dwelling Fabric Energy Efficiency (DFEE) must be equal or better than the notional dwelling's Fabric Energy Efficiency (TFEE)				2017 SAP Consultation (Residential energy calculation method) * Reduction in grid carbon intensity (22%) * Significant increase in district heating losses * Updated overheating methodology * Thermal bridge y-value 0.2	
Regional Policy						SAP 10.0 Released for information only (not used in Compliance) * Reduced carbon factor for electricity from 0.519 kg CO ₂ /kWh to 0.233 kg CO ₂ /kWh * Increased heat loss factors for heat networks	
						* Part L1a 2020 consultation expected	* New Part L1a 2020 introduced * SAP 10.0 is adopted for use * Additional requirements unknown
		New London Plan - Currently in Draft 					
		Mayor of London: New London Plan 2019 * SI 1 Air Quality: All major developments are air quality neutral, and have preliminary Air Quality Assessments (AQAs) carried out prior to design * SI 2 Minimising green house gas emissions: Major developments to be zero carbon (inc offsets). At least 35% reduction carbon emissions against 2013 Part L. Resi 10%; Commercial 15% emissions reduction through energy efficiency measures. Be Seen: Major development required to monitor 5 years post completion i.e. DEC 5 years. Demonstrate of to be net zero by 2050. - Major developments: calculate CO ₂ from unregulated loads, and whole lifecycle carbon emissions - consider demand response * Use SAP 10 Carbon Factors to reflect grid decarbonisation * SI 3 Energy Infrastructure: Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system. Follow the heating hierarchy * SI 4 Managing Heat Risk: Minimise internal heat gain, optimise passive ventilation, and mechanical design * SI 7 Waste and Circular economy: Zero biodegradable / recyclable waste to landfill by 2026. Prepare circular economy statement for planning					
New Build Residential		2015 * Housing standards integrated into Building Regulations. Additional nationally defined standards (if justified) can be implemented for space, water consumption and accessibility * Local government maintains the ability to condition renewable energy implementation.					
		2016 * 35% improvement on Part L2a 2013 Onsite * Zero Carbon (can be through payment mechanism)				2019 * A zero-carbon target for major residential developments has been in place for London since October 2016.	
		2016-2019 * 35% improvement on Part L2a 2013				2019- Expected * Zero Carbon new non-domestic buildings * Definition and methodology are undefined	



Future trends – energy sources



Thank you

Phil Armitage

September 2019



IEA-IPEEC Joint Workshop Session 2: Low Energy Buildings and the Role of Smart Management Systems

World Green Building Council – Advancing Net Zero

GLOBAL PROJECT FUNDERS

**WE MEAN
BUSINESS**

CIFF

CHILDREN'S
INVESTMENT FUND
FOUNDATION

**ADVANCING
NET ZERO**



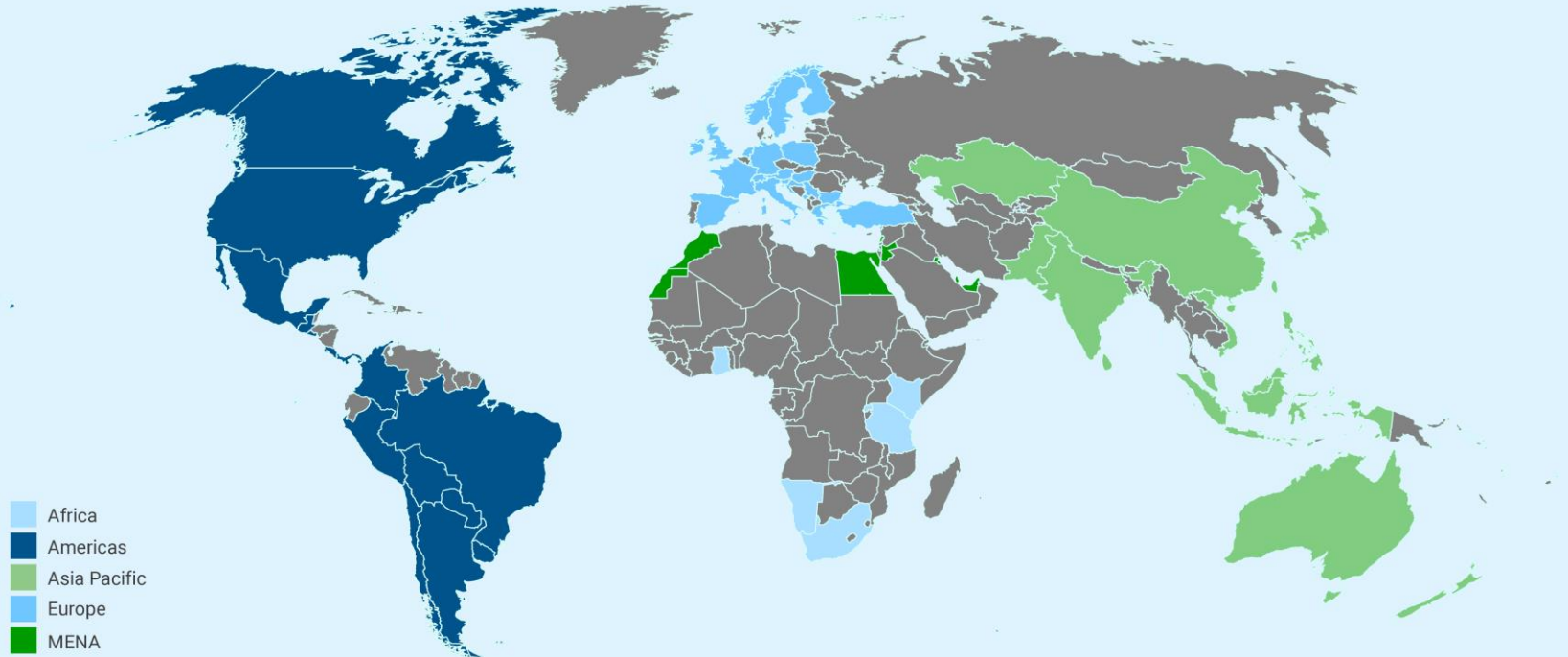
**WORLD
GREEN
BUILDING
COUNCIL**

World Green Building Council

ADVANCING
NET ZERO



A global network of Green Building Councils, with the aim of creating green buildings for everyone, everywhere.





Buildings play a critical role for human and planetary health



A low-angle, upward-looking photograph of several modern skyscrapers with glass facades, reaching towards a clear blue sky. The perspective creates a sense of height and scale, with the buildings' lines converging towards the top of the frame.

Achieving Paris Agreement
=
Urgent action towards
Net Zero Carbon Buildings

ADVANCING NET ZERO

A global campaign to accelerate uptake of net zero carbon buildings to 100% by 2050

Project targets

- Increase awareness and education
- Achieve alignment and commonality between GBC approaches and certification schemes
- To expedite uptake in global markets by sharing market leadership examples



Advancing Net Zero

WorldGBC definition:

A net zero carbon building is highly energy efficient with all remaining energy from on-site and/or off-site renewable sources

100% of buildings must operate at net zero carbon

2050

2030

All new buildings must operate at net zero carbon

GOVERNMENT
ENGAGEMENT

TRAINING &
EDUCATION

CORPORATE
ENGAGEMENT

CERTIFICATION

Key Principles

1. Measure and disclose carbon

Carbon is the ultimate metric to track; buildings must achieve an annual operational net zero carbon emissions balance based on metered data



2. Reduce energy demand

Prioritise energy efficiency to ensure that buildings are performing as efficiently as possible, and not wasting energy



3. Generate balance from renewables

Supply remaining demand from renewable energy sources, preferably on-site followed by off-site, or from offsets



4. Improve verification and rigour

Over time, progress to include embodied carbon and other impact areas such as zero water and zero waste





ADVANCING NET ZERO

Status Report 2019

www.worldgbc.org #AdvancingNetZero @WorldGBC

GBC ACTION TIMELINE

June 2016 WorldGBC launch Advancing Net Zero project

May 2017 Canada GBC launch Zero Carbon Building Program and Standard
Canada's first green building programme to make carbon emissions the key indicator for building performance.
Find out more at cagbc.org

September 2017 EmiratesGBC release Defining Nearly Zero Energy Buildings in the UAE report

September 2017 DutchGBC establish 'Paris Proof' concept for buildings

October 2017 GBC Australia launch Green Star innovation challenges for carbon neutrality
The Australian Federal Government's National Carbon Offset Standard for Buildings and Precincts utilises Green Star - Performance and NABERS as pathways to demonstrate compliance, and sets rigorous requirements for achieving carbon neutrality.
Find out more on page 43 and at gbc.org.au

April 2018 Sweden GBC release draft NollCO₂ certification manual

May 2018 DGNB launch Framework for carbon neutral buildings and sites
Annual certification of requirements for carbon accounting, carbon disclosure and carbon management to achieve a net zero carbon balance for buildings in Germany by 2050, based on trajectories of carbon limit values.
Find out more at dgnb.de

November 2018 USGBC launch LEED Zero
LEED Zero verifies the achievement of net zero goals and signals market leadership in the built environment. Projects can achieve certification for LEED Zero Carbon, recognising buildings or plus certification options for LEED Zero Energy, LEED Zero Water, and LEED Zero Waste.
Find out more on page 42 and at usgbc.org

February 2019 EmiratesGBC announce partnership with ILFI for Zero Energy and Zero Carbon certifications. Find out more on page 45

April 2019 UKGBC launch a framework definition for net zero carbon buildings
The framework was developed by an industry task group formed of over 40 industry representatives from across the construction industry. The definition aims to provide a consistent approach that can over time, into policy and regulation.
Find out more on page 41 and at ukgbc.org

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Leading Green Building Council action

November 2016 Alliance HQE-GBC launch E+C- Bâtiment à Énergie Positive et Réduction Carbone
Launched in conjunction with the Government, to ensure construction sector is part of the strategy to meet the challenge of climate change, the system recognises positive energy buildings (E+) with low GHG emissions on life cycle approach included embodied carbon (C-).
Find out more at alliancehqe.org

August 2017 GBC Brasil launch Zero Energy Standard
Designed to complement existing local and international green building rating schemes, and recognises buildings that are "self-sufficient" in energy.
Find out more at gbcbrasil.org

October 2017 GBC South Africa launch Net Zero / Positive labels
Projects are able to achieve Net Zero or Net Positive ratings for carbon, water, waste and ecology. This recognises buildings that completely neutralise or positively redress their carbon emissions, water consumption, solid waste to landfill and/or negative ecological impacts.
Find out more at gbc.org.za

January 2018 EmiratesGBC establish Net Zero Centre of Excellence
A platform for government, academia, civil society and the private sector to learn and share knowledge to support future regulations and industry capacity towards decarbonisation of the building sector by 2050, offering tools and resources to advance the net zero movement in the UAE.
Find out more at emiratesgbc.org

June 2018 GBC Australia launch Carbon Positive Roadmap

August 2018 UKGBC launch Advancing Net Zero programme

November 2018 Indian GBC launch Net Zero Energy Standard

February 2019 Canada GBC release Making the Case for Building to Zero Carbon report
The report demonstrates definitively that Zero Carbon Buildings offer meaningful greenhouse gas reductions and positive financial returns in Canada. Specifically, the study shows that Zero Carbon projects will require only a modest capital cost premium.
Find out more at cagbc.org

February 2019 New Zealand GBC launch consultation for Net Zero carbon standard

May 2019 GBC España launch BUILD UPON 2
GBC is back as the Project Coordinator for the newly launched BUILD UPON 2 project, a Horizon 2020 project focused on developing deep renovation strategies at a national level across Europe.

Brazil, the Green Standard

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GBC NET ZERO CARBON BUILDINGS SCHEMES

The response of GBC certification schemes and programmes to the principles set out in the Advancing Net Zero infographic are shown here:

GBC COUNTRY SCHEME	Alliance HQE-GBC France	DutchGBC Netherlands	CaGBC Canada	GBC Brasil Brazil	GBCA Australia
	E+C: (new buildings)	'Paris Proof' concept	Zero Carbon Standard	Zero Energy Standard	Green Star Innovation Challenges
	Based on full lifecycle carbon analysis (LCA)	Annual verified carbon consumption data	Annual verified zero carbon operational emissions balance	Annual verified net zero energy balance	Annual verified consumption data
	Between 5-40% minimum energy reduction, dependent on building type and 2012 French thermal regulation	66% energy consumption reduction compared to the 2015 sector energy intensity averages	Heating energy efficiency targets set (Thermal Energy Demand Intensity) for each climate zone Report Energy Use Intensity; report peak demand	If 100% onsite renewable energy, no additional requirements If using offsite renewable energy, energy efficiency requirements set beyond ASHRAE	30% more energy efficient than baseline building
	Onsite renewable energy requirements for levels Energy 3 >100% energy demand for Energy 4	Onsite renewables included in net-consumption data Offsite renewables to account for remaining 33% demand	At least 5% of energy demand met by onsite renewable energy; offsite allowed with specific eligibility requirements Offsets not permitted	Onsite allowed; commercial buildings can use RECs for maximum 10% of energy demand Offsets not permitted	Onsite and offsite renewable energy allowed Any remaining non-electricity related CO ₂ emissions to be offset annually
	Certification is based on LCA covering embodied carbon and construction processes in addition to building energy and water	Future revision to include embodied carbon	Report on embodied CO ₂ of structural and envelope building materials	Future revision to include embodied carbon	Scope also includes refrigerants, waste-to-landfill and water consumption Embodied carbon also addressed

AND PROGRAMMES: A COMPARISON

GBCA South Africa	SwedenGBC Sweden	DGNB Germany	IndianGBC India	USGBC USA	UKGBC UK
Net Zero & Net Positive labels	NollCO ₂	Framework for carbon neutral buildings & sites	Zero Energy Standard	LEED Zero	Framework definition
Zero carbon operational emissions balance, verified every 5 years	Annual net zero operational carbon with regular verification	Annual verified net zero carbon balance	Annual verified net zero energy balance	Annual verified net zero carbon emissions from energy consumption and occupant transportation	Annual verified net zero operational energy carbon balance
Energy efficiency achieved via demand to supply strategy, low-carbon materials, offsite renewables or offsets can be included	40% improvement of energy performance than local code (BREEAM SE) 35% reduction beyond ASHRAE (LEED Gold) or local scheme	Minimum energy requirements by energy code Reduce Energy Performance Index Ratio against local baseline	Achieve energy performance LEED criteria for targeted performance level	Prioritise energy efficiency and energy use reductions, with energy use intensity targets to be included in future	
Onsite renewables encouraged, offsite renewables allowed through approved offset policies, e.g. onsite rooftop energy production from renewable energy sources	Payment of embedded and annual carbon debt through approved offset policies, e.g. onsite rooftop energy production from renewable energy sources	Generate as much renewable energy onsite as feasible Meet annual energy demand through both onsite and offsite renewable energy sources	Achieve energy generation LEED criteria for targeted performance level	Prioritise onsite renewables and offsite renewables with additionality Offset remaining carbon	
Cap on initial embodied carbon from production of materials and non construction and installation on site	Either operational emissions or operational plus embodied emissions of whole life cycle	Future versions to include waste, waste and carbon	Project must be LEED certified (any level) LEED Zero Water and Waste also available	Embodied carbon included under 'net zero carbon - construction' Future scope for 'net zero carbon - whole life'	



WORLD GREEN BUILDING COUNCIL

'The Race to Zero' cases, workshops and others on achieving net zero operational buildings and industry collaboratio.



Government action

We welcome the leadership action from governments that have already committed to net zero carbon buildings. Through our partnerships with key organisations such as C40, The Climate Group as secretariat to the Under2 Coalition and WRI (see page 46) we are seeing bold commitments being made at both a municipal and government building level, and for implementing regulation to mandate net zero carbon buildings and setting policy roadmaps for future direction. Action from leading cities, states and regions can inspire wider and deeper commitments from other subnational and national governments, in order to meet climate change obligations.

Cities

As of May 2019, 23 C40 city mayors have signed the **Net Zero Carbon Buildings Declaration** developed as part of WorldGBC's Net Zero Carbon Buildings Commitment, as a signal of the level of action needed to improve buildings across their jurisdictions and the benefits it will bring to their citizens. The Declaration states:

"...Net zero carbon buildings are green and healthy buildings. They use energy ultra-efficiently and are supplied by renewables. They are comfortable homes where money isn't wasted on energy bills, productive workplaces insulated from extreme temperatures, and healthy schools free from dirty air.

Action is needed today, because most buildings will be standing for generations to come. Missing this opportunity looks in the problem for our children and grandchildren, but delivering on this commitment will provide benefits for our citizens to enjoy long into the future. From lower energy bills for all, including our most vulnerable citizens, to reduced greenhouse gas emissions and cleaner air, the positive impacts of action are undeniable..."

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Government action

Government action

"By mid-century all buildings must be operating at zero carbon emissions, a radical shift from the situation today where 39% of global emissions are generated by construction and buildings. In cities, this figure is often much higher. Investors, developers and businesses will need to be prepared for the standards being put in place by city halls around the world."

Zoe Sprigings, Programme Director, Energy and Buildings, C40



Vancouver, Canada - Vancouver's Renewable City Action Plan establishes a high level roadmap for all buildings to achieve zero emissions by 2050. This includes requiring zero emissions in all new buildings by 2030, as well as setting energy and emission reduction targets for existing buildings.

The Zero Emissions Building Plan introduced in 2016 is a phased approach introducing greenhouse gas emission limits through building codes, updated in five-year increments to require zero emissions from all new construction by 2030.

The city has been carbon neutral in operations for all buildings owned and occupied since 2012. The Renewable Energy Strategy for City Owned Buildings introduced in 2016 requires all city-owned buildings to be zero emissions in their operations before 2040, eliminating offsets.

New city-owned developments must be built to Passive House or alternative zero emissions standard from 2018, and as part of capital renewal and maintenance planning, existing buildings are to be identified and scheduled or zero emissions retrofits.

35



Thank you!

Victoria Kate Burrows

Director of Advancing Net Zero

vburrows@worldgbc.org

GLOBAL PROJECT FUNDERS

**WE MEAN
BUSINESS**

CIFF

CHILDREN'S
INVESTMENT FUND
FOUNDATION

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**ADVANCING
NET ZERO**



**WORLD
GREEN
BUILDING
COUNCIL**

CUBE 2020

Opportunity for Market Transformation:

Addressing the Energy Transition for the Non-Residential Building Stock



The Origins of CUBE 2020: Need for sector-specific regulation

- In general, energy policy for the building sector is focused on regulating the residential sector...
- But in France alone, non-residential buildings make up $\frac{1}{4}$ of the existing building stock and represent $\frac{1}{3}$ of national energy consumption
- This means: 1 billion m² of non-residential, existing building stock that is subject to inefficient, non-operative technical regulations (*RT global*, *RT éléments*) focused on *means* with no *end* in sight

= Need for specific regulation for the existing building stock that sets binding targets

**More than an
energy saving
competition:**

An opportunity
to establish
sector-specific
legislation

Market Transformation in 3 Stages

2013 -- CUBE 2020

Set the policy-stage: transpose the proof-of-concept, CUBE 2020, & achieve necessary energy reductions (Results stage)

2015 -- **Tertiary Market Commitment**
begin gathering private & public stakeholders to draft a Regional or Local Charter addressing current building stock energy consumption & and setting result-based targets (*Building Policy*

2019 -- Establish the regulation that will ensure the tertiary building sector meets energy & environmental requirements
(Regional/National Law stage)

MAKE 5 - 25% OF SAVINGS *

CUBE 2020: The Principle

Work on use, the
3rd pillar of energy
efficiency

**Raise awareness
and mobilise** while
having fun
competing in a
contest

**Monitor progress
and track your
ranking**



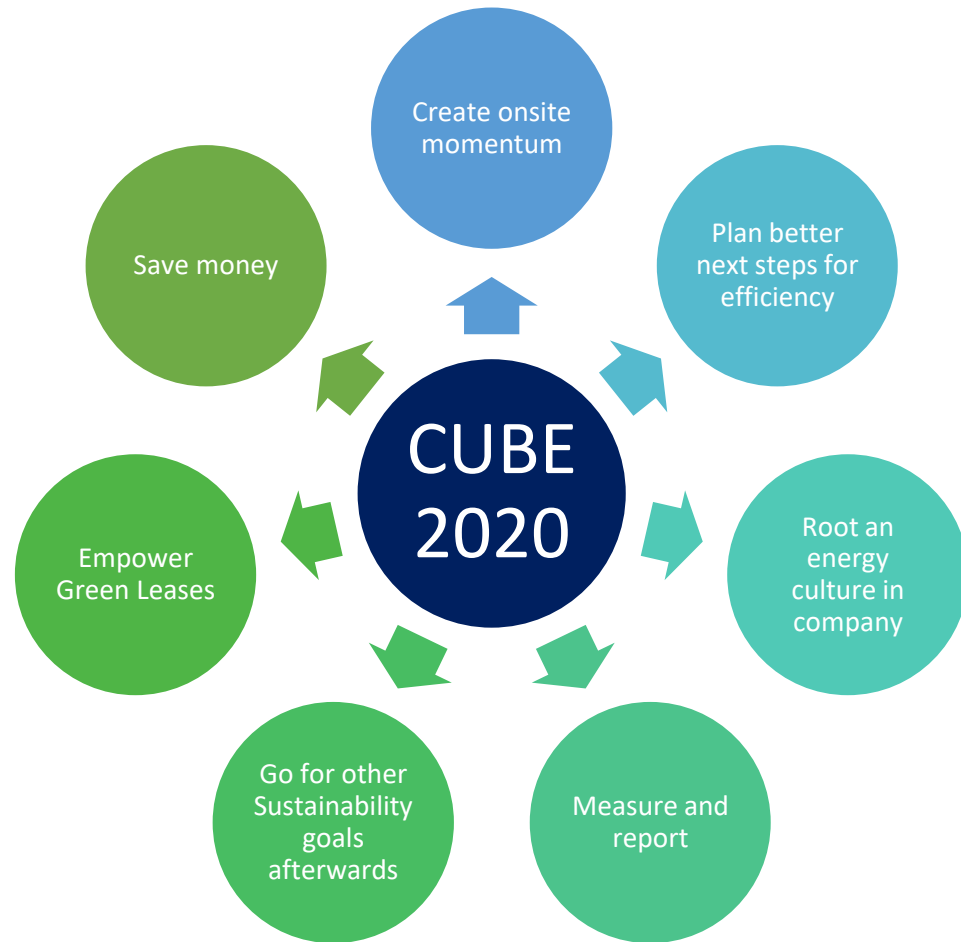
Users of **non-residential buildings** compete throughout **1 year** to achieve the most energy savings, adopting user best practices and fine tuning their installations.

Players include: large companies, SME's, French national government, local government, & more.

*11,5% average savings for other similar European experiences.
Average energy savings up to 12% for CUBE 2020.

The Proof of Concept:

Sociological studies, or SOCIOCUBE, confirmed the “transformation effect” in companies



12 % average energy savings, **670**
candidates, with the best reaching **38.5%**

85 000 000

kWh saved

5 300 000 m²

320 000

Employees
participated

Ideal partners to transpose our model:

(Can also be an
alliance of
organisations)

To develop CUBE 2020 abroad, must have:

- A connection to building industry and companies as building users
- Country-wide organization, in touch with national players and policy makers
- Ability to coordinate a dynamic program that influences the tertiary sector to move towards energy savings and reducing CO2 emissions
- Capacity to dedicate time to develop the contest (economically a self-standing activity), find partners/sponsors, and capacity to recruit candidates

TODAY 1000+ public schools participate in CUBE.S

**Think about how CUBE could impact your
building sector!**



Interested in bringing about this market transformation?

Get in touch to learn more about launching CUBE near you!

Contact information:

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Amanda Garcia

Program Manager, International Partnerships

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+33 6 64 82 76 15

Procel Edifica

Energy Performance and Comfort Perception of Buildings in Use





Federal Government Program created in 1985 under the Ministry of Mines and Energy (MME) and managed by Eletrobras

Mission: Promote energy efficiency in order to increase the society's life quality and contribute on the improvement of services and consumer's goods, reducing the environmental impacts.

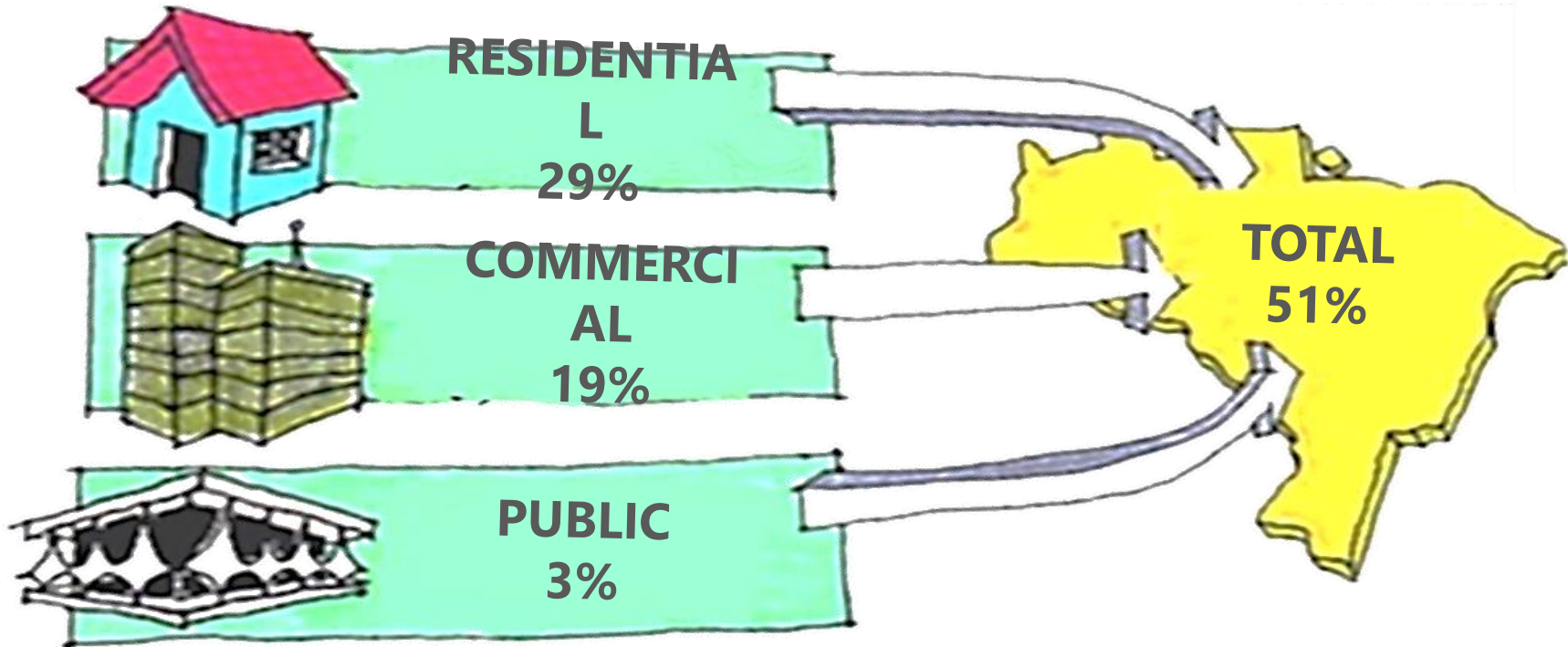
Since 1986 Eletrobras has already invested around US\$ 2.6 billion on Procel = 92.2 million MWh saved!

Objectives:

- Manage electric energy waste;
 - Encourage the rational and efficient use of electric energy;
 - Encourage and support the policymakers (regulations and laws) concerning energy efficiency;
- Increase the country competitiveness;
- Reduce environmental impacts;
- Provide benefits to society.

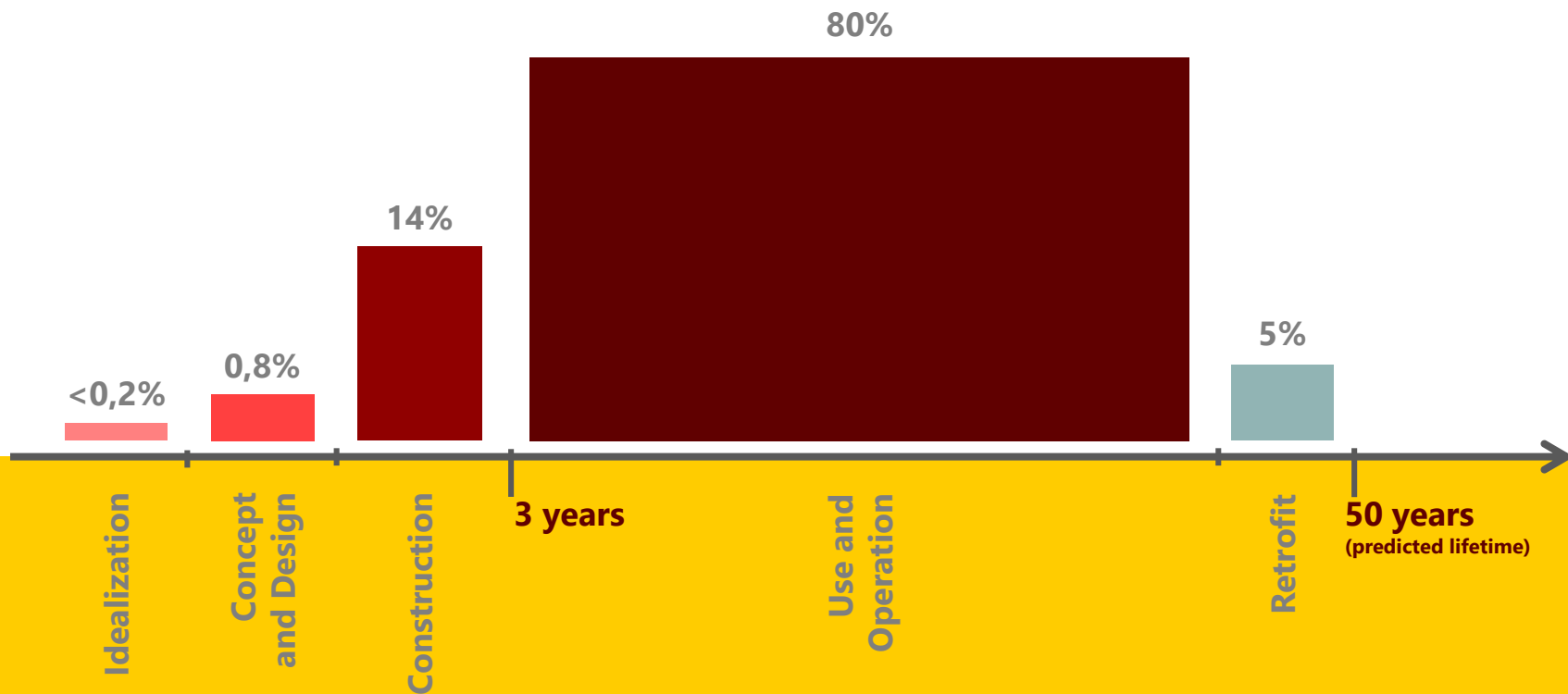


BRAZIL | ELECTRIC ENERGY CONSUMPTION



Total: 472,242 TWh

Source: EPE 2018



Energy consumption percentage during a corporate building's life cycle.

Source: CEOTTO, 2008.

Corporate buildings' benchmark equation

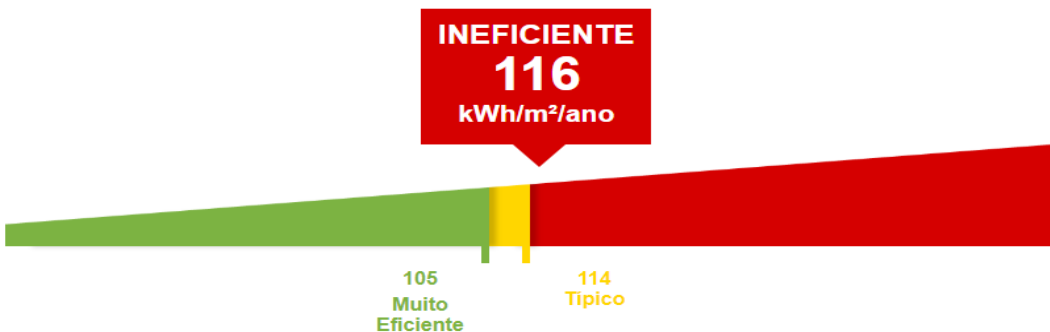
$$E_{benchmark} = c_0 + c_1 \times \frac{GHR}{1000} + c_2 \times \frac{A_{estac}}{A_{util_ocup}} + c_3 \times (N_{f,média} - N_f) + c_4 \times N_{andar} \times \frac{N_{elev}}{A_{util_ocup}} + \frac{E_{CPD}}{A_{util_ocup}} + \frac{E_{outros}}{A_{util_ocup}}$$

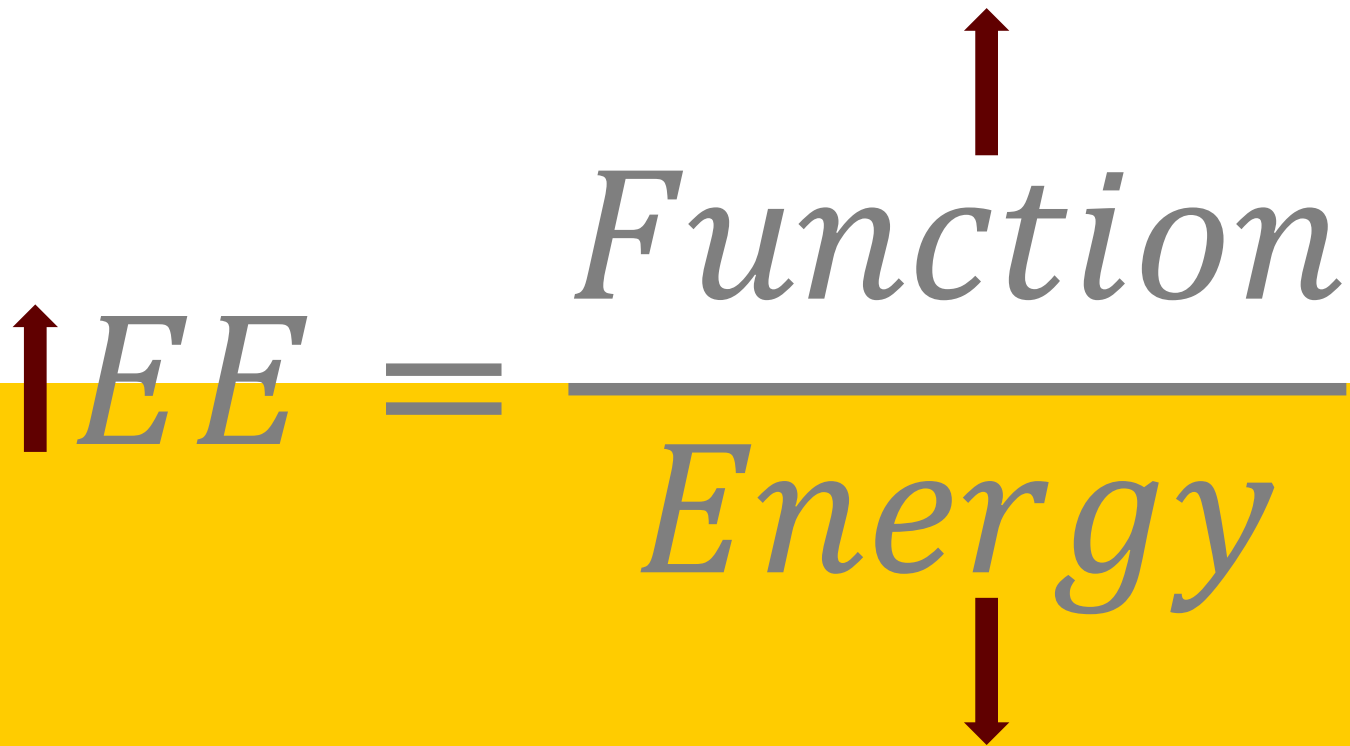
Parameters considered:

- Conditioned area (m²)
- Local → climate (bioclimatic zone)
- Building's population
- Occupancy rate (%)
- Number of floors
- Number of elevators
- Underground area / parking (m²)
- Data Center (binary)
- Kitchen / exceptional uses (binary)

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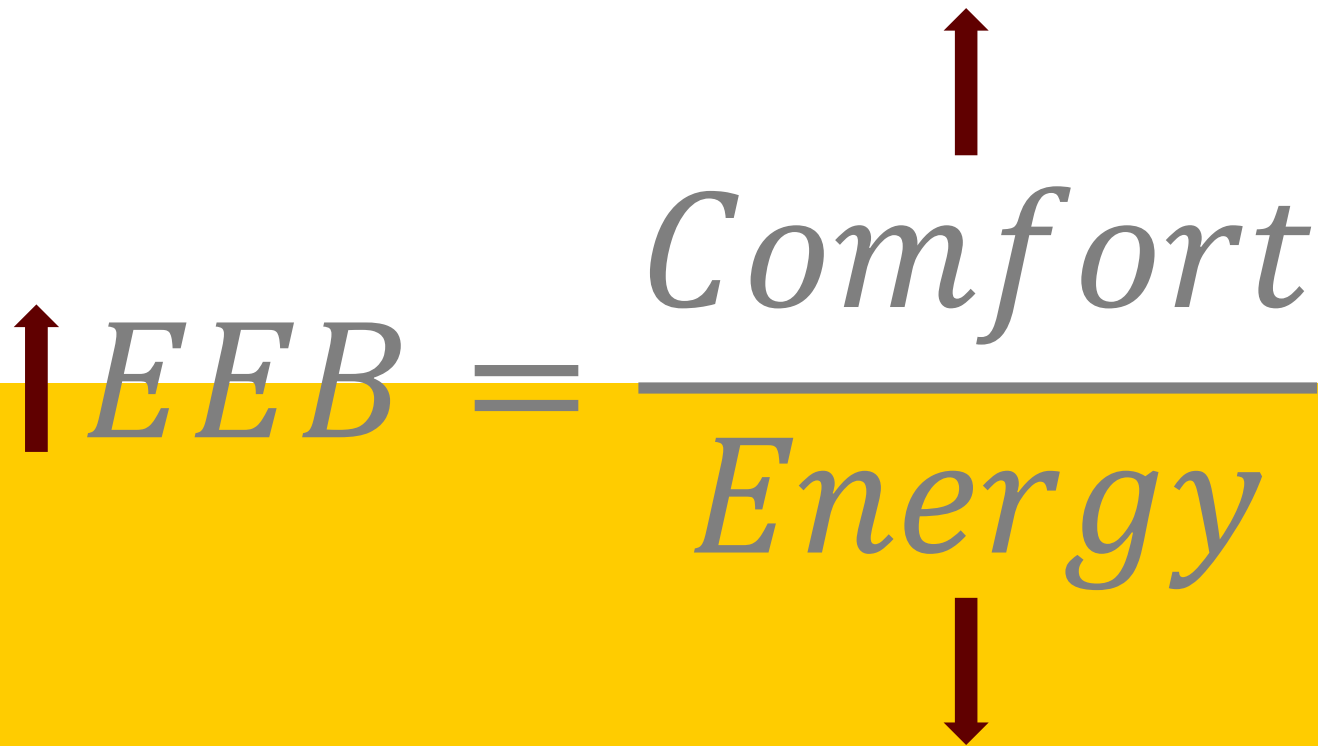
Cálculo	Constante	Típico	Boa prática	Unidades
Benchmark	c ₀	145,15	111,31	kWh/m ² /ano
	c ₁	0,39	0,33	kWh/m ² /(1000 GHR)/ano
	c ₂	14,4	10,0	kWh/m ² /ano
	c ₃	4,15	4,15	kWh/pessoa/ano
	c ₄	700	700	kWh/andar/elevador/ano





The diagram illustrates the formula for Energy Efficiency (EE) as the ratio of Function to Energy. The entire equation is positioned on a yellow background. The word 'Function' is in the numerator, and 'Energy' is in the denominator. A dark red arrow points upwards from the top of the 'Function' text, indicating that the function should be maximized. Another dark red arrow points downwards from the bottom of the 'Energy' text, indicating that energy should be minimized. The 'EE' is written in a larger font size than the other terms.

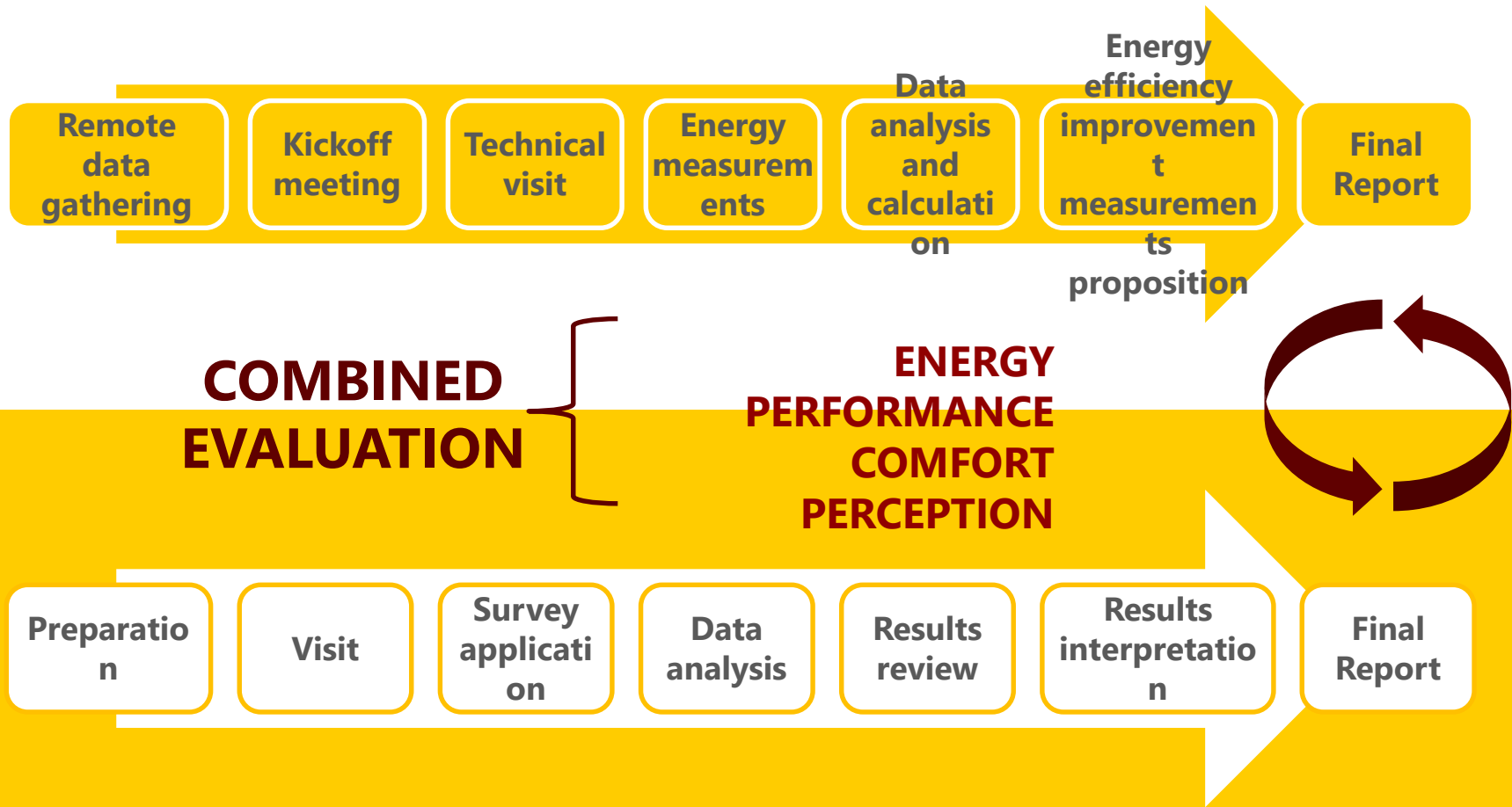
$$\uparrow EE = \frac{\text{Function}}{\text{Energy}} \downarrow$$



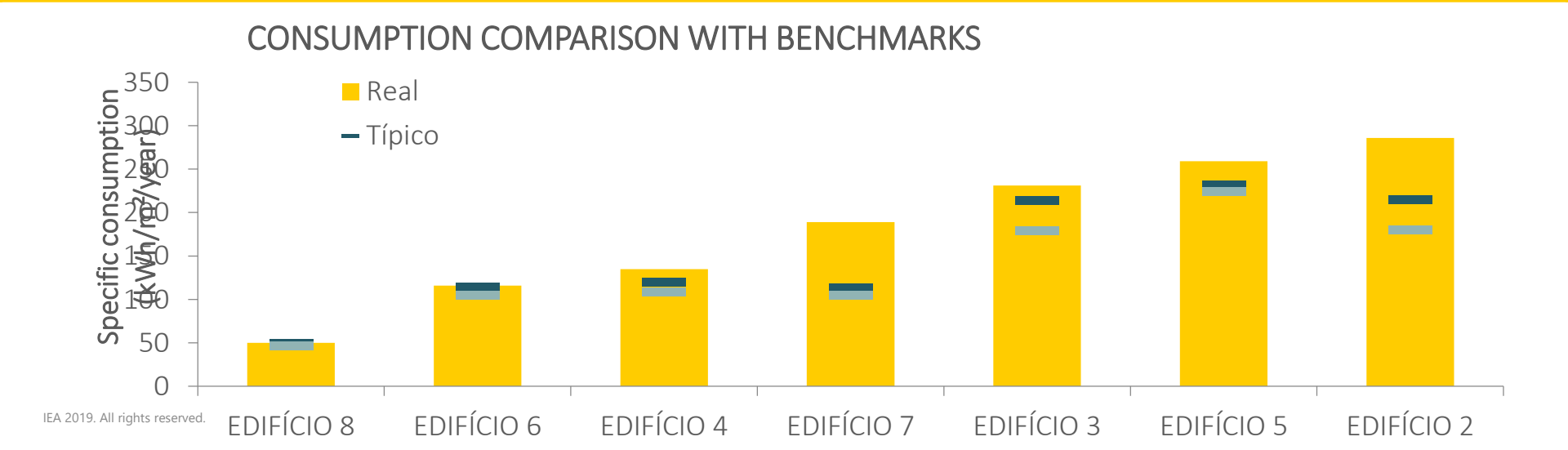
The diagram illustrates the relationship between three variables: EEB , $Comfort$, and $Energy$. The equation $EEB = \frac{Comfort}{Energy}$ is presented in a grey serif font. A horizontal yellow bar is positioned behind the equation, spanning the width of the fraction. Three dark red arrows indicate the direction of change: an upward arrow to the left of EEB , an upward arrow above $Comfort$, and a downward arrow below $Energy$.

$$\uparrow EEB = \frac{\uparrow Comfort}{\downarrow Energy}$$


$$\underline{Rationing} = \frac{Comfort}{Energy}$$

RESULTADOS		BUILDING 8	BUILDING 6	BUILDING 4	BUILDING 7	BUILDING 3	BUILDING 5	BUILDING 2
Construction year		2014	1972	2007	2008	1967	2013	1967
Specific energy consumption (kWh/m ² /year)	Real	50	116	135	189	231	259	286
	Typical	49	114	120	113	214	232	215
	Good practice	46	105	108	105	179	224	180



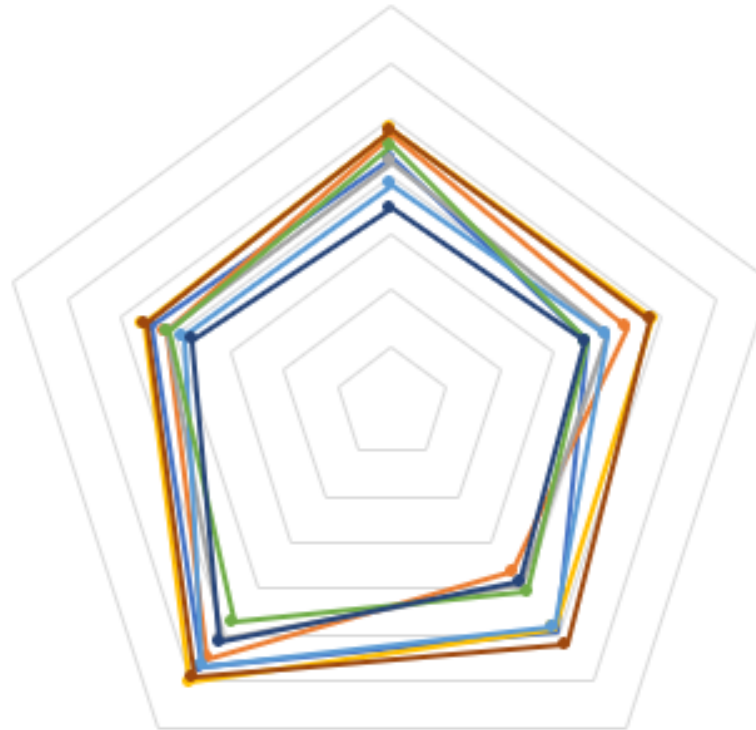
INTERNAL AIR – COLD PERIODS

INDIVIDUAL HEALTH IMPACT

INTERNAL AIR – HOT PERIODS

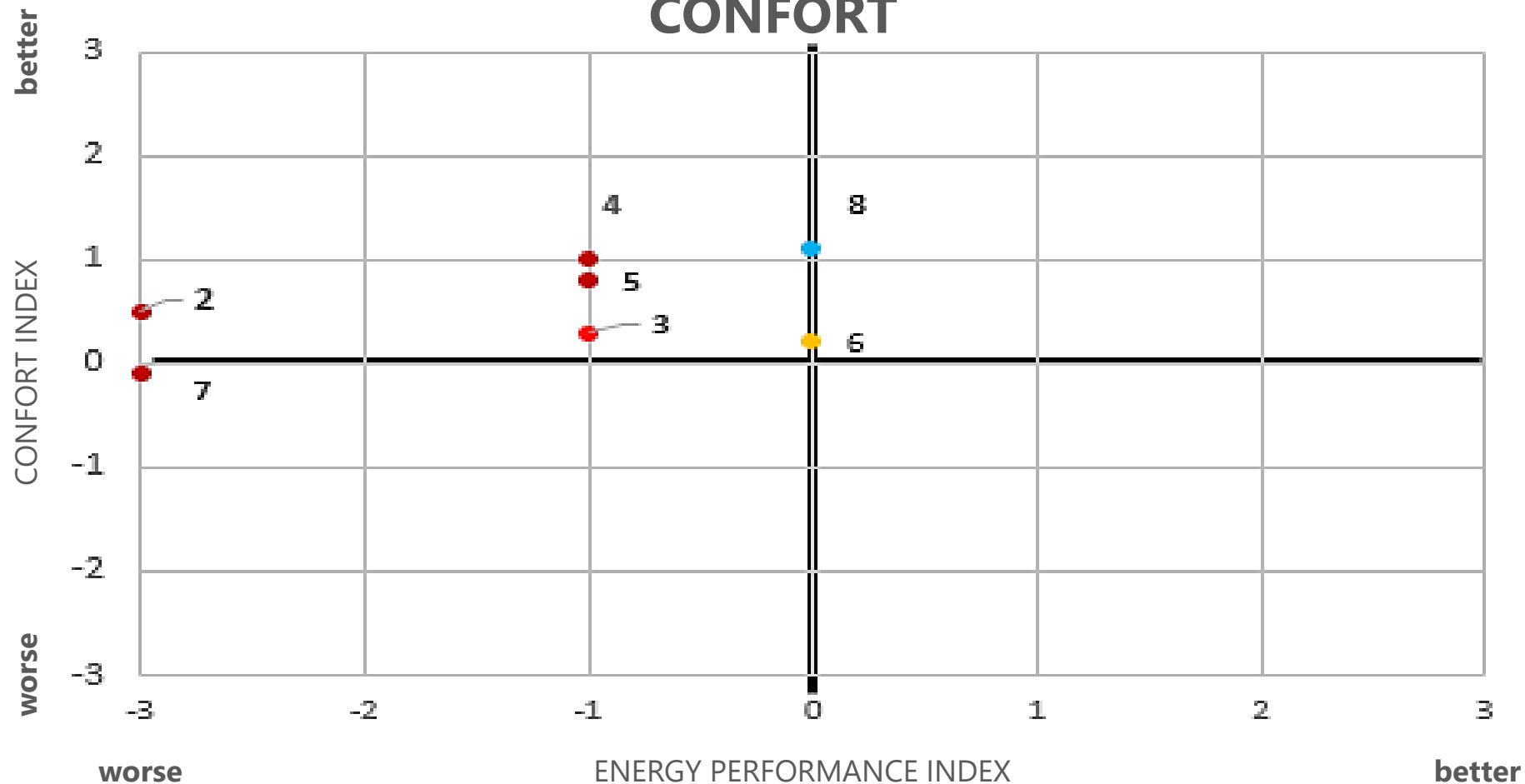
LIGHTING (GENERAL)

NOISE (GENERAL)

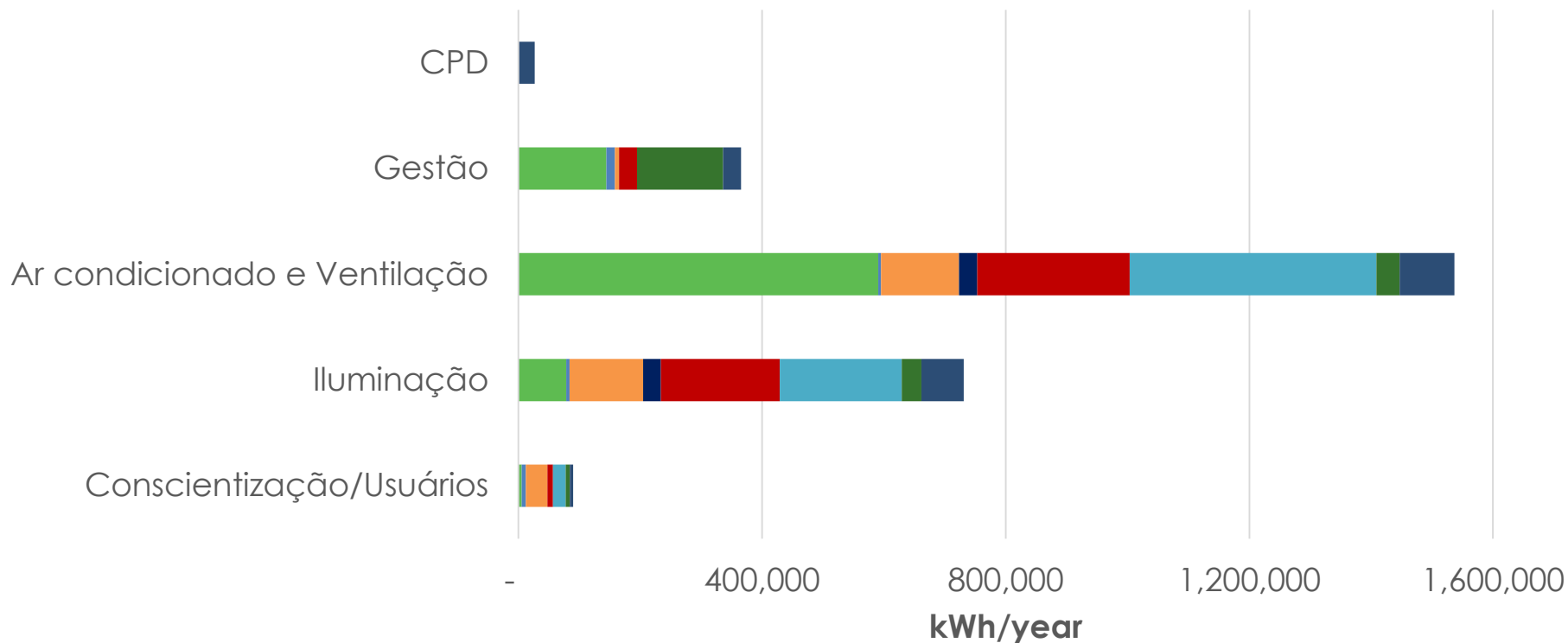


- EDIF 1
- EDIF 2
- EDIF 3
- EDIF 4
- EDIF 5
- EDIF 6
- EDIF 7
- EDIF 8

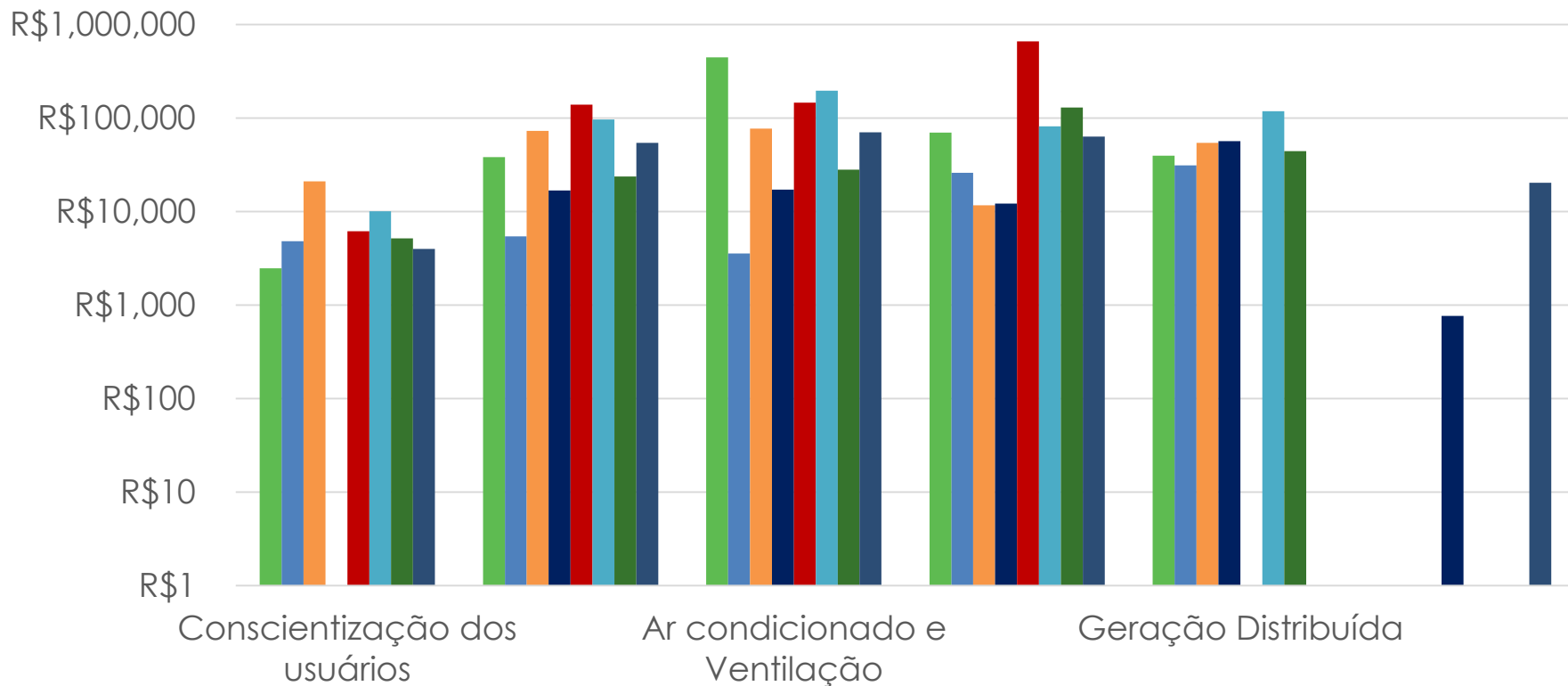
GLOBAL PERFORMANCE: ENERGY X CONFORT



ECONOMY POTENTIAL BY IMPROVEMENT MEASURE (KWH/YEAR)



ECONOMY POTENTIAL BY IMPROVEMENT MEASURE (R\$/YEAR)





15 new benchmarks under development

1	Bank agency (update)
2	Big Hotel / Resort
3	Medium Hotel
4	Small Hotel / Hostel
5	Shopping Center
6	Supermarket
7	Big Retail Store
8	Small Store
9	Restaurant / Food Preparing
10	Preschool
11	Primary / Secondary School
12	University / Technical School
13	Hospital
14	Health Center / Social Assistance
15	Datacenter

Procel's Information



Appliances



Buildings



www.procelinfo.com.br



Results



Public Lighting



**More than 54.000
Current users**



**More than 1,4 million
pageviews in 2018**



National Program of Electric Energy Conservation

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MINISTÉRIO DE
MINAS E ENERGIA





Australian Government

Department of the Environment and Energy

CBD Program and NABERS: An Australian case study

Nicole Thomas, Department of the Environment and Energy



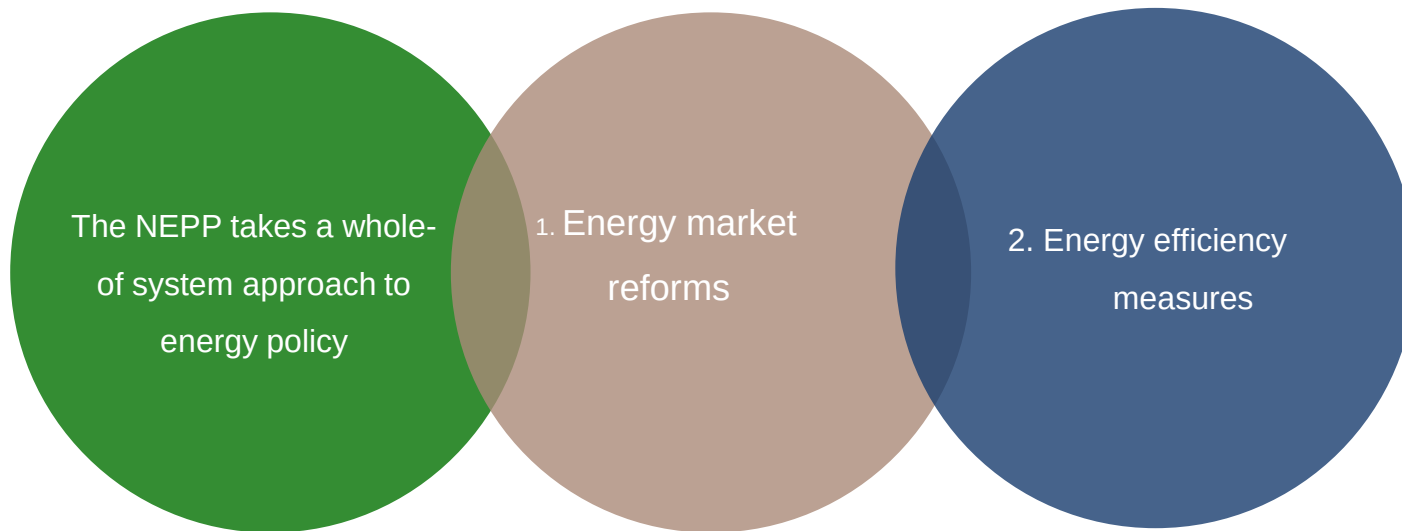
177 Pacific Highway (North Sydney) have successfully achieved a 5 Star Green Star As Built Certified Rating. The commercial building has also achieved a 5.5 Star NABERS Rating above and beyond the 5 Star requirement under the contract.

<https://www.leading-edge-automation.com/177-pacific-highway-exceeding-energy-expectations/>



2015 - NATIONAL ENERGY PRODUCTIVITY PLAN (NEPP)

The NEPP is a Council of Australian Governments Energy Council package of measures to improve Australia's energy productivity by 40% between 2015 and 2030



WHAT IS THE COMMERCIAL BUILDING DISCLOSURE (CBD) PROGRAM?

- The CBD Program was introduced by the Commonwealth in 2010 and fully implemented in 2011.
- It allows buyers and tenants to compare office buildings based on the energy rating of the base building and its lighting system.
- Building owners must obtain a Building Energy Efficiency Certificate when offering office floor space over 1000m² for sale or lease, including:
 - National Australian Built Environment Rating System (NABERS) Energy rating (a 'base-building' rating, excluding tenant energy usage)
 - Tenancy Lighting Assessment.
- Owners of affected buildings must include their NABERS Energy rating in all advertising when offering office space for sale or lease.





COMMERCIAL BUILDING DISCLOSURE

- The CBD Program is an initiative of the Council of Australian Governments (COAG). It was established by the [*Building Energy Efficiency Disclosure Act 2010*](#) and is managed by the Australian Government Department of the Environment and Energy.
- The Commercial Building Disclosure (CBD) Program requires energy efficiency information to be provided in most cases when commercial office space of 1000 square metres or more is offered for sale or lease.
- The aim is to improve the energy efficiency of Australia's large office buildings and to ensure prospective buyers and tenants are informed.

LEARN MORE
www.cbd.gov.au

NABERS KEY FEATURES



Applies when a large office building or office space (1,000m² or more) is offered for sale or lease



Provides clear and credible information to the office building market



Overcomes non-price barriers



Requires a NABERS rating to appear on all advertisement

S

The NABERS Energy star rating must be provided on all forms of advertising



BUILDING ENERGY EFFICIENCY CERTIFICATE (BEEC)

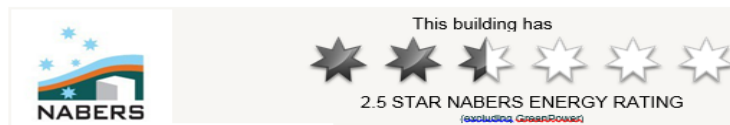
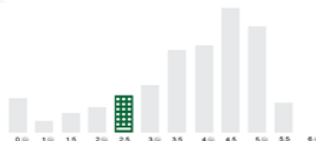


BUILDING ENERGY EFFICIENCY CERTIFICATE

BUILDING DETAILS

Building name	Example Building	Certificate no.	B0085-2018/3
Owner's name	LEADING OWNER PTY LTD	Current from	29 Jan 2018
Building address	1 Example St, Sydney, NSW, 2000	Current to	22 Jan 2019
Net Lettable Area of the building	16,678.7 m ²	CBD assessor name	Sample Assessor
		CBD assessor no.	CBDA0XXX

PART 1 - NABERS ENERGY RATING



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

The average tenancy lighting efficiency in the assessed spaces of your building is 'Very Poor'.

YOUR LIGHTING	NATIONAL AVERAGE
Excellent	Excellent
Good	Good
Median	Median
Poor	Poor
Very Poor	Very Poor

This table shows how your building compares with other buildings that were issued a BEEC nationally in 2017.

These averages are area-weighted. Individual spaces may perform better or worse than the average.

The worst performing space in this building is Level 12 – Whole Floor (27.0 W/m²). The full Tenancy Lighting Assessment is on page 3, and shows details of all assessed spaces.



Australian Government

Department of the Environment and Energy



NABERS FAST FACTS



[About](#) ▾

[Ratings](#) ▾

[Publications](#) ▾

[Training](#)

[Data gallery](#)



Some key industry achievements over the past 2 decades...

400
million dollars

in energy bills saved by
NABERS users since 2010

826,578
tonnes

of CO2 emissions saved -
enough to power 75,200
homes for 1 year

81
percent

of Australia's office space
rated with NABERS

[Our story](#)

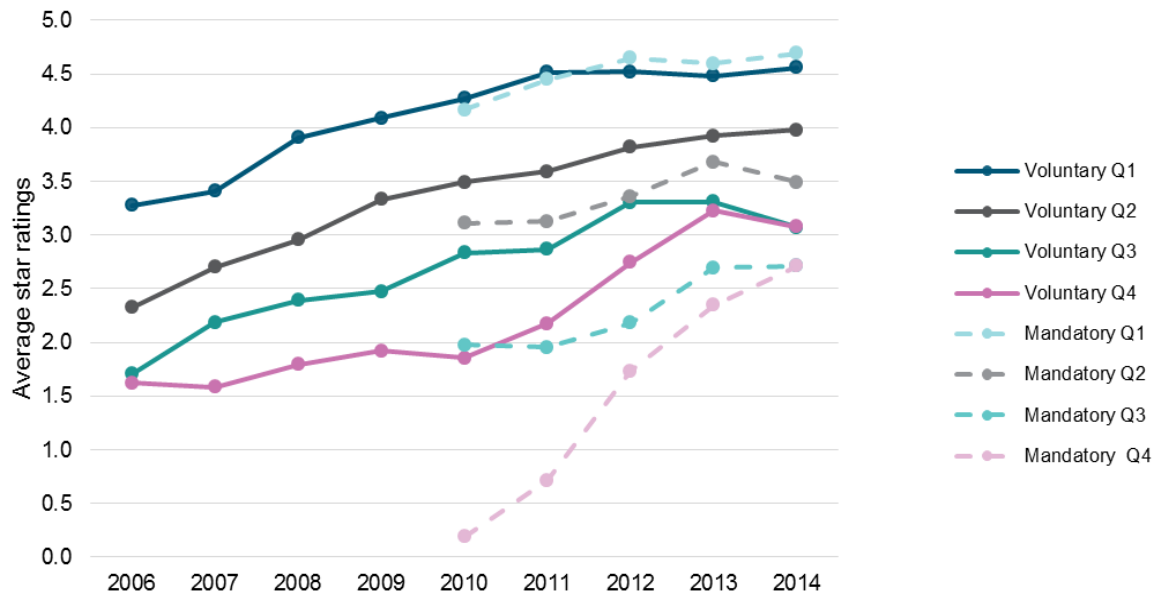


LEARN MORE

<https://www.nabers.gov.au>



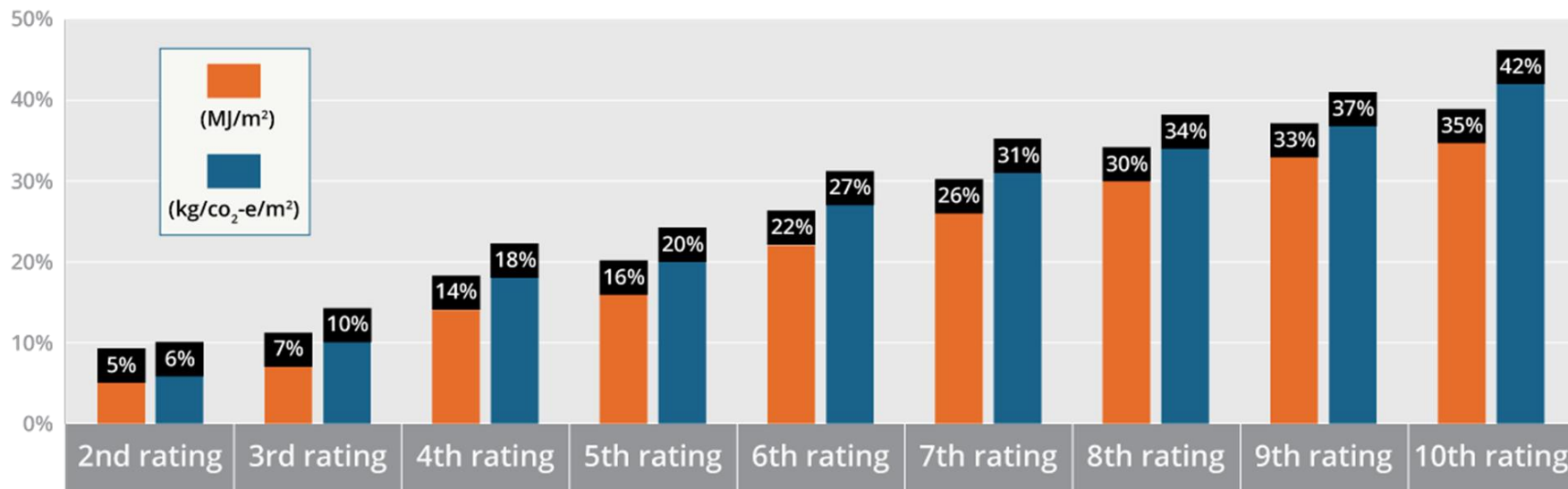
SUCCESS IN INDUCED BEHAVIOURAL CHANGE



From inception in 2006 there has been recognisable increases in NABERS star ratings both
voluntary and mandatory

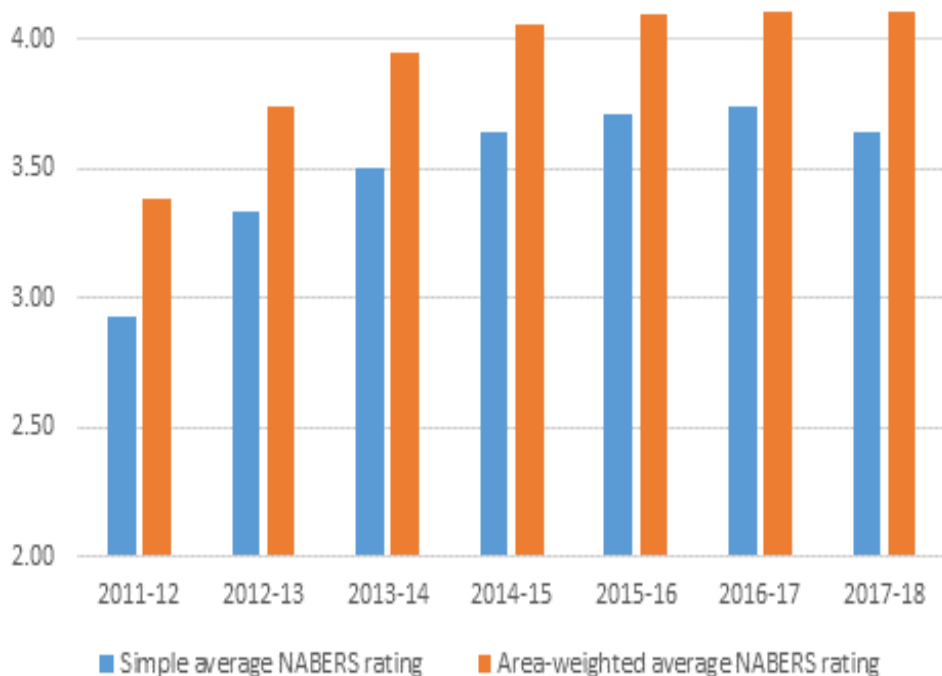


CONTINUOUS IMPROVEMENT THROUGH REPEAT RATINGS





NABERS AVERAGE RATINGS



- Prior to the start of CBD the average area-weighted rating for a commercial office building was **2.5** stars
- The area-weighted average rating as at 2018 was **4.1** stars

This translates to an energy saving in the office sector of 25%-33%



REVIEW OF THE COMMERCIAL BUILDING DISCLOSURE PROGRAM

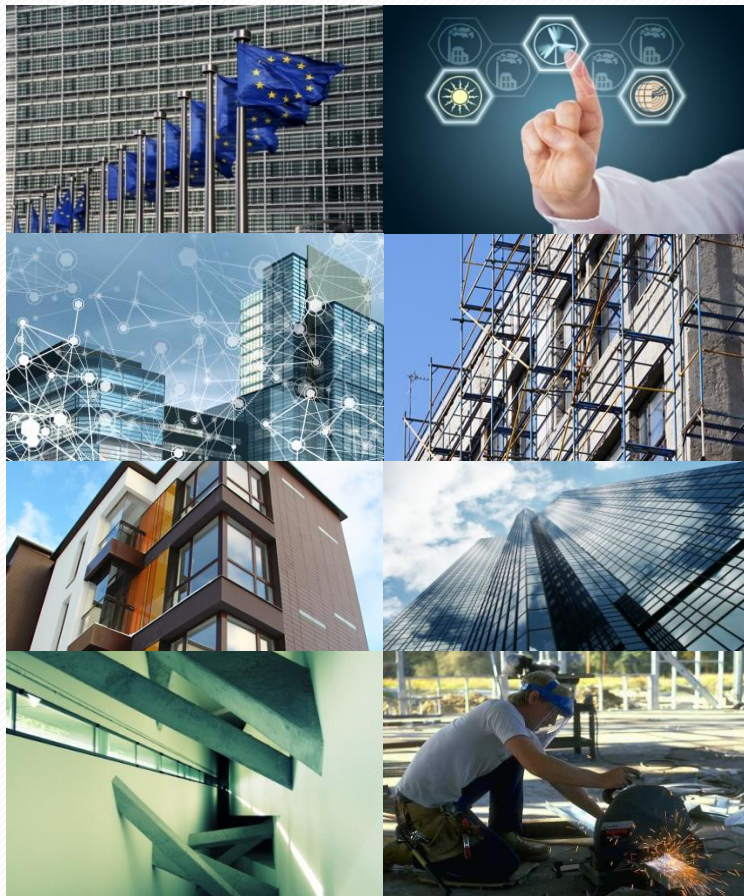
In 2014/15, ACIL Allen Consulting were appointed to undertake an independent review of the program

The CBD review found the program to be:

a *successful and effective* way to deliver significant benefits at a minimal cost to industry and government

effective in inducing positive behaviour change in relation to commercial building energy efficiency in affected buildings

- The review concluded the program delivered \$44 million in benefits over the first four years by assisting to improve the energy efficiency of Australia's large office buildings
- The review recommended expansion of the program by lowering the threshold to 1000m², which was implemented on 1 July 2017



Innovative policy instruments to trigger renovation

IEA – IPEEC workshop

Global Energy Efficiency Benchmarking, and

Low Energy Buildings and the Role for Smart Management Systems



@BPIE_eu

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Paris, 18 September 2019



Awareness

Don't know where to find the right information

Limited understanding of energy performance

Uncertainty of what to do and where to start



Financial

Cost of renovation is too high

Lack of attractive financial products

No energy savings guarantees



Other

Lack of time for renovation works

Low trust in installers/professionals

Too much hassle

Need to use the space (i.e. no room for renovation)

Administrative barriers

Residential

Non-residential

- **Provides independent and trusted advice on renovation options**
- **Reflects the personal circumstances of owners and/or occupiers**
- **Provides advice on financing opportunities**
- **Creates one trusted point of contact**





Staged deep renovation

Lower upfront cost enables more people to engage in energy renovations (that might lead to a low-energy level over time).

Carrying out renovation works at the time when certain building components must be replaced anyway due to completion of service life such as windows, boilers etc.

It enables flexibility and the possibility to incorporate measures that weren't considered initially, such as additional rooms or space planning requirements.

It allows the integration of new technologies that may not exist or have reached maturity when the renovation is initiated.

It may not require the building to be completely vacated and regular activities can run partially.

It reduces overall carbon emissions due to usage of legacy equipment with the new systems.

Lower risk of lock-ins in one step renovations effects because of the possibility of integrated planning and implementation of the renovation.

The cumulative energy savings are higher if renovation is carried out in one step.

Overall quality of renovation is better in one step renovation (better airtightness, less thermal bridges, systems dimensioned consistently with envelope performance).

Staged renovation can cause a larger inconvenience to the occupants due to multiple construction works at the same time.

Potentially lower total investment costs compared to staged energy renovation. In one step renovations, synergies arise from scaffolding to site set-up to planning costs, along with being able to scale heating equipment to lower capacities.



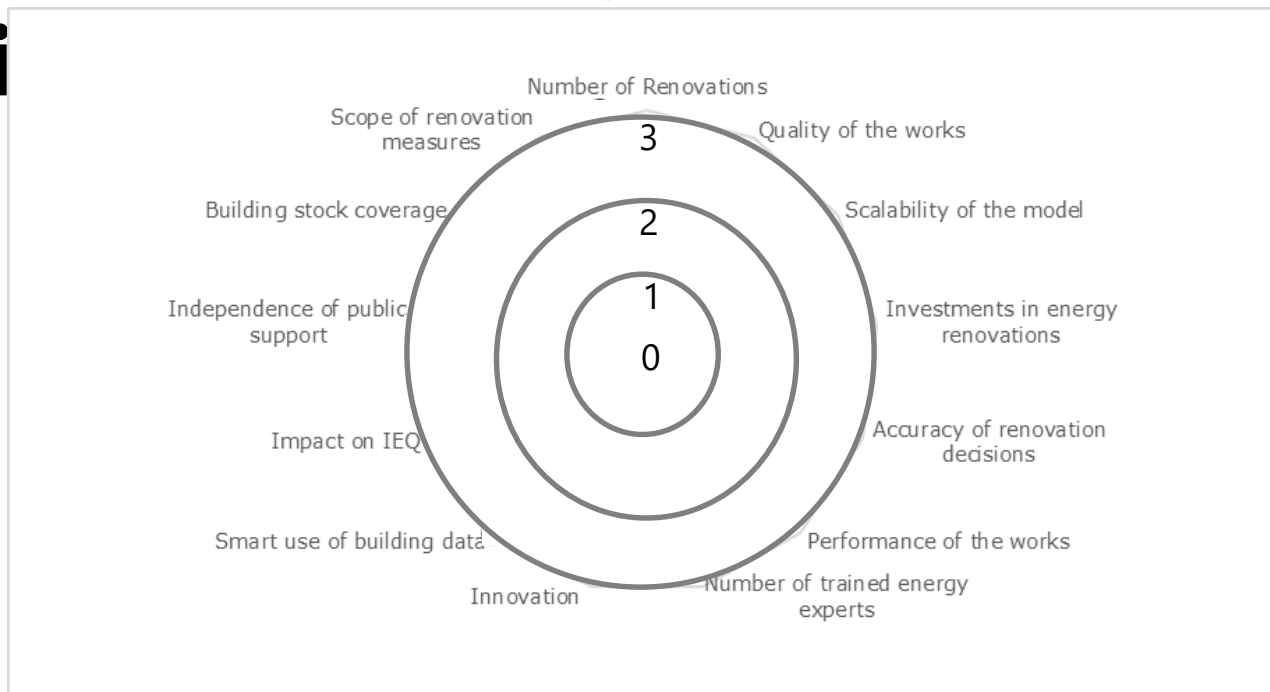
One step renovation

Examples of renovation advisory systems

Type	Nr	Case	Country	Number of Renovation	Quality of the works	Scalability of solution	Investments in energy renovations	Accuracy of renovation decision	Performance of the works	No. of trained auditors and energy experts	Innovation	Smart use of building data	Effect on IEQ	Level of support by public authorities	Building stock coverage	Scope of renovation measures	Score	Comments/r emarks	Link
BRP	1	Sanierungsfahrplan BW	DE	3	2	1	2	3	3	2	2	1	2	2	2	3	34		https://um.baden-wuerttemberg.de/de/energieeffizienz/sanierungsfahrplan/
BRP	2	Woningpas & EPC+	BE	1	2	2	1	3	3	2	3	1	2	2	2	3	33		https://www.energiesparen.be/woningpas/
BRP	3	Passeport Efficacité Énergétique	FR	0	3	3	3	2	3	1	1	3	2	2	2	2	33		http://www.experience-c2e.org/
BRP		Individueller Sanierungsfahrplan für Wohngebäude (ISFP)	DE	2	2	1	2	3	3	2	1	2	2	2	2	3	33		https://www.dena.de/themen-projekte/projekte/
BRP	4	Parity projects - Home Energy Masterplan	UK	3	2	2	1	3	1	3	1	1	1	3	2	3	33		https://www.parityprojects.com/households
CERT	5	Det digitale energimærke	DK	3	1	2	3	1	1	3	2	3	1	2	3	2	33		https://ens.dk/ansvarsomraader/energi/maerke
OSS		BetterHome	DK	2	2	2	2	2	1	1	2	3	2	3	2	2	32		https://www.betterhome.today/
CERT	6	Certificação Energética dos Edifícios	PT	3	1	2	2	2	1	1	2	3	2	2	2	3	32		https://www.adene.pt/edificios/
OSS	7	Oktave	FR	1	3	2	3	1	3	3	2	1	2	1	2	2	31		https://www.oktave.fr/oktave/guj-est-oktave
BRP		Le Passeport Énergie Habitat (ALEC49)	FR	1	2	3	2	3	2	1	2	1	2	2	2	2	31		https://www.alec49.fr/
AUD	8	Energieberatung	DE	3	1	2	2	2	1	3	1	1	2	2	3	2	31		https://www.bafa.de/DE/Energie/Energieberatung/
OSS		Picardie Pass Rénovation	FR	2	2	1	3	2	3	3	2	1	1	1	2	2	30		https://www.pass-renovation.picardie.fr/
OSS		Superhomes	IE	1	2	2	2	3	3	1	2	1	2	2	2	2	30		https://superhomes.ie/
OSS	9	Rénoclimat	CAN	3	1	3	2	2	1	2	1	0	1	2	2	3	30		https://www.transitionenergetique.gouv.qc.ca
BRP		effilogis - Bourgogne-France-Comté	FR	2	2	1	2	3	3	1	2	1	1	2	2	3	30		https://www.bourgognefranchecomte.fr/site
OSS		DORéMi	FR	1	2	1	2	3	3	2	3	1	2	2	2	2	30		https://www.renovation-doremi.com/proprio
OSS		Local Energy Renovation Platform - Bordeaux	FR	2	2	2	3	1	2	1	2	2	1	2	2	2	30		http://www.energy-cities.eu/resources/cities
APP		Effizienzhaus-online (Bosch)	DE	1	2	2	2	1	1	1	1	3	0	0	2	2	29		https://application.oeffizienzhaus-online.de/
BRP		iBRoad	EU	0	1	3	1	3	3	2	2	3	2	0	2	3	29		https://ibroad-project.eu/
OSS		Huizenaanpak	NL	2	2	2	1	2	1	2	2	1	1	2	2	3	29		https://huizenaanpak.nl/
CERT		Home Energy Score	US	3	1	2	1	2	1	3	1	1	1	2	2	2	28		https://betterbuildingsinitiative.energy.gov/hes
APP		Building Energy Asset Score	US	3	1	2	1	1	1	3	1	2	1	2	2	2	28		https://www.energy.gov/eere/buildings/bulk
APP		BM/WVI Sanierungskonfigurator	DE	3	2	2	2	1	1	0	1	3	0	0	2	2	28		http://www.sanierungskonfigurator.de
APP		Heizspiegel (CO2online)	DE	3	1	2	1	2	1	0	1	3	1	2	2	2	27		https://www.co2online.de/service/energie/gap
CERT		Building Energy Rating Certificate	IE	3	1	1	1	1	1	2	1	2	2	2	3	2	27		https://www.seai.ie/energy-ratings/building/
OSS		Efficiency Capital	CAN	1	3	1	3	2	2	1	1	0	1	2	1	3	26		http://www.energycapco.com/
BRP		ALDREN	EU	0	1	3	1	3	3	2	2	2	3	0	1	3	26		https://aldren.eu/
CERT		Hers index	US	3	1	3	1	1	1	2	1	3	1	1	2	1	24		http://www.hersindex.com/understanding
APP		Eigenheim Manager	DE	2	0	3	2	0	0	0	1	3	0	0	3	0	19		https://eigenheim-manager.de/
OSS		Parma Progetto Energia	IT	0	1	2	2	1	1	2	0	2	0	1	2	2	19		http://www.comune.parma.it/notizie/news/
OSS		Stuttgart's care-free energy renovation package	DE	0	2	2	1	2	1	0	1	0	0	1	1	2	17		http://www.energy-cities.eu/in-Stuttgart-pr
CERT		Enerfund	EU	1	1	3	1	1	1	1	3	1	1	1	3	1	16		http://enerfund.eu
BRP		Irish "Building Renovation Passport"	IE	0	0	2	1	1	1	1	1	2	1	0	3	1	10		https://www.igbc.ie/policy-and-regulation/re
BRP		Dutch "Woningpas"	NL	0	1	1	1	1	1	1	1	1	1	1	1	1	0		



Our methodology to evaluate the exi



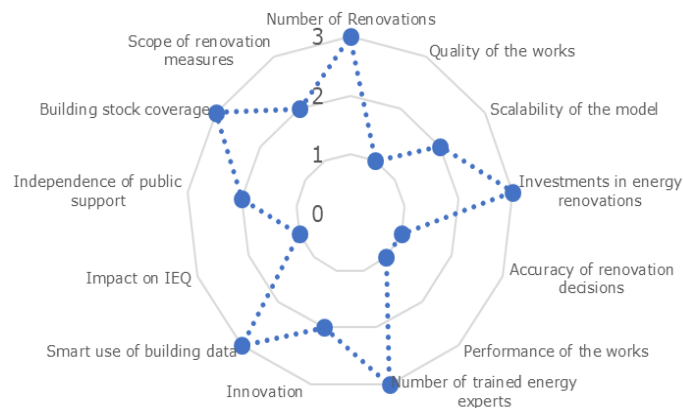
Meta-data of the deep dives

What?	Data
Number of deep dives	16
Geographical spread	8 countries (7 European countries + Canada)
Types of cases	6 one-stop-shops 6 building renovation passports 2 energy performance certification schemes 1 energy audit framework 1 online application
Level of governance	8 regional, 4 national and 4 privately governed schemes

Nr	Case	Country	Type
1	BetterHome	DK	One-stop-shop
2	Certificação Energética dos Edifícios	PT	Energy performance certificate
3	Det digitale energimærke	DK	Energy performance certificate
4	Energieberatung	DE	Energy audit framework
5	EPC+ & Woningpas	BE	Building renovation passport
6	HeizCheck	DE	Online advice tool
7	Home Energy Masterplan	UK	Building renovation passport
8	Individueller Sanierungsfahrplan für Wohngebäude	DE	Building renovation passport
9	Ma Rénov	FR	One-stop-shop
10	Oktave	FR	One-stop-shop
11	Passeport Efficacité Energétique	FR	Building renovation passport
12	Passeport Energie Habitat	FR	Building renovation passport
13	Picardie Pass Rénovation	FR	One-stop-shop
14	Rénoclimat	CAN	One-stop-shop
15	Sanierungsfahrplan BW	DE	Building renovation passport
16	Superhomes	IE	One-stop-shop

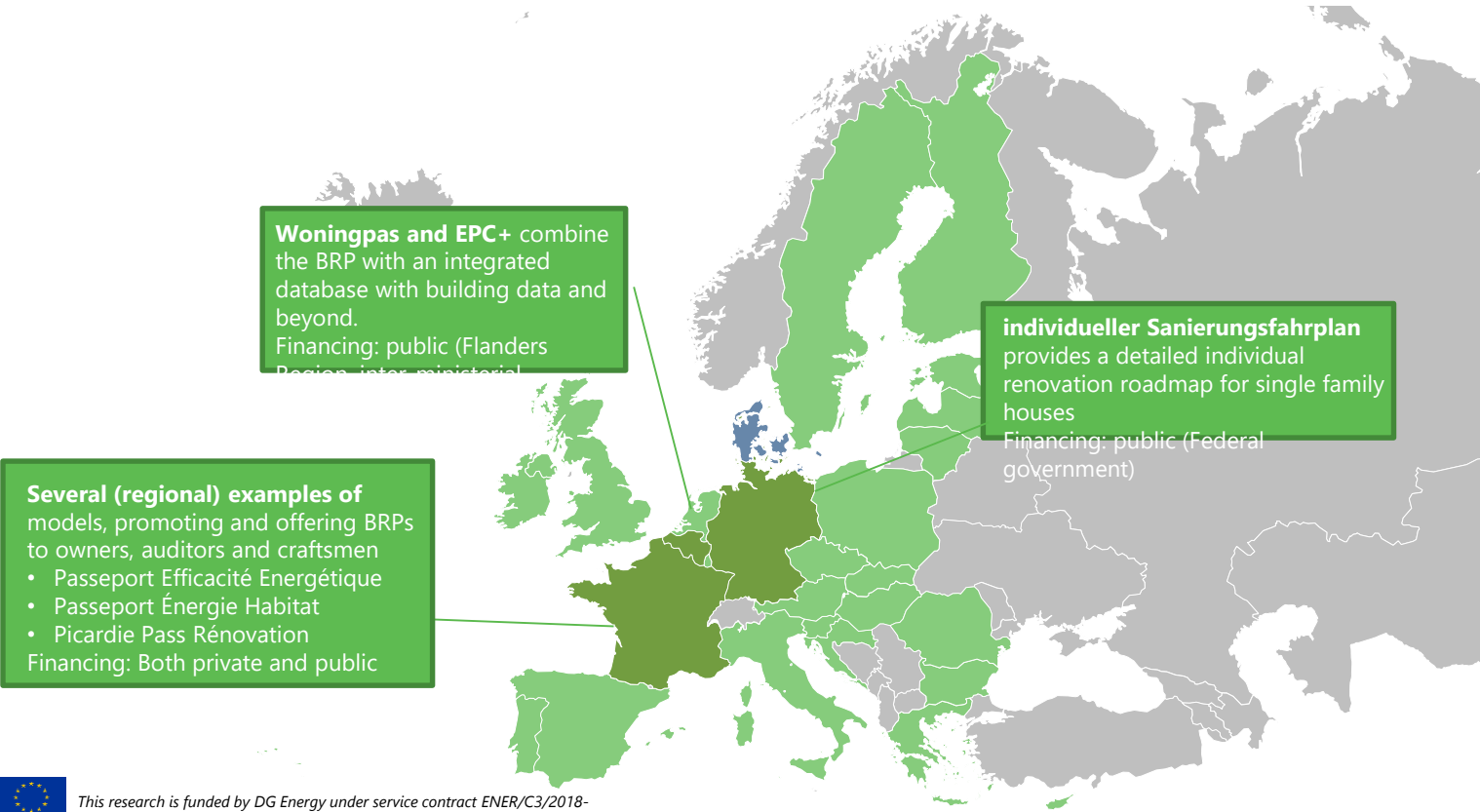


Danish EPC framework



Key results

- A survey of 1006 Danes who bought a property in 2015, shows that 65% stated that they read the whole report that comes with the EPC [8]
- 45% of owners are living in a building with a lower EPC rating (E-F-G) have implemented at least one of the EPC-listed energy-saving measures (for people living in D=35%, C=16%, B=15%, and A=7%) [8]
- When asked about the importance of the EPC when they bought their building, 22% described the EPC as very important, while 36% saw it as somewhat important [8]
- Most building owners were satisfied with an EPC rating C (37%), followed by D (22%). Only 7% desired an EPC rating A to be satisfied [8]
- 38% of the building owners implemented measures because it was "financially attractive", while 28% did so in conjunction with other renovation work. Only 5% did so to reduce their climate and environmental impact [8]
- 46% of the building owners knew that it is possible to view their own or other EPCs online; while 46% out of these had used this function [8]
- 6% said they would have renovated if the EPC report included more detailed information and additional suggestions for renovation measure [8]
- The most commonly implemented measures from the recommendations related to windows (42%), roof (39%), heating system (28%), doors (21%) and external wall (19%) [8]



Woningpas and EPC+ combine the BRP with an integrated database with building data and beyond.
Financing: public (Flanders Region, inter-ministerial)

individueller Sanierungsfahrplan provides a detailed individual renovation roadmap for single family houses
Financing: public (Federal government)

Several (regional) examples of models, promoting and offering BRPs to owners, auditors and craftsmen

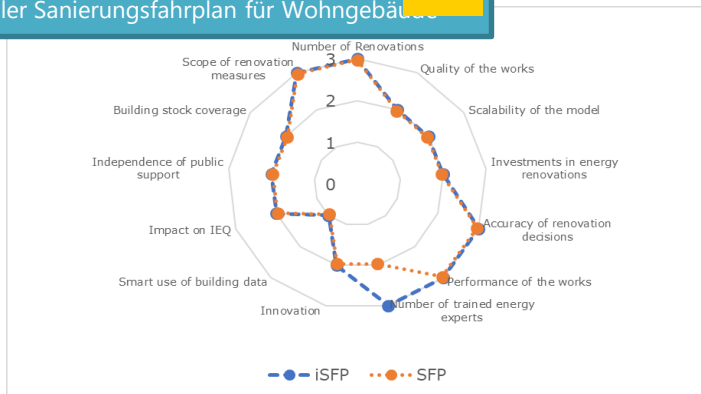
- Passeport Efficacité Énergétique
- Passeport Énergie Habitat
- Picardie Pass Rénovation

Financing: Both private and public

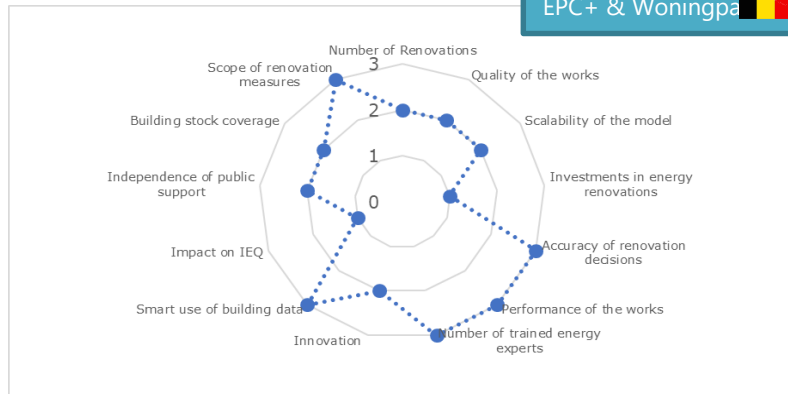
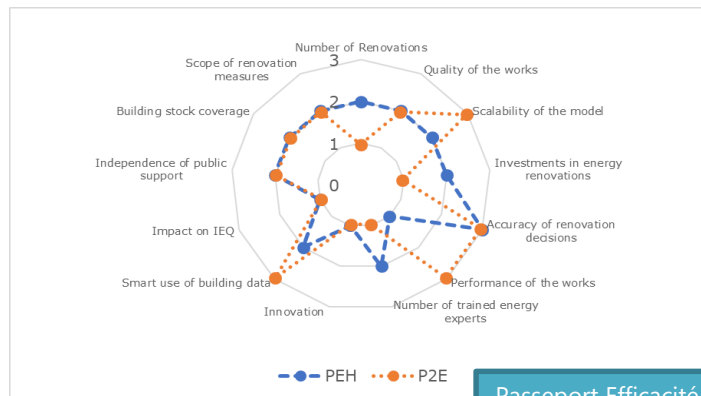
Some well developed examples

Sanierungsfahrplan BW

Individueller Sanierungsfahrplan für Wohngebäude

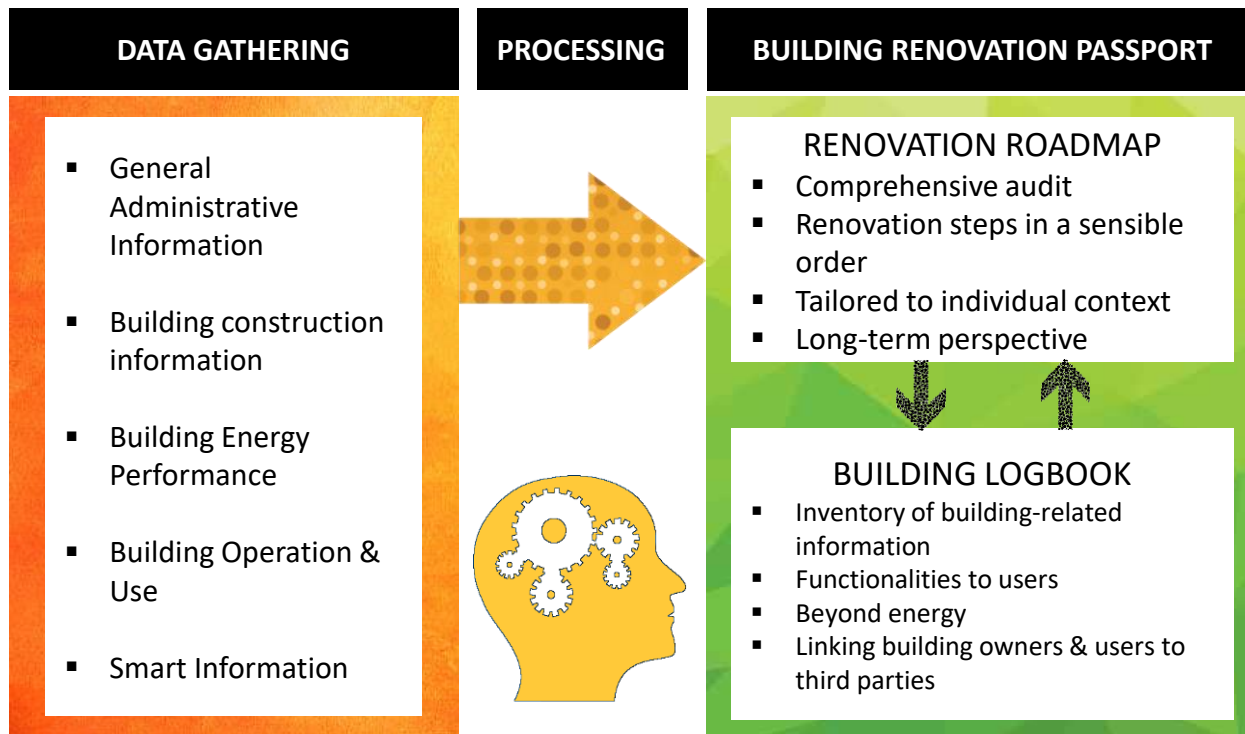


EPC+ & Woningpa



Passeport Efficacité Énergétique



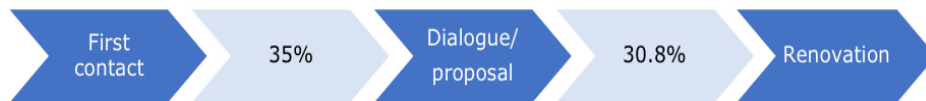




This research is funded by DG Energy under service contract ENER/C3/2018-

447/05
IEA 2017. All rights reserved.

- **Conversion rate (average numbers from 4 deep dives):**
 - 35% of the homeowners informed about the scheme chose to get an on-site energy check, while;
 - 31% of the homeowners that received the energy check (and subsequent renovation advice) decided to invest in an energy renovation;
 - consequently, 10.8% of the building owners that receives the first contact will go on and finally invest in an energy renovation



- **The existing schemes and initiatives do not target any hard-to-reach groups (not interested, low-income etc.)**
- **Indoor environmental quality and the environmental aspects of renovations are not included in the analysed cases**

Main findings (ii)

- **Renovation advice is more effective when it is integrated with, and reinforced by, other elements (e.g. simple access/use, financial support, communication)**
- **BRPs are effective in alleviating two of the main barriers to renovation;**
 - low awareness of the benefits of energy renovation and;
 - insufficient knowledge of what measures to implement and in which order
- **Tailored renovation advice, together with other support measures, has an impact on;**
 - the decision to renovate,
 - the number of measures to implement and their performance level,
 - as well as on what kind of measures that are being implemented



Thank you!

Oliver.Rapf@bpie.eu

You can find all our reports on

www.bpie.eu

The analysis on BRP will shortly be available at
<https://renovation.epbd19a.eu/documents>

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Grid Interactive Efficient Buildings

Global Energy Efficiency Benchmarking, and Low Energy Buildings and the Role for Smart Management Systems

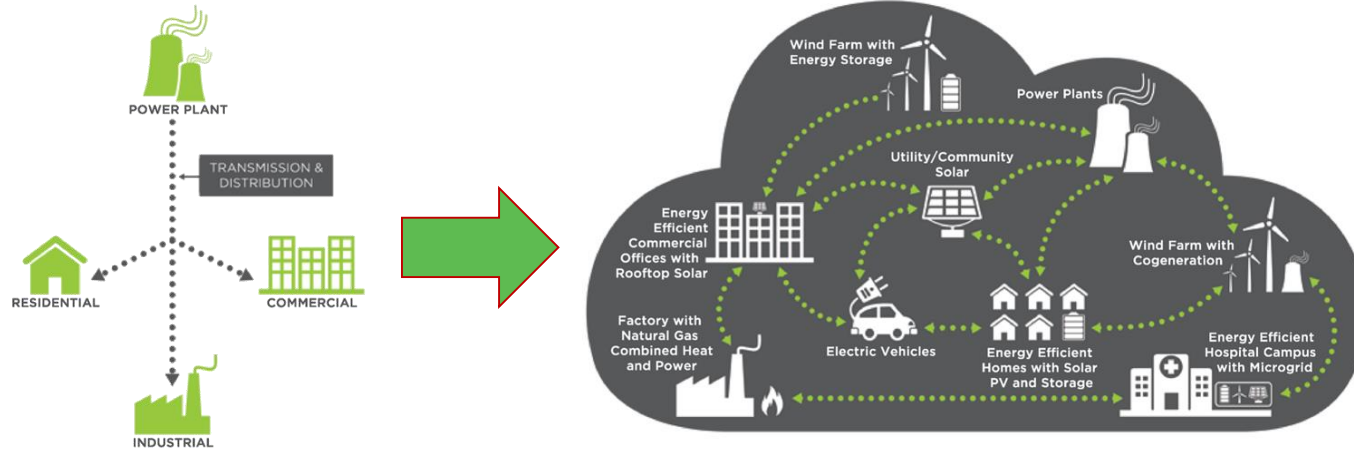
Alexander N. Fitzsimmons

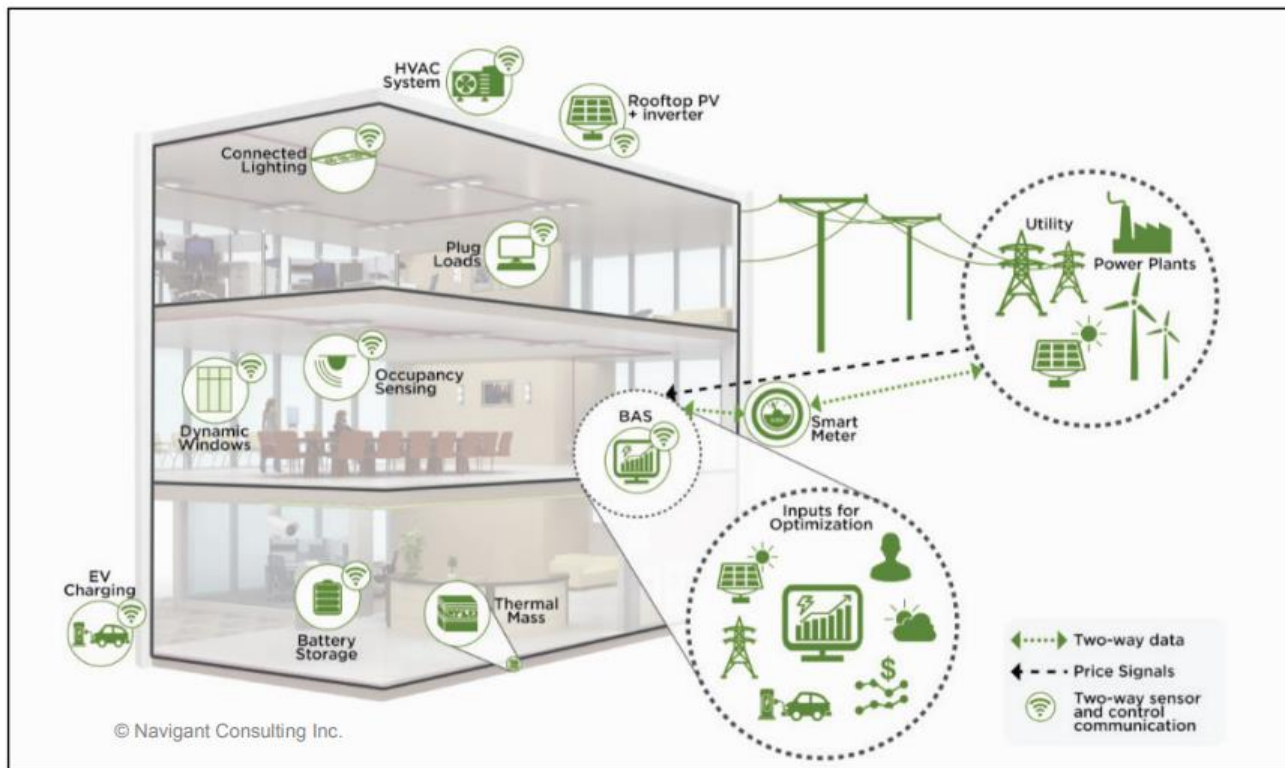
Deputy Assistant Secretary for Energy Efficiency/A, U.S. Department of Energy

September 18, 2019

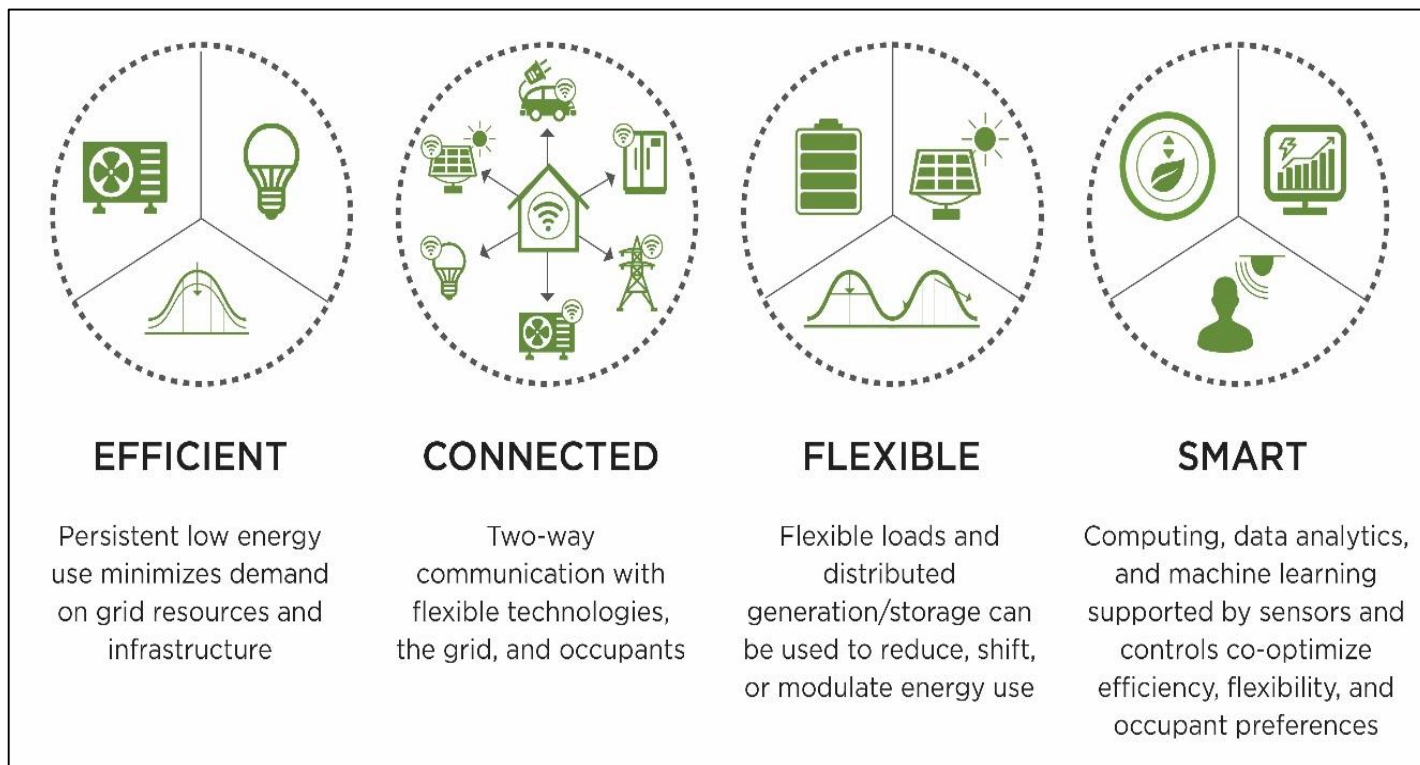


Today's one-way power system is evolving into a flexible, grid-interactive, IoT-
powered
network of distributed energy resources

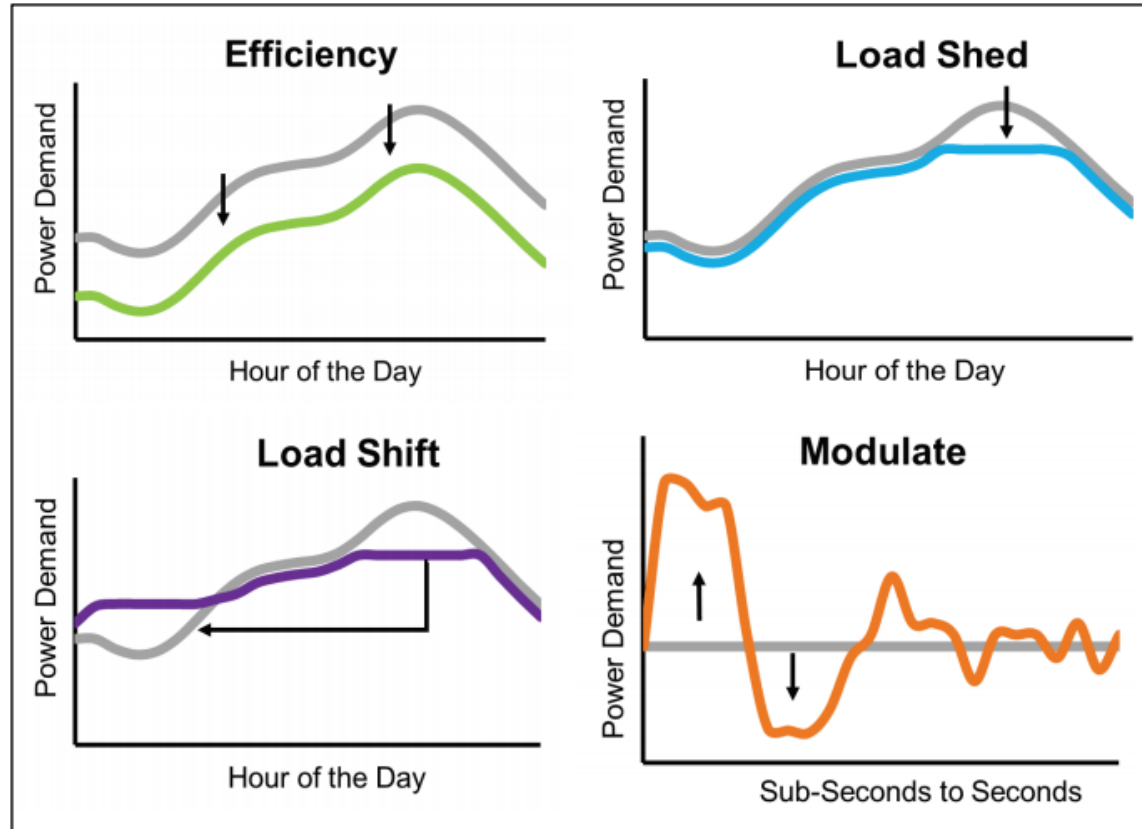




Characteristics of Grid Interactive Efficient Buildings

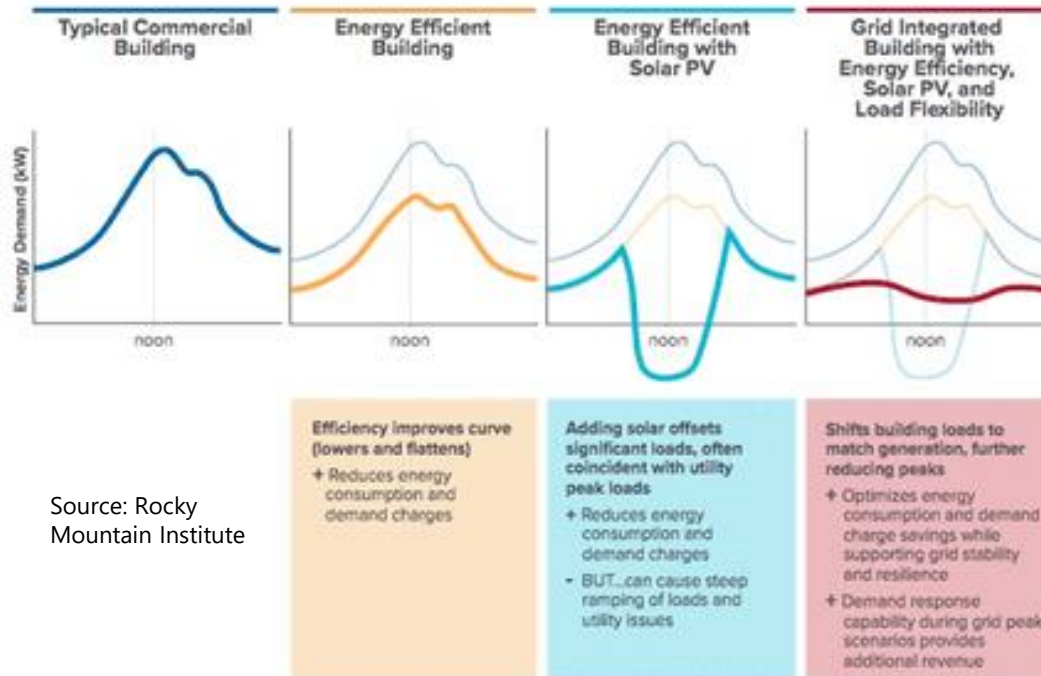


Characteristics of Grid Interactive Efficient Buildings



Characteristics of Grid Interactive Efficient Buildings

Grid Integrated Building: Load Profiles

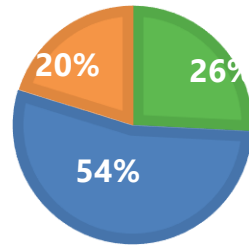


Source: Rocky Mountain Institute

Field Validation of Grid Interactive Buildings



■ Solar consumed



This Smart Neighborhood in Birmingham, Alabama integrates high-performance homes, energy efficient systems and appliances, connected devices, and a microgrid on a community-wide scale for the first time in the Southeast.

With 62 homes, it supports the community's energy needs by using microgrid technology with PV panels, battery storage, and a backup natural gas generator. These features help maximize the efficiency of the grid, while providing cost savings.

The microgrid can operate both independently or together with the wider grid and can also control individual end-use equipment such as appliances and HVAC equipment in the home. This adds to community resilience.

Alabama Power partnered with homebuilder Signature Homes, researchers at Southern Company, U.S. Department of Energy's Oak Ridge National Laboratory, the Electric Power Research Institute, and others on this project.

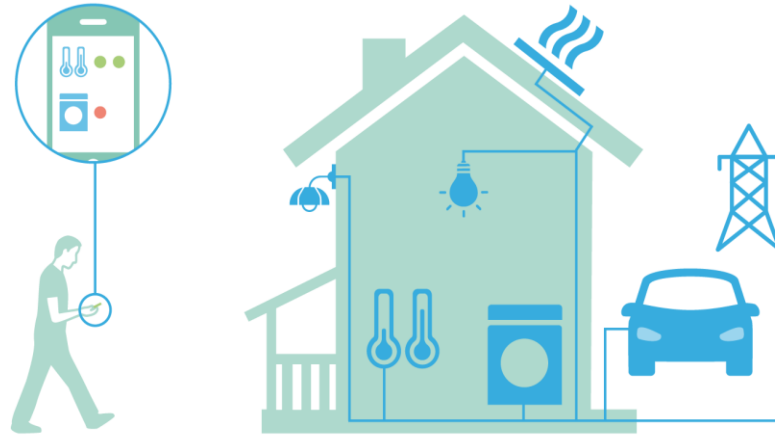
Future Research to Advance Grid Interactive Buildings

- Quantifying the impact of demand flexibility on occupant preferences as well as the value of those impacts
- Determining the impacts of demand flexibility on equipment lifetime
- Determining the role of demand flexibility in different energy market contexts
- Quantifying the potential of demand flexibility in groups and districts of buildings
- Understanding regulatory constraints for aggregation to exercise inter-building demand flexibility and energy exchange and identifying business models

The EU scheme to rate the Smart Readiness of Buildings

Paul Waide
Waide Strategic Efficiency Europe

Smart technologies in buildings



EXPECTED ADVANTAGES



optimised energy use as a function of (local) production



optimised local (green) energy storage



automatic diagnosis and maintenance prediction



improved comfort for residents via automation

A greater uptake of smart technologies is expected to result in significant energy savings in a cost-effective way, while helping to improve comfort and occupant satisfaction and enabling buildings to play a key role in smart energy systems.

SRI 1st technical support study

ENER/C3/2016-554

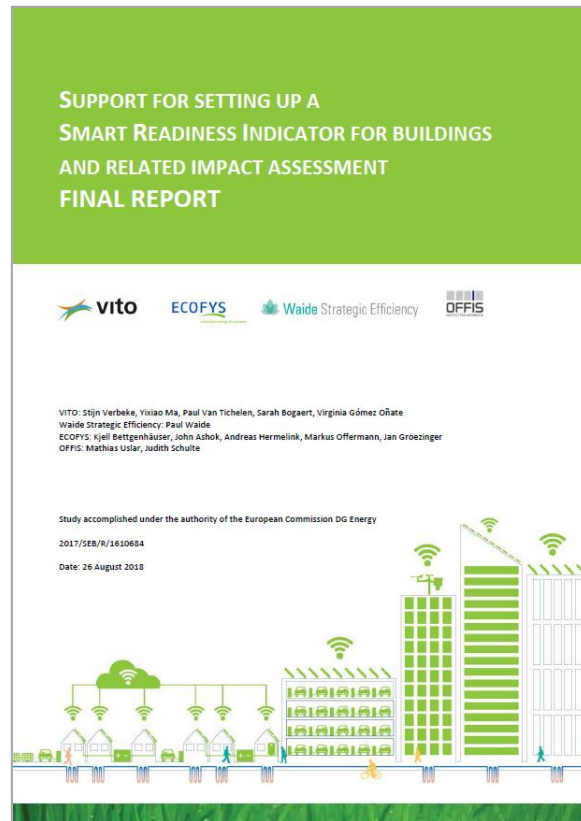


Aim

To provide technical support to the DG Energy in order to investigate the possible establishment of an SRI under the EPBD.

- Study led on the basis of the EC proposal,
- Focus on the calculation methodology.

March 2017 – August 2018



Verbeke S., Waide P., Bettgenhäuser K., Usler M.; Bogaert S. et al.; "Support for setting up a Smart Readiness Indicator for buildings and related impact assessment - final report"; August 2018; Brussels

Smart Readiness Indicator in the EPBD

The revised **Energy Performance of Buildings Directive** (EPBD) (19 June 2018) requires the Commission to develop **an optional Common Union scheme for rating the smart readiness of buildings: the “Smart Readiness Indicator” (SRI)**



*The indicator is intended to **raise awareness** about the benefits of smart technologies and ICT in buildings (from an energy perspective, in particular), **motivate consumers** to accelerate investments in smart building technologies and **support the uptake of technology innovation** in the building sector*

“Smart readiness” aspects considered

1

The ability to adapt its operation mode in response to the needs of **the occupant** paying due attention to the availability of user-friendliness, maintaining healthy indoor climate conditions and ability to report on energy use



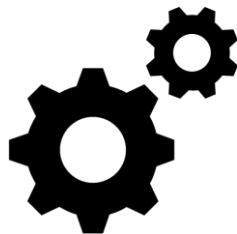
e.g. use of CO2 sensors to decide when to increase ventilation

e.g. Dashboards displaying current and historical energy consumption

“Smart readiness” aspects considered

2

The ability to maintain energy efficiency performance and **operation** of the building through the adaptation of energy consumption for example through use of energy from renewable sources



e.g. Management of heating and lighting system based on occupancy sensors

e.g. Load-shifting to increase self-consumption of local generated renewable energy

“Smart readiness” aspects considered

3

The flexibility of a building's overall electricity demand, including its ability to enable participation in active and passive as well as implicit and explicit demand-response, in **relation to the grid**, for example through flexibility and load shifting capacities.



e.g. Reduce power consumption when grid demand is high

2nd technical support study for the establishment of the SRI

ENER/C3/2018-447

"Support to the establishment of a common European scheme for rating the smart readiness of buildings"

Website <https://smartreadinessindicator.eu/>

Consortium



Aim

Provide technical inputs to feed the establishment of the SRI of buildings by the European Commission and the related proposals for delegated and implementing acts, in accordance with the provisions of the revised EPBD.

Timeline

Dec 2019 – June 2020

Working version of the proposed SRI methodology

I. Determine the individual smart ready services present in a building

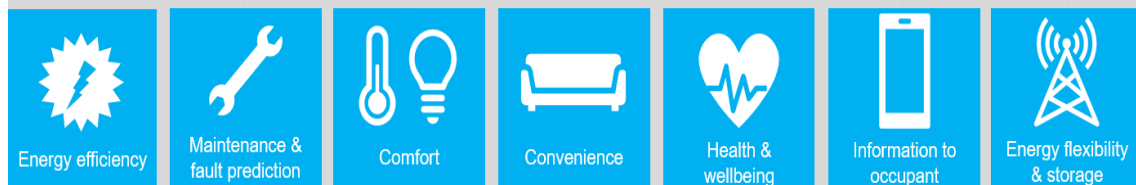
II. Assess the impact score of the service against various impact criteria (checklist approach)

III. Derive an overall score using a multi-criteria assessment method

Nine domains where smartness is assessed



Eight impact criteria smartness services are assessed against



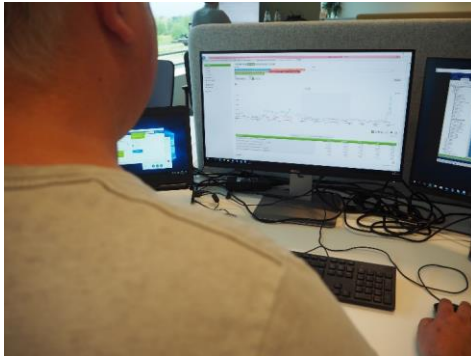
I M P A C T S

D O M A I N S

	 Energy efficiency	 Maintenance and fault protection	 Comfort	 Convenience	 Health and well-being	 Information to occupants	 Energy flexibility & storage	SRI
Total	39%	18%	60%	71%	48%	59%	0%	42%
 Heating	32%	18%	62%	55%	24%	74%	0%	
 Sanitary hot water	17%	0%	45%	70%	67%	83%	0%	
 Cooling	65%	51%	78%	72%	61%	55%	0%	
 Controlled ventilation	41%	0%	55%	60%	34%	44%	0%	
 Lighting	85%	14%	90%	100%	83%	15%	0%	
 Dynamic building envelope	10%	0%	31%	56%	22%	46%	0%	
 Electricity	10%	0%	-	-	-	68%	0%	
 Electric vehicle charging	-	38%	-	82%	-	84%	0%	
 Monitoring and control	52%	43%	62%	72%	45%	64%	0%	

Example building: EnergyVille I office, Genk, Belgium

inspecting the various services



A**Simplified online
quick-scan**

Checklist approach with limited /
simplified services list

Online

Self-assessment
(or contractor,...)

15 minutes

Restricted to
residential buildings

B**Expert SRI
assessment**

Checklist approach, covering
catalogue of smart services cf.
1st study outcomes

On-site inspection

Third-party qualified
expert

1 hour – max 2 days

Non-residential: offices and
education (+ others later on?)
? Residential as well?

C***In-use smart building
performance***

*Measured / metered data
(potentially restricted set of
domains)*

*In-use buildings, metered data
Part of the commissioning?*

*TBS self-reporting their
actual performance*

*Gather data over a long period
(e.g. 1 year)*

*Residential and non-residential
Restricted to occupied buildings
(not in design phase)*

Next steps

- Clarifying the methodology – currently undergoing testing in a large sample of buildings
- Noting that the scheme is voluntary at the Member State level an exploration of prospective implementation pathways, including linkages to existing initiatives e.g. EPCs or heating/cooling inspections, is underway
- Considering format options including testing in focus groups and by surveys
- Leading to the issuing of a *Delegated Act* to set out the calculation methodology and format, and an *Implementing Act* clarifying the modes of implementation expected next year



Experience of IDAE in collecting and benchmarking energy efficiency data in Spain

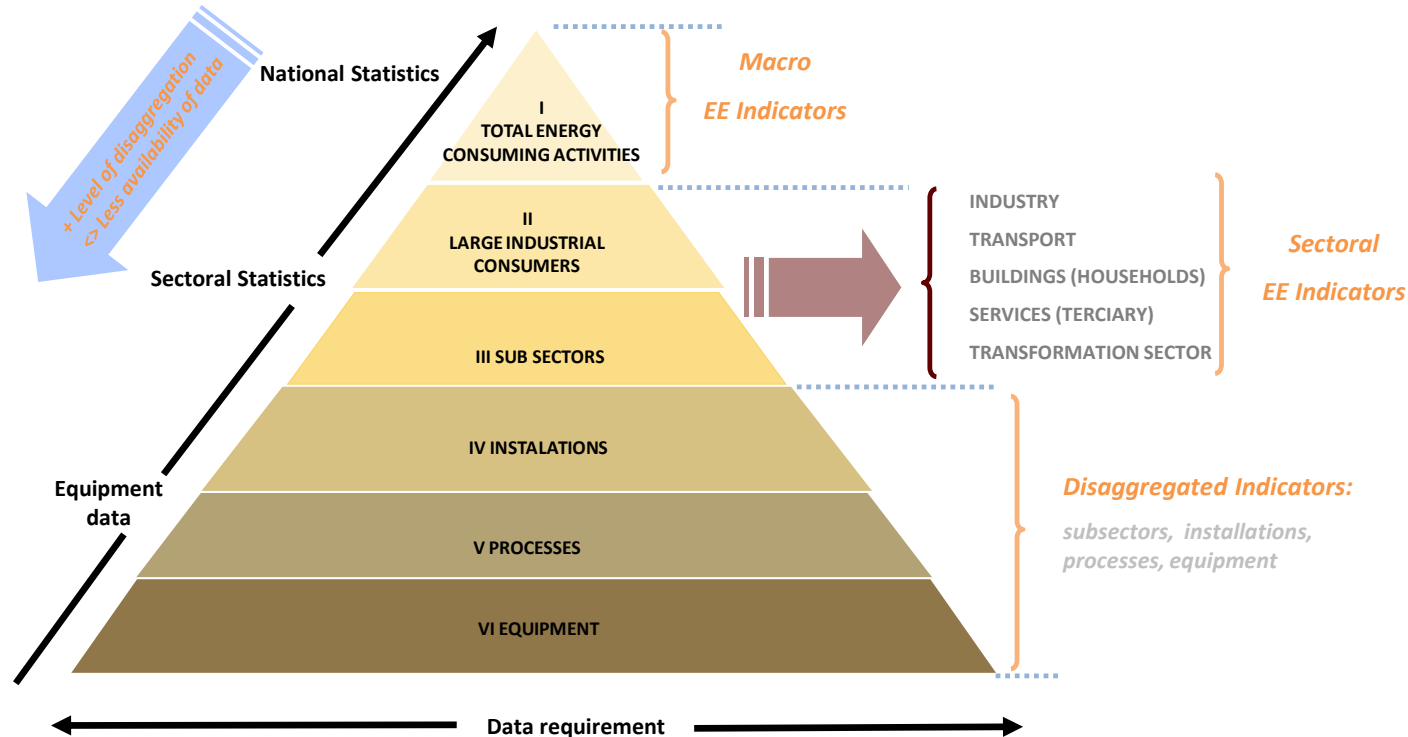
IEA/EEWP 44th Meeting, 18 September 2019

Carlos Garcia Barquero
Head of Planning and Studies Department
IDAE

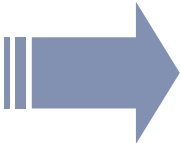
❑ IDAE main experience in EE data collecting and updating

- Support to the Energy authorities for the elaboration of **national energy statistics** to be submitted to EUROSTAT/IEA (End use sectors statistics and energy balances; RES and CHP statistics)
- **Collaboration with sectoral associations** in the most energy intensive sectors (industry, transport, services..).
- Development of ***ad hoc* sectoral studies** aimed at collecting and updating EC in end use sectors:
 - Sectoral studies (SES studies): Education; Hotels; Hospitals; Heat Pumps; Biomass; Energy audits; Public transport; based on surveys...
 - SPAHOUSEC I and SPAHOUSEC II- Analyses of the Energy Consumption of the Household Sector in Spain based on the development of in situ measurements/surveys
- Development of a **Manual for statistics on energy consumption in households (MESH Project)**, addressed to get an homogenous basis for a better comparison of energy statistics and associated indicators in the household sector.
- **International EE studies**: ODYSSEE-MURE; BESS (Energy Benchmarking in SMEs), MeetMED (EE in Mediterranean regions), NATCONSUMERS (Consumer's Sustainable Behavior) ...

Disaggregation of EE Indicators



□ Energy consumption and energy efficiency

$$I_{EE} = EC / A_{CT}$$


$$\Delta_{EC} \approx f(A_{CT}, I_{EE})$$

Main factors:

A_{CE} : Variation in energy consumption

A_{CT} : Level of activity

I_{EE} : Level of energy efficiency

E_{ST} : Structural effect

C_{UN} : Unit consumption (equipment)

EE_{TECH} : Technological effect (performance of equipment)

E_{USE} : Behaviour effect (Use of equipment)

$$\Delta_{EC} \approx f(A_{CT}, E_{ST}, C_{UN})$$

$$\Delta_{CE} \approx f(A_{CT}, E_{ST}, EE_{TECH}, E_{USE})$$

□ EE Indicators: Main data gathered

Energy data	Socioeconomic data
Primary energy consumption: total, by energy sources	GDP; VAB by (sub)sectors; Income and expenditure of households
Final energy consumption: total, by energy sources, end use sectors and uses	Heating Degree-Days
	Population
	Stock of dwellings
	New dwellings and useful surface
Specific consumption of equipment, electrical household appliances, ...	Equipment in dwellings
Specific consumption of cars..	Stock of vehicles by types and transport modes
	Travelled distance by type of vehicles
	Traffic (pkm)/(tkm)
	Physical production, IPIs by industrial branches
	Employment: total, by branches of Services sector
	Activity variables of Services sector: beds (hospitals); overnights (hotels); students (education)

□ Main sources used for the EE indicators collecting and updating

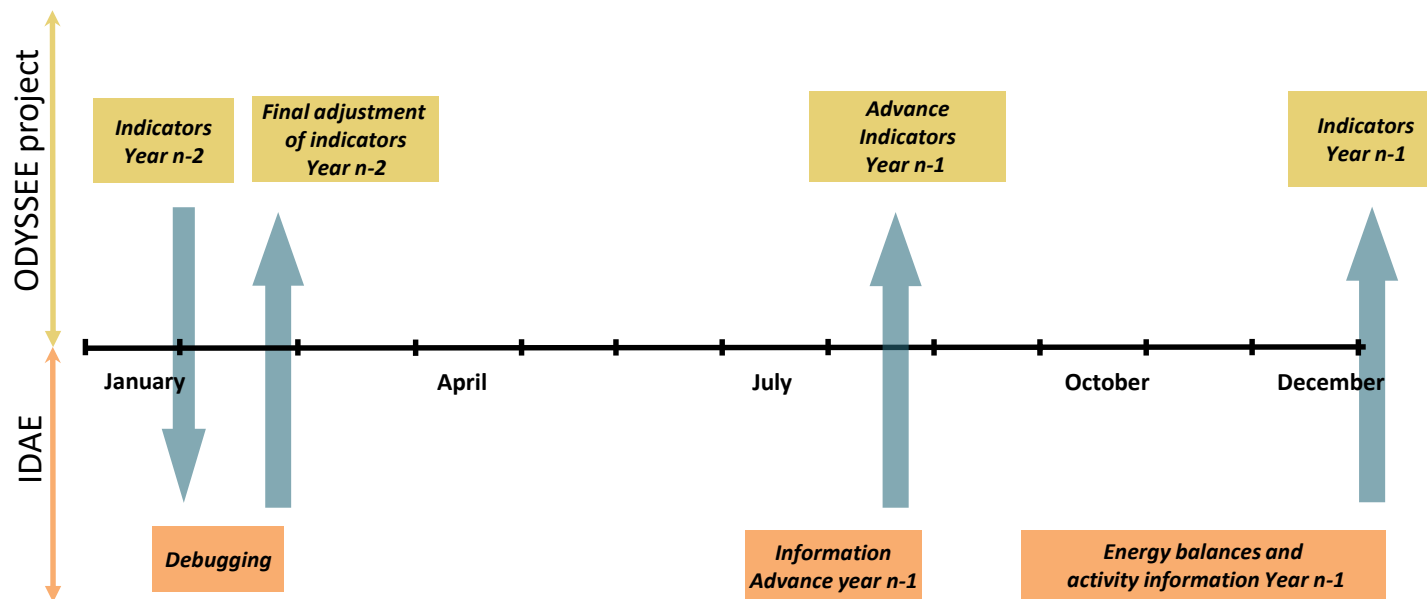
Source		Web link
INE	Spanish Statistics Office	http://www.ine.es/
ASPAPL	Spanish Association of Pulp and Paper Manufacturers	http://www.aspapel.es/
OFICEMEN	Spanish Cement Association	https://www.oficemen.com/
UNESID	Association of Steel Producers and Primary Steel Processors in Spain	https://unesid.org/
MITECO	Ministry for the Ecological Transition	https://energia.gob.es/en-us/Paginas/index.aspx
DGT	Directorate General of Traffic	http://www.dgt.es/es/
Mfom	Ministry of Development	https://www.fomento.gob.es/
MEC	Ministry of Education and Science	http://www.educacionyfp.gob.es/portada.html
MSPS	Ministry of Health and Consumer Affairs	https://www.mscbs.gob.es/

□ EE Indicators in Spain

☞ $\cong$ 160 EE indicators

- **Macro:** purchasing power parity, climate correction, constant structure intensities
- **Industry:** industry intensity, manufacturing at constant structure intensity, unit consumption of intensive branches (cement, paper and steel)
- **Transport:** intensity, unit consumption by fuels, unit consumption by passenger and freight transport modes, specific consumption of the stock of (new and existing) vehicles by fuels
- **Residential:** unit consumption by dwelling (global, thermal and electric), unit consumption with climate correction, unit heating consumption..
- **Services:** purchasing power parity, climate correction, thermal and electricity intensities, unit consumption (by employees)

□ EE indicators' updating in Spain: Annual Schedule



- Main sources of information: MITECO, Mfom, IDAE, MEH, INE, DGT, Associations, etc.
- Most relevant improvement areas:
 - Better basic information → Improvement in EE indicators.
 - Need for sectoral studies and measurements (SPAHOUSEC, etc.)

❑ Main barriers and tools for EE Indicators' updating and benchmarking

🔑 Barriers:

- **Loss of data caused by methodological changes, lack and/or disruption of data series**, mainly in the case of official statistics
- **Data protection and privacy** (confidentiality)
- **Lack of disaggregated information** available
- **Lack of full correspondence between economic data (NACEs) and energy data** ➡ limitation in the elaboration and follow up of energy intensities (kep/€) associated with some industrial branches
- Household and Service sectors: Sectors with greater constraints because of the **heterogeneity of consumers'** demands
- Limited comparison among EU countries because of **differences in methodological and statistical approaches**

🔑 Statistical tools

- **Surveys** with different level of detail and complexity
 - ✓ From sectoral energy studies based on simple questionnaires with low cost and easy to implement (SES studies) to surveys which require more intensive field research (commonly addressed to samples of households)
- **Modelling**
- **"In situ"** measurements

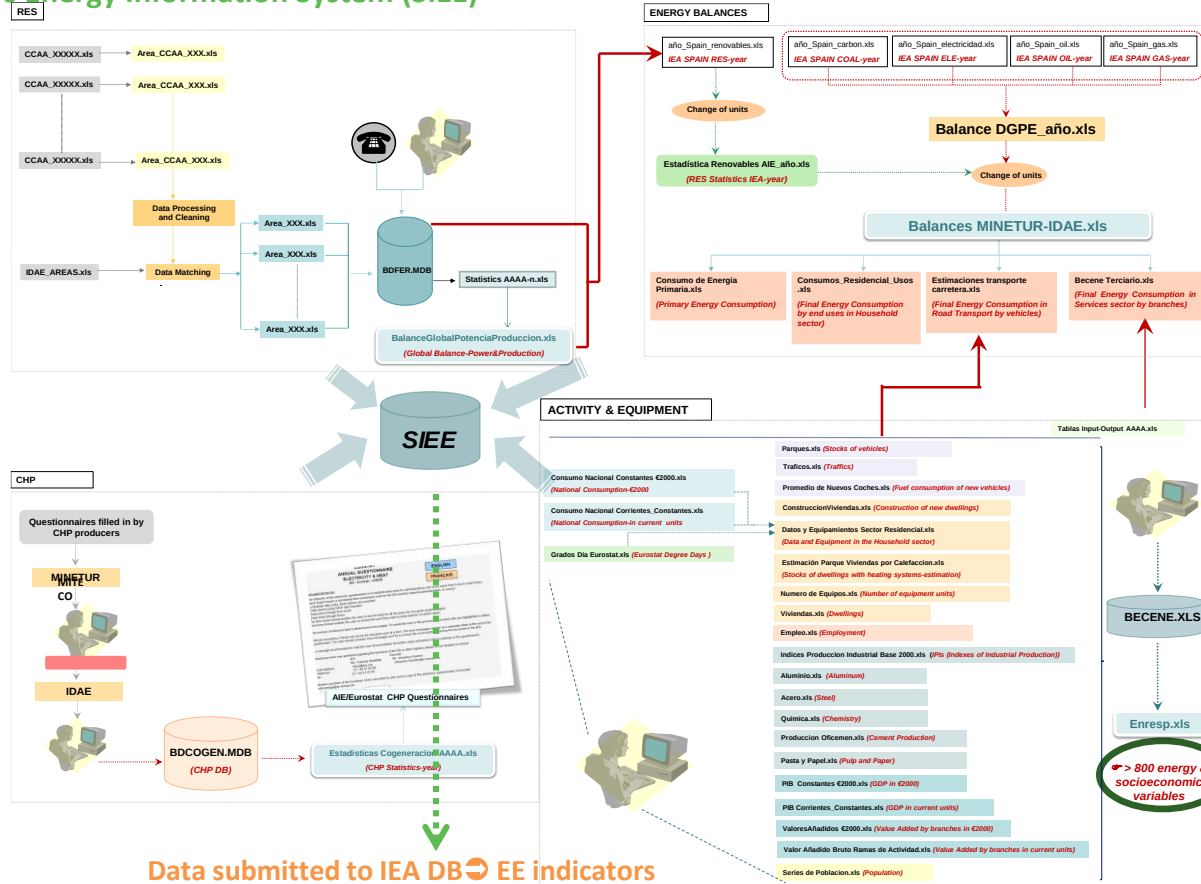
- ➡ **Spain supports IEA initiatives** addressed to the improvement in **EE data acquisition and benchmarking**, mainly in **key intensive sectors** as a basis for a better design of energy planning and sector-targeted policies in the context of National Energy and Climate Plans (NECPs).

¡Thank you!

<http://www.idae.es/>

cgbarquero@idae.es

□ IDAE's Energy Information System (SIEE)



Data submitted to IEA DB & EE indicators