

# edilportale® TOUR

## Renovation Wave

La decarbonizzazione dei sistemi di riscaldamento e del  
raffrescamento

**Andrea Gasparella**

Ancona, 12 ottobre 2022

STAGE



Embodied

Embodied

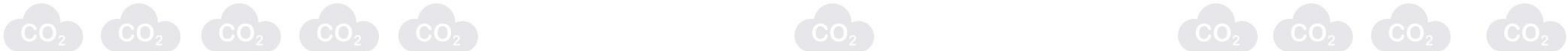
Embodied

**Operational**

Embodied

Embodied

GHG Emissions



Time



Extract raw materials

Transport to factory

Manufacture products

Transport to site

Construct the building

**Use** and maintain the building

Demolish the building

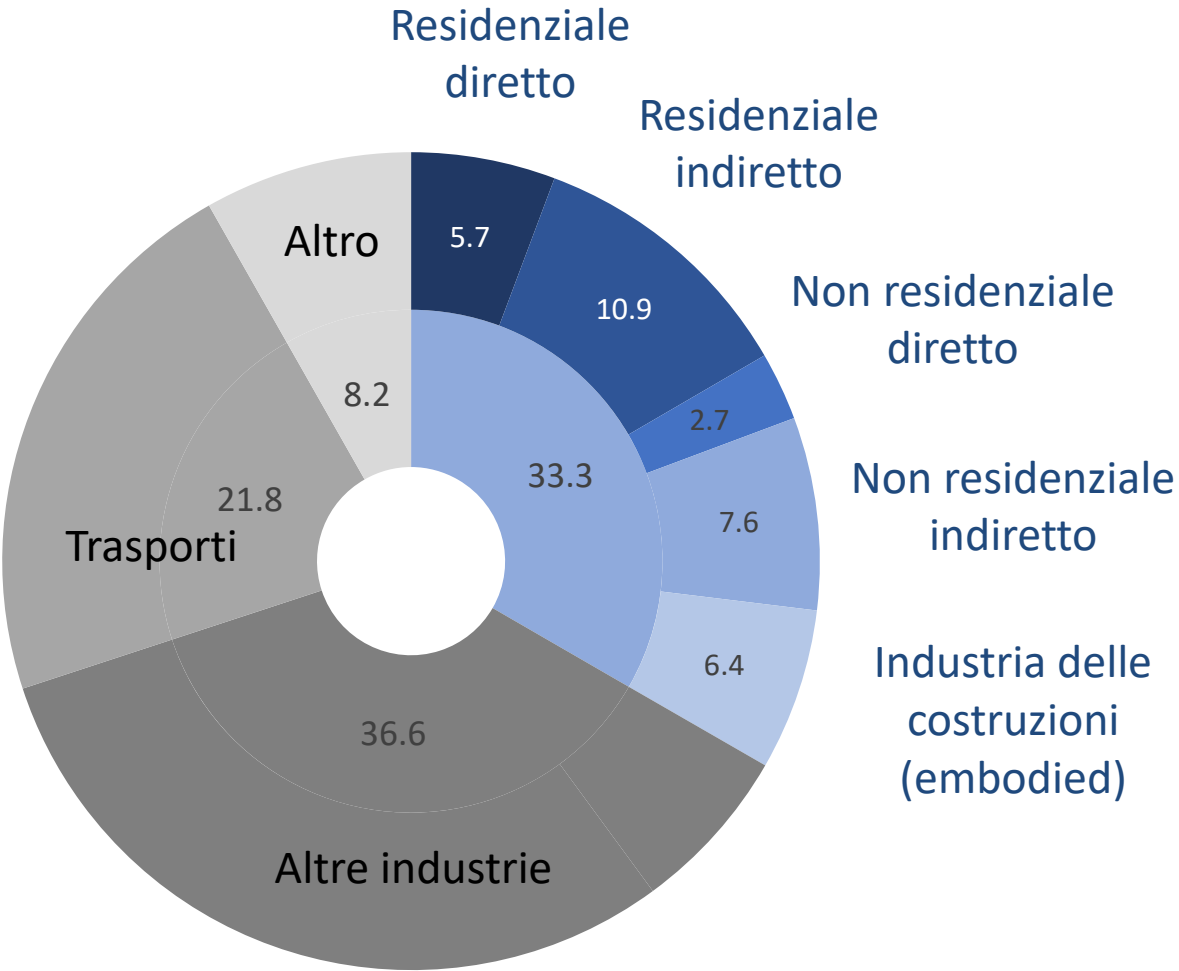
Haul away waste materials

Landfill (or recycle)

Reuse/Recovery



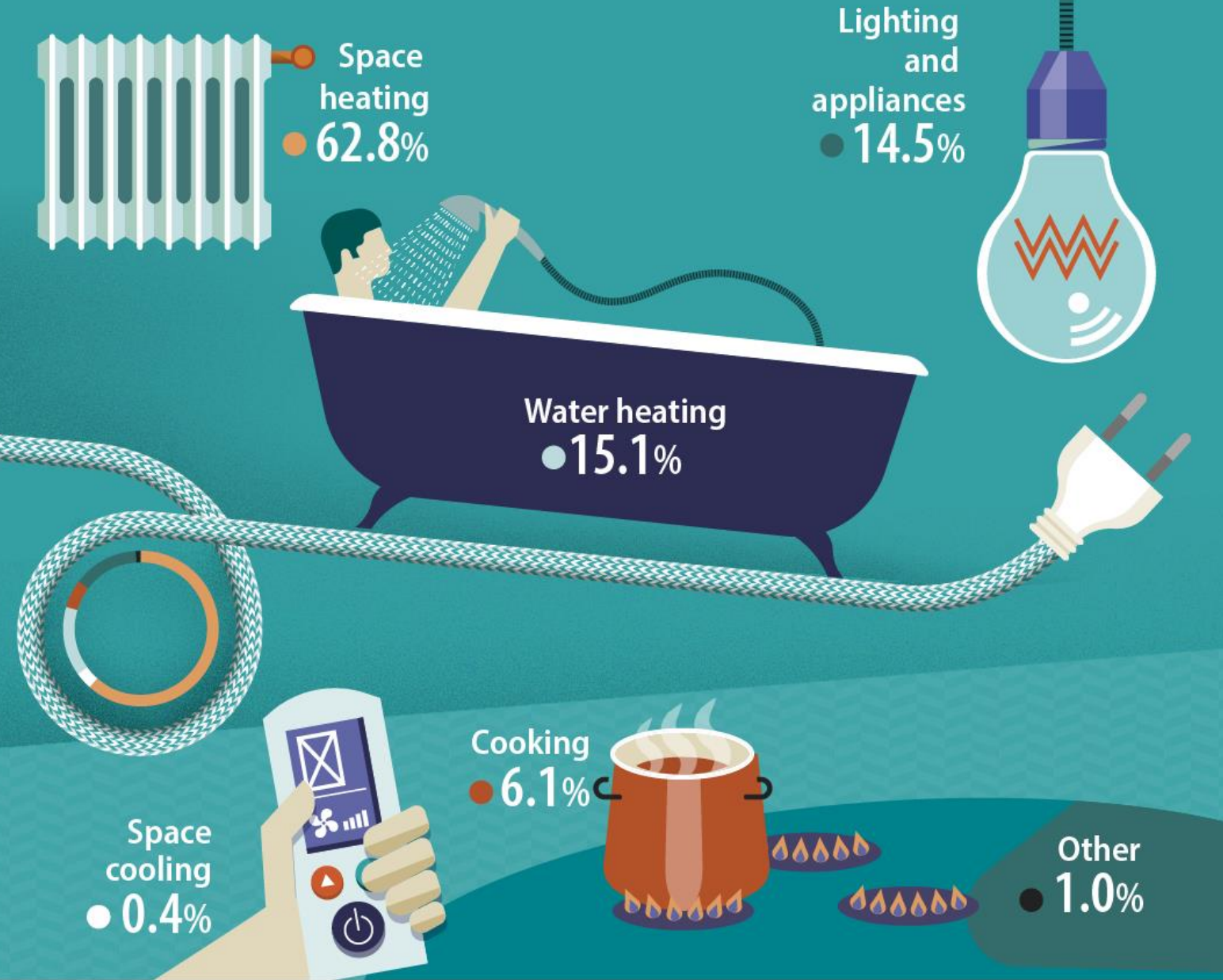
MODULE



# Global energy and process emissions from buildings, including embodied emissions from new construction 2021

Direct energy related emissions are from the direct consumption of fossil fuels in buildings, such as natural gas for heating. Indirect energy-related emissions are from electricity generation or during the sourcing, processing, and transportation of fuels attributed to the building

# Energy consumption in EU households (2020)



## Share of final energy consumption in the residential sector by type of end-use, 2020

(%)

	space heating	space cooling	water heating	cooking	lighting and electrical appliances	other end use
<b>EU</b>	<b>62.8</b>	<b>0.4</b>	<b>15.1</b>	<b>6.1</b>	<b>14.5</b>	<b>1.0</b>
Belgium	72.7	0.1	11.7	1.7	13.2	0.6
Bulgaria	54.5	0.5	17.1	8.3	19.7	:
Czechia	68.4	0.1	16.5	6.2	7.2	1.7
Denmark	58.3	:	22.7	1.8	16.7	0.5
Germany	67.1	0.2	16.7	5.9	9.0	1.1
Estonia	72.1	:	11.6	4.9	11.4	:
Ireland	60.8	:	19.7	2.2	16.4	0.9
Greece	57.1	4.2	13.9	8.0	16.7	:
Spain	40.7	:	19.4	7.8	32.1	0.0
France	62.9	0.6	12.0	5.9	18.6	:
Croatia	68.2	1.9	10.2	6.7	13.1	:
Italy	65.4	0.7	12.2	6.8	13.6	1.3
Cyprus	37.2	10.2	22.7	7.9	20.0	2.0
Latvia	64.2	0.0	18.8	7.2	9.1	0.6
Lithuania	69.0	:	9.2	6.4	15.4	:
Luxembourg	81.0	0.5	7.5	3.3	7.8	:
Hungary	63.7	0.2	16.3	6.7	13.2	:
Malta	19.4	12.3	25.1	13.1	29.2	0.8
Netherlands	60.9	0.3	17.4	2.1	19.2	0.1
Austria	69.8	0.0	14.3	2.6	10.2	3.1
Poland	63.3	0.0	17.2	8.6	10.9	:
Portugal	30.5	0.9	17.9	31.4	19.4	0.0
Romania	62.2	0.3	13.8	9.8	13.9	:
Slovenia	62.0	0.6	16.2	4.1	17.2	:
Slovakia	73.1	0.1	12.3	4.3	10.2	0.0
Finland	63.6	0.2	16.4	1.4	12.5	5.8
Sweden	55.6	:	14.1	1.6	20.5	8.2
Norway	65.2	0.1	13.4	1.6	18.9	0.8
North Macedonia	68.7	2.4	8.6	7.3	13.0	:
Albania	32.6	8.0	23.6	31.2	4.6	:
Serbia	66.3	0.4	11.8	7.1	14.4	:
Bosnia and Herzegovina	73.4	0.6	9.4	5.1	11.5	:
Kosovo*	67.8	4.0	7.6	8.4	10.9	1.3
Moldova	68.1	0.1	10.0	13.0	8.9	:
Georgia	56.8	0.3	13.7	17.5	11.7	:

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Source: Eurostat (online data code: nrg\_d\_hhq)



## Share of final energy consumption in the residential sector by type of end-use, 2020

(%)

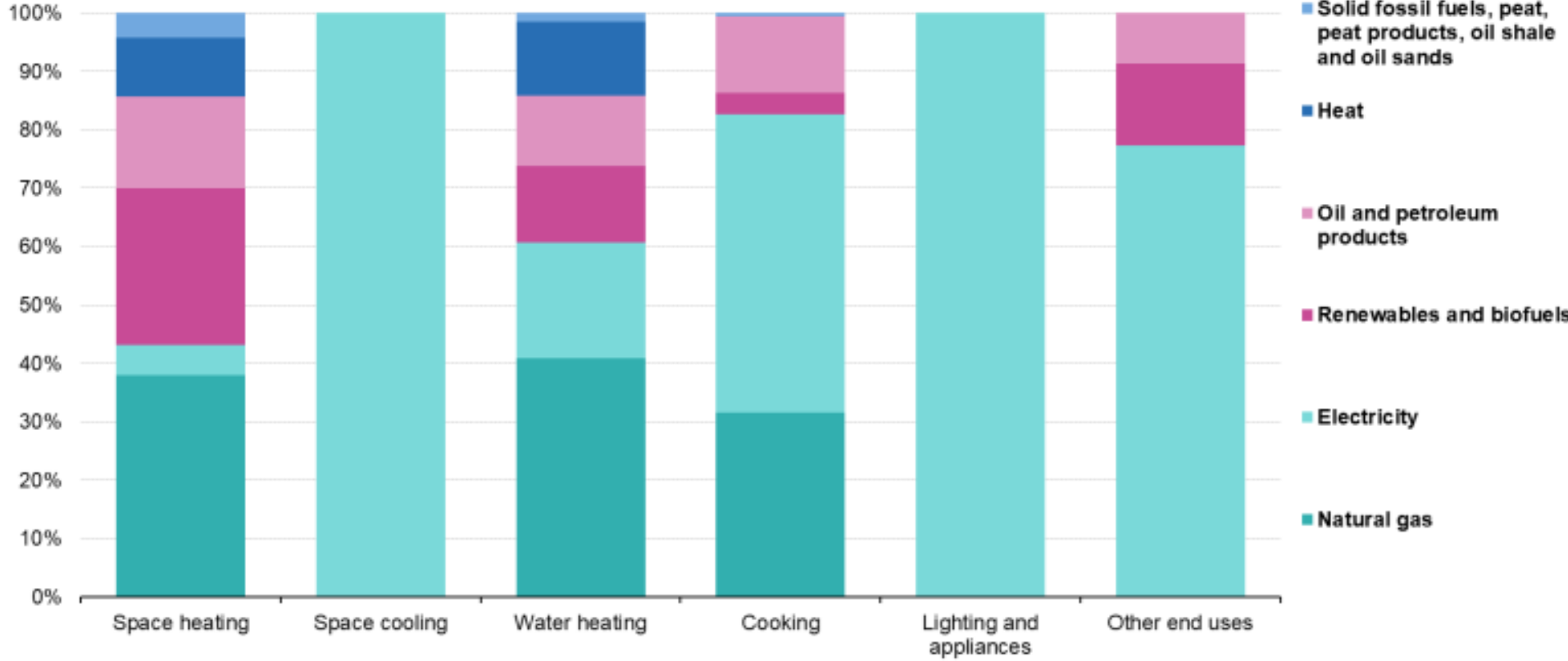
	space heating	space cooling	water heating	cooking	lighting and electrical appliances	other end use
<b>EU</b>	<b>62.8</b>	<b>0.4</b>	<b>15.1</b>	<b>6.1</b>	<b>14.5</b>	<b>1.0</b>
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Belgium	72.7	0.1	11.7	1.7	13.2	0.6
Bulgaria	54.5	0.5	17.1	8.3	19.7	:
Czechia	68.4	0.1	16.5	6.2	7.2	1.7
Spain	40.7	:	19.4	7.8	32.1	0.0
France	62.9	0.6	12.0	5.9	18.6	:
Croatia	68.2	1.9	10.2	6.7	13.1	:
Italy	65.4	0.7	12.2	6.8	13.6	1.3
Cyprus	37.2	10.2	22.7	7.9	20.0	2.0
Latvia	64.2	0.0	18.8	7.2	9.1	0.6
Lithuania	69.0	:	9.2	6.4	15.4	:
Portugal	30.5	0.9	17.9	31.4	19.4	0.0
Romania	62.2	0.3	13.8	9.8	13.9	:
Slovenia	62.0	0.6	16.2	4.1	17.2	:
Slovakia	73.1	0.1	12.3	4.3	10.2	0.0
Finland	63.6	0.2	16.4	1.4	12.5	5.8
Sweden	55.6	:	14.1	1.6	20.5	8.2
Norway	65.2	0.1	13.4	1.6	18.9	0.8
North Macedonia	68.7	2.4	8.6	7.3	13.0	:
Albania	32.6	8.0	23.6	31.2	4.6	:
Serbia	66.3	0.4	11.8	7.1	14.4	:
Bosnia and Herzegovina	73.4	0.6	9.4	5.1	11.5	:
Kosovo*	67.8	4.0	7.6	8.4	10.9	1.3
Moldova	68.1	0.1	10.0	13.0	8.9	:
Georgia	56.8	0.3	13.7	17.5	11.7	:

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**Part of the main energy products in the final energy consumption in the residential sector for each type of end-use, EU, 2020**



Source: Eurostat (online data code: nrg\_d\_hhq)

## Share of fuels in the final energy consumption in the residential sector for space heating, 2020

(%)

	Solid fossil fuels, peat, peat products, oil shale and oil sands	Natural gas	Oil and petroleum products	Renewables and biofuels	Electricity	Heat
<b>EU</b>	<b>4.2</b>	<b>38.0</b>	<b>15.6</b>	<b>26.8</b>	<b>5.2</b>	<b>10.2</b>
Belgium	0.6	44.1	41.5	10.5	3.0	0.2
Bulgaria	7.4	6.0	0.1	61.9	8.6	15.9
Czechia	14.2	24.8	0.8	41.9	5.0	13.3
Denmark	:	17.2	3.2	38.0	3.9	37.7
Germany	0.8	43.8	28.0	16.8	1.7	9.0
Estonia	0.1	6.1	0.3	51.5	5.5	36.6
Ireland	17.2	21.9	54.8	2.3	3.7	:
Greece	0.1	16.9	46.7	29.0	5.2	2.1
Spain	0.6	27.4	31.3	32.8	7.9	0.0
France	0.1	35.7	13.6	34.1	12.6	3.9
Croatia	0.1	23.8	4.0	63.4	1.8	6.9
Italy	:	59.9	6.9	28.9	0.4	3.8
Cyprus	:	:	62.6	21.3	16.0	:
Latvia	0.2	8.0	3.3	52.3	0.9	35.3
Lithuania	3.3	11.9	1.9	46.1	1.5	35.3
Luxembourg	0.1	56.8	31.9	4.1	7.1	:
Hungary	1.9	84.2	0.1	:	2.3	11.6
Malta	:	:	21.0	43.5	35.4	:
Netherlands	0.0	83.9	0.6	9.3	2.9	3.2
Austria	0.4	26.8	18.1	35.4	4.7	14.6
Poland	40.3	15.9	0.7	21.0	1.0	21.1
Portugal	:	1.8	6.1	86.8	5.2	0.1
Romania	0.6	32.0	0.0	52.8	0.2	14.3
Slovenia	0.0	11.6	15.9	56.2	7.0	9.4
Slovakia	1.9	45.8	0.2	28.4	7.0	16.7
Finland	0.1	0.6	5.2	40.4	24.8	29.0
Sweden	:	0.3	4.6	19.7	28.7	46.7
Norway	:	0.1	0.2	35.5	60.7	3.5
North Macedonia	0.2	0.0	1.2	51.3	37.2	10.1
Albania	:	:	19.9	27.9	52.2	:
Serbia	11.4	9.6	0.9	53.7	6.2	18.3
Bosnia and Herzegovina	4.4	2.2	2.0	83.6	0.4	7.4
Kosovo*	1.3	:	:	84.3	12.1	2.4
Moldova	4.0	19.7	0.0	64.6	0.5	11.2
Georgia	0.0	73.2	:	24.9	1.9	:

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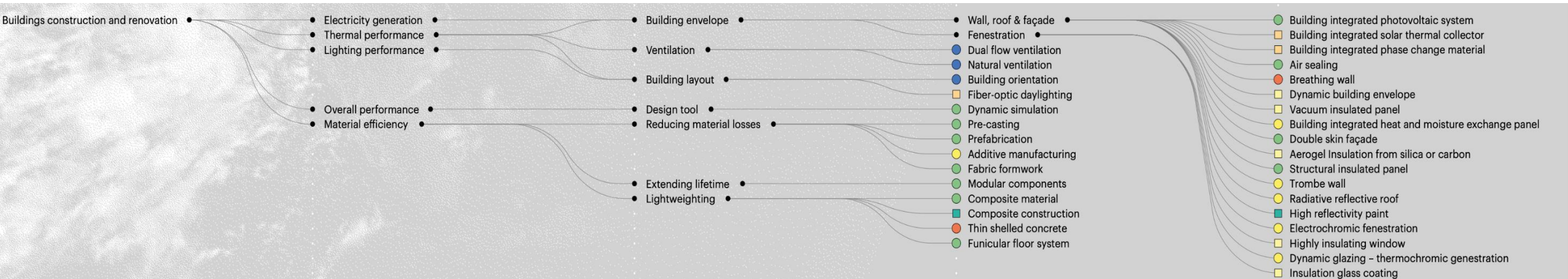
(%)



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<b>EU</b>	<b>4.2</b>	<b>38.0</b>	<b>15.6</b>	<b>26.8</b>	<b>5.2</b>	<b>10.2</b>
Belgium	0.6	44.1	41.5	10.5	3.0	0.2
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France	0.1	35.7	13.6	34.1	12.6	3.9
Croatia	0.1	23.8	4.0	63.4	1.8	6.9
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Finland	0.1	0.6	5.2	40.4	24.8	29.0
Sweden	:	0.3	4.6	19.7	28.7	46.7
Norway	:	0.1	0.2	35.5	60.7	3.5
Austria	0.4	26.8	18.1	35.4	4.7	14.6
Poland	40.3	15.9	0.7	21.0	1.0	21.1
Portugal	:	1.8	6.1	86.8	5.2	0.1
Romania	0.6	32.0	0.0	52.8	0.2	14.3
Slovenia	0.0	11.6	15.9	56.2	7.0	9.4
Slovakia	1.9	45.8	0.2	28.4	7.0	16.7
Finland	0.1	0.6	5.2	40.4	24.8	29.0
Sweden	:	0.3	4.6	19.7	28.7	46.7
Norway	:	0.1	0.2	35.5	60.7	3.5
North Macedonia	0.2	0.0	1.2	51.3	37.2	10.1
Albania	:	:	19.9	27.9	52.2	:
Serbia	11.4	9.6	0.9	53.7	6.2	18.3
Bosnia and Herzegovina	4.4	2.2	2.0	83.6	0.4	7.4
Kosovo*	1.3	:	:	84.3	12.1	2.4
Moldova	4.0	19.7	0.0	64.6	0.5	11.2
Georgia	0.0	73.2	:	24.9	1.9	:

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Basic principles have been defined
- 2 APPLICATION FORMULATED  
Concept and application of solution have been formulated
- 3 CONCEPTS NEEDS VALIDATION  
Solution needs to be prototyped and applied
- 4 EARLY PROTOTYPE  
Prototype proven in test conditions
- 5 LARGE PROTOTYPE  
Components proven in conditions to be deployed
- 6 FULL PROTOTYPE AT SCALE  
Prototype prove at scale in conditions to be deployed
- 7 PRE-COMMERCIAL DEMONSTRATION  
Solution working in expected conditions
- 8 FIRST OF A KIND COMMERCIAL  
Commercial demonstration, full scale deployment in final form
- 9 COMMERCIAL OPERATION IN RELEVANT ENVIRONMENT  
Solution is commercially available, needs evolutionary improvement to stay competitive
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Solution is commercial and competitive but needs further integration efforts
- 11 PROOF OF STABILITY REACHED  
Predictable growth

Building envelope ●

Ventilation ●

Building layout ●

Design tool ●

Reducing material losses ●

Extending lifetime ●

Lightweighting ●

● Wall, roof & façade ●

● Fenestration ●

● Dual flow ventilation

● Natural ventilation

● Building orientation

● Fiber-optic daylighting

● Dynamic simulation

● Pre-casting

● Prefabrication

● Additive manufacturing

● Fabric formwork

● Modular components

● Composite material

● Composite construction

● Thin shelled concrete

● Funicular floor system

● Building integrated photovoltaic system

● Building integrated solar thermal collector

● Building integrated phase change material

● Air sealing

● Breathing wall

● Dynamic building envelope

● Vacuum insulated panel

● Building integrated heat and moisture exchange panel

● Double skin façade

● Aerogel Insulation from silica or carbon

● Structural insulated panel

● Trombe wall

● Radiative reflective roof

● High reflectivity paint

● Electrochromic fenestration

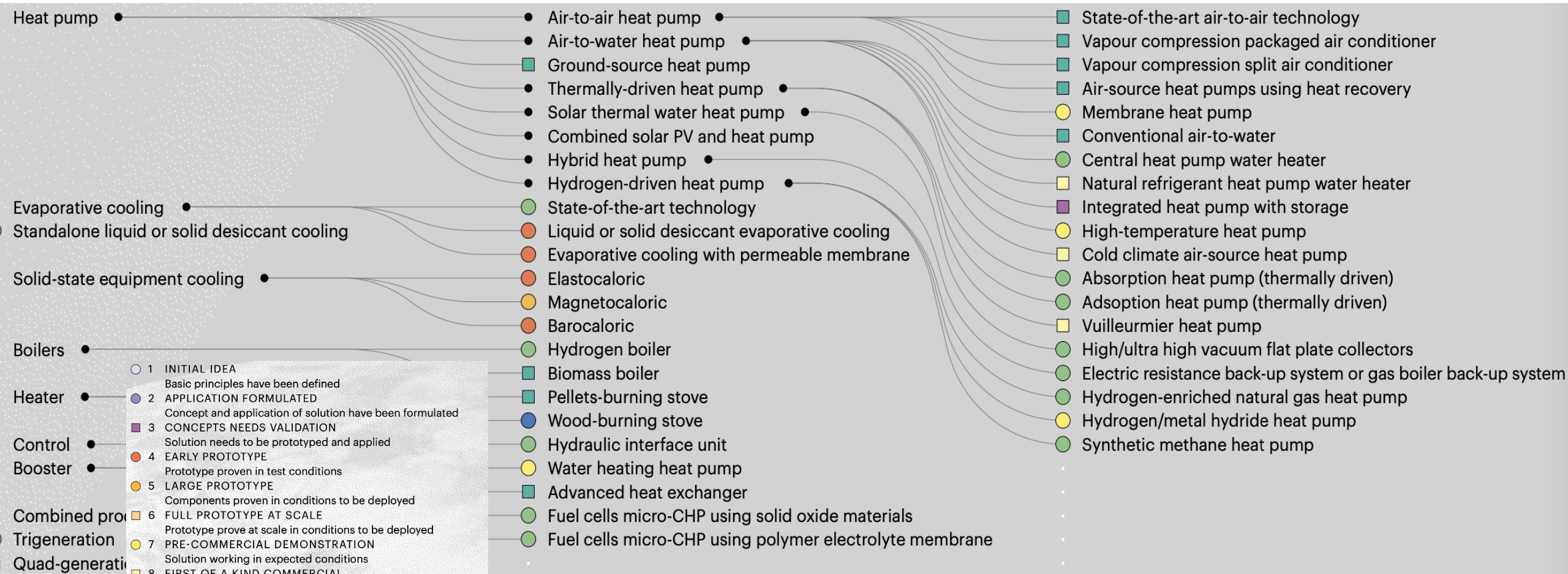
● Highly insulating window

● Dynamic glazing – thermochromic generation

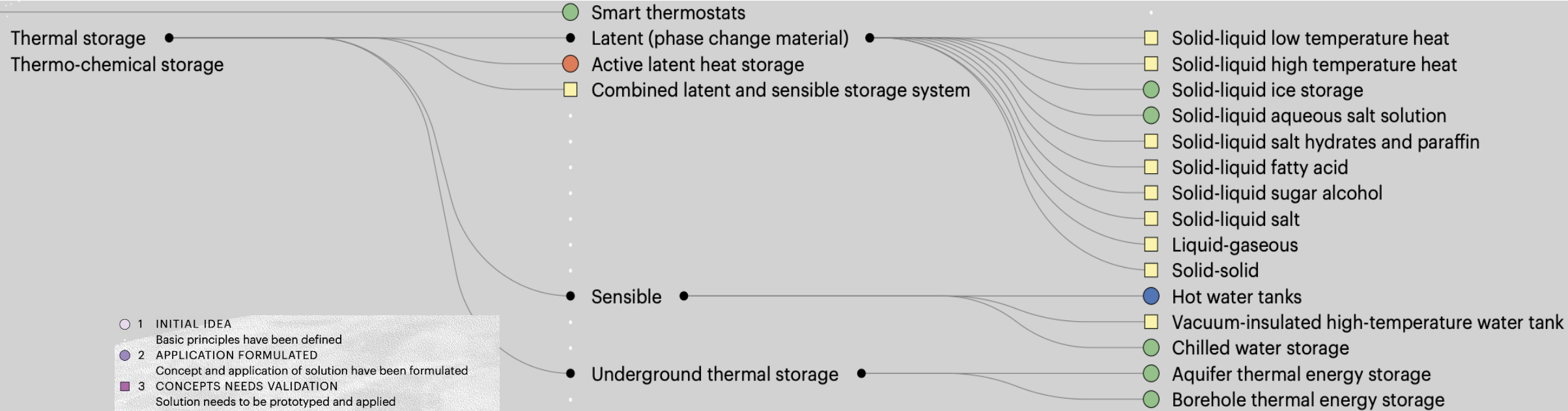
● Insulation glass coating

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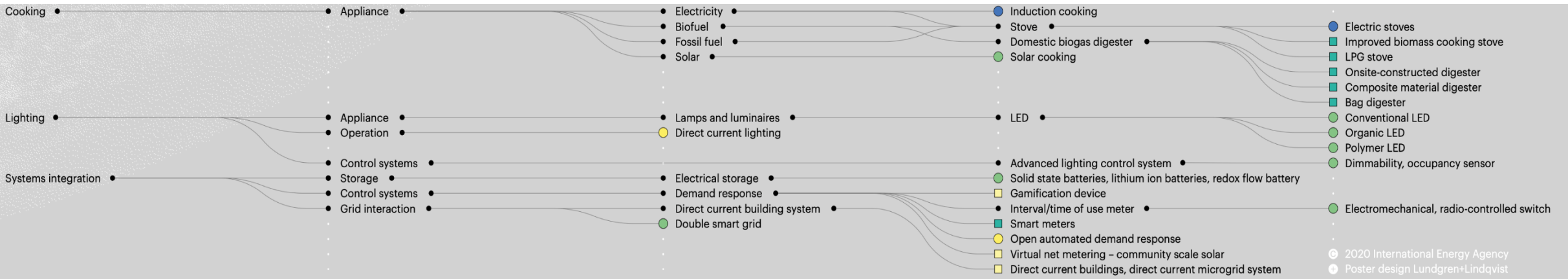


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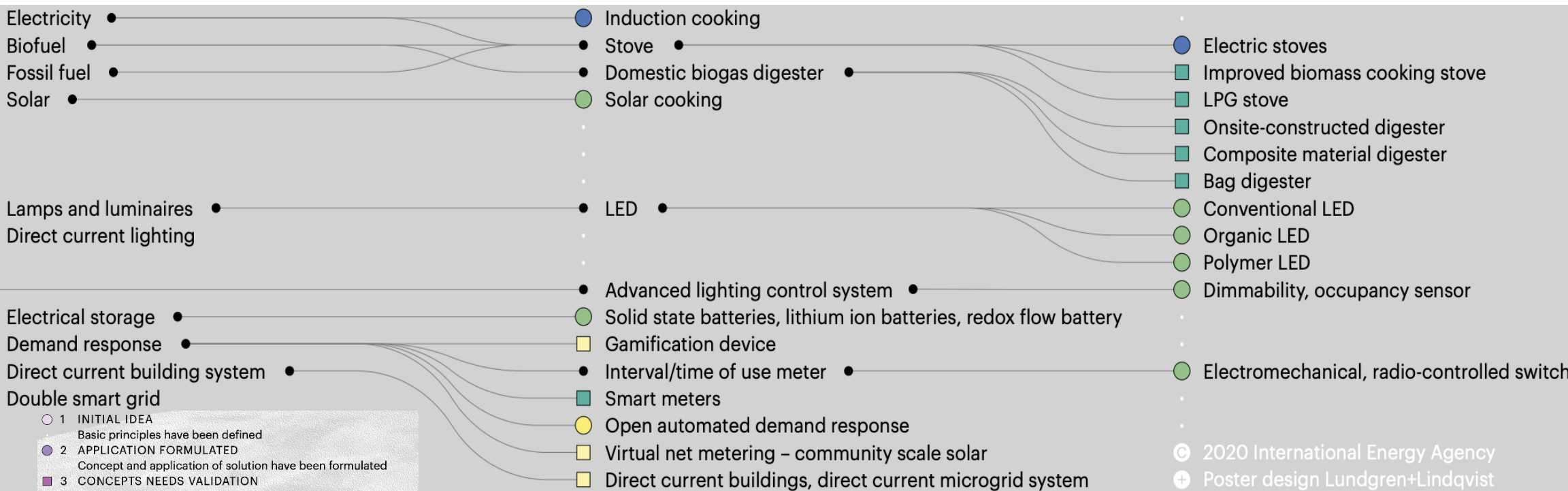


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Area	Technology	
Building Envelope	Wall, roof, façade	BIPV (BIST) (Phase change materials) Double skin facades High reflective paint
	Fenestration	Electrochromic (Thermochromic)
Ventilation	Dual flow Natural ventilation	
Layout	Orientation	
Design tool	Dynamic simulation	
Reducing material losses	Pre-casting Prefabrication (Additive manufacturing)	
Extending lifetime	Modularization	
Lightweight		
Heat pump	Air to air Air to water GSHP Solar thermal Combined solar PV and HP	
Evaporative cooling		
Boilers	(Hydrogen) Biomass/Biogas Pellets Wood	
CHP	Fuel cells micro CHP	
Control/digitalization	Smart thermostats IoT Predictive control	
Thermo-chemical storage	Batteries/electric storage Sensible/Latent heat storage Building mass Ground Aquifers	

1. Ridurre le dispersioni
2. Massimizzare gli apporti (in maniera controllabile)
3. Recuperare dalla ventilazione (pre-riscaldamento/raffrescamento)
4. Elettrificare
5. Utilizzare le fonti rinnovabili
6. Accumulare:
  - a. Scambio con la rete
  - b. Accumulo elettrico
  - c. Accumulo termico (giornaliero, stagionale): buffer, edificio, terreno
7. Automatizzare (IoT, BA, Predictive Control)

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