



ALDREN WP 2.4

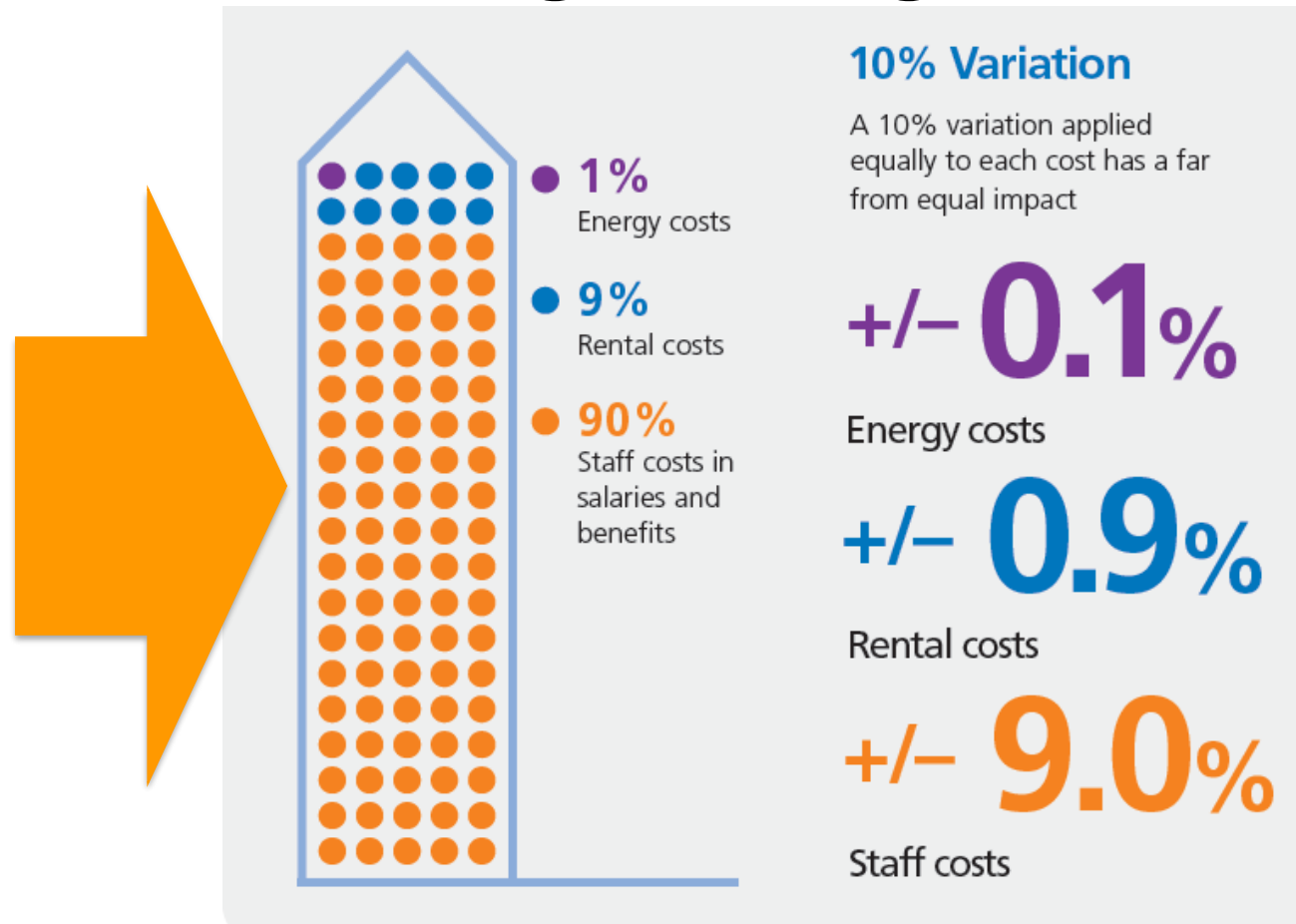
Addressing health and well-being

ALDREN Alliance for Deep RENovation in buildings

Implementing the European Common Voluntary Certification Scheme, as back-bone along the whole deep renovation process



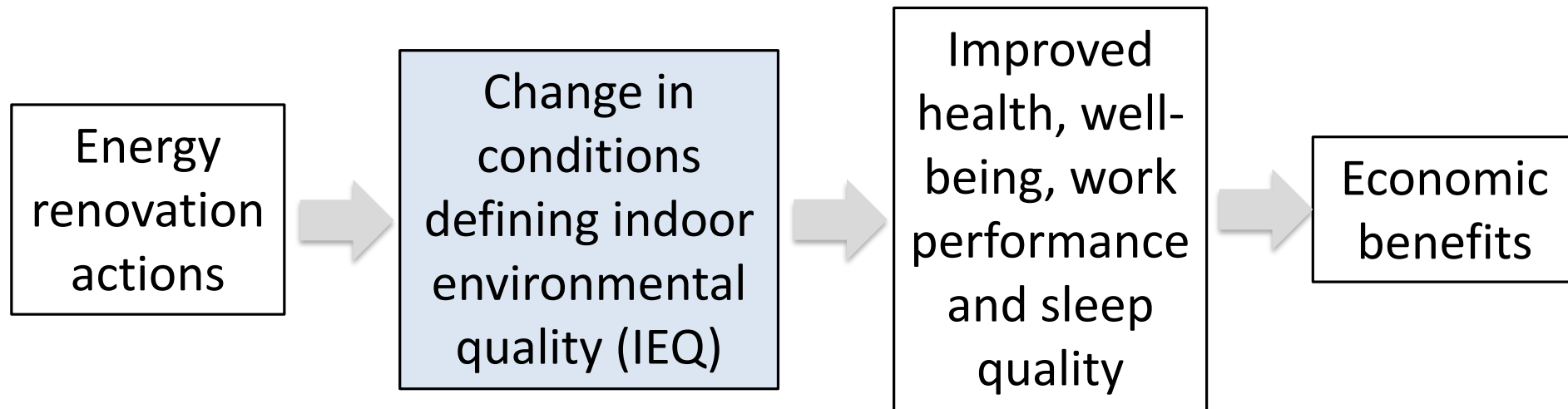
Non-energy benefits constitute dominant costs of running buildings



Usually not considered in deep energy renovation projects



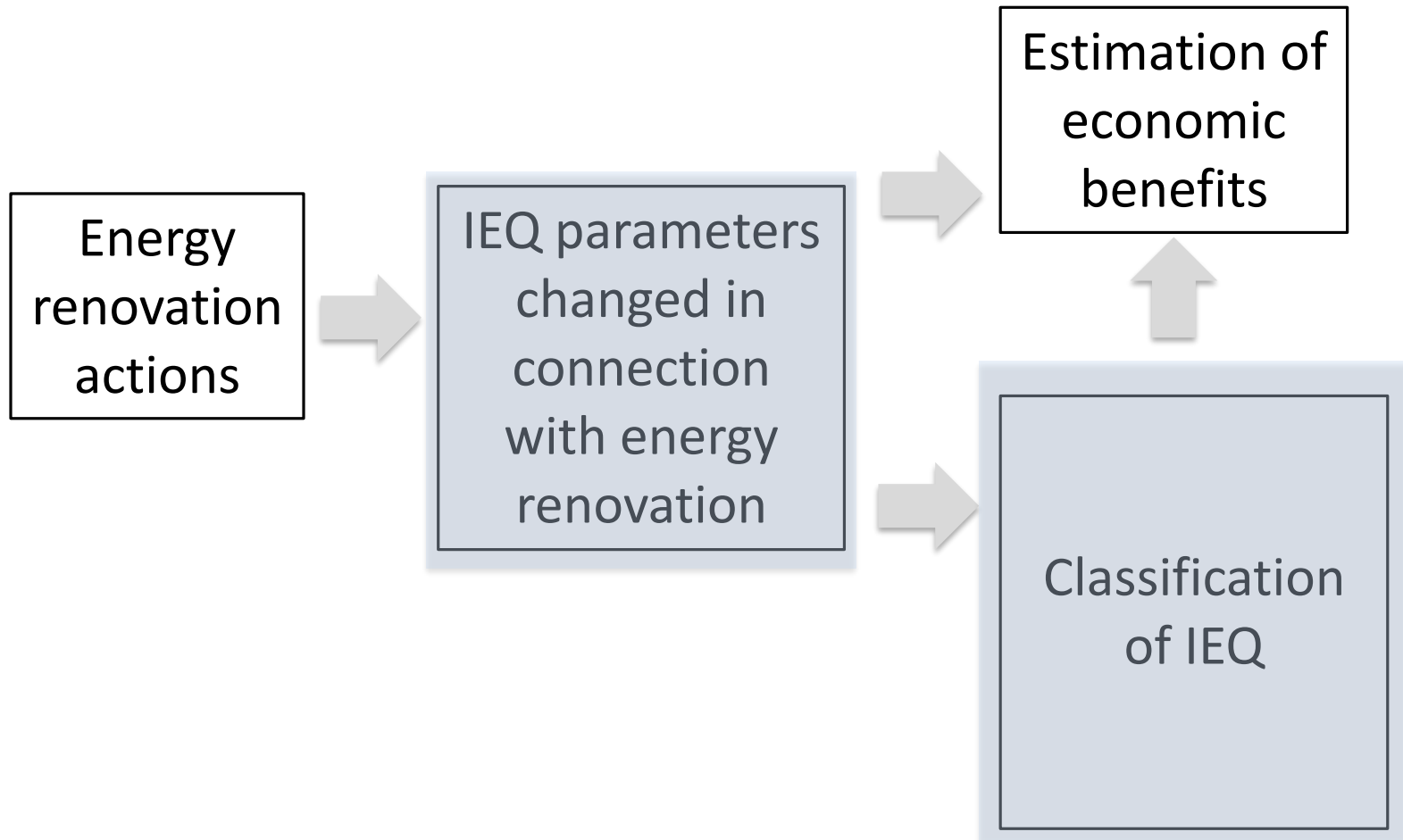
Framework for integration of indoor air quality, comfort and health in the scope of deep energy renovation



IEQ: Parameters describing indoor air quality, thermal, acoustic and visual environment



Addressing health and well-being in ALDREN



Criteria for selection of IEQ parameters for ALDREN procedures

- Parameters that are changed due to the process of deep energy renovation (not deliberately act on IEQ)
- Parameters that have been shown to affect productivity, as well as health, well-being and comfort of building occupants (to allow estimation of economic benefits)
- Parameters that are measureable and/or can be modelled (to allow verification)
- Parameters that are included/recommended by the current standards and existing building certification schemes (to allow quick adoption of ALDREN procedures)
- Comfort, well-being, health, productivity ARE NOT measured directly, are estimated through proxies (IEQ parameters)



IEQ parameters impacted by energy renovation actions

- **General and local thermal environment** (air temperature, mean radiant temperature, radiant asymmetry, reduced cold draft, reduced risk of overheating/overcooling and free cooling): thermal rehabilitation (insulation) of envelope, roof, ground floor, etc., new low-energy windows, installation of low temperature heating and high temperature cooling hydronic systems, air-based cooling and heating systems, improved control of heating/cooling systems, installation of sunscreens
- **Mold**: thermal rehabilitation (reduced cold bridges), installation of ventilation system
- **Moisture levels**: installation of ventilation system
- **Radon**: thermal rehabilitation of ground floor and cellars
- **Ventilation and air quality**: installation of ventilation system, low-emitting materials
- **Penetration of ambient pollution, airtightness**: tightening of envelope, thermal rehabilitation of envelope and new windows, installation of ventilation system
- **Ambient noise penetration**: new windows, tightening of envelope and thermal rehabilitation of envelope
- **Daylight**: skylights, new windows
- **Visual environment, illuminance**: renovation of low-energy artificial lighting system
- **Glare**: installation of sunscreens

- **No impact on IEQ**: use of renewable energy sources, heat pumps, more effective boilers, connection to district heating, etc



IEQ parameters included in standards and certification schemes

Review of indoor environmental quality indicators for non-residential buildings – the scientific basis of the ALDREN indicators

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A review was performed to identify indicators used to quantify indoor environmental quality in buildings. The review was motivated by the ALDREN (ALliance for Deep RENovation in buildings) project founded by the European Commission. The ALDREN project aims to develop a harmonized procedure to foster deep energy renovation operations in offices and hotels. Within the frame of energy retrofit, ALDREN focuses on the aspects of health and well-being, and proposes a set of indicators allowing quantification of these aspects. This review creates the reference for developing these indicators. It comprised 14 green building (GB) certification schemes (10 European and 4 non-European schemes), 14 research articles, 7 reports of European projects, and one major standard (EN 16798, 2018). Ninety different indicators used to characterize indoor environmental quality (IEQ) presumably associated with health and well-being of building occupants were identified in the collected documents. The IEQ indicators were classified into four major components defining thermal environment, indoor air quality (IAQ), acoustic environment and visual environment. The average weightings (credit-wise) attributed to these components in the GB schemes were 27%, 34%, 17%, and 22%, respectively. For thermal environment the common indicators were PMV, PPD, room operative temperature, room air temperature, room air relative humidity and air speed. For IAQ the common indicators were ventilation rate, TVOC, formaldehyde, CO₂, CO, PM₁₀, PM_{2.5}, ozone, benzene and radon. For acoustic environment the common indicators were ambient noise and reverberation time. For visual environment the common indicators were illuminance level, daylight factor and spatial autonomy.



Parameters defining IAQ

	Measured	Modelled
CO ₂	x	x
Ventilation rate (m ³ /h)	x	
Formaldehyde (µg/m ³)	x	
Benzene (µg/m ³)	x	
PM _{2.5} (µg/m ³)	x	
Radon (Bq/m ³)	x	
Indoor air relative humidity (%)	x	x
Surface relative humidity (%)		x
Visible mould (cm ²)	Visual inspection	



Parameters defining thermal, acoustic and visual environment

	Measured	Modelled
Indoor air temperature (°C)	x	x
Indoor air relative humidity (%)	x	x
PMV and PPD		x
Noise level (dB(A))	x	
Daylight factor (%)		x
Illuminance (lux)	x	x



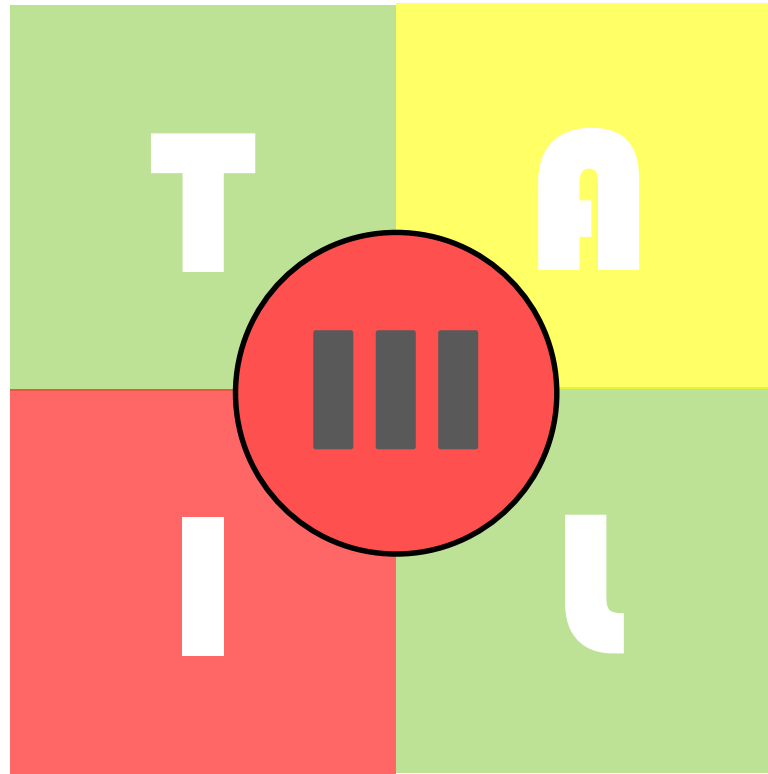
Measuring procedures, protocols (example)



INDOOR AIR QUALITY			
Parameter	Rationale for inclusion	Assessment method	Criteria for the ranking ³
Carbon dioxide (CO ₂)	Avoiding discomfort Included in EN16798 and Level(s). Included in the following certification schemes:	<p>Modeling – simulations (prior to and after renovation)^{1,2} Modeling period 1 year</p> <p>On-line measurements (prior to and after renovation in occupied building)^{1,2} Measuring period 1 week.</p> <p>Calibrated sensors with accuracy of at least ± 50 ppm $\pm 5\%$ of reading shall log temperatures in one location per floor, with a maximum of 10 locations in office buildings and 10 rooms in hotels for a full week (Monday-Friday in offices and 7 consecutive days in hotels). The locations are determined in the same way as for other measurements (except Radon).</p> <p>The measurements shall be made at the same locations as for other parameters.</p> <p>In offices only data for the period corresponding to working hours shall be used. The locations shall be occupied and measurements in locations expected to be unoccupied shall be avoided; at best measurements should be made at full nominal occupation. The 10 locations in offices shall include measurements on ground floor, top floor and floors in-between. The rooms shall be randomly sampled among all room configurations within the total useful floor area that are used for office-related work. One sensor per xx m² floor shall be deployed at the working desk. The measurements shall be made at the same locations as temperature measurements.</p> <p>Ten randomly selected hotel rooms shall include rooms on the top floor, ground floor (if relevant, i.e. with bedrooms) and the intermediate floors, as well as the rooms having different sizes. The rooms shall be randomly sampled among all room configurations within the total useful floor area that are used for hotel rooms used by guests. The sensors in the hotel rooms shall be placed at the bedside table close to the head region of a bed.</p> <p>An additional measurement of CO₂ concentration is recommended both in offices and hotels; else 400 ppm can be used.</p>	<p>Maximum conc. above outdoors during full occupancy; outdoor level can be assumed to 400 ppm (or measured value should be used) determined based on comfort requirements (avoid the % people dissatisfied with air quality)</p> <p>Cat I. ≤ 550 ppm Cat II. >500 and ≤ 800 ppm Cat III. >800 ppm and ≤ 1350 ppm Cat IV. >1350 ppm</p>



Classification, TAIL-score (under development)





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for Deep RENovation
in buildings



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