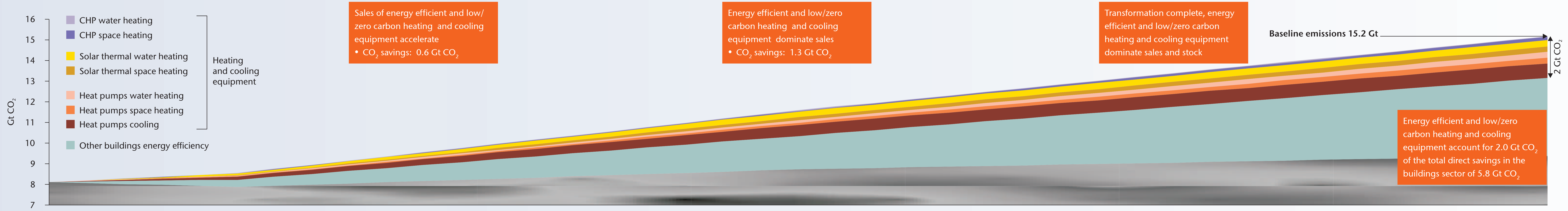
IEA Roadmap targets

International Energy Agency

Key findings

- Low/zero-carbon and energy-efficient heating and cooling technologies for buildings have the potential to reduce CO_2 emissions by up to 2 gigatonnes (Gt) and save 710 million tonnes oil equivalent (Mtoe) of energy by 2050. Most of these technologies – which include solar thermal, combined heat and power (CHP), heat pumps and energy storage – are commercially available today.
- An additional USD 3.5 billion a year needs to be made available for research and development (R&D) by 2030. R&D efforts should focus on reducing costs and improving the efficiency and integration of components. R&D into hybrid systems could lead to highly efficient, low-carbon technologies (e.g. integrated solar thermal/heat pump systems, CHP). Beyond 2030, R&D needs to focus on developing technologies that go beyond the best that are currently available.
- Governments need to create the economic conditions that will enable heating and cooling technologies to meet environmental criteria at least cost. Policies need to be "broad" to address specific barriers (*e.g.* lack of installer awareness) and "deep" to reach all of the stakeholders in the fragmented building sector.
- Governments should develop national roadmaps, tailored to local circumstances, which help to drive market expansion, advance systems development and integration, shape supportive policy and enhance collaboration. Policies should set measurable and meaningful targets, such as CO_2 emissions reductions, or ensure that programme effectiveness is verified regularly.



Roadmap action plan

Regulatory framework and support schemes

- Convene policy co-ordination group and review existing policies
- Develop national and/or regional roadmaps and vision for buildings, including heating and cooling equipment
- Streamline policy framework for buildings and remove barriers from current non-energy and environment policy goals/regulatory frameworks
- Develop an integrated policy package in consultation with stakeholders (conduct periodic ex-post reviews of effectiveness)
- Implement policy package, including framework for the support of heating and cooling technologies
- Internalise the external costs of heating and cooling equipment
- Implement support policies for specific heating and cooling technologies
- Gradually phase out technology-specific support mechanisms and transition to technology neutral policies

Market facilitation and transformation

- Harmonise international test procedures to facilitate trade and transparency on performance
- Improve education and training of building sector professionals with energy efficient/low carbon heating and cooling technologies
- Develop installer certification and product quality labelling schemes where not currently available
- Improve information available to decision-makers (architechts, engineers, installers, equipment purchasers, etc.)
- Develop effective communication strategies to raise awareness and understanding of energy and CO_2 savings opportunities in heating and cooling equipment
- Consolidate all installer certification and equipment quality labeling schemes into one overarching system for heating and cooling equipment
- Introduce efficiency/CO_2 labelling schemes for all heating and cooling equipment
- Transition to mandatory CO_2 based labelling schemes

Technology development and R&D

- Develop cross-stakeholder consensus on the importance of stable long-term RD&D funding for buildings
- Develop specific RD&D short- and long-term goals for heating and cooling technologies to meet national roadmaps
- Make an additional USD 3.5 billion per year available for heating and cooling tehcnology RD&D by 2030

Key actions over the next ten years:

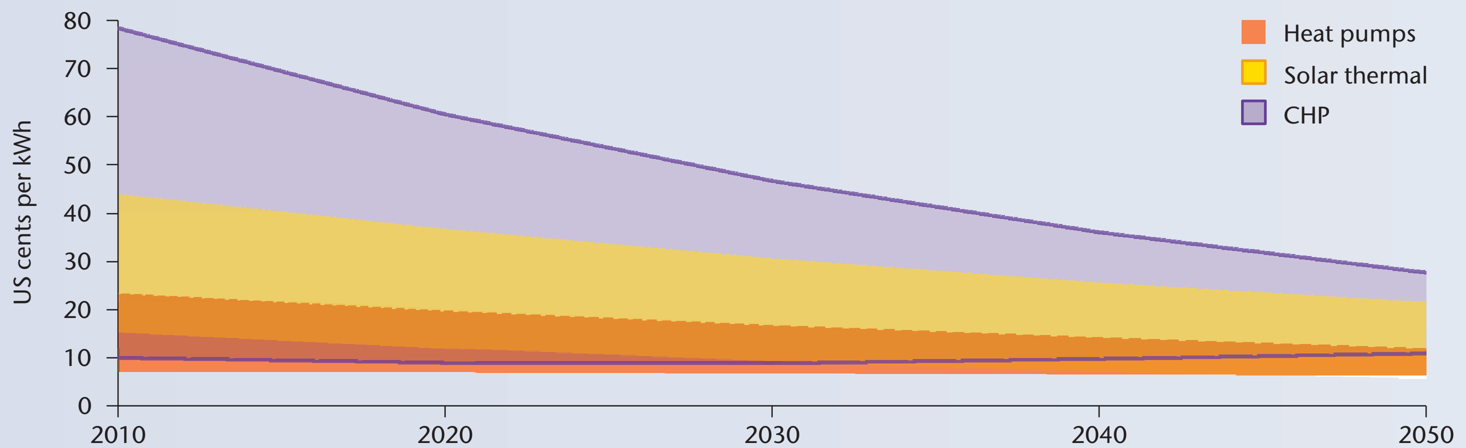
- Policy working groups should be convened that include stakeholders from all areas of government to develop policy and ensure that other buildings policies (*e.g.* fire, equipment safety, local planning, etc.) are aligned with energy-efficient and low-carbon technology priorities, or at least are not barriers to their deployment.
- Policies such as minimum energy performance standards, labelling, utility programmes and financial incentives need to be implemented to address market barriers – such as high initial costs and low priority of energy efficiency in decision-making – and market failures (e.g. principal-agent problems, transaction costs, search costs, compliance issues).
- Governments should improve standard education of key professionals, such as architects, designers, engineers, builders and building owners and operators/users.
- A wide variety of standardised information packages, tailored to individual decision makers' needs, should be developed to allow decision makers to compare the potential of technology alternatives, identify performance targets and energy and CO_2 savings at the time of design or purchase. Governments need to highlight the role of technologies in reducing financial risks, such as energy and carbon price volatility.
- Governments should expand and/or implement mandatory quality assurance and certification schemes for equipment and installers (including training) and harmonise these across the heating and cooling technology industry.
- Industry and governments need to work together internationally on R&D, market deployment, performance and test procedures, harmonisation/comparability of heating and cooling system tests, and policy development.

Energy-efficient Buildings

Heating and Cooling Equipment

Cost reduction and R&D goals

Delivered energy cost reduction goals

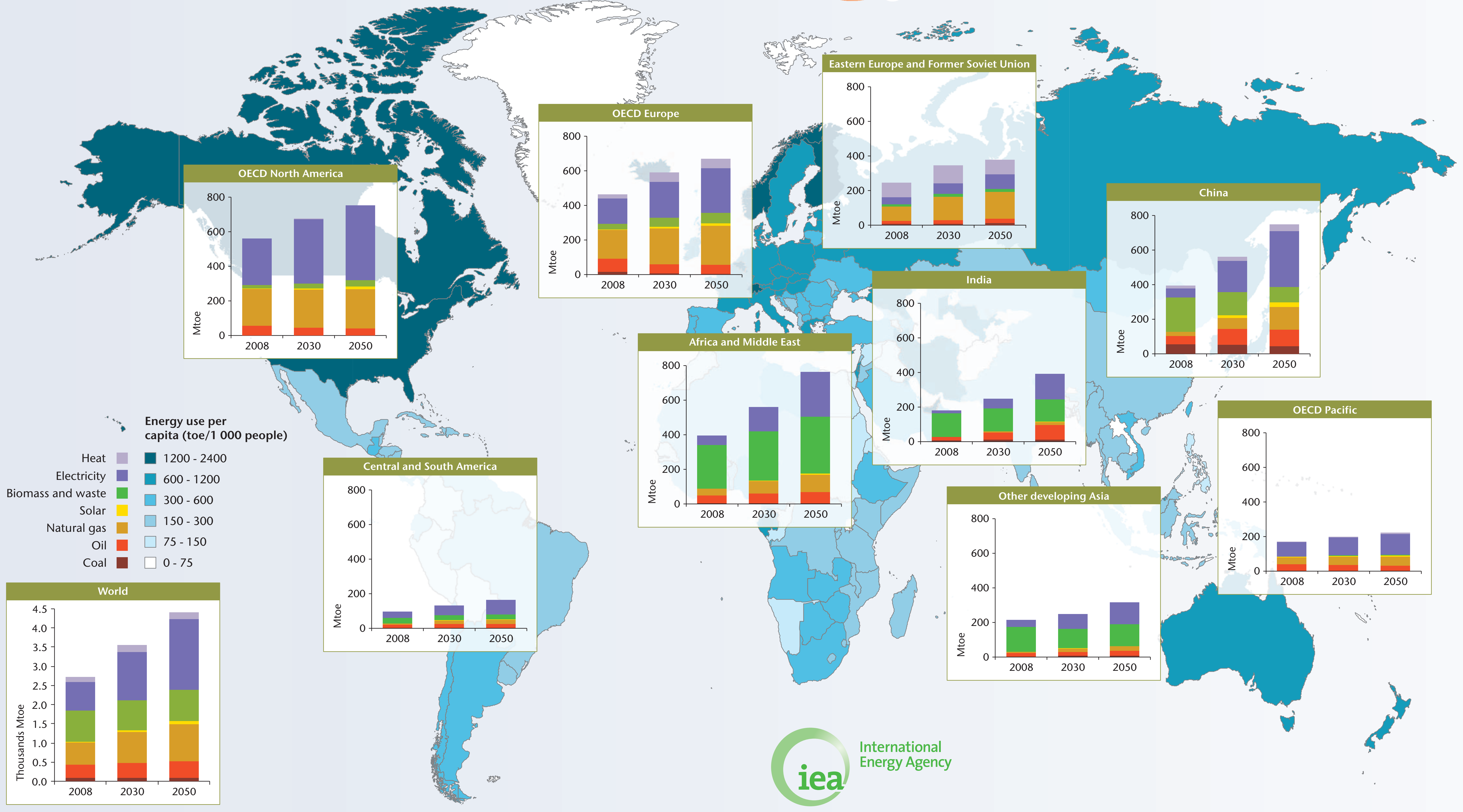


Cost and performance goals for heating and cooling technologies 2020, 2030 and 2050

	2020		2030		2050	
Active solar thermal						
Installed cost	-30% to -50%		-50% to -75%		-50% to -75%	
Maintenance cost	0% to -40%		0% to -40%		0% to -40%	
Delivered energy cost	-30% to -45%		-50% to -60%		-50% to -65%	
Thermal energy storage	PCM, thermal-chemical and centralised		PCM, thermal-chemical and centralised		PCM, thermal-chemical and centralised	
Installed cost	-35% to -50%		-50% to -75%		-65% to -85%	
Delivered energy cost	Depends on cycle regime		Depends on cycle regime		Depends on cycle regime	
Heat pumps	Space/water heating	Cooling	Space/water heating	Cooling	Space/water heating	Cooling
Installed cost	-10% to -20%	-5% to -15%	-20% to -30%	-5% to -15%	-30% to -40%	-5% to -20%
Coefficient of performance	10% to 20% improvement	10% to 30% improvement	30% to 50% improvement	20% to 40% improvement	40%to 60% improvement	30% to 50% improvement
Delivered energy cost	-10% to -20%	-10% to -15%	-20% to -30%	-10% to -20%	-30% to -40%	-15% to -25%
CHP	Fuel cells	Microturbines	Fuel cells	Microturbines	Fuel cells	Microturbines
Installed cost	-20% to -40%	-5% to -10%	-40% to -55%	-20% to -30%	-60% to -75%	-30% to -50%
Electrical efficiency	30% to 37%	25% to 35%	35% to 40%	30% to 35%	35% to 45%	35% to 40%
Total efficiency	70% to 80%	65% to 70%	75% to 80%	70% to 75%	75% to 85%	75% to 85%
Delivered energy cost	-15% to -35%	-5% to +5%	-45% to -65%	-10% to +5%	-75% to -85%	-15% to +20%

Note: Improvements in costs or performance are expressed as a percentage relative to the base year (2010) specification. However, the electrical and total efficiencies for CHP are actual percentages, not improvements. For fuel cells, the delivered energy cost is for thermal energy and is based on a long-run cost of CO_2-free hydrogen of between USD 15/GJ and USD 25/GJ in 2050.

Buildings sector energy demand today and in the Baseline Scenario to 2050



2050 Blue Map energy consumption in buildings (Mtoe)

Service sector	175	246	90	116	40	76	79	34	59	65	
Residential	OECD Europe 239	OECD North America 264	OECD Pacific 67	China 313	India 258	Other developing Asia 170	Eastern Europe and Former Soviet Union 151	Central and South America 92	Africa 243	Middle East 121	

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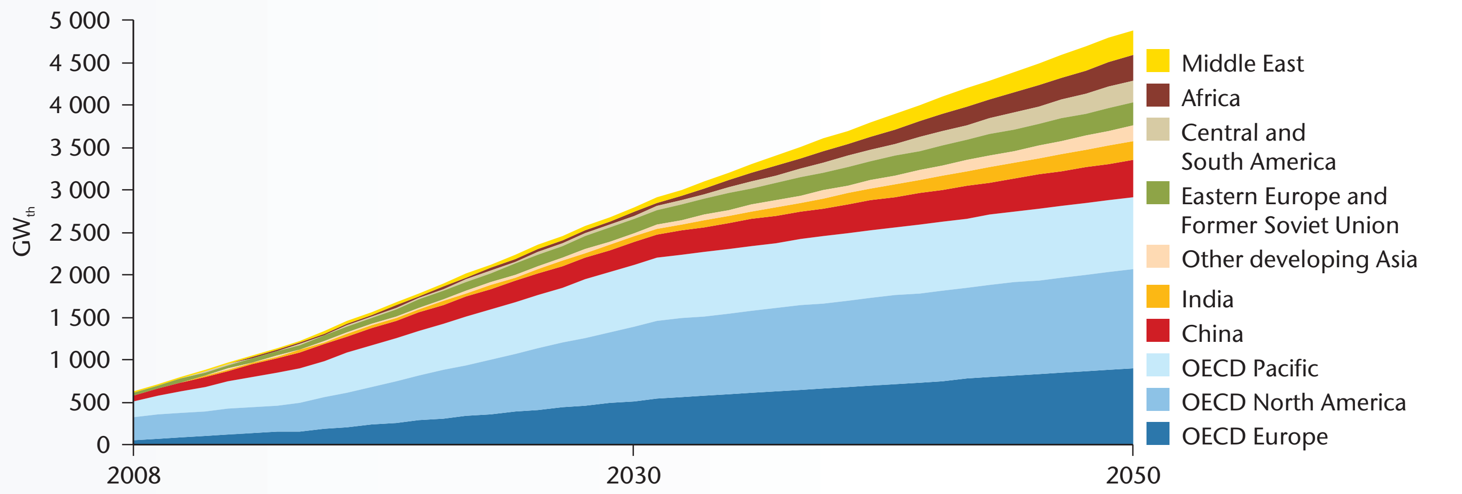
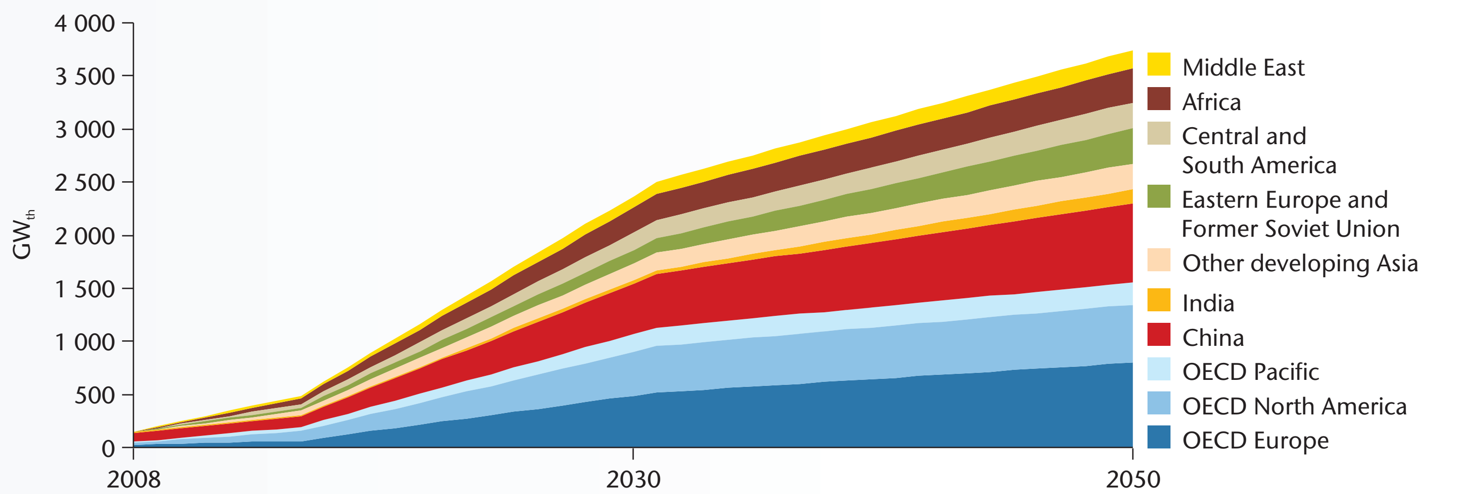
Heating equipment deployment in the BLUE Map Scenario

Heat pumps



Solar



CHP