Count On Cooling Webinar

Heating & Cooling Synergies

Creating a circular and more efficient energy system

Driving the shift towards renewables

Tuesday 22 September 2020: 9.30 – 11.00

Instructions to participants

- All participants should remain in mute mode during the entire time of the webinar
- Only speakers will unmute themselves during their time of presentation and Q&A session
- A 15 minutes Q&A session will take place at the end of the webinar
- During the Q&A session, participants are kindly requested to submit their questions through the chat to “Everyone”
- The EPEE Secretariat will read these questions to the speakers
- If time doesn’t allow to cover all questions, they will be submitted to speakers after the webinar and we will keep you informed of their response
- Presentations will be shared after the webinar
- Please note that this webinar is recorded

Webinar programme

Timing	Agenda	Speakers
9.30-9.45	Synergies between heating & cooling to enable decarbonisation	Andrea Voigt, EPEE Director General
9.45-10.00	Strategy for Energy System Integration	Jan Ciampor, Policy Officer, DG ENER, European Commission
10.00-10.15	Technical solutions: challenges and opportunities	Prof. Peter Radgen, IER, University of Stuttgart, Germany
10.15-10.30	Electrification and renewable energy	Frauke Thies, Executive Director, smartEn
10.30-10.55	Q&A	
10.55-11.00	Closing remarks	Andrea Voigt, EPEE Director General

Andrea Voigt
EPEE

Jan Ciampor
European Commission

Peter Radgen
University of Stuttgart

Frauke Thies
smartEn

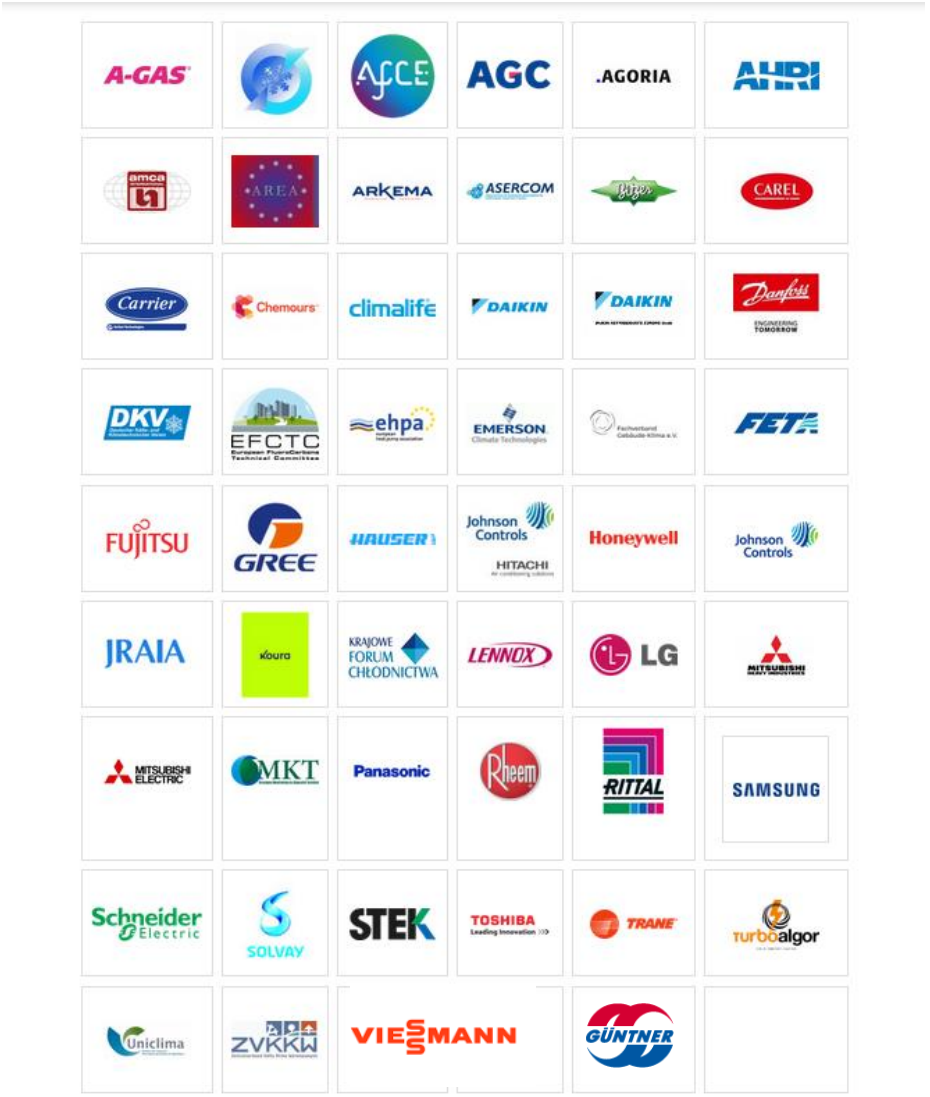
Synergies between heating & cooling to enable decarbonisation

Andrea Voigt, EPEE

Who is EPEE? The full value chain. A true voice.

EPEE represents the manufacturers of refrigeration, air-conditioning and heat pump technologies

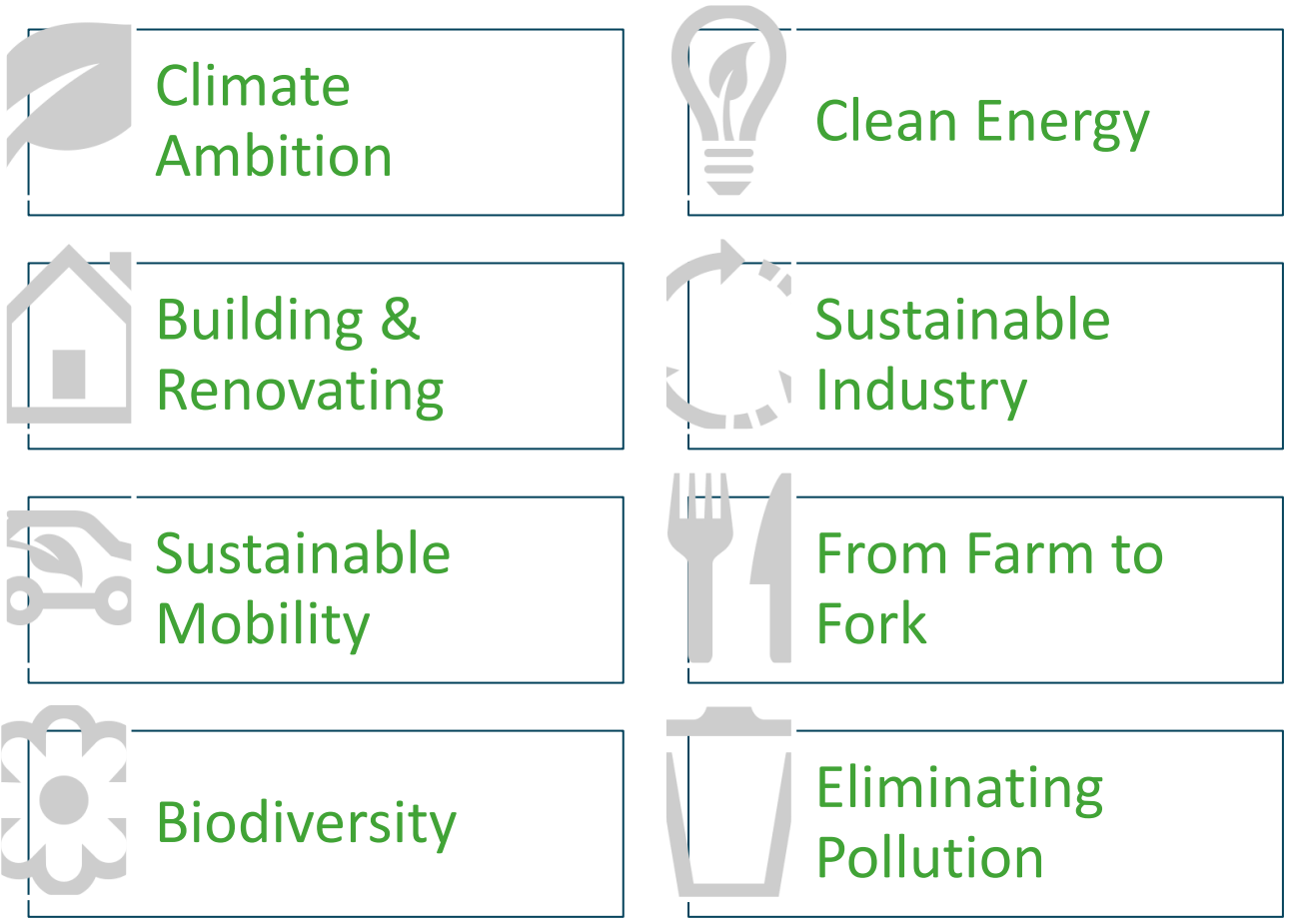
- Founded in 2000, headquartered in Brussels, Belgium
- Committed to promoting sustainable heating and cooling technologies
- Small – medium – large size companies
- Members from three continents: Europe, Asia, North America
- Over 200,000 direct employees, over €30bn turnover, production throughout Europe
- More about sustainable heating and cooling technologies here: www.countoncooling.eu



On the way to carbon neutrality by 2050

EU Commission President Ursula von der Leyen:
„We have to change the way we eat and heat“

How to get there: Key Pillars of the European Green Deal



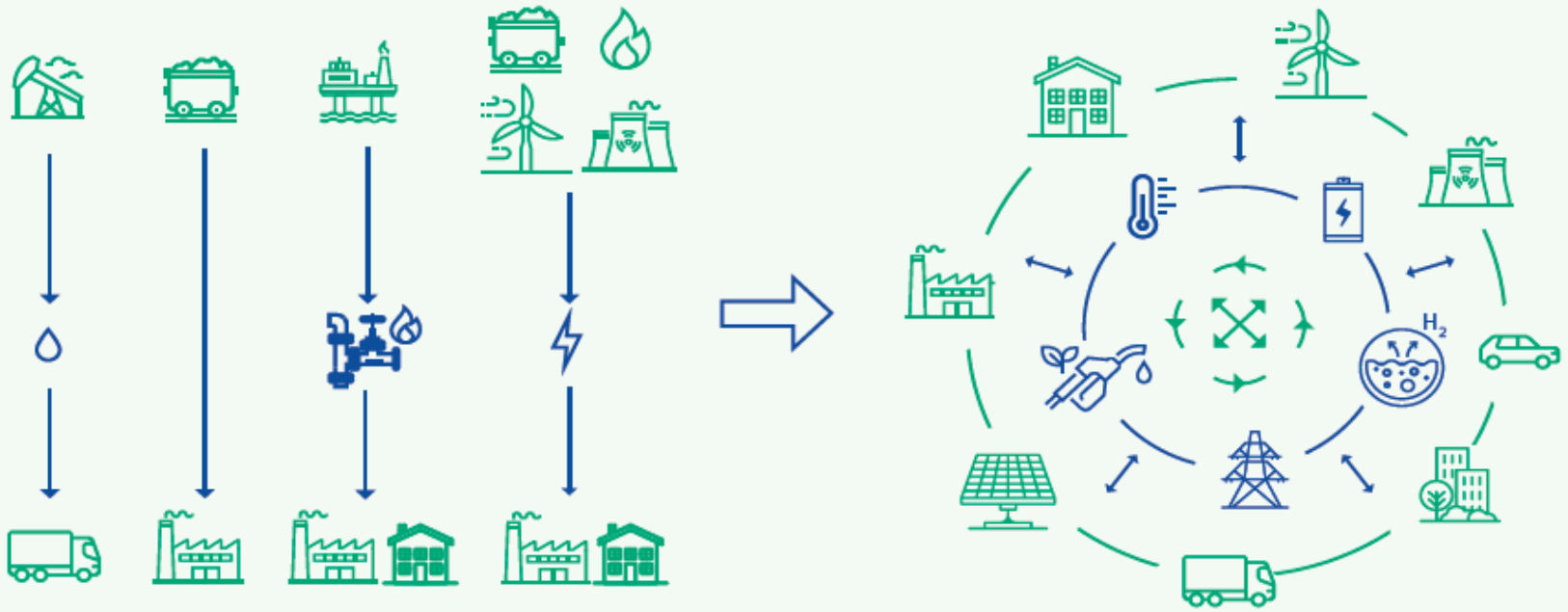
Important related initiatives:

- Energy System Integration Strategy
- New Circular Economy Action Plan
- Renovation Wave
- Industrial Strategy
- European Green Deal Investment Plan
- Review of relevant climate and energy related legislation:
  - Renewable Energies Directive
  - Energy Efficiency Directive …

Focus on the new Energy System Integration Strategy

The energy system today : linear and wasteful flows of energy, in one direction only

Future EU integrated energy system : energy flows between users and producers, reducing wasted resources and money

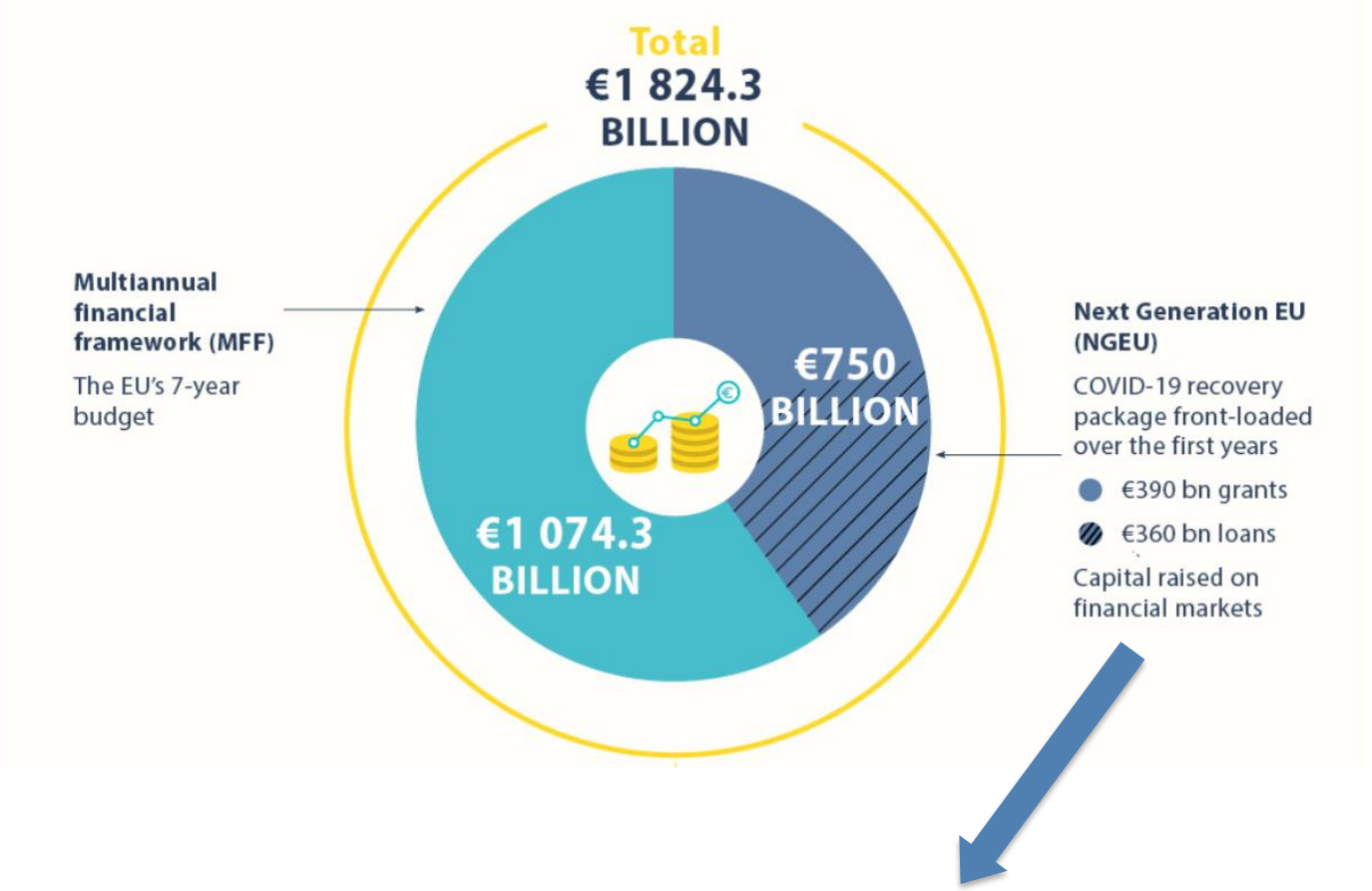


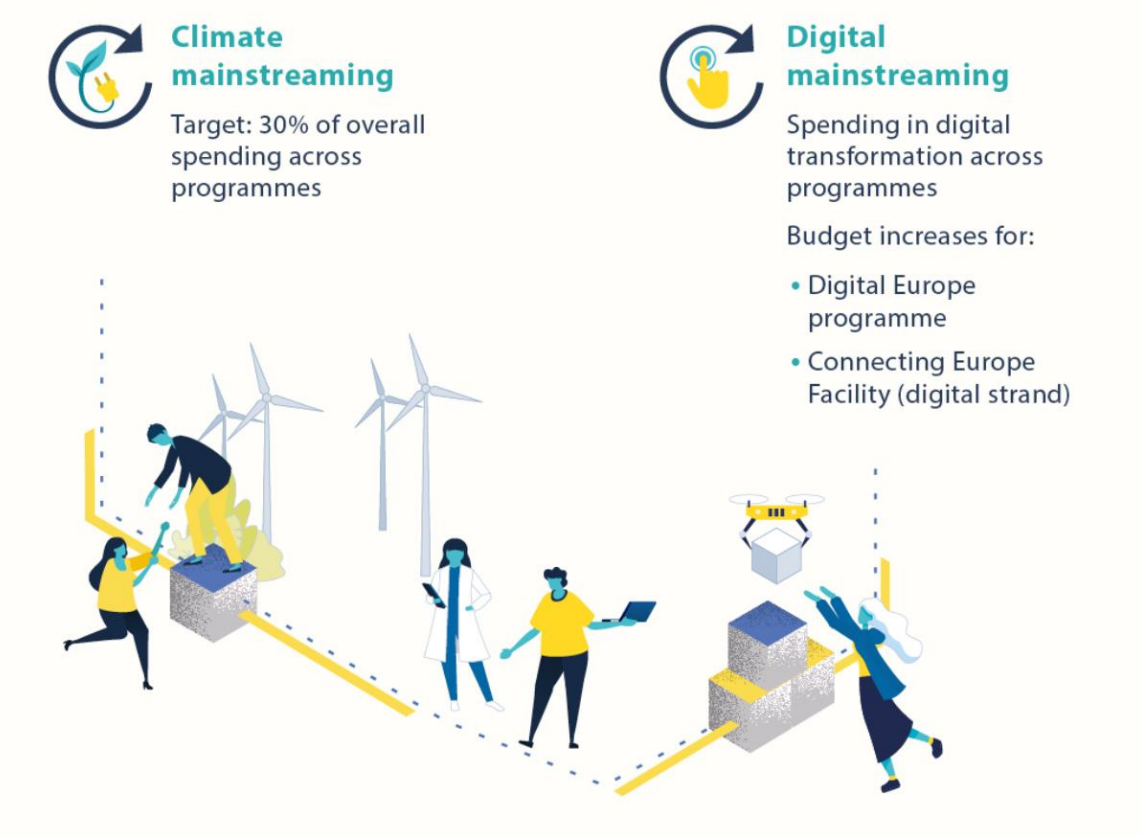
1. A more efficient and circular system where **waste energy** is captured and re-used

2. A cleaner power system with more **direct electrification** of end use sectors such as industry, heating of buildings and transport

3. A **cleaner fuel system** for hard to electrify sectors such as heavy industry or transport

The impact of COVID-19: EU Recovery Plan



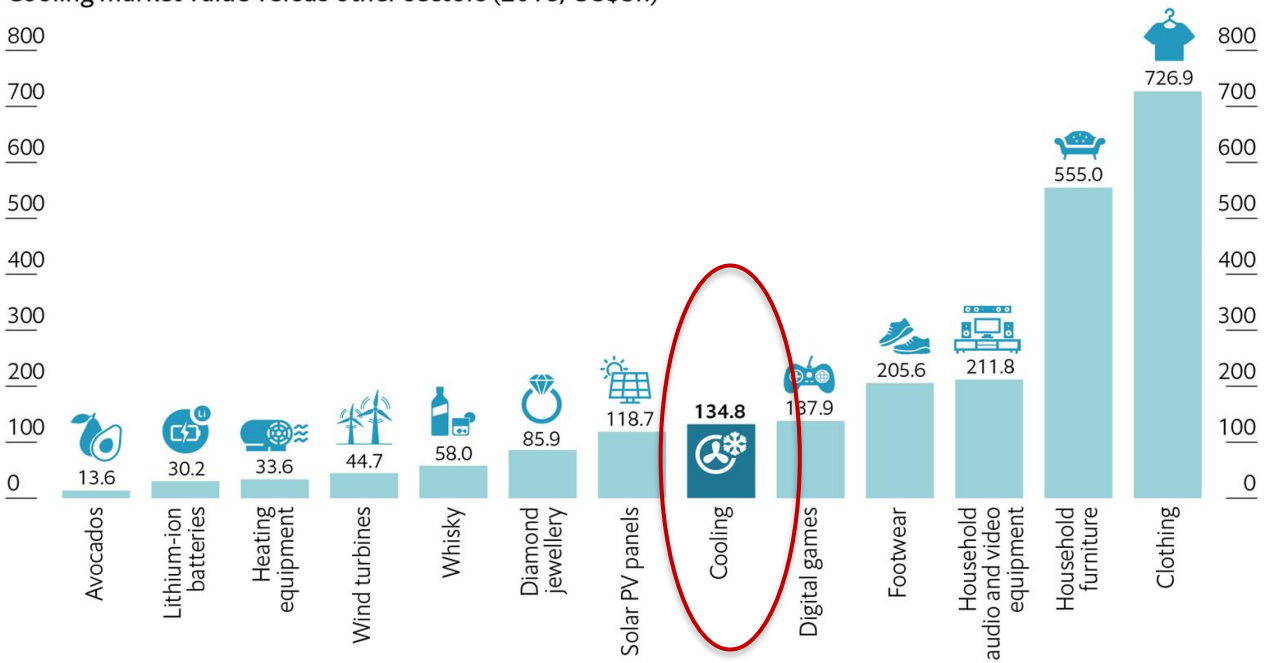


1. 37% of NextGenerationEU to be directly spent on European Green Deal objectives
2. Invest in EU lighthouse projects: Hydrogen, Renovation, 1 million electric charging points
3. Digitalisation: A European Cloud, Artificial Intelligence, Digital Infrastructure

The role of cooling: an important industry

Cooling in comparison

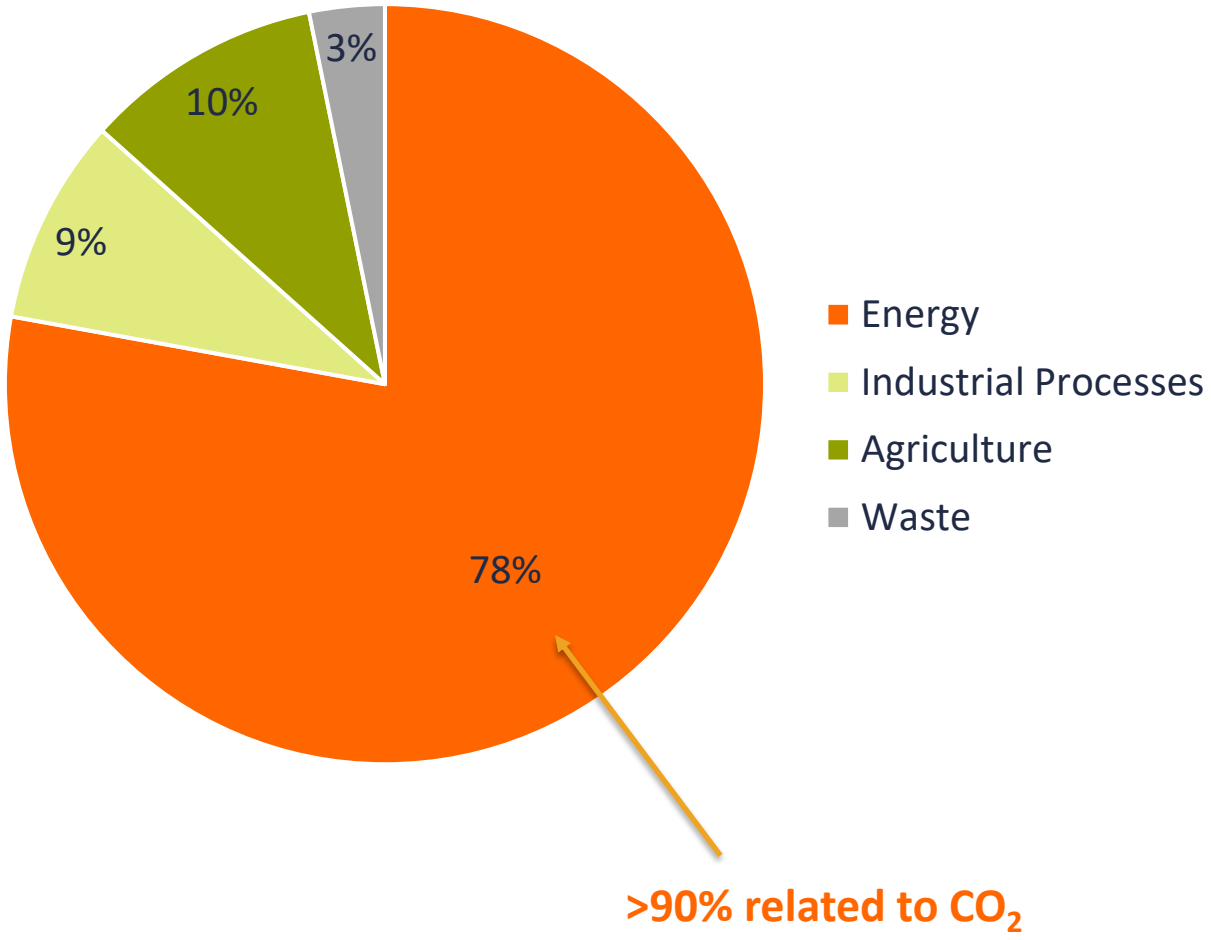
Cooling market value versus other sectors (2018, US$bn)



Source: EIU; Clean Cooling Landscape Assessment; Transparency Market Research; Grand View Research; Alrosa; Newzoo; Power Technology; Allied Market Research

- ✓ **Health**
- ✓ **Well-Being**
- ✓ **Food Security**
- ✓ **Medecines**
- ✓ **Thermal Comfort**
- ✓ **Digitalisation**
- ✓ **Productivity ….**

The Challenge: Energy & Emissions



Most of the EU's GHG emissions are related to energy

Source: annual EU GHG inventory

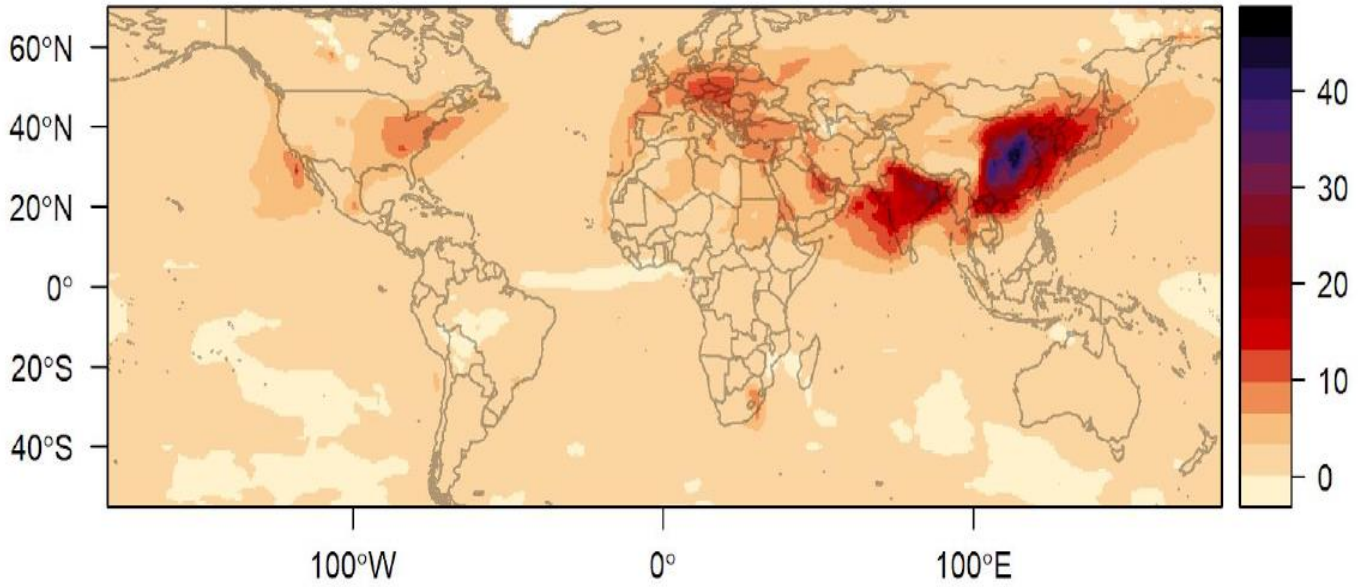
Air Quality

In 2018, air pollution from burning fossil fuels was responsible for:

- 4.5 million deaths
- 1.8 billion days of work absence
- 4 million new cases of child asthma
- 2 million preterm births
- Economic costs of 2.9 trillion USD

In Europe alone, 11,0000 deaths from air pollution were avoided during 1 month of lockdown (-40% NO2, -10% PM 2.5)

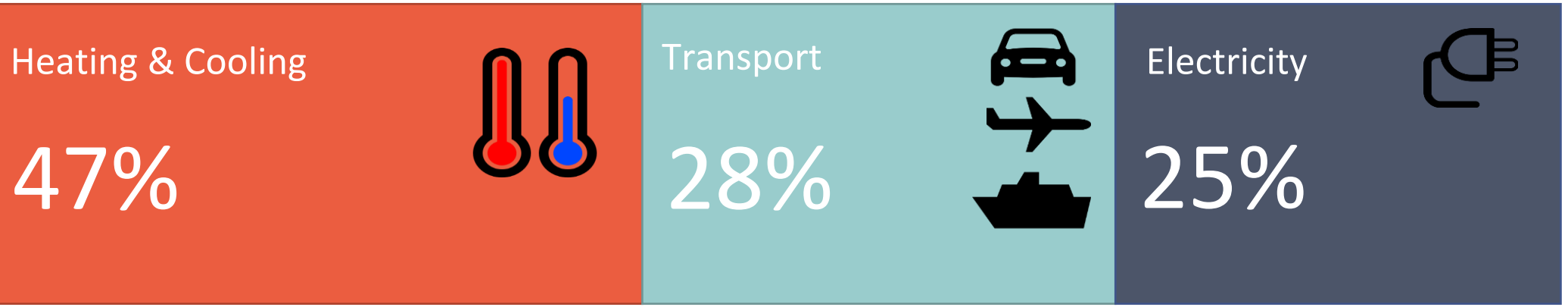
Annual av. PM 2.5 levels attributed to fossil fuels (ug/m3)

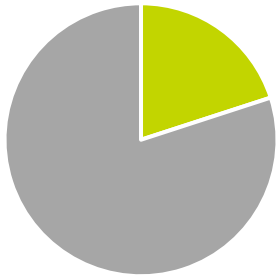


Source: Centre for research on energy and clean air

Heating & Cooling have an important role to play

ktoe final energy consumption in Europe





20% share of REN

8% share of REN

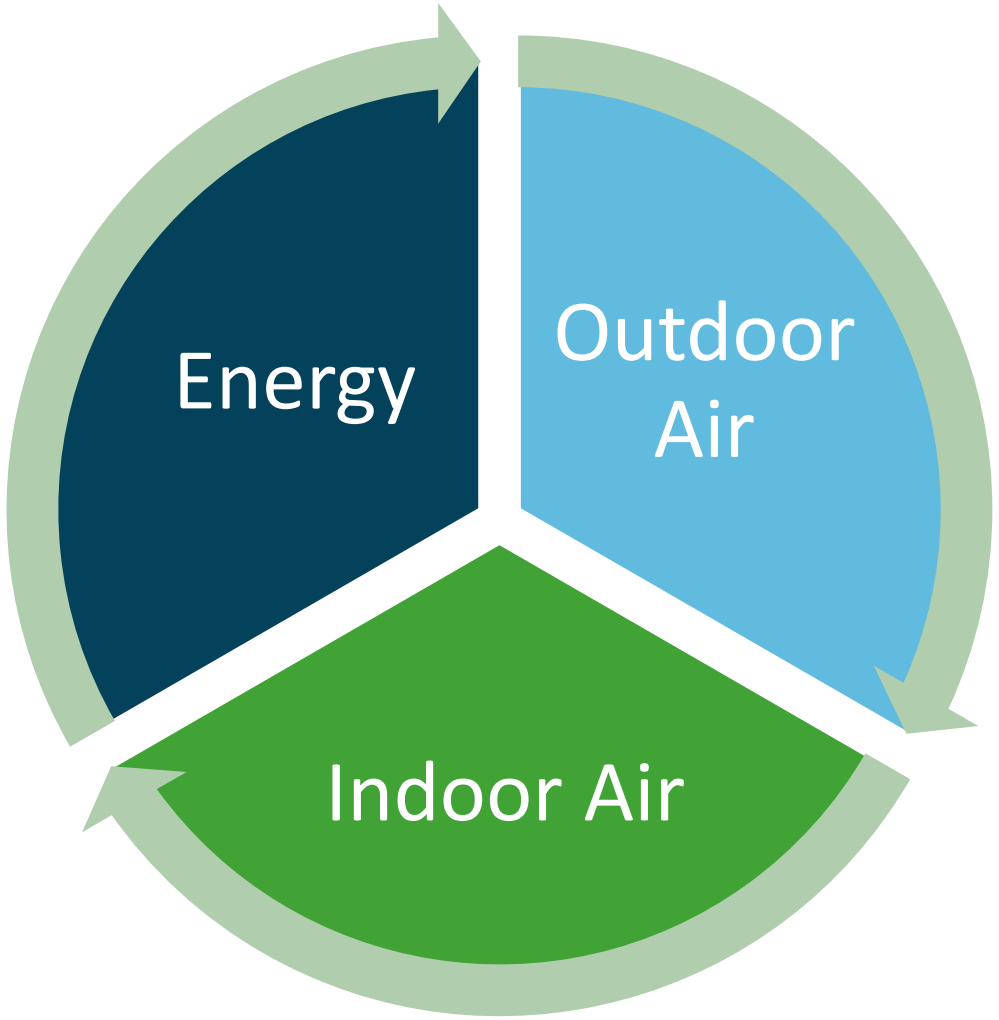
32% share of REN

Source: Eurostat, 2018

Sustainable heating & Cooling: A win-win solution

Enabling the phase-out of fossil fuels by reducing and decarbonising energy use:

- ✓ **Energy efficiency:** design, sizing, monitoring & control (BACS), service & maintenance
- ✓ **System integration:** waste heat recovery, thermal energy use and storage, electrification of end use sectors (heating)
- ✓ **Centralised and decentralised solutions:** Heat pumps, solar PV, district networks
- ✓ **Connectivity and Consumers:** Demand side flexibility, Internet of Things (IoT)



Sustainable heating and cooling:

- A win-win solution for the health of people and the planet!
- European Green Deal and EU recovery plan: a once in a lifetime opportunity to phase-out fossil fuels, reduce greenhouse gas emissions and improve the air quality
- Technologies are readily available. Now they need to be deployed.

Let's make it happen!

01.

• Strategy for Energy System Integration

- Jan Ciampor, Policy Officer, DG ENER, European Commission

Energy System Integration and Energy Efficiency

EPEE #CountOnCooling
Webinar on Heating & Cooling Synergies

22 September 2020

Jan Ciampor
Unit C3: Energy Efficiency: Policy and Financing
Directorate-General for Energy

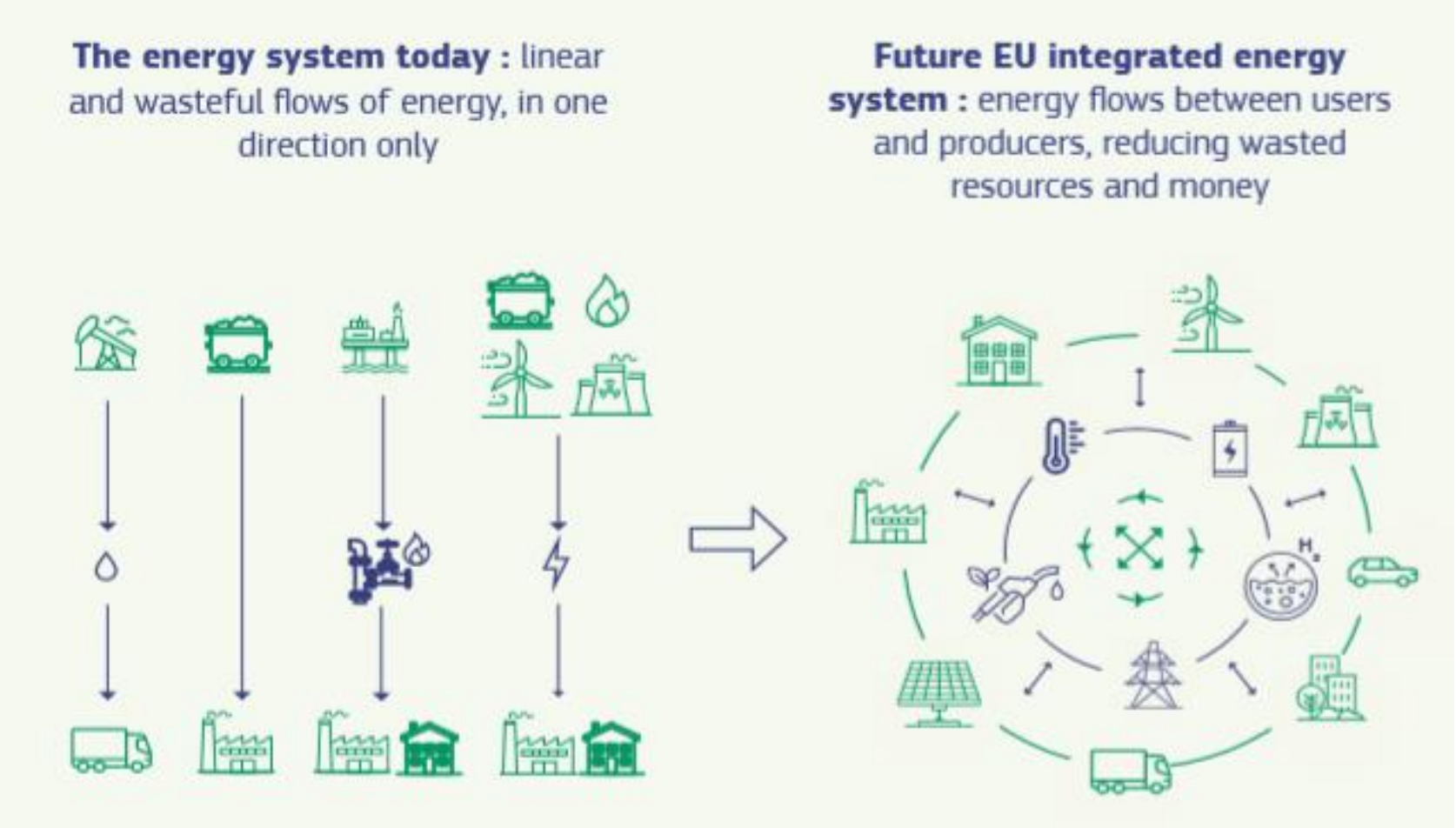
A changing energy landscape towards 2050

European Commission

Why a Strategy for Energy System Integration? Why now?

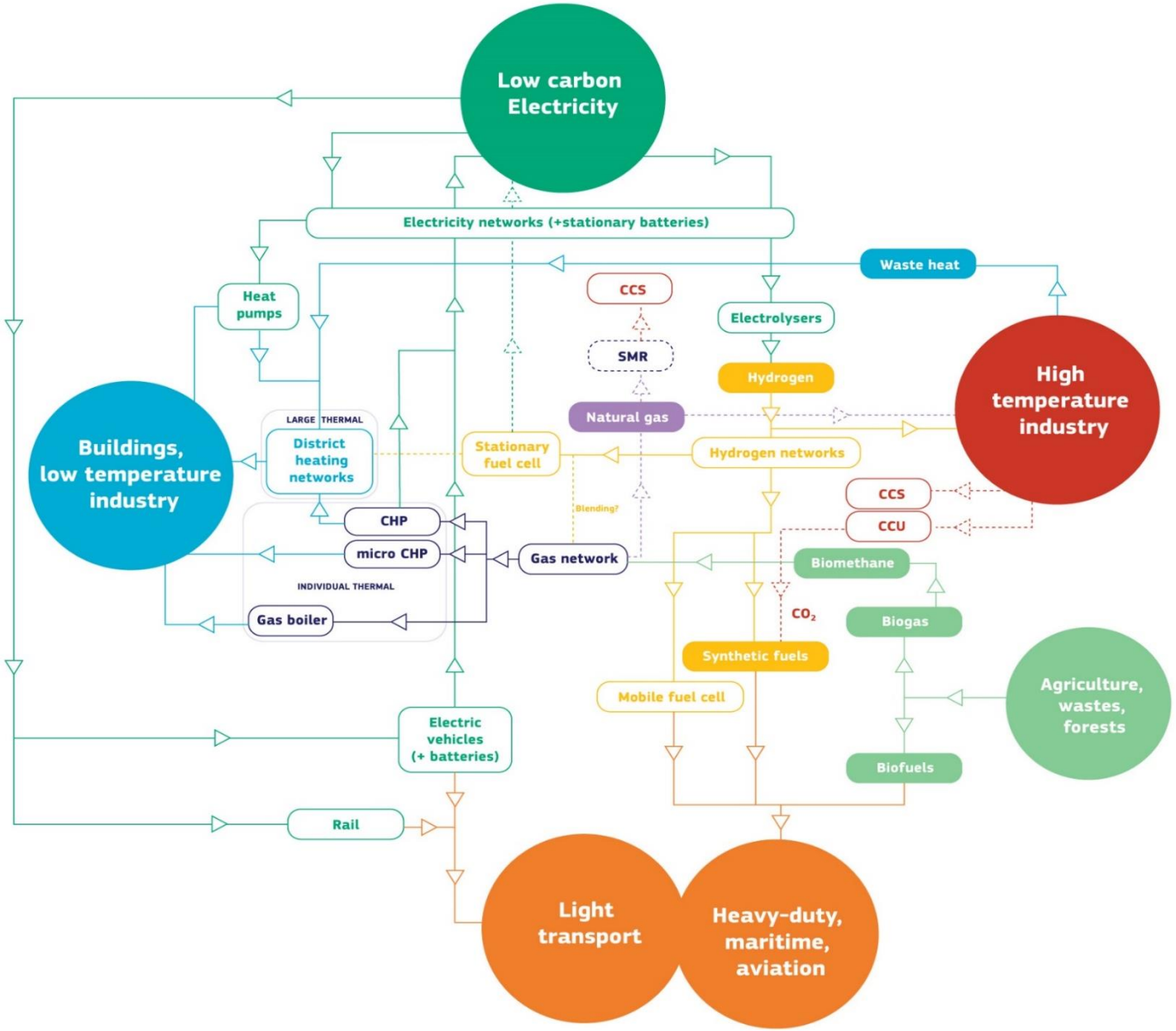
European Commission

What is energy system integration?



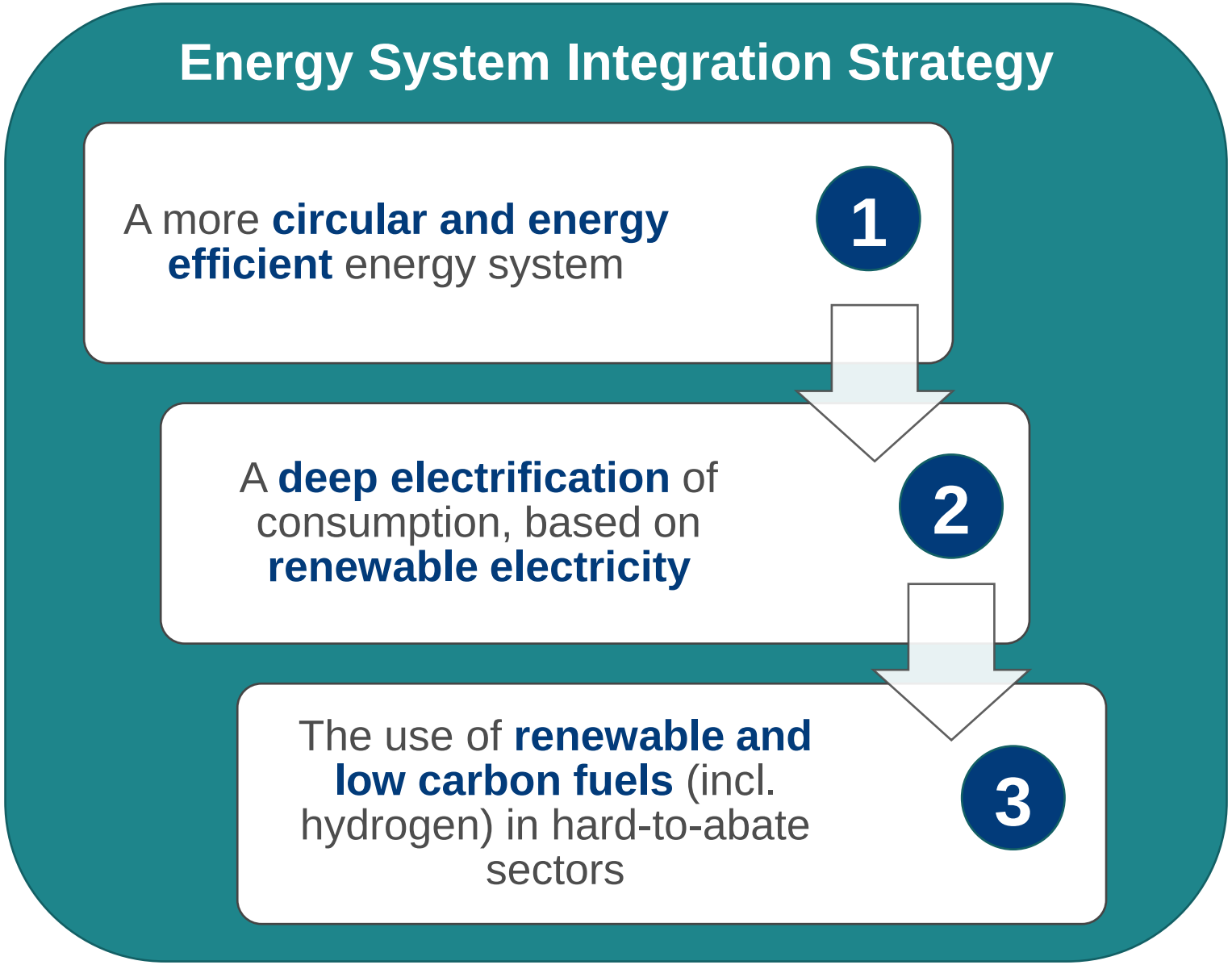
Energy System Integration (ESI) is the integrated planning and operation of the energy system ‘as a whole’, across multiple carriers, infrastructures and consumption sectors

The interlinkages of the integrated energy system



European Commission

Laying the foundation for a climate-neutral energy system



European Commission

Heating and Cooling in ESI

- Heating and Cooling is at the centre of the European Green Deal
- Importance of the Heating and Cooling sector is highlighted in ESI
  - Reduction in energy consumption
  - Integration of renewable energy sources
  - Waste heat reuse
  - Flexibility

Making it happen – an action plan for Energy System Integration

Pillar	Actions oriented towards	Main tools involved (*)
A more circular and energy efficient energy system	• **Better apply EEF principle & PEF** • **Build a more circular system**	RED, EED, TEN-E
A deep electrification of consumption, based on renewable electricity	• **Increased supply RES-E** • **Faster electrification end-use sectors** • Roll out EV infrastructure & new loads integration	RED, IED, AFID, TEN-E, TEN-T, CO2 emissions for cars, EU funding, offshore RES, Renovation wave, NC Flexibility
RES & low carbon fuels for hard-to-abate sectors (incl. hydrogen)	• Promoting RES fuels from biomass • Promoting RES hydrogen • Enabling CCUS incl. for synthetic fuels	RED, Aviation/Maritime initiatives, EU funding + Hydrogen Strategy Follow-up
Energy markets fit for decarbonisation & distributed resources	• Creating a level playing field across carriers • Review gas regulatory framework • Improve customer information	ETD, ETS, State Aid, gas legislation, guidance on non price components
A more integrated energy infrastructure	• **More integrated planning** at gas, electricity, **heat** and hydrogen • Better governance	TEN-E, TEN-T, RED, EED, TYNDP
A digitalised energy system & supportive innovation framework	• Ensure digitalisation support energy system integration • Research and innovation as a key enabler	Energy Digitalisation Action Plan, NC cybersecurity, impact oriented research outlook

(*) Non-exhaustive list

EED review and revision

- The review and possible revision were announced in the European Green Deal - June 2021
- The revision was confirmed in the recent Communication on the Climate Target Plan
- One of the policy actions identified in the ESI to deliver objectives
- EED Review process was launched on 3 August 2020
- Heating and Cooling plays an integral role in the review and revision
- Expert workshop on Energy Efficiency in Heating and Cooling and Article 14 of the EED
  - Cooling
  - Waste heat
  - Comprehensive assessments and policy implementation
  - Local heating and cooling planning

Thank you for your attention!

Jan.CIAMPOR@ec.europa.eu

European Commission

02.

• Technical solutions: challenges and opportunities

- Prof. Peter Radgen, IER, University of Stuttgart, Germany

Universität Stuttgart
Institute of Energy Economics
and Rational Energy Use (IER)

Technical Solutions: Challenges and Opportunities

#CountonCooling

Webinar on
Heating & Cooling Synergies,
September 22, 2020

Peter Radgen

Source: https://www.wilhelmsen.com/marine-products/refrigeration-solutions/

Source: https://www.flickr.com/photos/tab2/416172313/

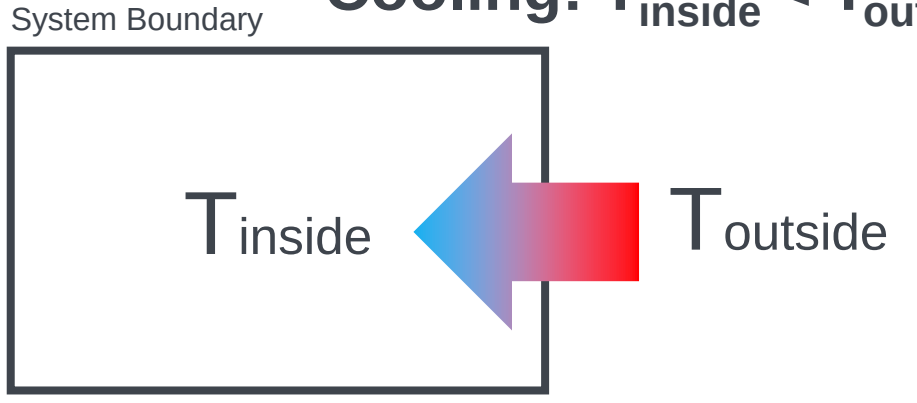
What is the Difference between Heating and Cooling ?

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung

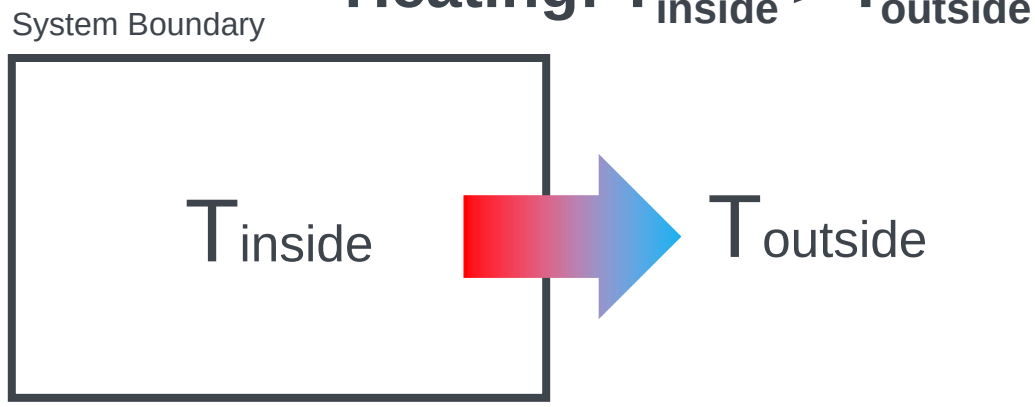
- Thermodynamics do not distinguish between cooling and heating.
- Both require the transfer of energy across a system boundary
- The total amount of energy always remains constant (first law of thermodynamics)
- Energy only flows in the direction of the driving force, for heating and cooling this is the temperature difference (second law of thermodynamics).

$$E_{total} = E_{inside} + E_{outside} = const.$$

Cooling: $T_{inside} < T_{outside}$

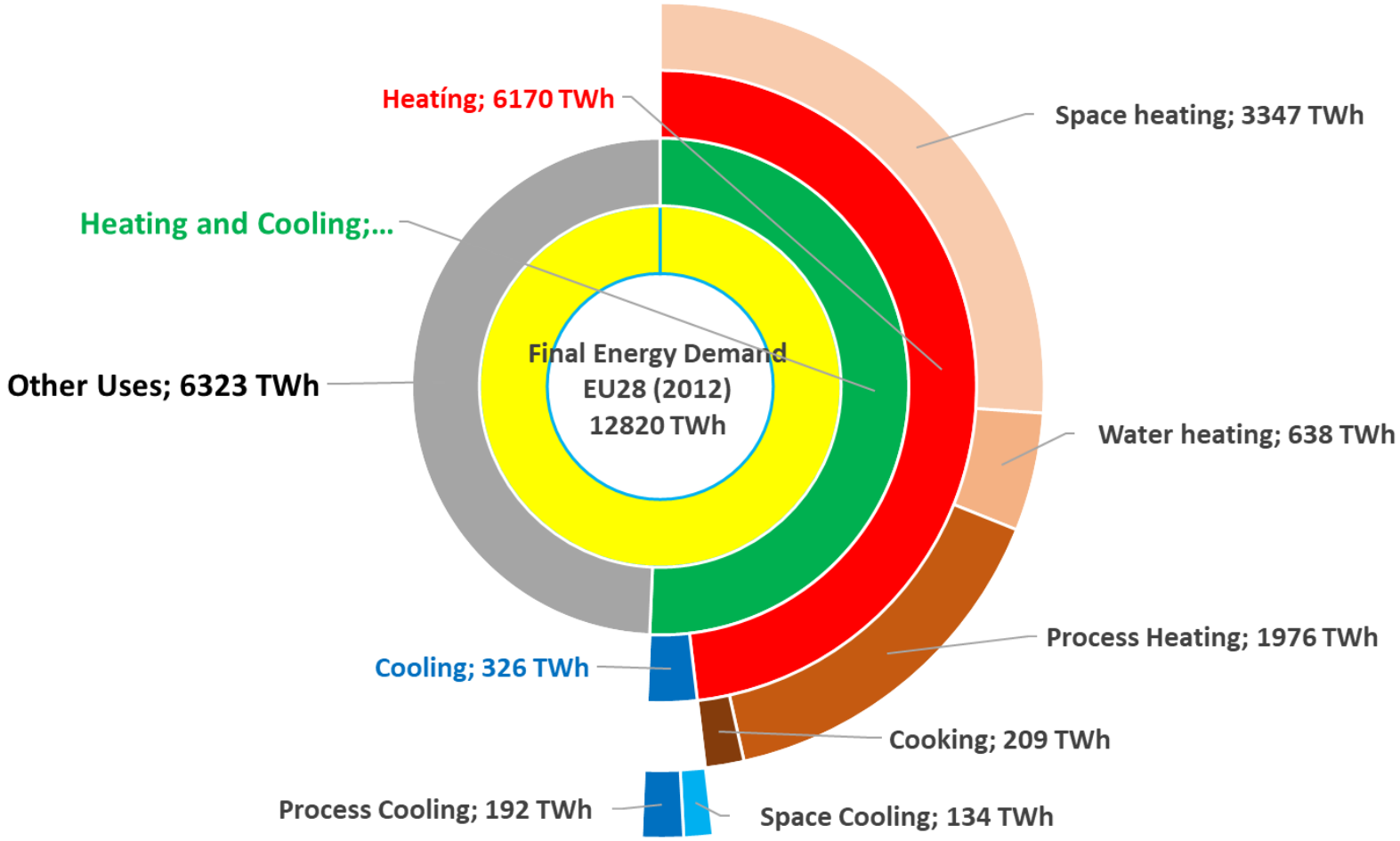


Heating: $T_{inside} > T_{outside}$



Heating and Cooling Demand in EU 28 (2012)

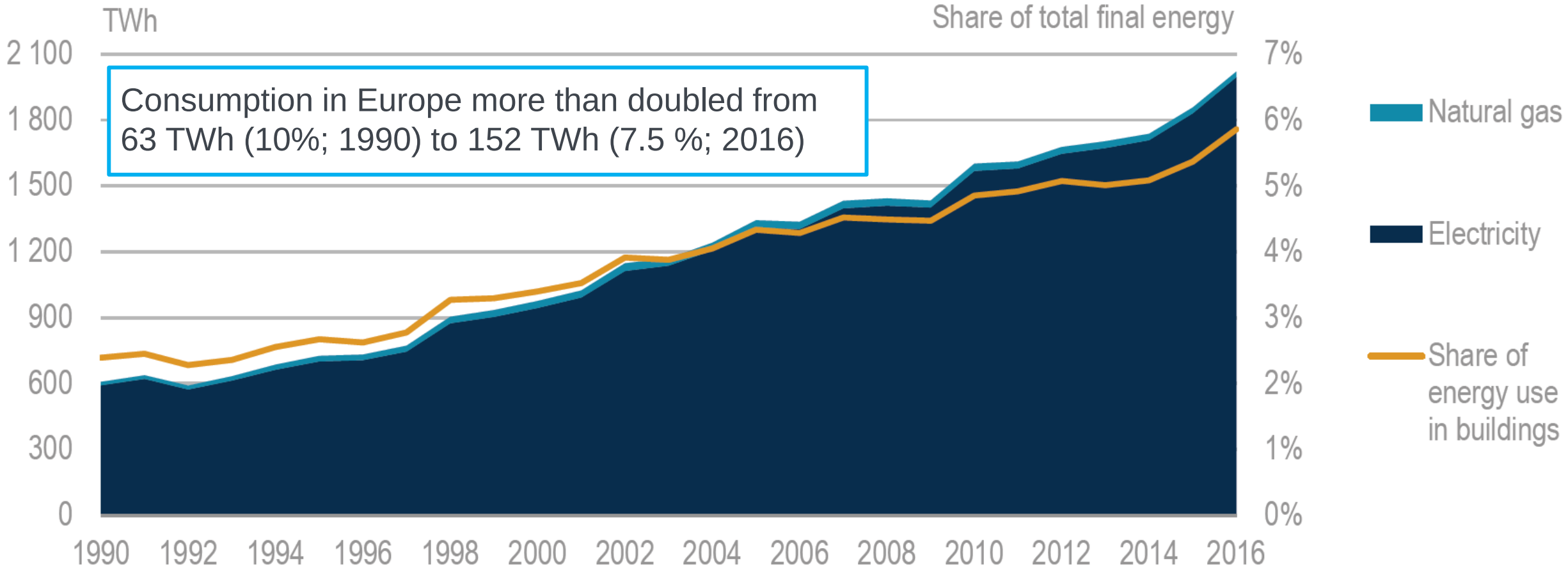
Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung



Source: Own Grafics based on on data from: Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables), Executive summary, Final report, September 2016, https://ec.europa.eu/energy/studies/mapping-and-analyses-current-and-future-2020-2030-heatingcooling-fuel-deployment_en

Worldwide Energy Use for Space Cooling

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung



Source: The future of cooling, IEA, Paris, 2018

Technical Solutions for Cooling

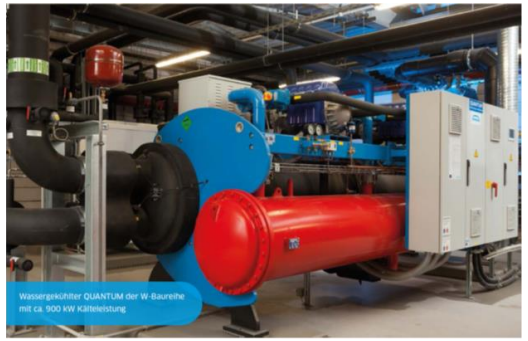
Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung

Passively driven

- Free cooling
- Evapo-ration

Actively driven

- electric
  - Com-pression cooling
- thermal
  - Steam jet refrige-ration
  - Ad-sorption chiller
  - Ab-sorption chiller



Quelle: Engie Refrigeration, 2017

Quelle: Bine Informationsdienst : themeninfo 01/04 – Klimatisieren mit Sonne und Wärme; 2004

Working Fluids

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und
Rationelle Energieanwendung

- Compression Refrigeration and Compression Heat Pumps require a working fluid for the application
- The working fluid should be
  - non-toxic
  - non inflammable
  - have a high evaporation enthalpy
  - enable an efficient cycle
  - should not mix with lubricants
  - chemically stable
  - have a low global warming potential (GWP)
  - applicable at low pressures
  - availability world wide
  - low cost

Each fluid has it`s pros and cons !

Possible Linkages between Heating and Cooling

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung

	Using Heating for Cooling	Using Cooling for Heating
Energy Input	CHP, waste heat, solar thermal	Electricity
Carbon Footprint	• Waste heat and solar thermal zero, • CHP depending on fuel used and system configuration	Depending on electricity mix; continuously declining
Technology	• Absorption Cooling • Adsorption Cooling	• Direct utilisation of waste heat from condenser • Indirect application using heat pumps
Efficiency	ε = 0.5 to 0.8	$\varepsilon = \infty$ to 2

Heat / Cold Storage for System Flexibility

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung

Storage Technologies

Electricity

- mechanical
- elec-tric — 200-600 Wh/l
- electro-chemical
- chemi-cal — 800-1000 Wh/l

Heat

- sensible — 20-100 Wh/l
- latent — 50-150 Wh/l
- thermo-chemical

Source. VDI, https://www.ingenieur.de/technik/fachbereiche/energie/groesster-batteriespeicher-welt-ging-in-china-ans-netz/, 2014

Source. Lipp GmbH, https://www.lipp-system.de/tanks/thermal-storage-tank-large/, 2020

Thermal Energy Storage

Advantages

- **lower cost**
- technology available
- high reliability
- broader spectrum of energy inputs
- can act as **indirect electricity storage** with CHP and compression cooling

Disadvantages

- **lower energy density**
- lower efficiency
- higher losses

Summary

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und Rationelle Energieanwendung

- Cooling demand continues to raise but will remain much lower than the heating demand.
- Today cooling mainly based on electricity, heating on fossil fuels.
- Economics highly depend on ratio between electricity and fuel price.
- Using the waste heat from the condenser of a cooling cycle could help to decarbonise the heating sector.
- R&D work on new and improved working fluids required for the heating and cooling sector.
- Storage of heat (below or above ambient) provides system flexibility to cope with fluctuating renewable energy.

Universität Stuttgart
IER Lehrstuhl für Energieeffizienz
Institut für Energiewirtschaft und
Rationelle Energieanwendung

Thank you very much!

Prof. Dr.-Ing. Peter Radgen

E-Mail peter.radgen@ier.uni-stuttgart.de

Phone +49 (0) 711 685- 87877

Fax +49 (0) 711 685- 77877

University of Stuttgart
Institute of Energy Economics and
Rational Energy Use
Heßbrühlstraße 49a
70656 Stuttgart
Germany

03.

- **Electrification and renewable energy**

  - **Frauke Thies, Executive Director, smartEn**

EPEE Webinar

#CountOnCooling

Frauke Thies, Executive Director, smartEn

22 September 2020

smartEn
Smart Energy Europe

About smartEn

smartEn
Smart Energy Europe

smartEn Members

Executive Members

ade · APPLiA Home Appliance Europe · bne Bundesverband Neue Energiewirtschaft · centrica Business Solutions · EDF · enel X · Entelios · ntra Agregación y Flexibilidad · epq · geo smarter energy

NODES · Schneider Electric · SIEMENS Ingenuity for life · vaasa ETT · Voltalis

Regular Members

3E · AFRY Af Pöyry · ampx · AutoGrid · BayWa r.e. renewable energy · CUCULUS · CYBERGRID · DNV·GL · EATON Powering Business Worldwide · ENERGY·21

Energy Pool · epexspot · EVBOX · FLEXIBLEPOWER ALLIANCE NETWORK · Honeywell · JOULE ASSETS · Microsoft · THE MOBILITY HOUSE

NUVVE · sonnen · TESLA · tiko · WATTSDAT · WIREPAS

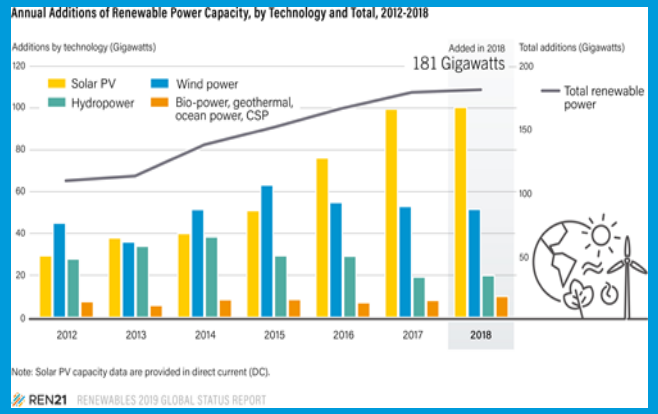
Associate Members

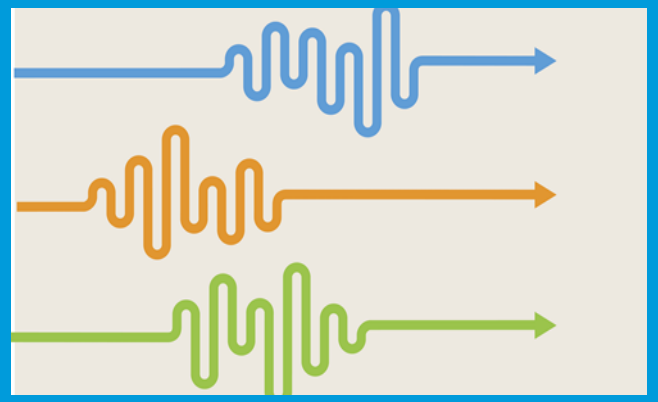
DELTA Energy & Environment · ENERCOUTIM Alcoutim Solar Energy Association · CATAPULT Energy Systems · e·on · EVN · KOENAtec · kWIQly · M Climate · next

NOVOJY · Ørsted · POWER ANALYTICS · REGALGRID sharing your power · SOLVERA LYNX · ThermoVault · Vestas

smartEn Smart Energy Europe

New Challenges

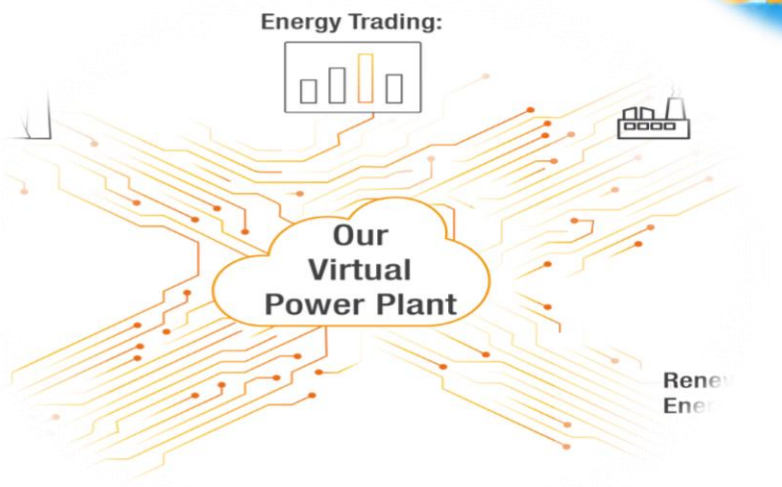




From scaling renewables to running a system with very high shares of variable and decentralised generation

smartEn
Smart Energy Europe

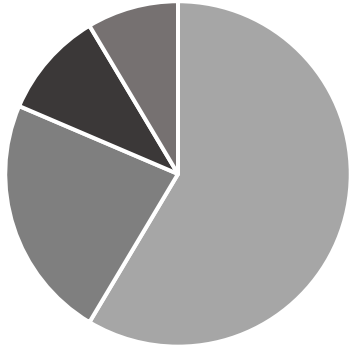
Activating Flexibility: Implicit & Explicit



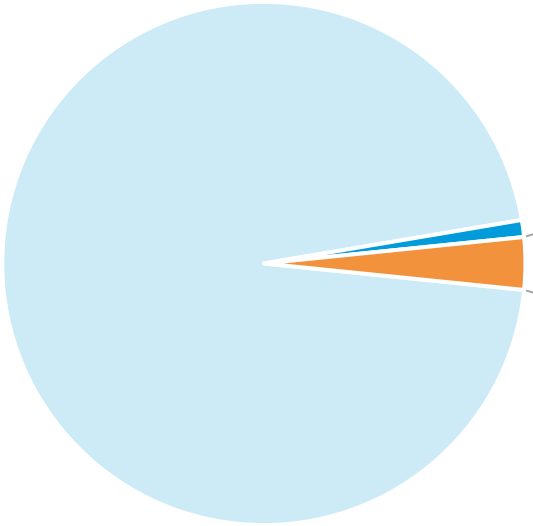
smartEn
Smart Energy Europe

Snapshot: residential flexibility

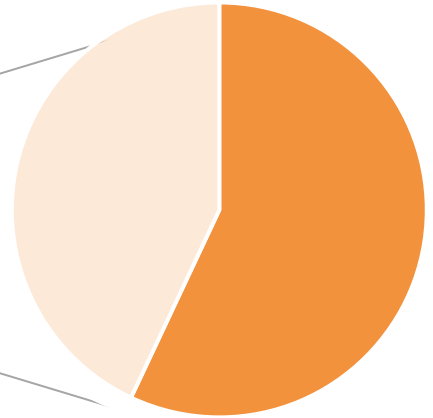
65 GW new assets until 2025



200 GW installed assets



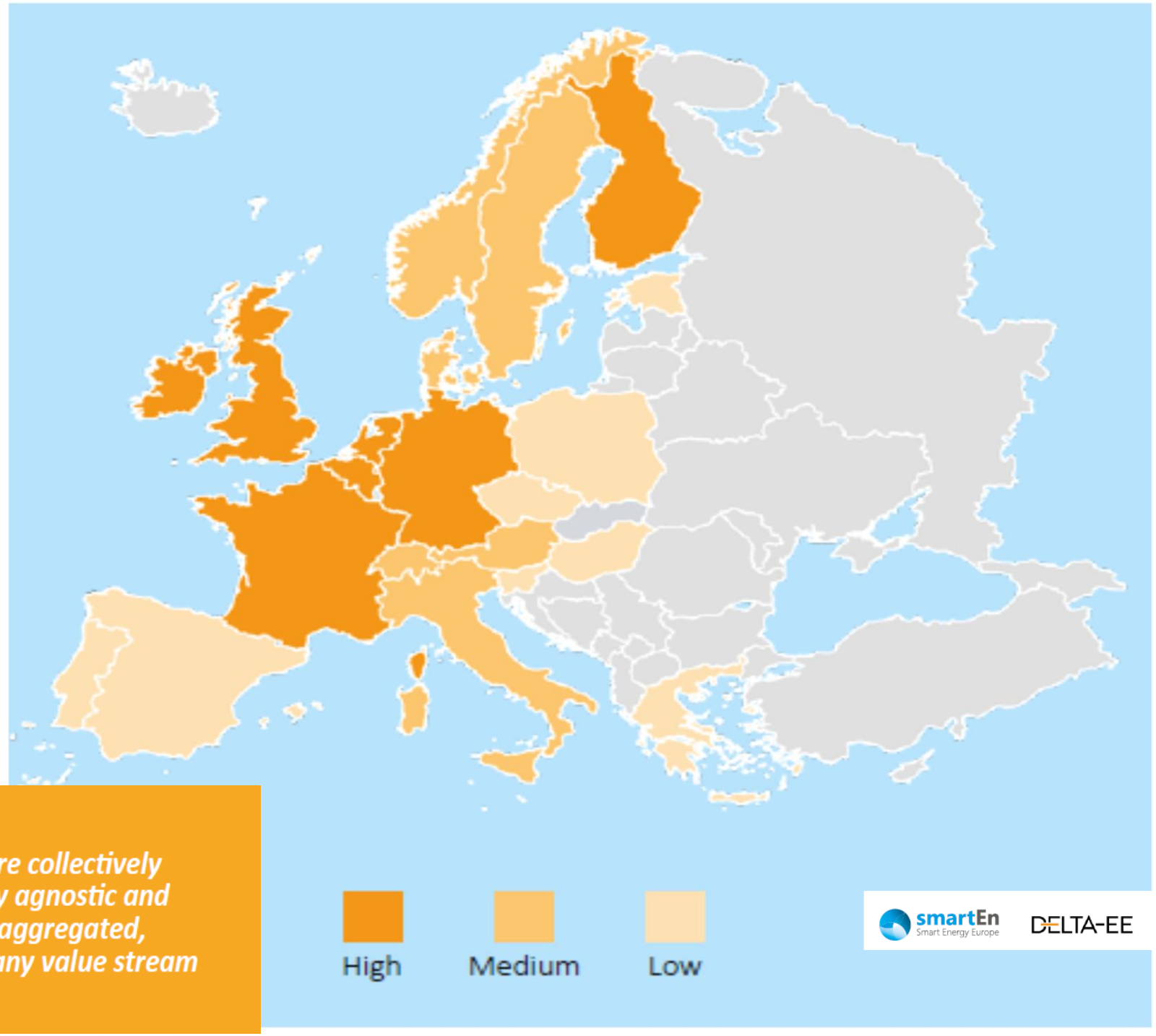
5.5 GW EV charge points & home batteries



based on *Delta-ee, June 2020*

smartEn
Smart Energy Europe

Today's Market Context



OUR DEFINITION OF DEMAND SIDE FLEXIBILITY

Behind-the-meter decentralised sources of flexibility are collectively termed demand side flexibility (DSF). DSF is technology agnostic and refers to the turning on / off, up / down, or shifting of aggregated, decentralised loads, batteries and generation, across any value stream and customer segment.

Creating the Markets

Central changes from the European Clean Energy Package

OPEN ALL MARKETS TO DR AND DER

FAIR MARKET ACCESS FOR NEW SERVICE PROVIDERS

PROCUREMENT OF FLEXIBILITY SERVICES FOR DSOS+TSOS

RELEVANT DATA ACCESS

EFFECTIVE PRICE SIGNALS AT RETAIL AND WHOLESALE LEVEL (?!?)

What Next? – Important Elements

Ambition and Targets → Sector Integration: System Efficiency → Renovation Wave: Smart Buildings

smartEn
Smart Energy Europe

smartEn
Smart Energy Europe

Smart Energy Europe
Rue d'Arlon 69-71
BE-1040 Brussels

+32 (0) 2 58 88 992
info@smarten.eu
www.smarten.eu
@smartEnEU

Q&A session

Closing remarks

- Andrea Voigt, EPEE

CountOn Cooling

EPEE

EPEE - European Partnership for Energy and the Environment

Avenue des Arts, 46 - 1000 Brussels
Tel: +32 (0)2 732 70 40
Fax: +32 (0)2 732 71 16 secretariat@epeeglobal.org
www.epeeglobal.org