



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

A strategic vision from the IEA Technology Collaboration Programmes

Austrian IEA TCP Day, “Mission Net Zero“- Vienna, 27<sup>th</sup> September 2022

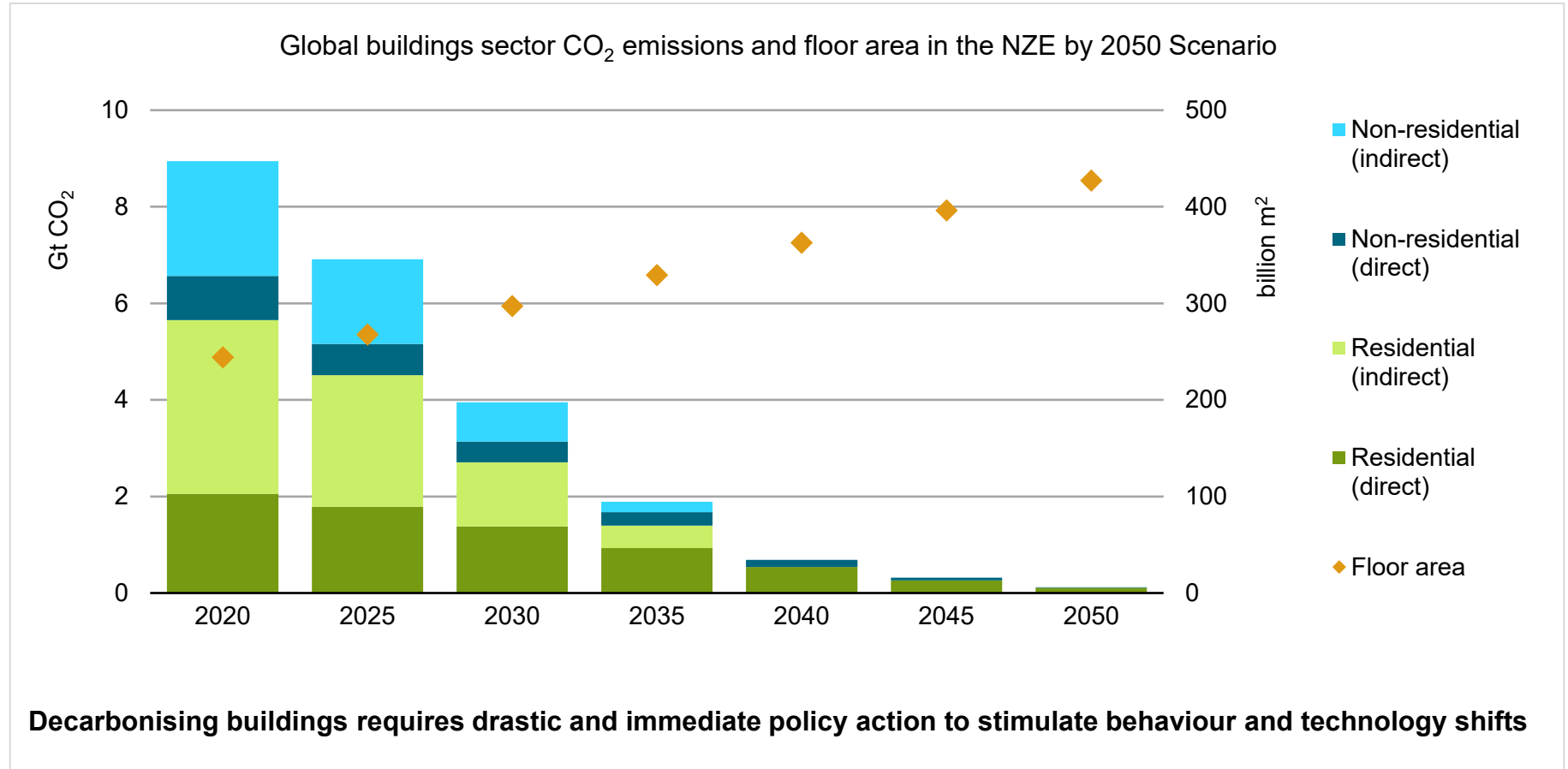
Ezilda Costanzo, IEA EUWP Building vice-chair (ENEA, IT)

Chiara Delmastro, International Energy Agency (IEA)



# Background and format

# Short terms actions are urgently needed to achieve 2050 goals



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

## 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**

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>

## About this report

This report provides the strategic vision of experts from the IEA [Technology Collaboration Programmes \(TCPs\)](#) on how to help achieve some of the most impactful short-term milestones for the buildings sector outlined in the [IEA's Net Zero by 2050 Roadmap](#).

## Explore online contents

Access to the different sections

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

### TCPs strategic vision on IEA Net Zero by 2050's buildings milestones to 2030

Series of articles' titles based on some of the most critical IEA Net Zero by 2050's buildings milestones to 2030

All countries targeted for zero-carbon-ready codes for new buildings by 2030

[Learn more](#)

Renovation of near 20% of existing building stock to zero-carbon-ready by 2030 is ambitious but necessary

[Learn more](#)

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

[Learn more](#)

Approximately 100 million households rely on rooftop solar PV by 2030

[Learn more](#)

Solar PV and wind supply about 40% of building electricity use by 2030

[Learn more](#)

350 million building units connected to district energy networks by 2030, provide about 20% of space heating needs

[Learn more](#)

Solar thermal technologies deployed in around 400 million dwellings by 2030

[Learn more](#)

Targeting 100% LED lighting sales by 2025

[Learn more](#)

Residential behaviour changes lead to a reduction in heating and cooling energy use by 2030

[Learn more](#)

By 2030 EVs represent more than 60% of vehicles sold globally, requiring an adequate surge in chargers installed in buildings

[Learn more](#)

## TCPs strategic vision



# Outcomes



Market creation and standards	
Building codes review	<ul style="list-style-type: none"> <li>Adapt metrics to also include <b>carbon requirements</b>, and <b>flexibility</b></li> <li>Consider <b>mixed performance/prescriptive codes</b> for wider scope (e.g. circularity)</li> <li>Establish <b>intergovernmental cooperation</b> on certification tools, monitoring and compliance</li> </ul>
Create the market for RES-based and clean heating and cooling	<ul style="list-style-type: none"> <li>Ban “fuel-based technologies” (e.g. new fossil fuel boilers and coal-fired plants non in CHP)</li> <li>Establish clean Heating and Cooling technology roadmaps</li> </ul>
Planning instruments	
Integrated and holistic approach to local design and planning	<ul style="list-style-type: none"> <li>Develop <b>tools to combine EE and RES</b> measures into buildings and district renovation</li> <li>Value the role of <b>digitalisation</b> for data harvesting and processing and to provide evidence-base</li> <li><b>Use life-cycle costing</b> to compare alternatives</li> </ul>
Economic and financial instruments	
Accelerating technology deployment	<ul style="list-style-type: none"> <li>New <b>business models</b> (low income population, flexible operation, decision making ...)</li> <li><b>Financial incentives</b> to reduce consumers’ upfront costs for ZCRB, make RES and energy storage systems more accessible, encourage manufacturing of domestic products (PV, LED)</li> <li>Promote <b>flexible electricity prices</b> that reflect the carbon intensity of energy and products and make consumers choose smart options and shift use time</li> </ul>
Education and training	
End user awareness and acceptance	<ul style="list-style-type: none"> <li>Show wider benefits of ZCRB through <b>awareness campaigns</b> and consultancy to end-users</li> <li>Provide evidence using <b>demonstration cases</b> in target areas</li> </ul>
Capacity building	<ul style="list-style-type: none"> <li>Promote <b>energy simulation tools</b> and training and upskilling packages for ZCRB supply chain</li> <li><b>Knowledge sharing</b> programmes, e.g. ‘twinning’ cities (DH, renovation)</li> </ul>

# 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

**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

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

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

- 2022 FBF (Canada, 19<sup>th</sup>-21<sup>st</sup> 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

## TCPs' magazines & news

### Explore the full range of IEA's unique analysis

Explore our analysis

#### Report Security of Clean Energy Transitions 2022



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

A strategic vision from the IEA Technology Collaboration Programmes  
September 2022

**International Energy Agency (IEA)**  
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To reach international climate & energy goals, policy action is needed in the buildings sector to

- Accelerate technological deployment & innovation
- Spur behavioural changes

More in our new report from IEA Technology Collaboration Programme experts

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

1 September 2022

Technology and innovation pathways for zero-carbon-ready buildings by 2030 – Analysis - IEA  
iea.org • 1 min read

## IEA Newsletter 5/09/2022

### In other news:

The rapid deployment in the buildings shifts, supported by innovation strategies, emissions by 2030, paving the way for [report](#) we published last week provide [Collaboration Programmes](#) on how to milestones for the buildings sector out 2050.

#### HEAT PUMPING TECHNOLOGIES NEWS

### Release of IEA report “Technology and innovation pathways for zero-carbon-ready buildings by 2030 – A strategic vision from the IEA Technology Collaboration Programmes”

On September 1<sup>st</sup>, 2022, IEA released a report which provides the strategic vision of experts from the IEA Technology Collaboration Programmes (TCPs) on how to help achieve some of the most impactful short-term milestones for the buildings sector outlined in the IEA Net Zero by 2050 Roadmap. The report consists of 10 articles and each article's title reflects one of these milestones.

The rapid deployment in the building sector of clean energy technologies and behavioral shifts, supported by innovation strategies, has the potential to significantly reduce carbon dioxide (CO<sub>2</sub>) emissions by 2030 and paves the way to achieve the zero-carbon buildings stock targets under the IEA's Net Zero Emissions by 2050 Scenario (NZE Scenario). Buildings operations account directly and indirectly for approximately 30% of global energy sector emissions.

Reaching those targets for a zero-carbon buildings stock by 2050 is a significant challenge, but one that also opens important opportunities. The current decade is a critical period for governments to put in place policy frameworks and regulations to support this vision. Technologies that are available on the market today are theoretically able to provide nearly all of the emissions reductions required by 2030 in the NZE Scenario, but a multitude of complex issues make full implementation very challenging at present.

In this report, experts from the IEA Technology Collaboration Programmes (TCPs) provide their strategic vision on how to overcome the challenges and offer recommendations for the technology solutions.

strategies and policy instruments needed to help reach the required milestones for buildings by 2030 outlined in the NZE Scenario—valuable benchmarks on the way to 2050.

Series of articles' titles based on some of the most critical IEA Net Zero by 2050's buildings milestone to 2030

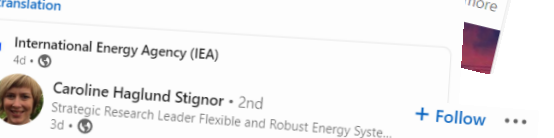
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- Solar PV and wind supply about 40% of built electricity use by 2030
- 350 million building units linked together district energy networks by 2030, provide a 20% of space heating needs
- Solar thermal technologies deployed in around 400 million dwellings by 2030
- Targeting 100% LED lighting sales by 2025
- Residential behavior changes lead to a reduction in heating and cooling energy use by 2030
- By 2030 EVs represent more

The report's article titled "Installation of about 600 million is covering 20% of buildings heating needs by 2030" was authored and reviewed by experts from the IEA Technology Collaboration Program on Heat Pumping (HPT) TCP.

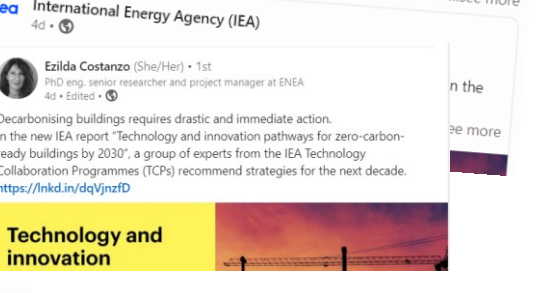
Figure 1. Global buildings sector CO<sub>2</sub> emissions and floor area in the Net Zero Emissions by 2050 Scenario. Sources: Data from IEA's Net Zero by 2050 Roadmap for the Global Energy Sector. All rights reserved.



Quali sono le soluzioni per ottenere edifici ad emissioni 0? Qual è il ruolo del settore dell'edilizia nel processo di decarbonizzazione? Il nuovo report dell'[International Energy Agency \(IEA\)](#) evidenzia le tecnologie e le innovazioni del settore necessarie per il processo di transizione



Proud to be one of the main authors of the articles in this report - about what is needed to accelerate deployment and innovations for heat pumps - the primary technology driving reduced emissions from heating in the bu... see more



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