European Commission

INNOBYG Spring Conference 2014

"THE VALUE OF INDOOR CLIMATE – comfort, health, business"

15 May 2014, Copenhagen

Strategies to reduce health risks in energy efficient buildings: reducing pollution at source

Stylianos Kephalopoulos and Pilar Aguar Fernandez

European Commission, Joint Research Centre
Institute for Health and Consumer Protection
Chemical Assessment and Testing Unit

Joint Research Centre

The European Commission's in-house science service

Joint Research Centre

European Commission

❖ Building related energy consumption in EU

Buildings account for about 40% of the energy consumption in EU and 30% of all greenhouse gas emissions in the atmosphere.

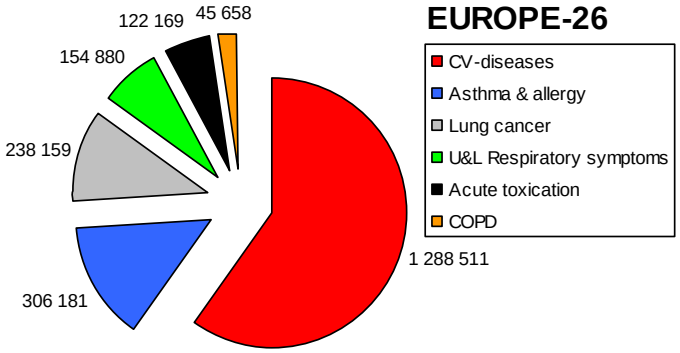
……IN PARALLEL……

❖ Building related health impact assessment

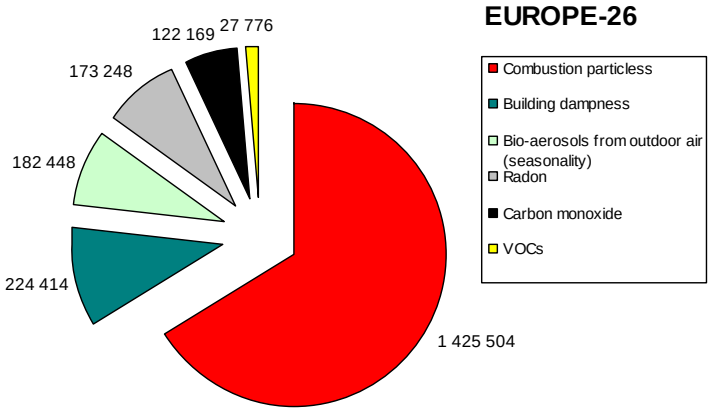
2.2 million healthy years are lost annually in Europe due to poor indoor air quality in buildings.

European Commission

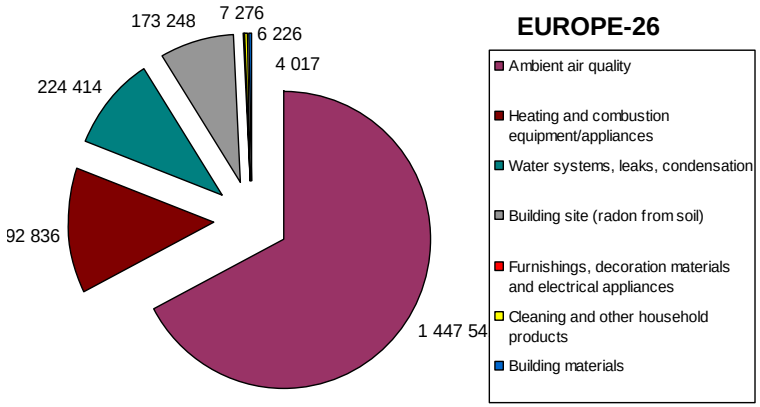
IAQ associated BoD in kDALY/yr attributed to diseases – in total 2.2 MDALY/yr, excluding ETS



IAQ associated BoD in kDALY/yr attributed to exposure agents



IAQ associated BoD in DALY/yr attributed to sources of exposure

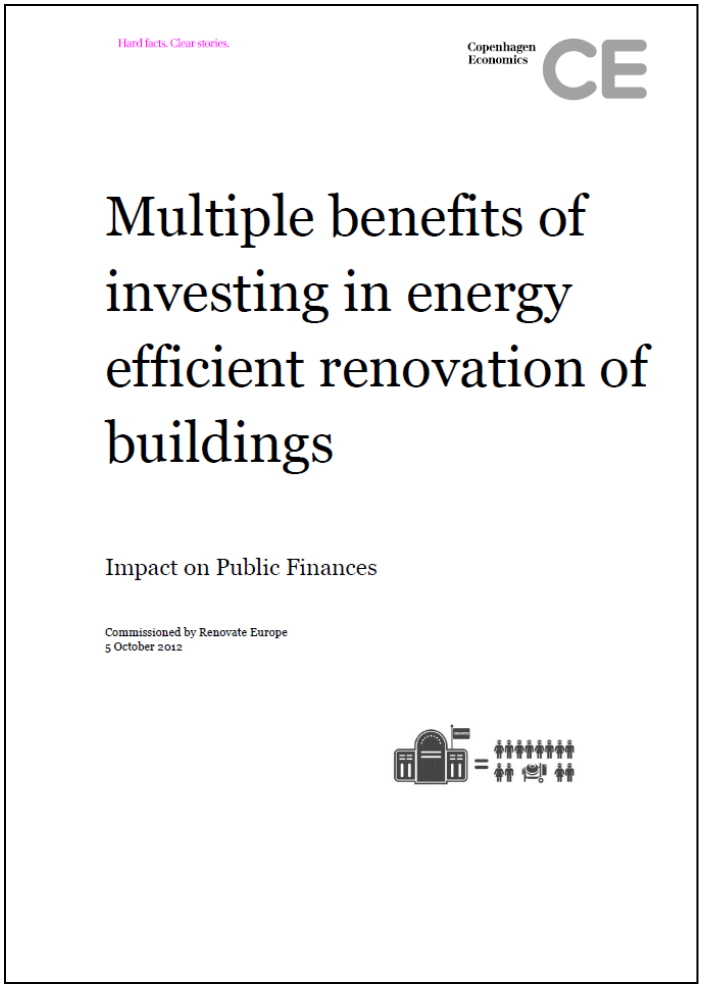


Source: DG SANCO's IAIAQ project (2010-2011):

Impact Assessment of IAQ related policies, actions and projects

Joint Research Centre

European Commission



.....YET.....

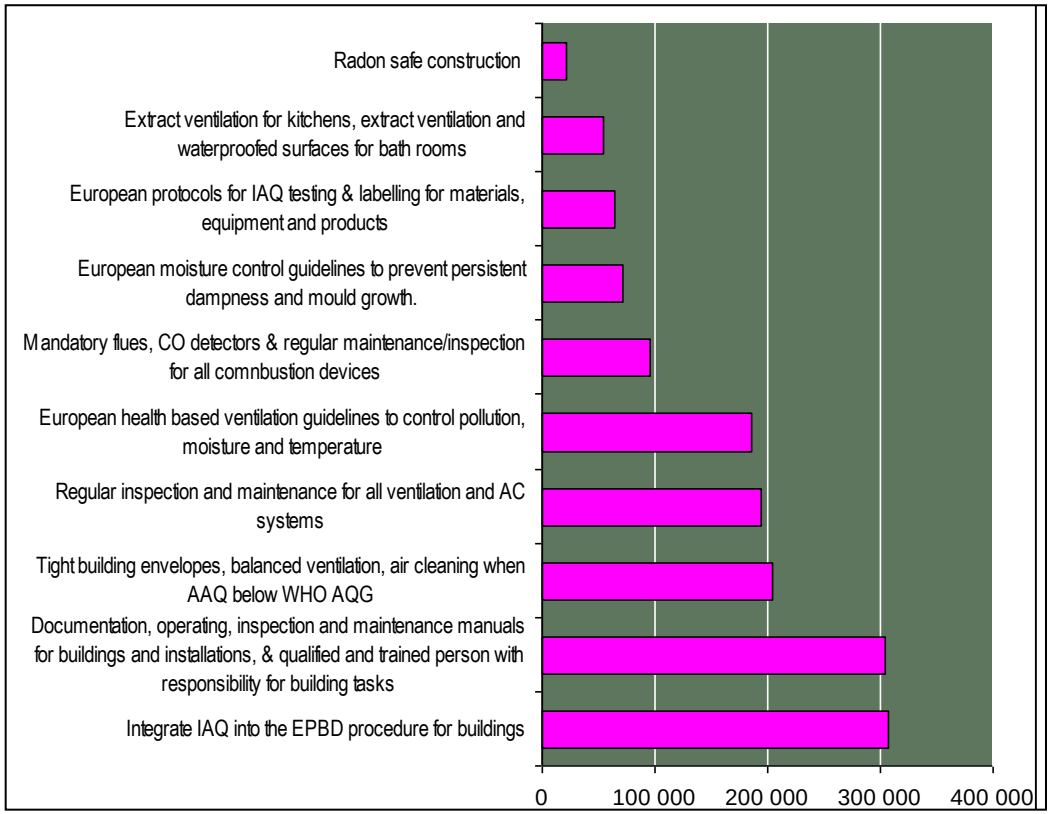
Substantial health benefits from improved indoor climate from energy efficient renovation of buildings are estimated in the order of €64-140 billion annually in 2020 in the high energy efficiency scenario through improved life quality, less public health spending and fewer missed days of work.

These figures are the same order of magnitude with those estimated when considering the energy savings alone!!!

Copenhagen Economics, 2012

European Commission

Health benefits in EU-26 in the 10th year of implementation of 10 building related policies



DG SANCO's IAIAQ project (2010-2011):

Impact Assessment of IAQ related policies, actions and projects

(Partners: KTL-FI, UMIL-IT, UPORTO-PT, JRC)

Joint Research Centre

European Commission

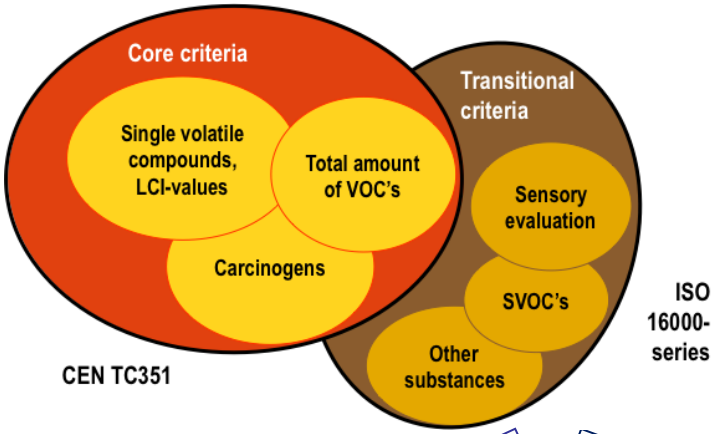
STRATEGIES TO REDUCE HEALTH RISKS IN ENERGY EFFICIENT BUILDINGS

……a combination of 3 strategies……

1. **Reducing pollution at source**
2. **Diluting pollution through ventilation**
3. **Producing innovative and safety by design solutions for construction materials and consumer products**

European Commission

Harmonisation frameworks for labelling and health-based evaluation of construction products



To decrease existing burdens for the construction industry in producing and certifying safe construction materials and products and help removing barriers to trade across the European market.

In collaboration with:

- European Commission (DG SANCO, DG ENTR)
- Mandatory and voluntary labelling schemes in EU, USA, China and Canada
- Construction and Chemical Industries
- Governmental organisations
- Standardisation bodies
- NGOs

JRC's ECA reports n. 27 (2012) & n. 29 (2013)

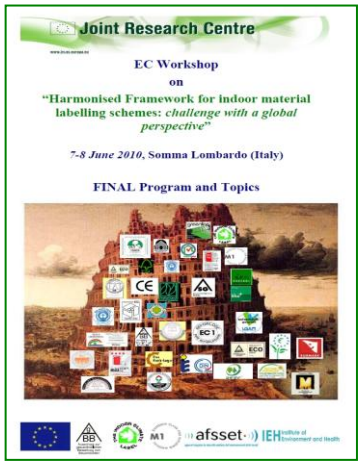
Joint Research Centre

Harmonisation framework for indoor products labelling schemes in EU (1/4)

- **Workshop on "Harmonisation framework for indoor material labelling schemes in EU: *challenge with global perspective*", 7-8 June 2010, Somma Lombardo, Italy**

100 participants:

- ✓ DG ENTR, DG SANCO
- ✓ DG JRC (IHCP, IPSC, IPTS)
- ✓ Existing labelling schemes in Europe, USA, Canada and China
- ✓ Industry partners from various building sectors and their European federations
- ✓ Governmental organisations
- ✓ Standardisation bodies and NGOs



Harmonisation framework for indoor products labelling schemes in EU (2/4)

- **ECA report no. 27 "Harmonisation framework for indoor products labelling schemes in the EU" (JRC, 2012)**

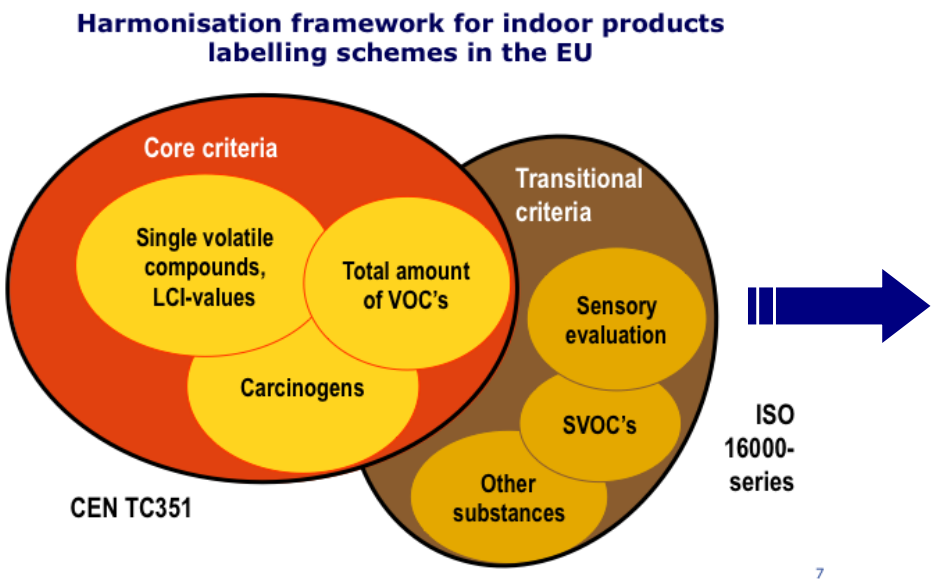
Core and transitional criteria for testing and evaluation methodologies.

✓ *Core* criteria:
Are those for which consensus has already been achieved and can be applied Europe-wide

✓ *Transitional* criteria:
Are those for which consensus is still to be reached and these continue to be applied locally during a transitional period.

However, participating labelling schemes should follow the commonly agreed measurement methods for the transitional criteria.

Harmonisation framework for indoor products labelling schemes in EU (3/4)



Requirements / Parameter	M1 Finland	DICL Denmark	AgBB Germany	AFSSET France	Consensus
Measuring method / Chamber	ISO 16000 series	ISO 16000 series	ISO 16000 series	ISO 16000 series	**Harmonised CEN Standard (based on ISO 16000 series)**
Measuring points (days)	28	3, 10 and 28	3 and 28	3 and 28	**3 and 28**
Core criteria					
Single VOCs evaluated (R = ∑ Ci/LCI <1))	No	comparison with irritation threshold	R < 1 170 LCIs (2010)	R < 1 165 LCIs (2009)	**R < 1 Harmonised list of LCIs**
Carcinogens evaluated according to concentration emitted	IARC class 1 SERa < 5 µg/m²h	IARC class 1	EU classes 1 and 2 56 listed compounds Sum < 1 µg/m³	EU classes 1 and 2 2 listed compounds < 1 µg/m³	**Harmonised list of EU carcinogens classes 1 and 2 compounds to be checked**
TVOC measured	SERa < 200 µg/m²h	No	1000 µg/m³	1000 µg/m³	**200-1000 µg/m³**
Formaldehyde measured	SERa < 50 µg/m²h	75 µg/m³	No[1]	10 µg/m³ (LCI)	**Value to be discussed**
Transitional criteria					
Compounds without LCI assessment ('not-yet-assessed' substances	No	No	Sum < 100 µg/m³	Sum < 100 µg/m³	**Sum < 100 µg/m³**
Other compounds evaluated	Ammonia	Aldehydes			
TSVOC measured	No	No	< 100 µg/m³	No	**Await validation CEN TC 351**
Sensory evaluation	Acceptability untrained panel 15 persons	Acceptability and intensity; untrained panel, minimum 20 persons	Yes (Pilot phase using ISO/FDIS 16000-28)	No	**Await ISO 16000-28**

[1] Formaldehyde measurement required for approval application at DIBt

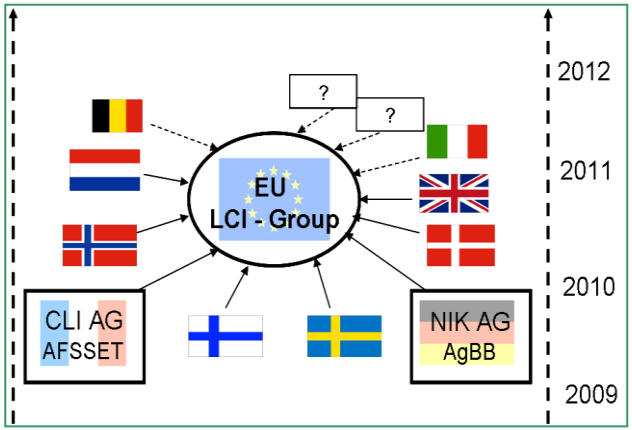
Harmonisation framework for indoor products labelling schemes in EU (4/4)

	Current criteria	Core and transitional criteria → Step I (*1 to 2 years*)	Harmonised criteria → Step II (*ca. 5 years*)
AFSSET	- R-value (based on LCI) - Carcinogens - TVOC	***Core* criteria:** - R-value - Carcinogens - TVOC	***Harmonised* criteria**
	- Sum of "not-yet-assessed" VOC	***Transitional* criteria:** - Sum of "not-yet-assessed" VOC	
AgBB	- R-value (based on LCI) - Carcinogens - TVOC	***Core* criteria:** - R-value - Carcinogens - TVOC	***Harmonised* criteria**
	- Sum of "not-yet-assessed" VOC - TSVOC - Sensory evaluation	***Transitional* criteria:** - Sum of "not-yet-assessed" VOC - TSVOC - Sensory evaluation	

	Current criteria	Core and transitional criteria → Step I (*1 to 2 years*)	Harmonised criteria → Step II (*ca. 5 years*)
DICL	- Irritation - Formaldehyde and other aldehydes - Carcinogens	***Core* criteria:** - R-value - Carcinogens - TVOC	***Harmonised* criteria**
	- Sensory evaluation	***Transitional* criteria:** - Sensory evaluation	
M1	- TVOC - Formaldehyde - Ammonia - Carcinogens	***Core* criteria:** **- R-value** **- Carcinogens** **- TVOC**	***Harmonised* criteria**
	- Sensory evaluation	***Transitional* criteria:** **- Sensory evaluation**	

EU-LCI harmonisation framework: issues, outcome, challenges

- EU-LCI *definition*
- EU-LCI *methodology*
  - Principle and rationale for the establishment of EU-LCI values
  - Protocol for the *de novo* derivation of EU-LCIs
    - ✓ Data compilation and evaluation
    - ✓ EU-LCI derivation
  - Application of assessment factors in EU-LCI derivation
  - Read-across guidance for EU-LCI derivation
  - Master list of Interim EU-LCIs



- *Practical application* of EU-LCIs
  - Account for multiple sources
  - Account for chemical mixtures

- *Alignment with* EU and National *policies*
  - CPR (how fits to the DG ENTR's EGDS concept of classes?)
  - REACH (starting point REACH guidance; but how EU-LCIs compare against DNELs?)
  - When and how the EU-LCIs will be transposed by EU MS into national legislation?

European Commission

Guidance in the application of assessment factors and read-across

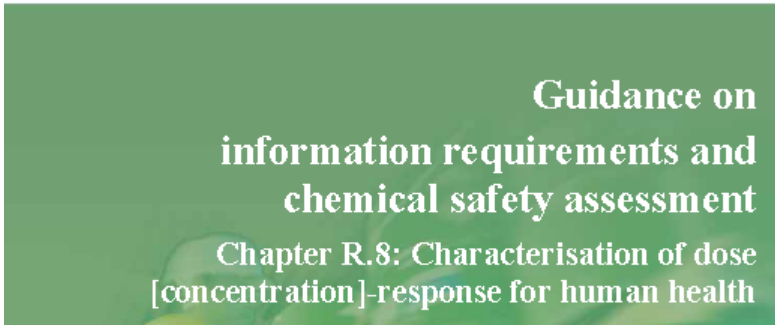
ECHA
http://echa.europa.eu

Application of assessment factors

- In line with REACH guidance (R.8) on information requirements and chemical safety assessment

Guidance for read-across

- In case of lack of adequate toxicological data to perform a *de novo* EU-LCI derivation
- Harmonising read-across procedure AFFSET – AgBB
- Based on existing read-across approaches (REACH, OECD, ….)
- Balance between case-by case basis (expert judgment) and some degree of standardisation
- Scientific underpinning & transparent, clear documentation of rationale for read-across

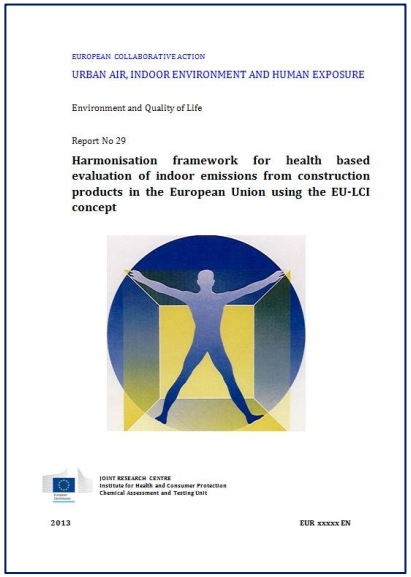


Joint Research Centre

EU-LCI derivation for priority chemical compounds

- **ECA report no. 29 "Harmonisation framework for health based evaluation of indoor emissions from construction products in the European Union using the EU-LCI concept" (JRC, 2013)**

Compound	CAS No.
1,2,4-Trimethylbenzene	95-63-6
2-Butoxyethanol	111-76-2
Toluene	108-88-3
Xylene	1330-20-7
1,4-Dichlorobenzene	106-46-7
Ethylbenzene	100-41-4
Styrene	100-42-5
Acetaldehyde	75-07-0
Tetrachloroethylene	127-18-4
Formaldehyde	50-00-0
ε-Caprolactam	105-60-2
α-Pinene	80-56-8


EUROPEAN COLLABORATIVE ACTION

URBAN AIR, INDOOR ENVIRONMENT AND HUMAN EXPOSURE

Environment and Quality of Life

Report No 29

Harmonisation framework for health based evaluation of indoor emissions from construction products in the European Union using the EU-LCI concept

JOINT RESEARCH CENTRE
Institute for Health and Consumer Protection
Chemical Assessment and Testing Unit

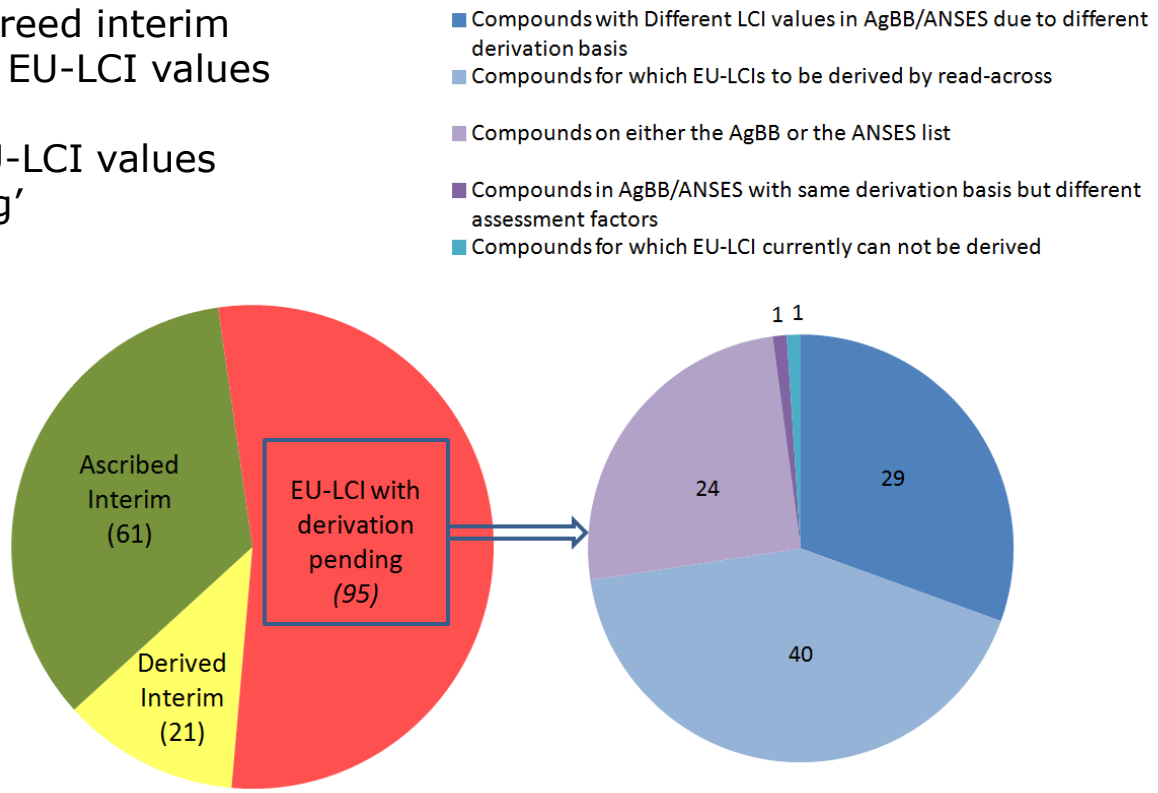
2013

EUR xxxxx EN

Relevant to DG ENTR's EGDS ad hoc group on performance classes which is linked to CE marking under the Construction Products Directive

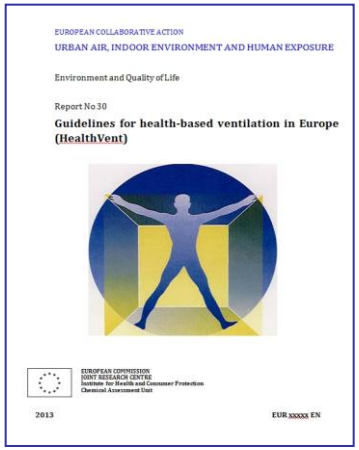
Master list of interim EU-LCI values (*177 compounds, as from July 2013*)

- 82 compounds with agreed interim ('ascribed' or 'derived') EU-LCI values
- 95 compounds with EU-LCI values with 'derivation pending'

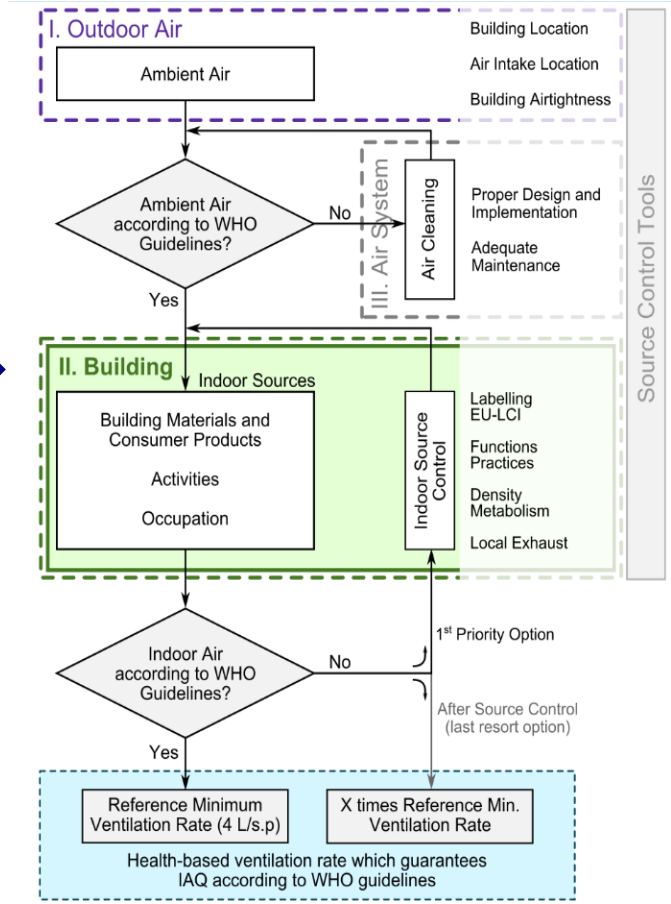


Guidelines for health-based ventilation in Europe

JRC's ECA report n. 30 (2014, *in print*)



Ensuring sufficient ventilation and energy efficiency requires optimisation and adaptability of ventilation levels according to the materials used, the type and level of occupancy and activities taken place in buildings



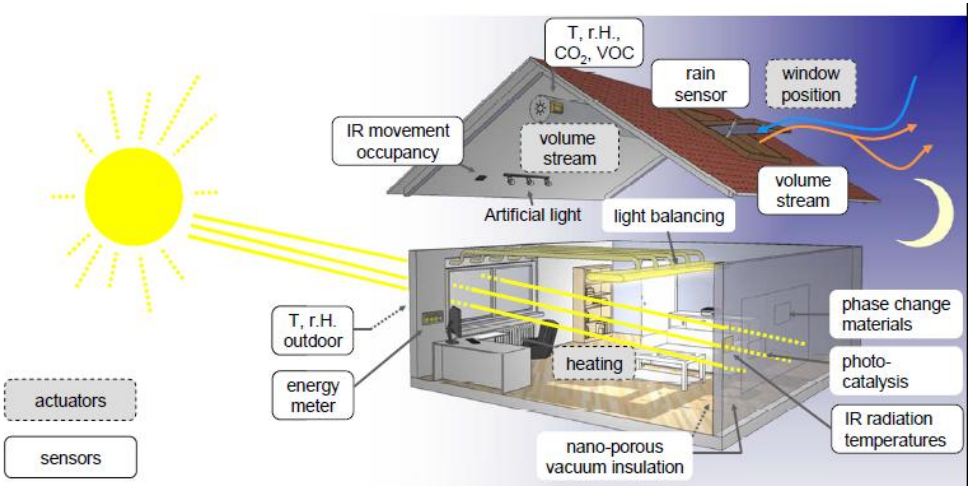
Change of paradigm!

- An integrative approach combining source control measures and health-based ventilation practices that guarantees the protection of health (i.e. according to WHO air quality guidelines) while rationalising over economic and energy expenditure
- Towads performance based ventilation strategies based on a set of common indicators: (*humidity, CO_2, few specific pollutants, energy consumption, comfort conditions*, ...)

- Photo-catalytic materials to purify air quality in buildings (decomposition of NO_x and VOC)
- Shutters and electrochromic window foils to reduce the building cooling load
- Nano-porous vacuum insulation combined with phase change materials to passively control temperature
- Sensitive nano-materials compatible with low-cost work function and conductometric transducer principles for reliable CO_2 and VOC detection
- Demand-controlled ventilation and air conditioning with use of natural and artificial ventilation strategies

clear-up

Clean and resource efficient buildings using appropriate materials and technology



European Commission

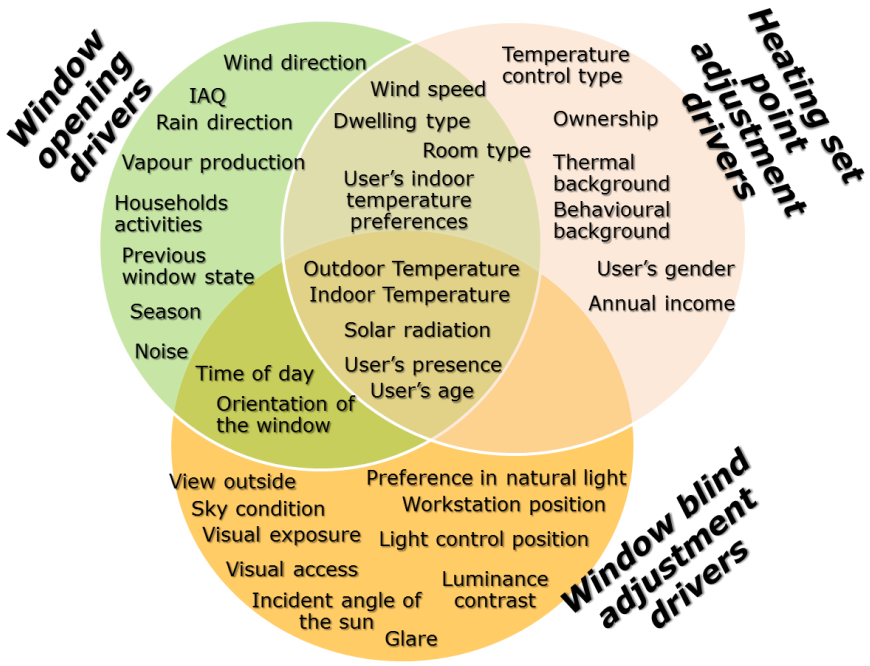
HUMAN BEHAVIOR:
AN UNDERESTIMATED VARIABLE

A Holy Grail?

- How does human behaviour influence indoor environment quality and energy?
- How does human behavior influence our exposure?
- How can we influence human behavior?

European Commission

BUILDING RELATED HUMAN BEHAVIORAL DRIVERS & NEEDS



Need for a shift of paradigm in the occupant's role in buildings

- From "Passive recipients" (occupants) of pre-determined comfort conditions

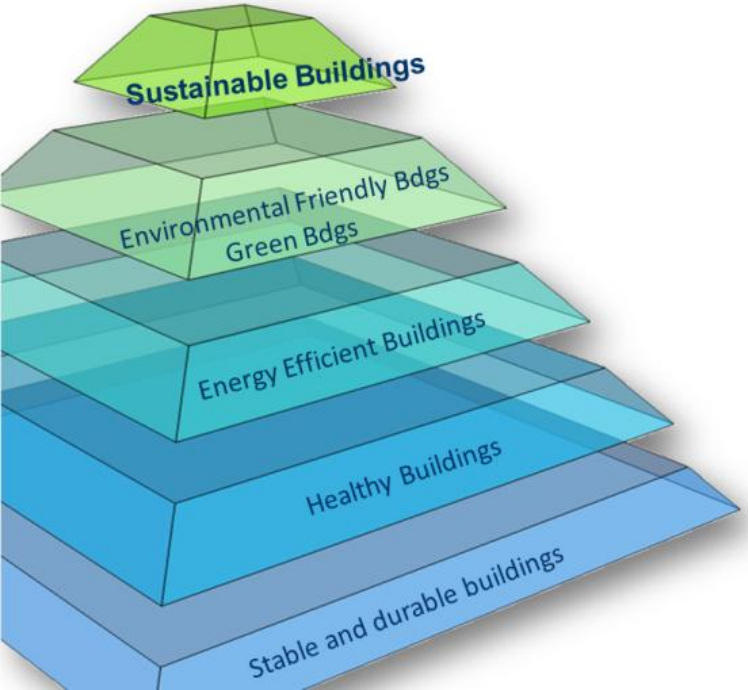
- "Inhabitants" (real users) playing an active role in the maintenance and performance of a building

Joint Research Centre

European Commission

In connection with Europe 2020 Strategy

- Need to streamline, develop and implement a **holistic** and **integrated** approach which bridges ***safety, health, energy efficiency*** *and* ***sustainability*** aspects across existing policies and standardisation activities having cross-cutting criteria related to the built environment



Cross-cutting policies, regulations, standards

- EPBD Recast (2010/31/EC)

  Energy Performance of Buildings Directive

- CPR (2011/305/EC)

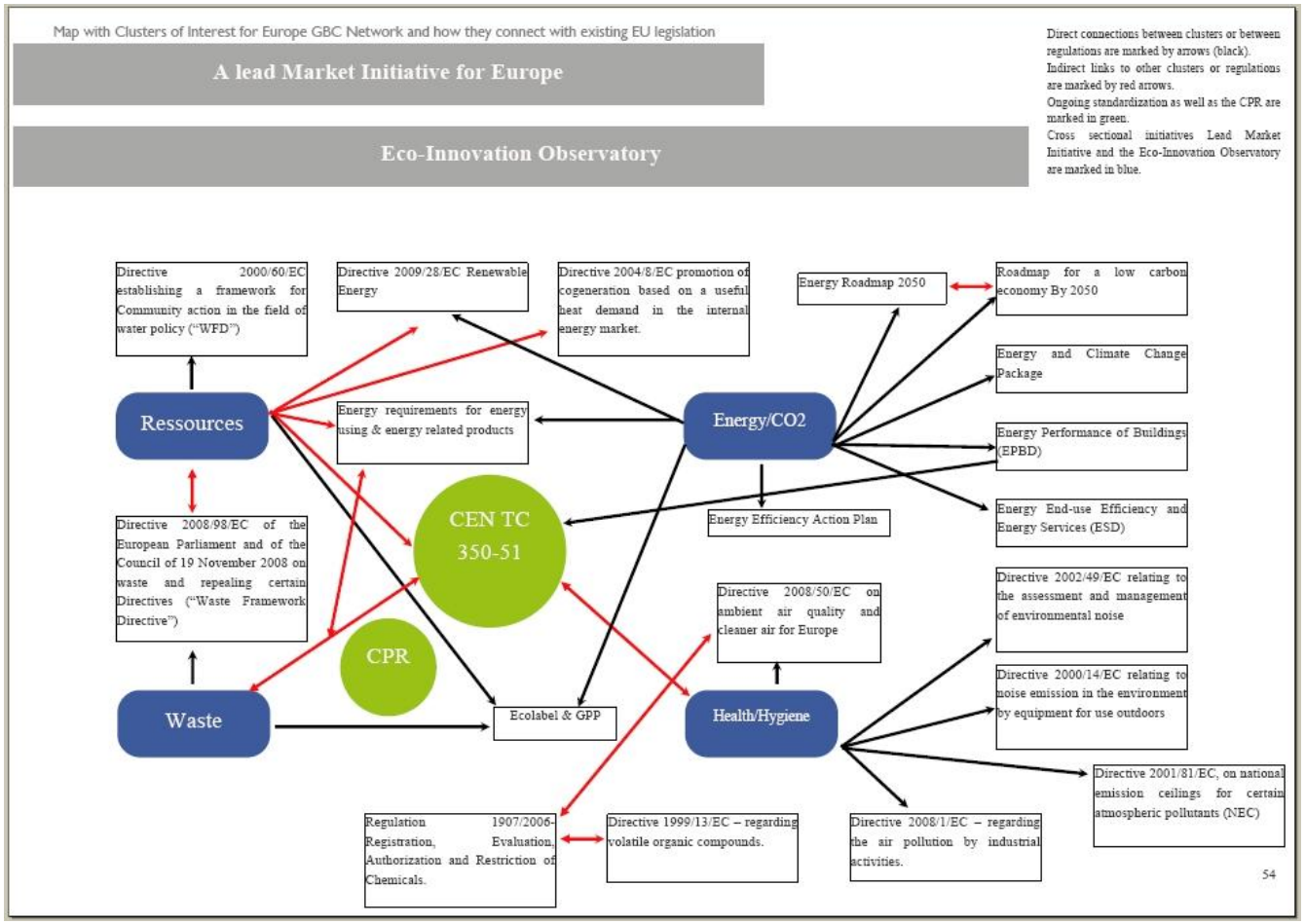
  Construction Products Regulation

- Eco-design Directive
- Energy Labelling Directive, Ecolabel
- …..

Joint Research Centre

European Commission

Is it so complicated?



Joint Research Centre

JRC SUPPORTING THE BUILDING OF TOMORROW: Needs

Future sustainable buildings with much more adaptive systems, optimum control and performance based

- Need for developing and testing novel solutions for efficient management of buildings such as energy-optimisation adaptive sensing and control strategies that account for human behavioral drivers affecting energy use, indoor environment quality and human exposure in buildings
- Help avoiding potential pitfalls of energy efficiency requirements in existing, new and renovated buildings which may negatively impact on human health

European Commission

JRC SUPPORTING THE BUILDING OF TOMORROW: How?

Setting up a JRC Cluster on "Efficient Buildings"

- To facilitate, ensure and formalise cross-Institute collaboration at JRC (IET, IHCP, IPSC, IES, IPTS) in order to face synergistically the holistic aspect of efficient buildings which entails coordinated actions across the cross-cutting issues of energy efficiency, health, safety, sustainability and innovation.
- Setup a new comprehensive bottom-up model to assess the energy efficient potential and the effectiveness of the EU building related policies.
- Assess the technology options (including evaluation of indoor air quality and climate, bio-climatic architecture and innovative and "safety by design" solutions for construction materials and consumer products) and produce technical guidelines for NZEBs (new and refurbished) accustomed across different climate zones in Europe.

European Commission

JRC SUPPORTING THE BUILDING OF TOMORROW: How?

Setting up a JRC Cluster on "Efficient Buildings"

- Support the EC and CEN to setup harmonised standards for the building sector by considering the interactions between the Basic Requirements for Construction Works of the Construction Products Regulation (CPR), in particular for energy economy and heat retention, environmental sustainability, health and security.
- Elaborate a strategy on how to achieve low-energy and low-carbon building stock by 2020, 2030 and 2050 across various policy scenarios, while ensuring a balance between rational use of energy and good environment quality in buildings through the use of innovative technologies and appropriate regulation and enforcement regimes.

JRC SUPPORTING THE BUILDING OF TOMORROW: How?

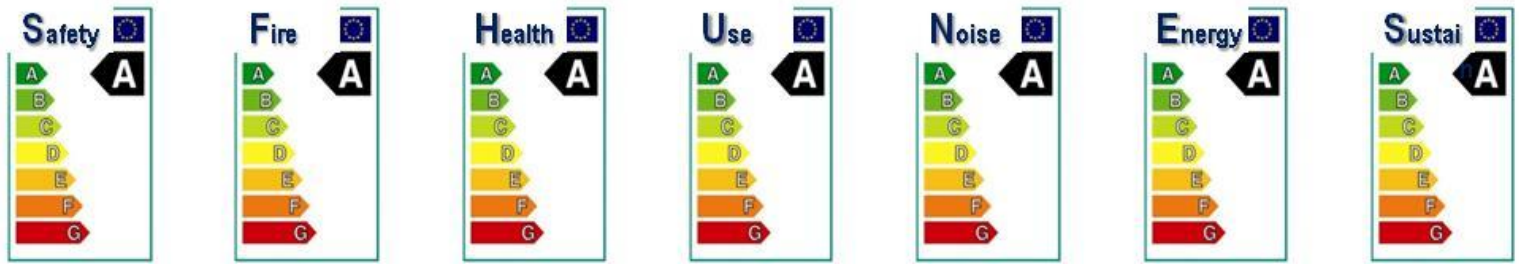
Setting up a JRC Cluster on "Efficient Buildings"

- To elaborate via a holistic approach science-based policy options with focus on streamlining, aligning and harmonising existing cross-cutting policies, regulations and standardisation work related to the construction sector.
- To help underpinning incentives and measures at both research and policy levels in a more co-ordinated and resource efficient way and removing barriers to trade related to the built environment.
- To boost innovative solutions (new materials and products) ready for large scale market uptake to be feasibly applied (financially and technically) in new and existing buildings in EU so that the European building stock can achieve the EU targets concerning health, safety, energy efficiency, innovation and sustainability.

European Commission

LABELLING THE PERFORMANCE OF THE BUILDING OF TOMORROW

- Towards the development of a multi-performance labelling of buildings in terms of safety, health, energy efficiency and sustainability ("Building Efficiency Index") with minimum mandatory requirements for EU MS?



A challenging endeavour

European Commission

Thank you for your attention

The JRC: *The European Commission's in-house science service*

***DISCLAIMER**: This presentation and its contents do not constitute an official position of the European Commission or any of its services. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this presentation or its contents.*

Joint Research Centre