CONGRESS EUROHEAT VIENNA 2013 & POWER

36th Euroheat & Power Congress

27-28 May 2013, Vienna, Austria

Future sustainable housing:

realities, needs and possibilities

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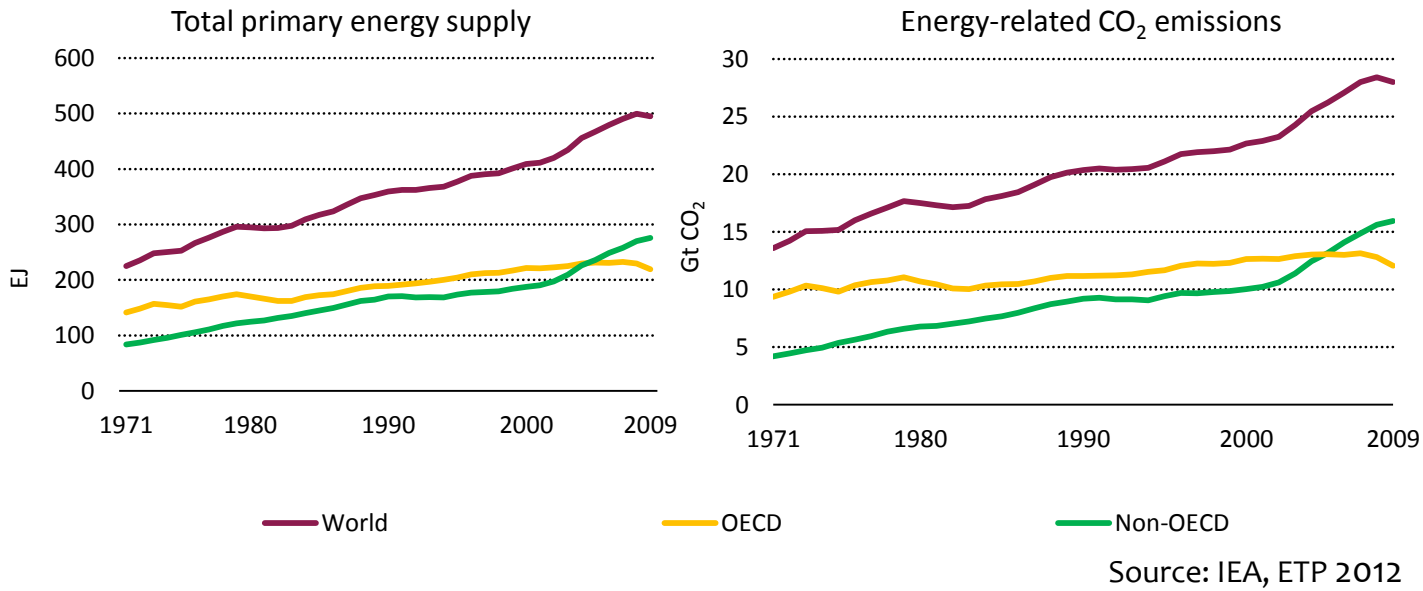
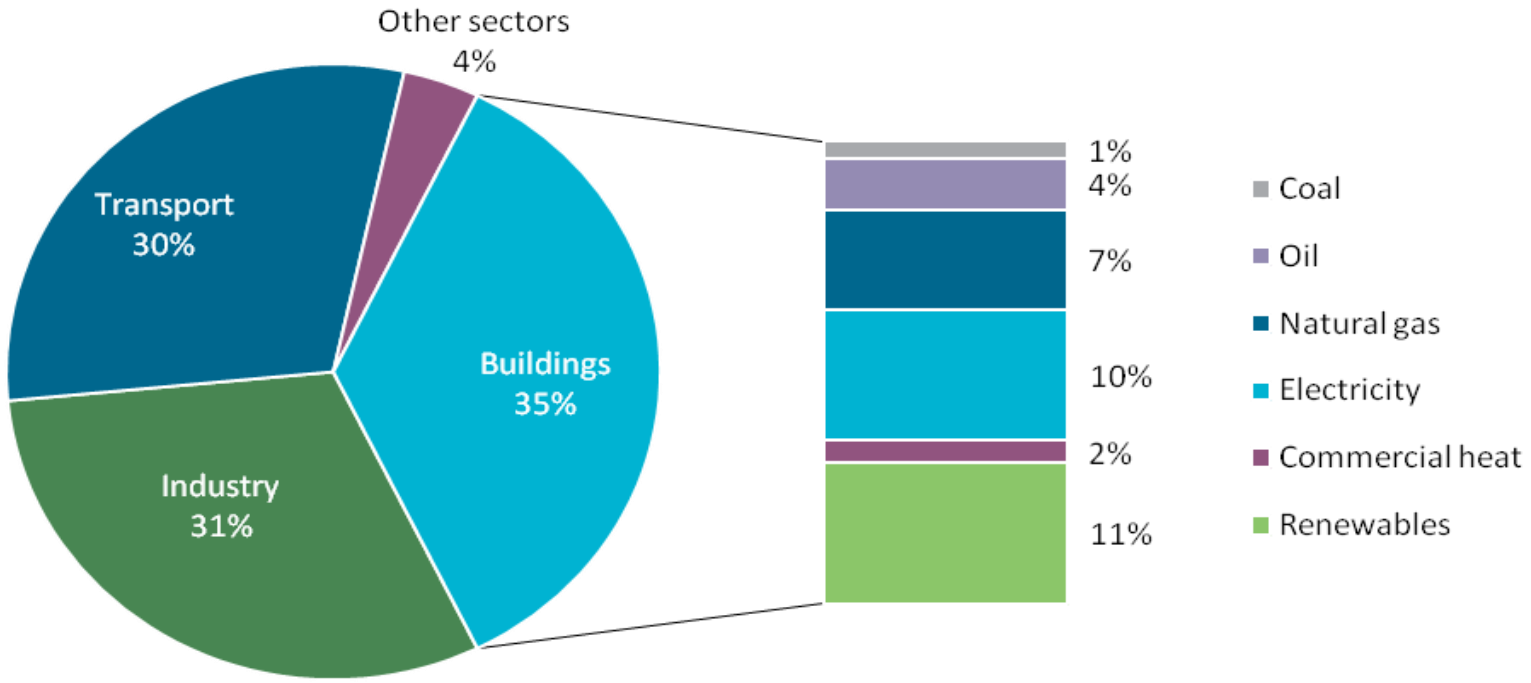
Energy and Emission Growth



Source: IEA, ETP 2012

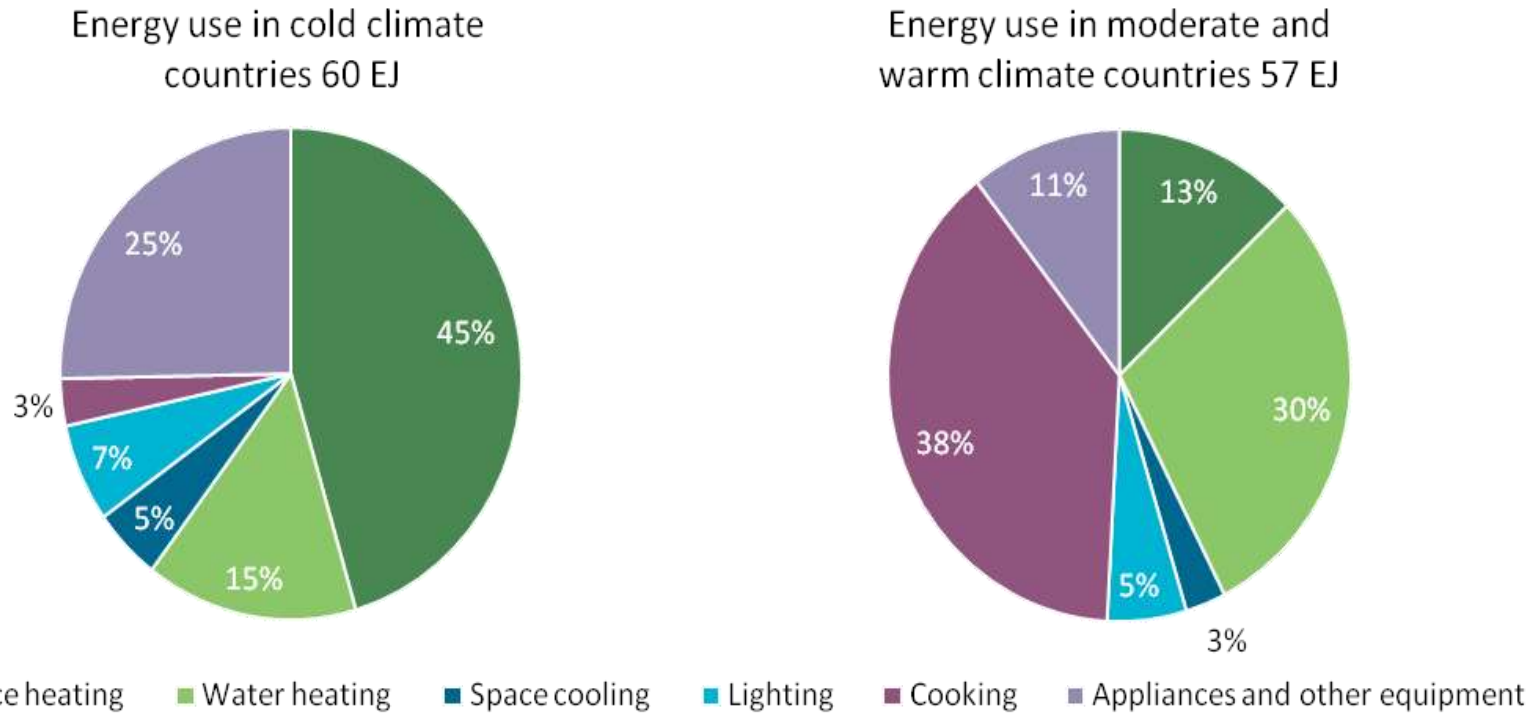
We need to accelerate energy efficiency policies to curtail growth – 2.5 billion people expected to be added to planet by 2050

Final Energy Consumption by Sector and Buildings Energy Mix, 2010



Source: IEA Buildings Model

Building End-Use Energy Consumption, 2010

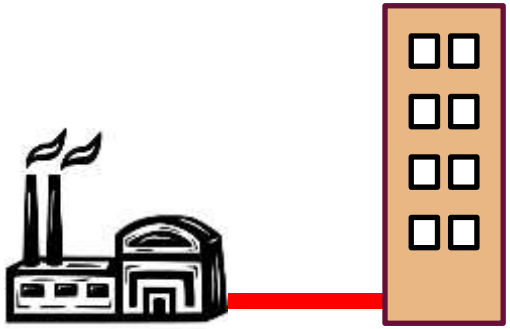


Source: IEA Buildings Model

District Heating Old vs New

Old

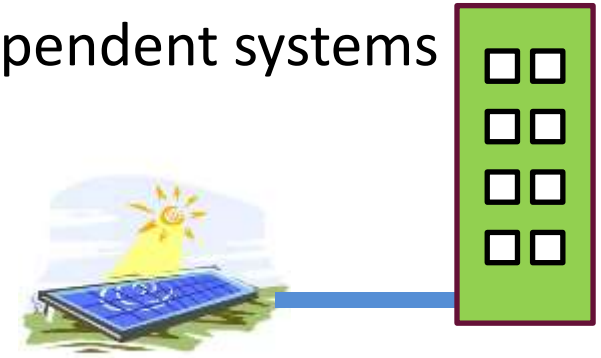
- Objective: highest heat load possible
- Driver: providing basic service, driven by cost



Source: inefficient fossil fuel boilers
Distribution: high temperature, poorly insulated (>20% loss)
Load: poor building envelope without individual control

New

- Objective: highest environmental benefit at least cost
- Driver: best choice compared to independent systems



Source: renewable, waste heat or high performance co-generation (CHP)
Distribution: low to moderate temperature, highly insulated and sealed (< 10% loss)
Load: highly insulated and sealed walls, roofs, and windows; smart controls

Core Building Technologies:
Compatible with Modern DHC

- Highly insulated windows in cold climates, including low cost retrofit solutions for all climates
- Exterior, cavity and interior wall insulation
- Insulated and reflective roofs
- Validated air sealing with controlled ventilation
- Heat pumps utilising low grade temperature distributed network to provide space and water heating
- Combined with on-site PV to obtain urban zero energy buildings
- Integrated daylighting facades and efficient solid state lighting
- Advanced control systems including low cost sensors and controls for older piping systems with multiple feeds per living unit

Alternatives to Provide Heat to Buildings, Macro Perspective

- Compare sources: conventional on-site boilers, conventional district heating boilers, co-generation (combined heat and power), waste heat with heat pumps, more efficient boilers, and distributed renewable energy systems[1]
- Rough approximation for primary energy impact considering full energy consumption for electricity using existing global heat and power shares for the building sector and current fossil fuel electricity generation efficiency
- Advanced building technologies to reduce heating loads (50%) and modest reduction in electricity loads (25%)
- Integrated CHP and waste heat with advanced buildings
- Comparison to advanced buildings, heat pumps, and on-site photovoltaic (PV) cells

1 Could be substituted with higher grade waste heat.

Alternatives to Provide Heat to Buildings, Macro Perspective

Options	Power/ Heat	Central Efficiency	DH/CHP Efficiency	On-Site Efficiency	Distribution	On-site Demand	Final Consumption	Primary Consumption	Total Consumption	Percent Change
Conventional, On-site Heat	Electricity	37%			N/A	31	31	84	153	Base
	Heat			75%	N/A	52	69	69		
Old District Heat Boiler	Electricity	37%			N/A	31	31	84	176	15.1%
	Heat		75%		25%	52	92	92		
Modern DH with CHP	Electricity	37%	25%		N/A	31	18	49	133	-12.9%
	Heat		50%		10%	52	115	115		
Waste Heat for Heat Pump	Electricity	37%			N/A	31	31	84	118	-22.6%
	Heat Pump			450%	10%	52	13	35		

Actual global building shares for heat and electricity (100% on-site).

Building Energy Efficiency (Reduced Demand)

Options	Power/ Heat	Central Efficiency	DH/CHP Efficiency	On-Site Efficiency	Distribution	Reduced Demand	Final Consumption	Primary Consumption	Total Consumption	Percent Change
Advanced Bldg (Envelope & Boiler)	Electricity	37%			N/A	23	23	63	90	-41.0%
	Heat			95%	N/A	26	27	27		
Advanced Bldg with Modern DH & CHP	Electricity	37%	25%		N/A	23	10	28	68	-55.6%
	Heat		50%		10%	26	58	58		
Advanced Bldg with Waste Heat & HP	Electricity	37%			N/A	23	23	63	80	-47.6%
	Heat Pump			450%	10%	26	6	17		
Advanced Bldg with Renewable DH	Electricity	37%			N/A	23	23	63	52	-66.0%
	Heat		100%		10%	26	29	29		
Advanced Bldg with HP and PV On-Site	Electricity			100%	N/A	23	23	23	32	-79.1%
	Heat			300%	N/A	26	9	9		

Assumptions.

Results compared to base.

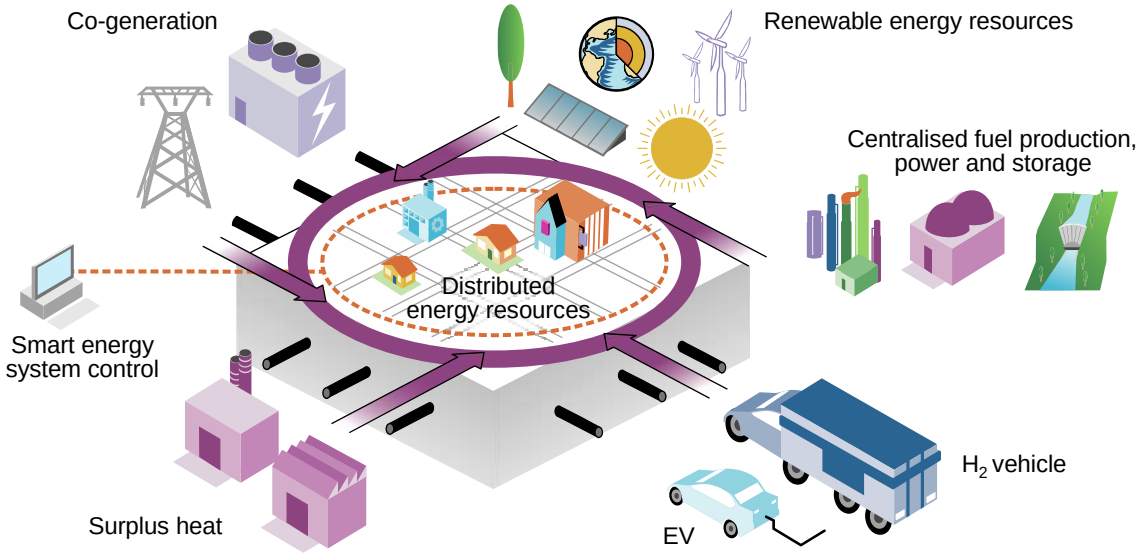
Preliminary Findings

- Advanced buildings are needed to achieve major savings
- Modern district heating is fully compatible with advanced buildings
- District heating with central renewable energy can save almost as much energy (66%) compared to on-site PV integrated systems (79%)
- More detailed analysis and environmental analysis required

Future Perspectives

- Advanced insulation has greatest value on piping due to geometry, high performance has least surface area (aerogels, vacuum insulated panels, etc)
- Old networks may need to be reconfigured with multiple small nodes using micro-turbine and fuel cell co-generation
- District heating and cooling will be most beneficial when renewable, waste heat, and free cooling are the prime driver
- Systems perspectives will need to be assessed and compared to standalone individual building solutions
- Integration with other sectors and advanced storage may create new opportunities

Future Integrated Systems



Sector integration (buildings, industrial, transportation, and power generation) will become a major focus of the future, clean energy supply and demand systems.

IEA CHP/DHC Collaborative Phase III Work Programme

A. Country CHP/DHC scorecards

- ✓Overview of CHP/DHC: national level
  - ✓ Technology
  - ✓ Market activity
  - ✓ Policy
- ✓Applied case studies
- ✓Policy recommendations
- ✓Country rating → benchmarking

- **•CHP average performance**
- **•CHP capacity breakdown by size and technology type**
- **•DHC energy supply mix**

- **•High level view of expected (2-5years) market development**

- **•Policy implementation for announced targets**

IEA CHP/DHC Collaborative Phase III Work Programme

B. Analysis report: *The role of CHP and DHC in the future energy system*

✓Develop a compendium of case studies: industrial CHP and integrated approaches of CHP with DHC

✓This will be the basis for the analysis:

- ✓Identify market failures
- ✓Distil lessons learned
- ✓Measures to overcome existing barriers to deployment
- ✓Impact of geographical conditioning

C. Next Event: IEA Workshop, Fall 2013

Current IEA Building Activities

- Comprehensive Building Technologies Publication (available soon)
  - Energy savings forecast to 2050
  - Regional analyses
  - Key technology descriptions and recommendations
  - Recommended policy action
- Building Envelope Roadmap
- Enhanced Building Modeling Collaboration with Stakeholders

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