International Energy Agency

Technology and innovation pathways for zero-carbon-ready buildings by 2030

A strategic vision from the IEA Technology Collaboration Programmes

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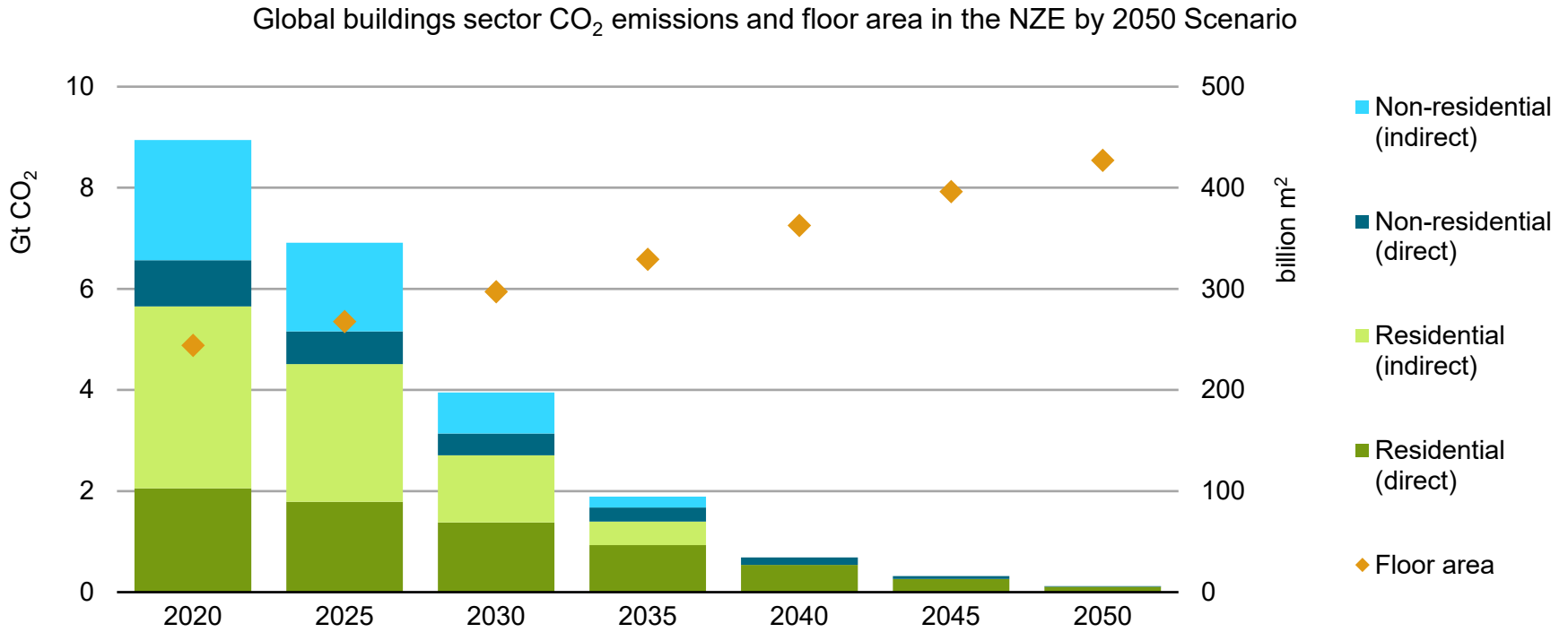
Background and format

Short terms actions are urgently needed to achieve 2050 goals



Decarbonising buildings requires drastic and immediate policy action to stimulate behaviour and technology shifts

Project background: TCP vision referred to recent IEA analysis

A zero-carbon-ready building (ZCRB) is highly energy efficient and either uses renewable energy directly, or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat. This means that a ZCRB will become a zero-carbon building by 2050, without any further changes (IEA Net Zero Report, box 3.4).

TCPs provided their vision on how to help achieve some of the most impactful **short-term (2030) key milestones** in the IEA analysis for the building sector.

*Key **milestones** in transforming the global buildings sector* (at 2030)	TCP vision author
All countries targeted for **zero-carbon-ready codes** for new buildings	EBC
20% of the **existing buildings** stock are renovated to the zero-carbon-ready level	EBC
About 600 million **heat pumps** are installed covering 20% of buildings heating	HPT
Approximately 100 million households are relying on **rooftop solar PV**	PVPS
Solar **PV and wind supply** about 40% of building electricity use	ES, ISGAN
350 million buildings connected to a **district energy network** (20% of heating needs)	DHC
Solar thermal technologies deployed in around 400 million dwellings	SHC
100% of global lighting sales in buildings are **LEDs** (by 2025)	4E
Residential **behaviour changes** lead to a reduction in heating and cooling energy use	USERS
By 2030 **Electric Vehicles** represent more than 60% of vehicles sold globally,	HEV

Initial objectives and achievements

Objectives:

- Unpack **recommendations** to achieve the building milestones in IEA Net Zero Report (thus Zero-carbon-ready buildings - ZCRB)
- Foster **cross-TCP exchanges** by developing, reviewing and editing analytical substance
- Provide an **entry point** for users unfamiliar with the TCP network
- Develop a product **jointly**, with participation of non-building TCPs

Achievements:

- Useful **perspectives** emerging from the report and useful for broader reflections
- **Transversal themes** emphasised in the introduction/conclusions.
- **Links highlighted** across different topics (related to each milestones)
- Relevant recent/predicted TCP **activities listed**
- **EV TCP** involved and interest from **Cities TCP**

Format

Coordination from the IEA secretariat and the sectoral (building) vice-chair of EUWP + several reviewers

Introduction/Conclusions: cross-cutting themes

Highlights/relevance: why the milestone is relevant for Net Zero by 2050 and transformation required

Current state: Technology availability related to the milestone

Challenges: Key risks and challenges to delivering on the milestone

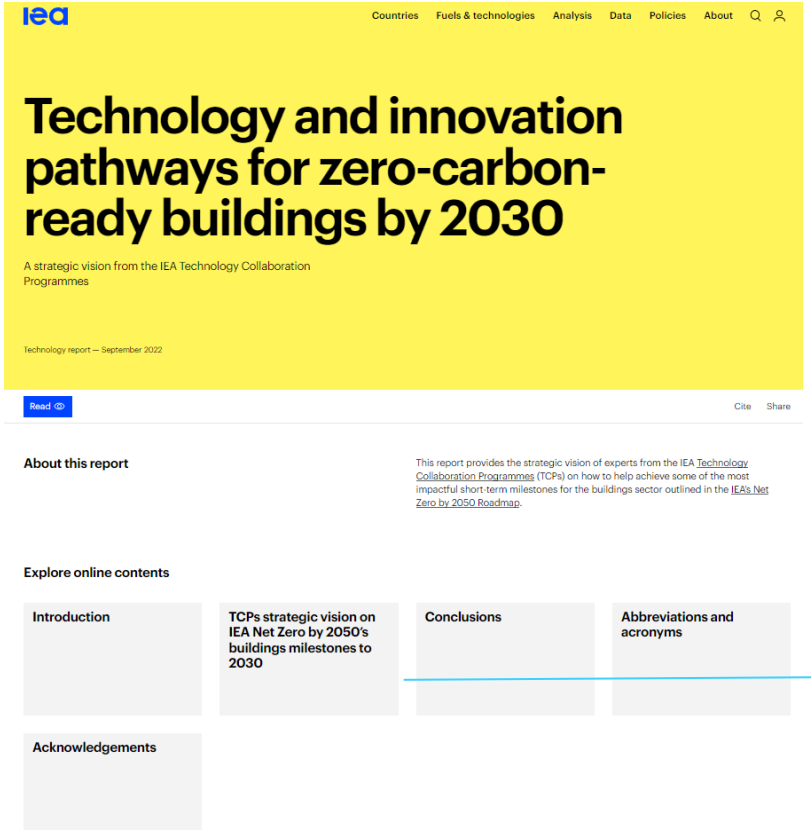
Innovation Themes: Priority R&D for the spread of zero-carbon ready buildings

Policy recommendations (grouped into recurrent categories):

- Market creation and standards (bans, standards, public procurement etc.)
- Planning instruments (urban planning, land-use planning, etc.)
- Economic and financial instruments (taxes, charges, subsidies, business models etc.)
- Cooperation-based instruments (voluntary commitments, collaboration platforms)
- Public support to R&D and Education and training (capacity building, labeling, etc.)

Publication webpage: landing page and access to different sections

https://www.iea.org/reports/technology-and-innovation-pathways-for-zero-carbon-ready-buildings-by-2030



Access to the different sections

Outcomes

Policy-recommendations

Market creation and standards	
Building codes review	• Adapt metrics to also include **carbon requirements**, and **flexibility** • Consider **mixed performance/prescriptive codes** for wider scope (e.g. circularity) • Establish **intergovernmental cooperation** on certification tools, monitoring and compliance
Create the market for RES-based and clean heating and cooling	• Ban “fuel-based technologies” (e.g. new fossil fuel boilers and coal-fired plants non in CHP) • Establish clean Heating and Cooling technology roadmaps
Planning instruments	
Integrated and holistic approach to local design and planning	• Develop **tools to combine EE and RES** measures into buildings and district renovation • Value the role of **digitalisation** for data harvesting and processing and to provide evidence-base • **Use life-cycle costing** to compare alternatives
Economic and financial instruments	
Accelerating technology deployment	• New **business models** (low income population, flexible operation, decision making …) • **Financial incentives** to reduce consumers’ upfront costs for ZCRB, make RES and energy storage systems more accessible, encourage manufacturing of domestic products (PV, LED) • Promote **flexible electricity prices** that reflect the carbon intensity of energy and products and make consumers choose smart options and shift use time
Education and training	
End user awareness and acceptance	• Show wider benefits of ZCRB through **awareness campaigns** and consultancy to end-users • Provide evidence using **demonstration cases** in target areas
Capacity building	• Promote **energy simulation tools** and training and upskilling packages for ZCRB supply chain • **Knowledge sharing** programmes, e.g. ‘twinning’ cities (DH, renovation)

Installation of about 600 million heat pumps covering 20% of buildings heating needs required by 2030

Challenges

- Higher **upfront costs** compared to fossil fuel-based heating options.
- Low **user awareness** and **acceptance** in some regions
- Fragmented policy support and obstacles

Innovation needs

- System **integration, flexibility, sector coupling, digitalization** ->DHC, PVPS, ES
- Systems for **retrofitted** and **multifamily** buildings ->EBC
- Extending **operating range**, cold climates, dehumidification, complex buildings ->EBC
- **Robust, sustainable** and **affordable** value chains
- **Safe** and **efficient** use of **low GWP** refrigerants

Policy recommendations

- Ban fossil fuel heating in boilers in new installations
- Invest in renewable electricity production and enforce the electric grid
- Reflect carbon content in energy pricing, taxes, incentives and subsidies, incentivize energy efficiency renovations
- Promote the development of MEPs and labelling schemes for smart, flexible operation of heat pumps
- Promote the development of open shared communication protocols for energy technologies
- Provide financial R&I support to advance heat pumps performance, system integration and innovations
- Support capacity building for installers of HP and public information campaigns

Common challenges

Urgent deployment and integration of available clean and efficient energy technologies

Innovation to achieve longer terms targets: lifetime perspective and systemic approach

Energy security: role of renovation, electrification (HP), RES integration and behaviour

- Improved technology performance (including noise, volume, aesthetics, health, maintenance/durability, controls)
- Reduced upfront costs of clean energy technologies (compared to fossil-based)
- Updated Code/Regulations (more evidence-based, easier to implement)
- Harmonized standards across countries
- New Tools and Processes (e.g. for integration into local planning)
- Impact improved by smart systems integration (HP PV, ES, Mobility) and interoperability
- Stakeholder awareness and better supply chain skills
- New suitable financial and business models
- Social inclusion and health

Innovation themes entailing further Collaboration

- Development of easy-to-use and reliable tools supporting **building codes**
- Life Cycle methodology to identify cost-effective **combinations of technologies** (including grids and H2)
- **Flexible operation, smart controls, system integration** with intermittent electricity generation and other electricity prosumers in the building (PV, ES, HP, EV, EBC, USERS)
- **Sector Coupling** and synergies across technologies and end-uses, in particular at the district and urban level (e.g. PV-SHC; HP-DHC; EBC, USERS) (reflected in new codes)
- **Energy data**, open-source models and protocols to maximise clean technologies uptake
- System solutions for **energy communities** and **positive energy districts** including necessary regulatory and social conditions (e.g. peer-to-peer models).
- Energy-efficient and cost-effective **cooling** strategies including district cooling

Collaboration opportunities within the BCG

2030 Milestones/TCP	Energy Storage	DHC	HPT	PVPS	SHC	EBC	USERS	EV	ISGAN
1. All countries targeted for **zero-carbon-ready codes** for new buildings (EBC BECWG)	System integration	New code metrics (including DHC and the e. grid.	MEPs and labelling schemes	Framework for BIPV	Solar planning	Behaviour **Cooling** HVAC calculation (tertiary b.), PECs	**Behavioural Insights**	EV Chargers/ Grid Integration	**Smart meters** Tarifs/ Codes
2. **Existing buildings** - 20% renovated to the ZCR level (EBC 75)	Storage systems design and control	Low temperature DH	**HP for NZEB**	System integration for deep retrofit	**Solar planning** Architecture Historic b.	**Flexibility** **Positive energy districts (PED)**	operation guidelines for PECS Hard to reach u.	EV Chargers/ Grid Integration	Grids improvement
3. **Heat pumps:** 600 million are installed covering 20% of buildings heating (HPT)	ES design and control Climate & Comfort Box Hybrid networks (sector coupling)	**RES Integration in existing** b. **Digitalisation**	HP for NZEB Large HP for retrofit (tertiary) HP in multifamily b. Ground source HP hybrid systems Connected devices Sector coupling	System integration with solar PV		New business models Building renovation at building and district level	**Behavioural Insights** (impact campaign Hard to r. users		New business models
4. Approximately 100 million households are relying on **rooftop solar PV** (PVPS)	**ES modelling and optimisation**	System integration: maximise local use of energy	Integrated smart controls	Efficiency Aesthetics Integrated (BIPV) LC impacts 100% RES Power System		Building renovation at building and district level **PED**	**Behavioural Insights** Acceptability Peer to P.	EV Chargers/ Grid Integration	

Ongoing collaboration Possible, mentioned by Authors Other opportunities

Collaboration opportunities within the BCG

2030 Milestones/TCP	ES -Energy Storage	DHC	HPT	PVPS	SHC	EBC	USERS	EV	**4E**	ISGAN
5. **Solar PV and Wind** supply about 40% of building electricity use by 2030 (ES - ISGAN)	**Compact Thermal ES** **ES Modelling**		Climate & Comfort Box	Integrated PV (BIPV) 100% RES Power System		**Positive energy districts Flexibility** B. Codes	**Peer-to-Peer, Community Social License**	EV Chargers/Grid Integration		**Grid solutions Flexibility markets**
6. **District Energy**: 350 million building units connected to a district energy network by 2030 (DHC)		Low T operation Hybrid networks District cooling Non-fossil low-T DH	Flexibility : HP in multi-vector energy systems and thermal networks HP in DHC		Solar DH- with higher T and digitalization Storage for DH	Demand Management of Buildings in Thermal Networks B. Codes	**Behavioural Insights** Acceptability			
7. **Solar Thermal**: 400 million dwellings use solar thermal by 2030 (SHC)	Compact thermal Storage	Solar DH			Solar planning Historic buildings Solar Cooling	PEDs Building Codes	Acceptability			
8. Targeting 100% **LED** lighting sales by 2025 (4E)					Integrated Solutions	B. Codes				
9. Residential **behaviour changes** lead to H&C energy reduction (USERS)	Confort and climate box	Smart district energy use			Solar neighborhood	PECS Behaviour B. Codes				**Smart meters** Tarifs/Codes

Ongoing collaboration | Possible, mentioned by Authors | Other opportunities

Follow up

- 2022 FBF (Canada, 19th-21st October): thematic sessions will deal with RD&D collaboration priorities and opportunities
- Next 2023 Building Coordination Group meeting
- A survey is on-going to gather feedback and thoughts from TCPs on the report

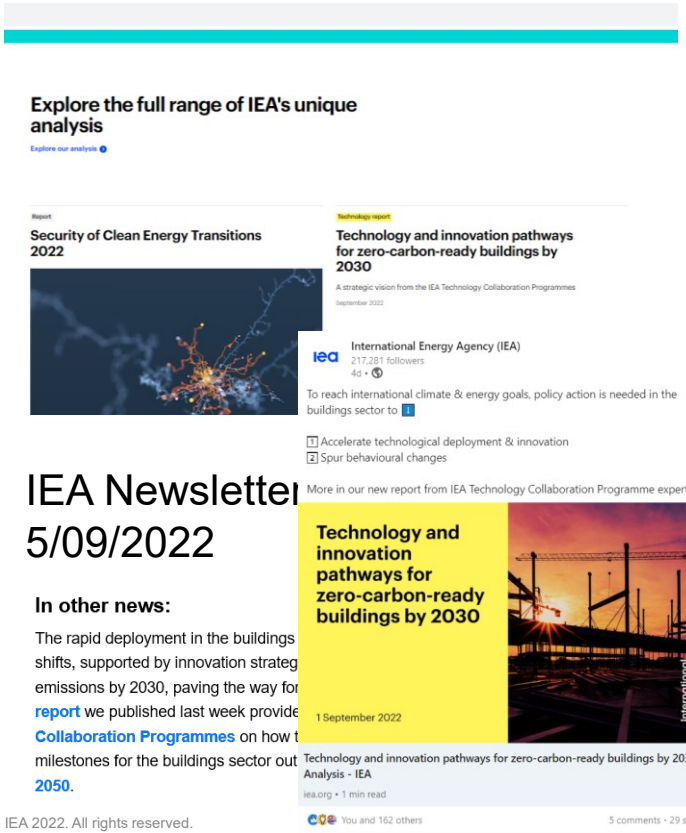
Other ideas:

- Better detect/track actual collaboration between TCPs
- Survey to prioritize policy recommendations and Innovation themes at **Country/regional level**

Communication

Communication plan: newsletters, websites and social networks

IEA Homepage and social



IEA Newsletter 5/09/2022

In other news:

The rapid deployment in the buildings
shifts, supported by innovation strateg
emissions by 2030, paving the way for
report we published last week provide
Collaboration Programmes on how t
milestones for the buildings sector out
2050.

TCPs' magazines & news