PATH TO NET-ZERO:

Is Waste-to-Energy part of the solution?

CEWEP

ESWET

PATH TO NET-ZERO:
Is Waste-to-Energy part of the solution?

PROGRAMME:

17:30 - PRESENTATIONS

- Paul De Bruycker, President of CEWEP:
“How will European Waste-to-Energy Sector Help to achieve EU Net-Zero?”

- Bruno-Frédéric Baudouin, Vice-President of ESWET:
“Recovering the non-recyclable: The Integrated Resource Recovery Facility”

18:10 - PANEL DISCUSSION:
EXPLOITING THE POTENTIAL OF CCUS IN WASTE-TO-ENERGY

- Chris Bolesta, CCUS Team Leader, DG Energy, European Commission
- Monica Praat, Logistics Manager at AVR
- Jacob H. Simonsen, CEO of Amager Ressourcecenter

19:00 - NETWORKING DINNER

PATH TO NET-ZERO:
Is Waste-to-Energy part of the solution?

Welcoming Remarks:

ELLA STENGLER,
Managing Director

PATRICK CLERENS,
Secretary-General

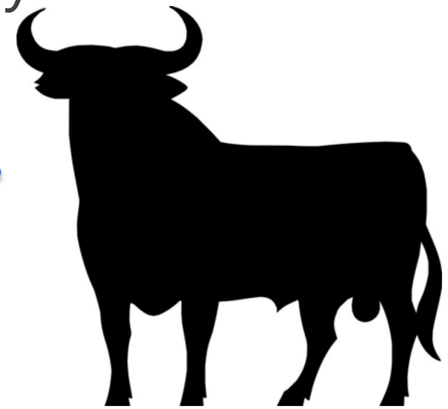
Waste sector has large potential for climate mitigation

- Recent study by **Prognos and CE Delft** examined the CO_2eq reduction potential of the waste management sector for EU27+UK.

- **Saving 150 Mt CO_2eq annually:** applying current EU waste laws and the same recycling and landfill targets as set for Municipal waste to Industrial and Commercial waste by 2035.

- **Saving 296 Mt CO_2eq annually:** With more ambitious recycling targets and diverting waste that can be used for material or energy recovery from landfills.

Equal to the total net GHG emissions of Spain for 2019



Waste-to-Energy (WtE) secures local, affordable and reliable energy for Europe (24/7)

- WtE has a significant potential to reduce our dependency on fossil fuels and contributes to diversification and security of energy supply, pathing the way towards a carbon-neutral Europe.

- Assuming that the EU waste targets are applied not only to Municipal waste, but also to Commercial and Industrial waste by 2035:

European WtE plants could produce **189 billion kWh** of useful energy/year

=

equivalent to **19.4 billion m³** of natural gas in terms of primary energy

=

Ca. **12.5% of natural gas imports** to the EU from Russia (155 billion m³ in 2021)

PATH TO NET-ZERO:
Is Waste-to-Energy part of the solution?

17:30 - Presentations

- ***PAUL DE BRUYCKER**, President of CEWEP:*
"How will European Waste-to-Energy Sector Help to achieve EU Net-Zero?"

- ***BRUNO-FRÉDÉRIC BAUDOUIN**, Vice-President of ESWET:*
"Recovering the non-recyclable: The Integrated Resource Recovery Facility"

cewep Confederation of European Waste-to-Energy Plants

Waste-to-Energy Climate Roadmap:

Path to Carbon Negative

Paul De Bruycker, President of CEWEP

21st June 2022, Brussels

CEWEP's Waste-to-Energy Roadmaps in the European Green Deal

Making a clean Circular Economy happen

Material and energy recovery are complementary solutions

→ Waste-to-Energy Sustainability Roadmap 2019

The Path to Carbon Negative

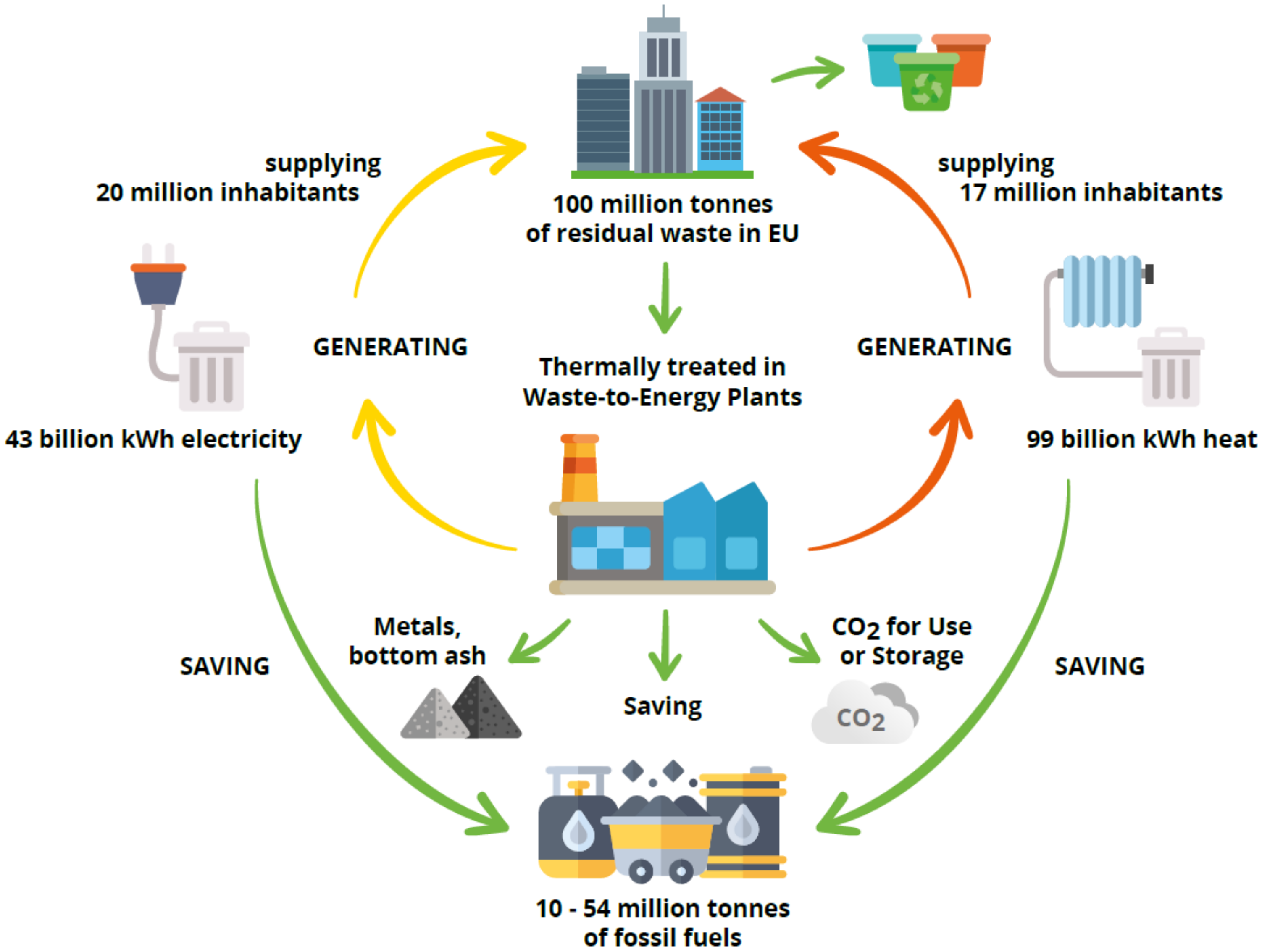
Energy substitution, landfill diversion, bottom ash recovery, CCUS

→ Waste-to-Energy Climate Roadmap 2022

Waste-to-Energy - Enabler of Circular Economy

- Turns non-recyclable waste in an environmentally safe way into secure energy and valuable raw materials;
- Keeps the circle clean by dealing with unwanted organic components in the material cycles (act as a pollutant sink, fulfilling a hygienic task for the society).

WtE's Double Role: Sustainable Waste Management + Energy and Climate



- Some **500 WtE plants** in Europe provide a continuous **hygienic task** to society
- Treating **100 M tonnes** of residual, non-recyclable waste from municipal + commercial and industrial activities
- The amount of primary energy generated by WtE in 2019 corresponds to approximately **9% of the natural gas imports to the EU from Russia**

Plastic – the main source of WtE's fossil CO2 emissions

- Significant number of plastic products put on the market are still non-reusable and non-recyclable.

- **Consumer behaviour and producer responsibility**: the entire waste and product value chain must take part in the effort to reduce fossil residual waste.

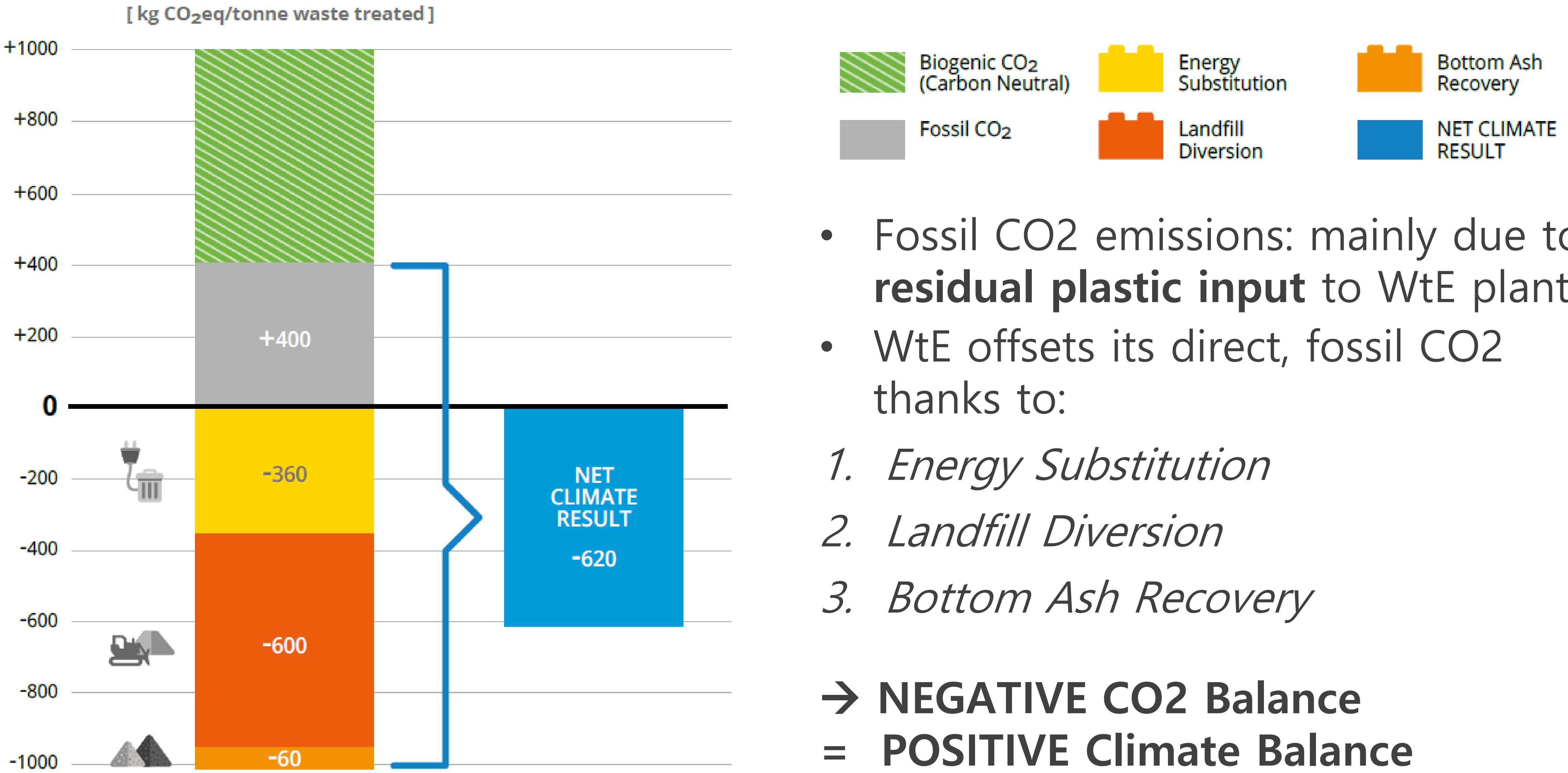
- Source separation is key to enable quality recycling.

- **Non-recyclable plastic waste can be effectively treated in Europe by WtE**

→ It would otherwise be landfilled or exported to other countries (with lower environmental and social standards)

- The WtE sector has, apart from its hygienic task, a pivotal role towards a resource-efficient, clean circular economy and carbon neutral future.

STATUS QUO: European WtE Sector's Current Climate Balance

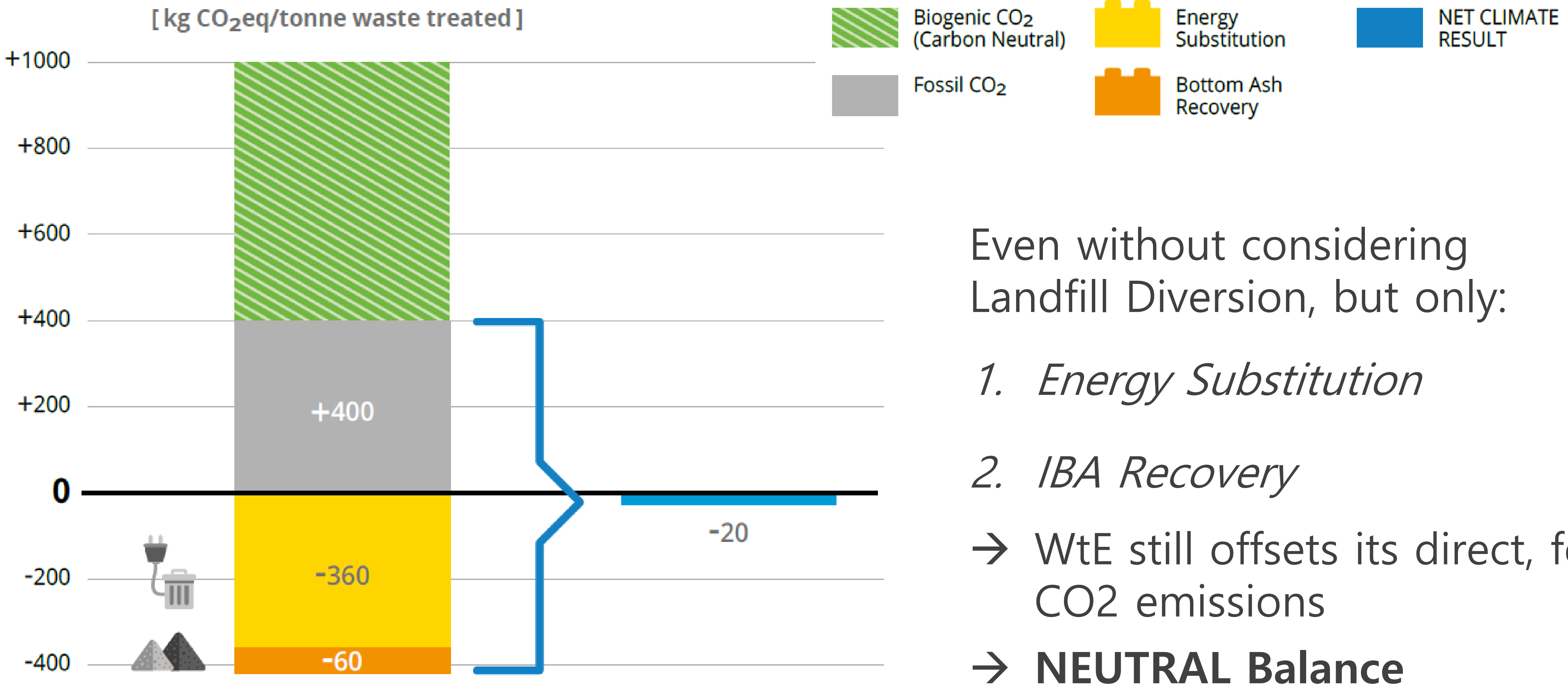


- Fossil CO2 emissions: mainly due to **residual plastic input** to WtE plants
- WtE offsets its direct, fossil CO2 thanks to:

1. *Energy Substitution*
2. *Landfill Diversion*
3. *Bottom Ash Recovery*

→ NEGATIVE CO2 Balance
= POSITIVE Climate Balance

STATUS QUO: European WtE Sector's Current Climate Balance



Even without considering Landfill Diversion, but only:

1. *Energy Substitution*
2. *IBA Recovery*

→ WtE still offsets its direct, fossil CO2 emissions

→ **NEUTRAL Balance**

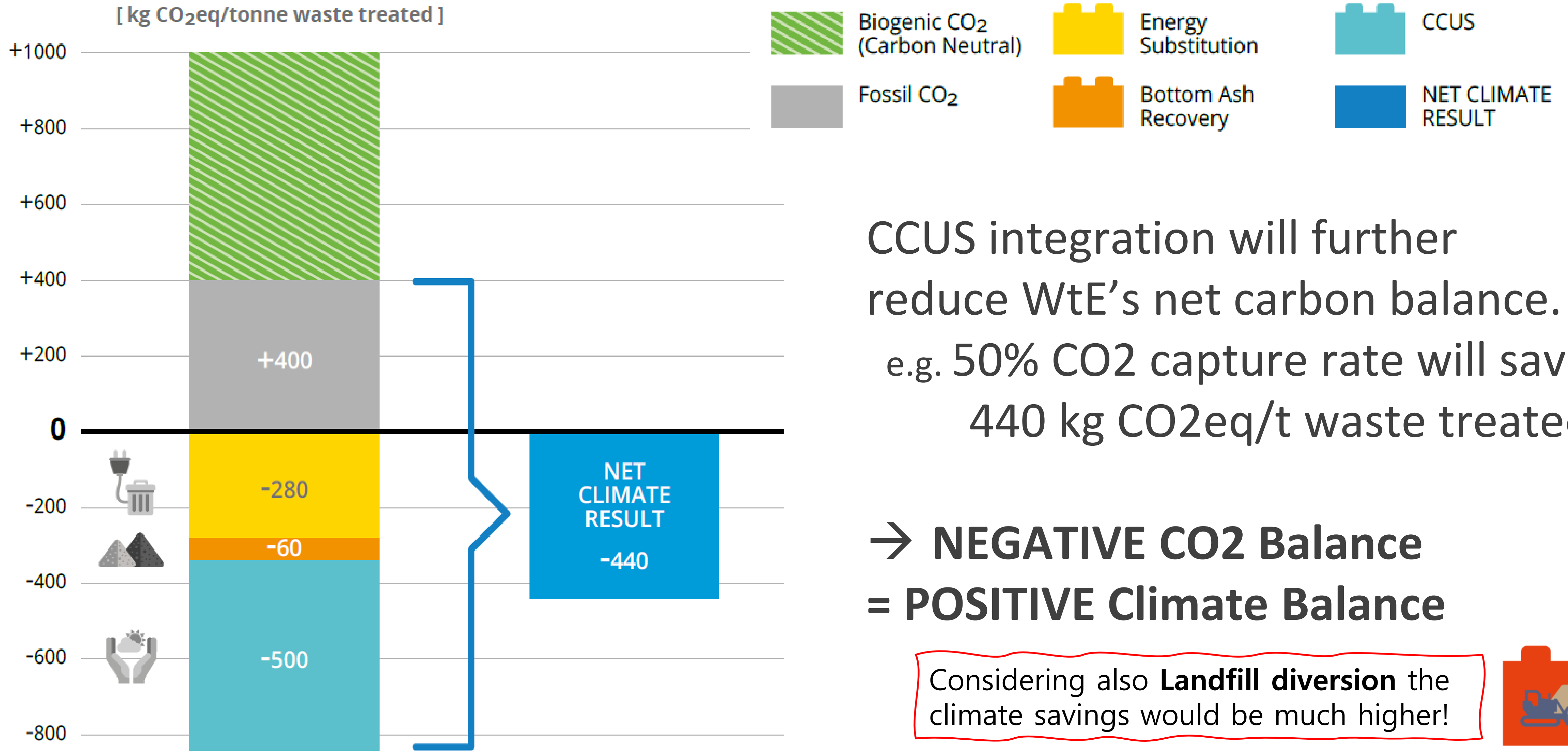
CCUS: Carbon Capture Utilisation and Storage

"The integration of WtE and carbon capture and storage (CCS) could enable waste to be a net zero or even net negative emissions energy source."

UN Intergovernmental Panel on Climate Change (IPCC), *AR6 WGIII, Mitigation of Climate Change, April 2022*

Source and credits: AVR

FUTURE: European WtE Sector's Carbon Balance with CCUS



CCUS integration will further reduce WtE's net carbon balance.
e.g. 50% CO2 capture rate will save 440 kg CO2eq/t waste treated

→ **NEGATIVE CO2 Balance**
= POSITIVE Climate Balance

Considering also **Landfill diversion** the climate savings would be much higher!

From Carbon Neutral to Carbon Negative

STATUS QUO

WtE is a climate neutral sector

BUILDING ON THE STATUS QUO

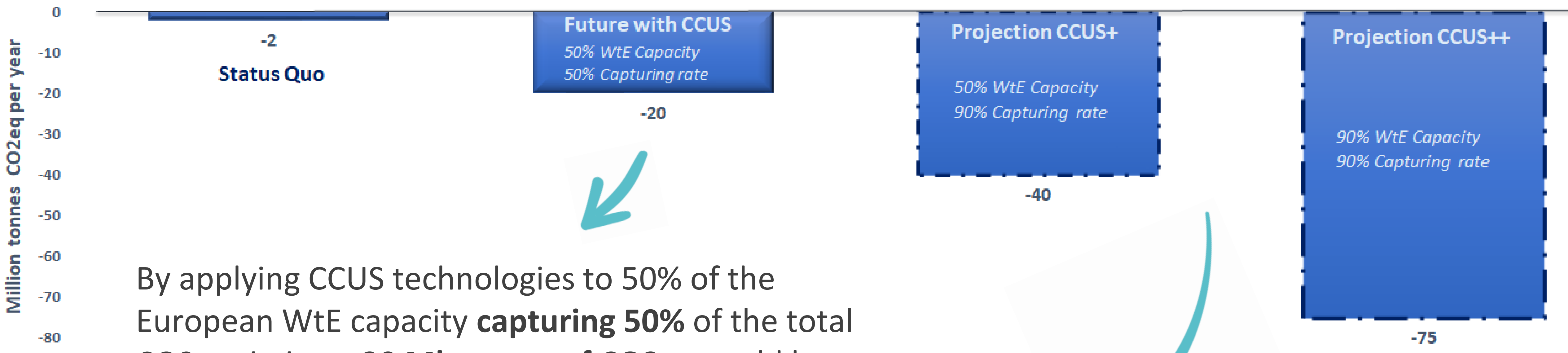
CCUS:
an extra but effective tool to reach a negative CO2 emission balance

CO2eq Reduction Potentials

WtE saves ca. **2 million tonnes of CO2eq /Yr**

Progress only possible with **adequate political support** and a **business model** on the EU and national levels

!



By applying CCUS technologies to 50% of the European WtE capacity **capturing 50%** of the total CO2 emissions, **20 Ml tonnes of CO2eq** could be saved every year .

<u>**Increasing ambition**</u>: With a broader integration of carbon capture equipment, greater reduction potentials can be foreseen as CCUS technologies will reach **full commercial maturity**.

Call to policymakers

Enabling conditions for CCUS:

- CO2 transport and storage infrastructure
- CCUS technology support
- Market mechanism and certification system for negative emissions
- CO2 market development

Enabling conditions for sustainable waste management:

- Minimising methane emissions from landfills
- Restricting landfills to waste not suitable for material and energy recovery
- Recognition of the role of WtE (incl. taxonomy)

Different CCUS projects in WtE kicked-off across Europe

Belgium	Indaver Power-to-Methanol project (Antwerp@c, Port of Antwerp)
Denmark	Amager Resource Center (ARC) (Copenhagen)
Finland	Fortum Carbon2x pilot (Riihimäki), Westenergy's EnergySampo CCU project (Mustasaari)
Portugal	Lipor (Porto): CCU for the production of synthetic aviation fuels
Netherlands	Twence (Hengelo), AVR (Duiven), AVR (Rozenburg), AEB (Amsterdam), HVC (Alkmaar)
Norway	Celsio Klemetsrud (Olso, part of Longship Project), Statkraft Varme, Returkraft, BIR, FORUS
Sweden	Renova (Gothenburg), SYSAV (Malmö)
UK	SUEZ (Haverton Hill, Teesside), Viridor (Runcorn, Dunbar, Cardiff Trident Park)
Switzerland	All 29 Swiss WtE plants committed to CCS in the long-term

...and many more on-going feasibility studies, pilot projects, etc. across Europe

WtE contributes to carbon neutrality by 2050. If supported by EU policies, WtE will be even a pivotal provider of negative CO2 emissions.

CEWEP – Members

Stowarzyszenie Producentów Energii z Odpadów

CTRASA

PRAŽSKÉ SLUŽBY

Dutch Waste Management Association
Partner in the circular economy

fortum

Gren

KRV

Kauno kogeneracinė jėgainė

WIEN ENERGIE

SVDU

Vilniaus kogeneracinė jėgainė

Avfall Norge

aeversu
Convertimos residuos en energía

BELGIAN WASTE-TO-ENERGY BW2E

SavoieDéchets
SYNDICAT MIXTE DE TRAITEMENT DES DÉCHETS

STEO

ITAD

AVALER

SAICA

eren

KIVO
SUOMEN KIERTOVOIMA

AVFALL SVERIGE

FKF

SIDOR

EVN

IRELAND CEWEP

urbaser ltd

Danish Waste Association
Waste is resources

NORTH LONDON WASTE AUTHORITY

TERMIZO

UTILITALIA
imprese acqua ambiente energia

VBSA ASIR ASED

Viridor

BRNO SAKO

PLZEŇSKÁ TEPLÁRENSKÁ
Více než energie

KOSIT

OLO
Odvoz a likvidácia odpadu a.s.

Returkraft

Thank you for your attention

Paul De Bruycker,
President of CEWEP
info@cewep.eu
www.cewep.eu

Recovering the Non-Recyclable: The Integrated Resource-Recovery Facility

Bruno-Frédéric Baudouin – ESWET Vice-President

About ESWET

- **ESWET** is the association representing the **European Suppliers of Waste-to-Energy Technology**.

- Our main task is to **foster the development** and **information sharing** about Waste-to-Energy Technologies.

- We seek to **share facts on the positive implications** of the technology towards **decarbonisation** and **circular economy** both for the environment and the recovery of energy and materials.

- ESWET has **33 members** which are all suppliers of the main components of Waste-to-Energy plants and are active building and maintaining Waste-to-Energy plants in Europe and throughout the world.

ESWET members

ESWET

AC BOILERS S.p.A. formerly Ansaldo Caldaie
ANDRITZ
APEX HEAT TRANSFER
B&W BABCOCK & WILCOX RENEWABLE
CARMEUSE
CLYDE BERGEMANN
DOOSAN Lentjes

GE
GENERAL KINEMATICS
Hitachi Zosen INOVA
Howden
IEM ConveyingSystems
Keppel Seghers Solutions for a Cleaner Future
Lab

Lhoist
LISEGA
loibl CONVEYING TECHNOLOGIES
LUEHR FILTER Air Pollution Control Technology
MAGALDI Dependable Technologies
MARTIN
meldgaard

MITSUBISHI POWER
NOOTER ERIKSEN NE
PAPREC ENGINEERING CNIM
SA GE EXPERT
SICK Sensor Intelligence.
SIEMENS energy
JFE Engineering Group Standardkessel Baumgarte JFE

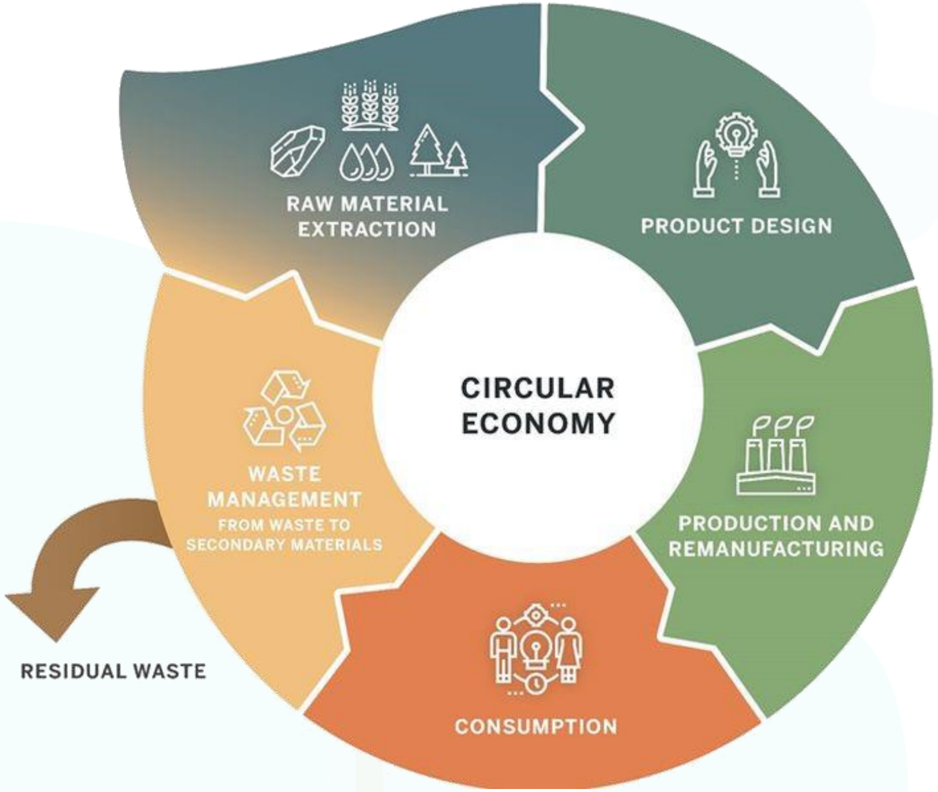
STC POWER
Steinmüller by Hitachi Zosen INOVA
steinmüller engineering The Engineers Company
Sumitomo SHI FW
VINCI ENVIRONNEMENT

The EU context

Decarbonisation of all industries

Transition to a circular economy

Ensuring resource security

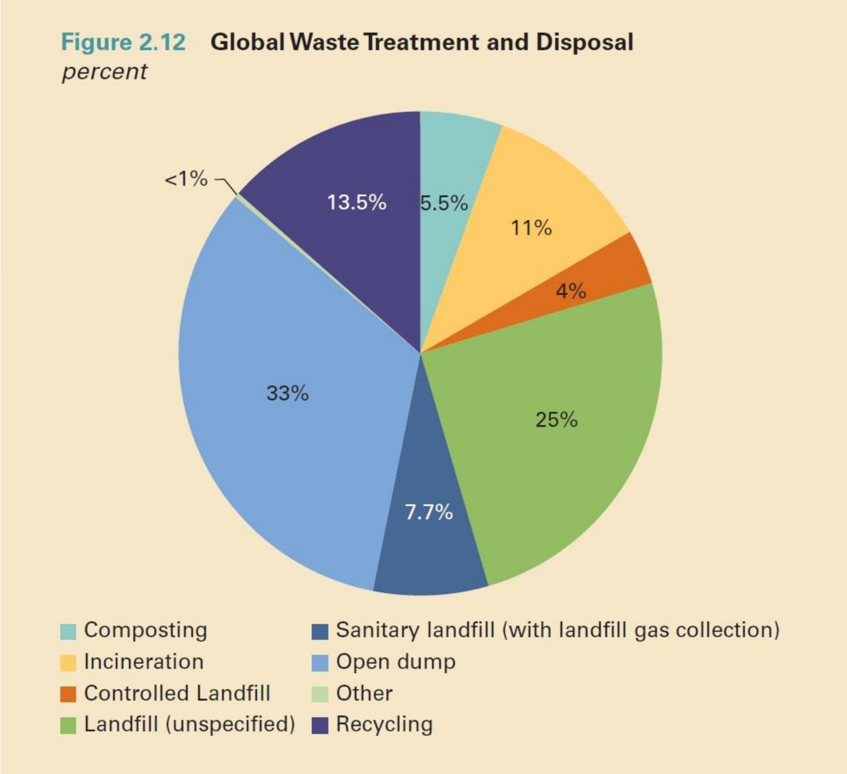


The global context

Waste generation is expected to reach **3.40 billion tons by 2050** generating up to 7% of global CO_{2eq} emissions

Landfills and open dumps are still the main treatment options for non-recyclable waste

Waste-to-Energy is recognised as a **sustainable solution and investment** to treat non-recyclable waste



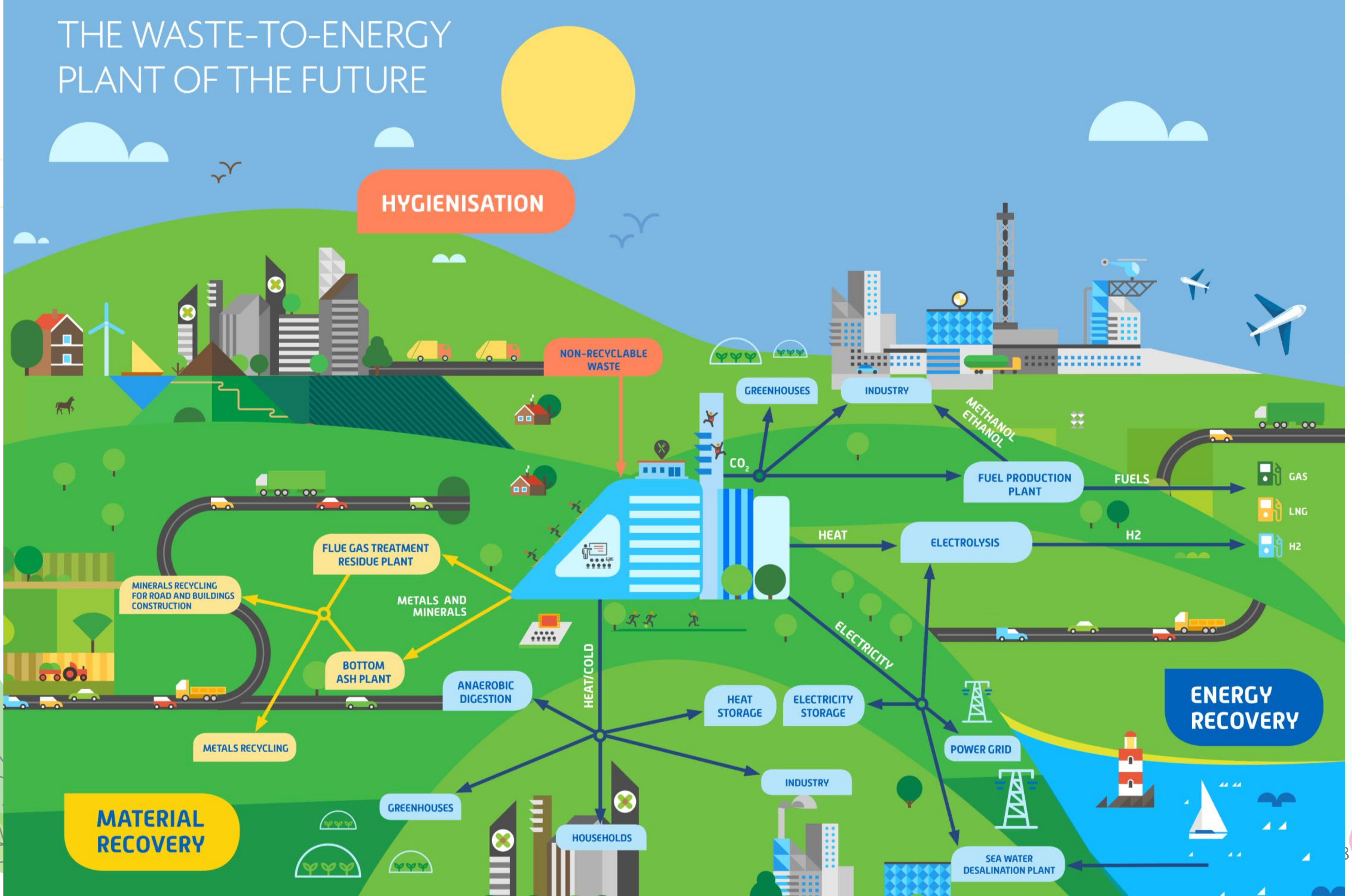
EU decisions have an overall influence on the global scale

Role of Waste-to-Energy

- ✓ Supplying **local, partly renewable, base load energy**
- ✓ Providing **metals and minerals** from incineration bottom and fly ashes
- ✓ Diverting non-recyclable waste from landfills
- ✓ Providing a **hygienisation service** to the community freeing land for life

While being **low carbon**

Still, more can be done to support the climate objectives exploiting a **valuable resource**


THE WASTE-TO-ENERGY PLANT OF THE FUTURE
HYGIENISATION
NON-RECYCLABLE WASTE
GREENHOUSES
INDUSTRY
METHANOL
ETHANOL
CO_2
FUEL PRODUCTION PLANT
FUELS
GAS
LNG
H2
HEAT
ELECTROLYSIS
H2
FLUE GAS TREATMENT RESIDUE PLANT
MINERALS RECYCLING FOR ROAD AND BUILDINGS CONSTRUCTION
METALS AND MINERALS
BOTTOM ASH PLANT
ANAEROBIC DIGESTION
HEAT/COLD
ELECTRICITY
HEAT STORAGE
ELECTRICITY STORAGE
POWER GRID
ENERGY RECOVERY
METALS RECYCLING
INDUSTRY
GREENHOUSES
HOUSEHOLDS
SEA WATER DESALINATION PLANT
MATERIAL RECOVERY

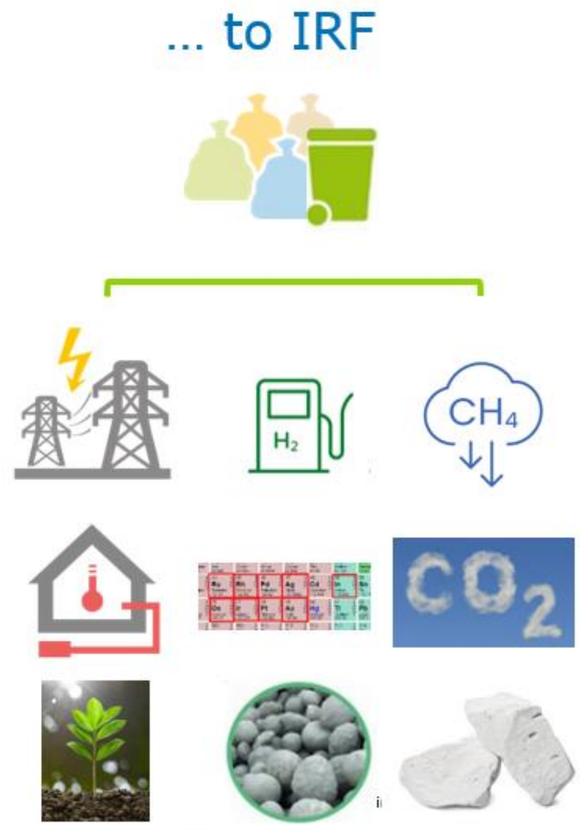
IRF – A new approach

Adopting a **holistic** approach to go from **carbon neutral** to **carbon negative**

The **Integrated Resource-Recovery Facility (IRF)** is a step-change evolution

From the standard WtE plant

To a **stronger generation of sustainable infrastructure** incorporating innovative technologies



Integrated Resource-Recovery Facilities

A key enhancing infrastructure to support

EU energy & raw material security,

decarbonisation and circular economy

EU Energy security

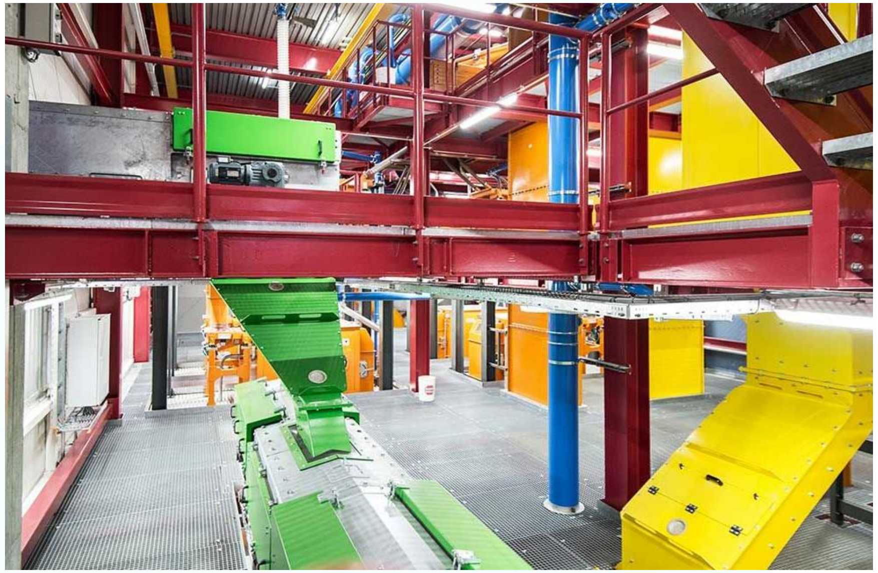
From 129 TWh of electricity and heat produced in 2020

To enhanced energy efficiency technologies to **significantly increase the energy generation.**

EU raw material supply security

Both metals and minerals are valuable resources

Addition of new technologies such as **dry processing of dry-discharged bottom ash**



Source: ZAV Recycling plant

Enhanced recovery of metals and minerals **further contribute to the circular economy and decarbonisation, as up to 60kg of CO_2 can be saved by tonne of treated waste!**

EU raw material supply security

From bottom ash

Recovering of metals only represents a potential market of over 2 b€ annually, and a potential of reduction of CO_{2eq} emissions of 14.5 mt!

The full potential with enhanced recovery is of:

✓ **0.7 million tons of Aluminium**

→ 11% of European imports

✓ **2.4 million tons of ferrous metals**

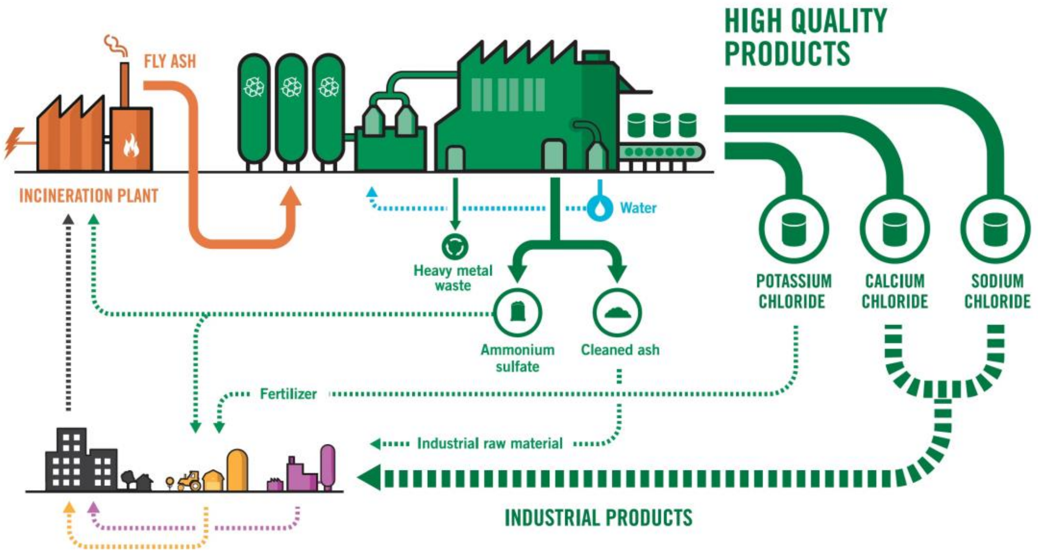
→ 27% of European imports from Russia

Source: Meldgaard

EU raw material supply security

From fly ash

- ✓ Recovering silicates, potassium chlorides, sodium chloride or other components
- ✓ Recovering zinc and heavy metals
- ✓ Using the ash as a base for aggregates



Source: Ash2Salt, EasyMining

Increase the **security of raw material supply**, boost the European **circular economy** while reducing offshore European **carbon footprint**

EU Decarbonisation

Adding to an IRF carbon capture, storage and utilisation technologies

✓ **Fully decarbonised plants**

✓ **Contribute to the circular economy** by capturing and using recycled CO_2

Amine-based post-combustion absorption

CO_2 utilisation is developing

For chemicals and minerals
Supplying greenhouses
Producing synthetic fuels

Source: Copenhill, B&W Volund

IRF – A new Paradigm

Hygienisation, heat & raw material recovery are the core functions & revenues of an IRF

Traditionally base load energy output, can be re-purposed to serve new urban needs to support circularity & decarbonisation e.g.

- **Hydrogen production** for mobility or gas grid injection leveraging urban localisation
- **CO_2 capture** with production of synthetic gaseous / liquid hydrocarbons or carbonate minerals

First biological methanation plant in Europe, Source: HZI

IRF can be purposed to being a key contributor to the **decarbonisation of hard-to-abate sectors while balancing the electrical grid on an as-needed basis** allowing for more intermittent renewable energy

Policy framework needed

- Preserve the **waste management hierarchy**
- Define the full sector's sustainability criteria under the EU Taxonomy
- **Consider the IRF's CO2 offsets** via a Life Cycle Analysis
- Maintain the current definition of "biomass" in the Renewable Energy Directive to include the biodegradable **fraction** of waste
- Classify hydrogen produced from IRF as **partly renewable** and **partly low carbon hydrogen**
- Guarantee the access to the renewable energy market for hydrogen and fuels derived from waste
- Support **CCUS implementation** for IRF to become carbon-negative through both regulation and funding
- Recognise the contribution of the sector to the circular economy via secondary raw materials recovery such as aggregates, metals and chemicals

IRF in the EU Green Deal

Enhanced benefits of IRF

Decarbonisation:

IRF can be carbon negative

Partly renewable hydrogen

Capture & storage of CO2

Circular economy:

Enhanced metal recovery

Recovery of salts & metals

Recycled CO2

Supply security:

Raw material & energy

Stability of the grid

Synthetic fuels

PATH TO NET-ZERO:
Is Waste-to-Energy part of the solution?

18:10 - Panel Discussion:

EXPLOITING THE POTENTIAL OF CCUS IN WASTE-TO-ENERGY

- *Chris Bolesta, CCUS Team Leader, European Commission*
- *Monica Praat, Logistics Manager at AVR*
- *Jacob H. Simonsen, CEO of Amager Ressourcecenter*

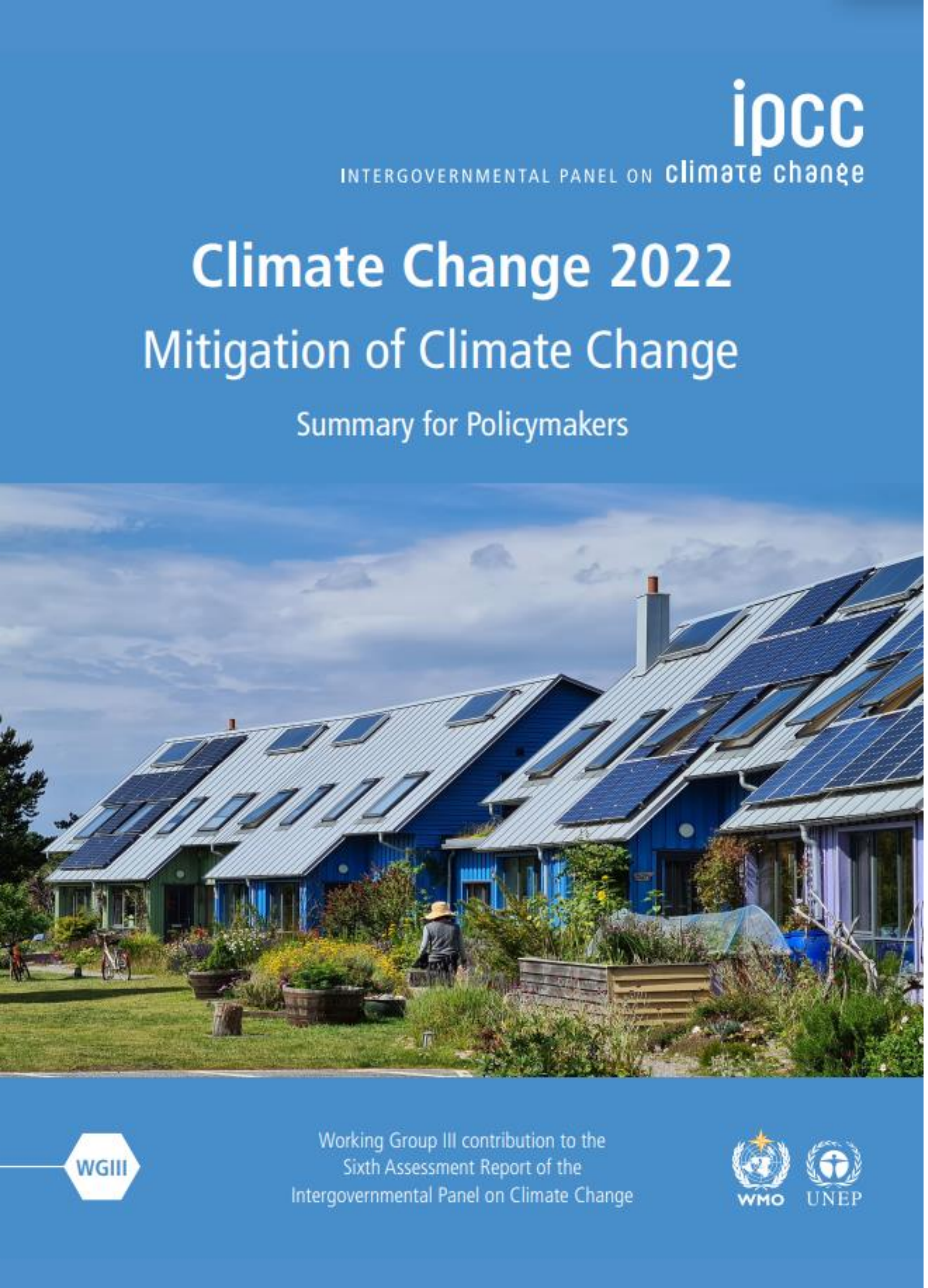
CEWEP

ESWET

CCS – part of the Solution

CEWEP & ESWET
21. June 2022

Licence to operate



Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.

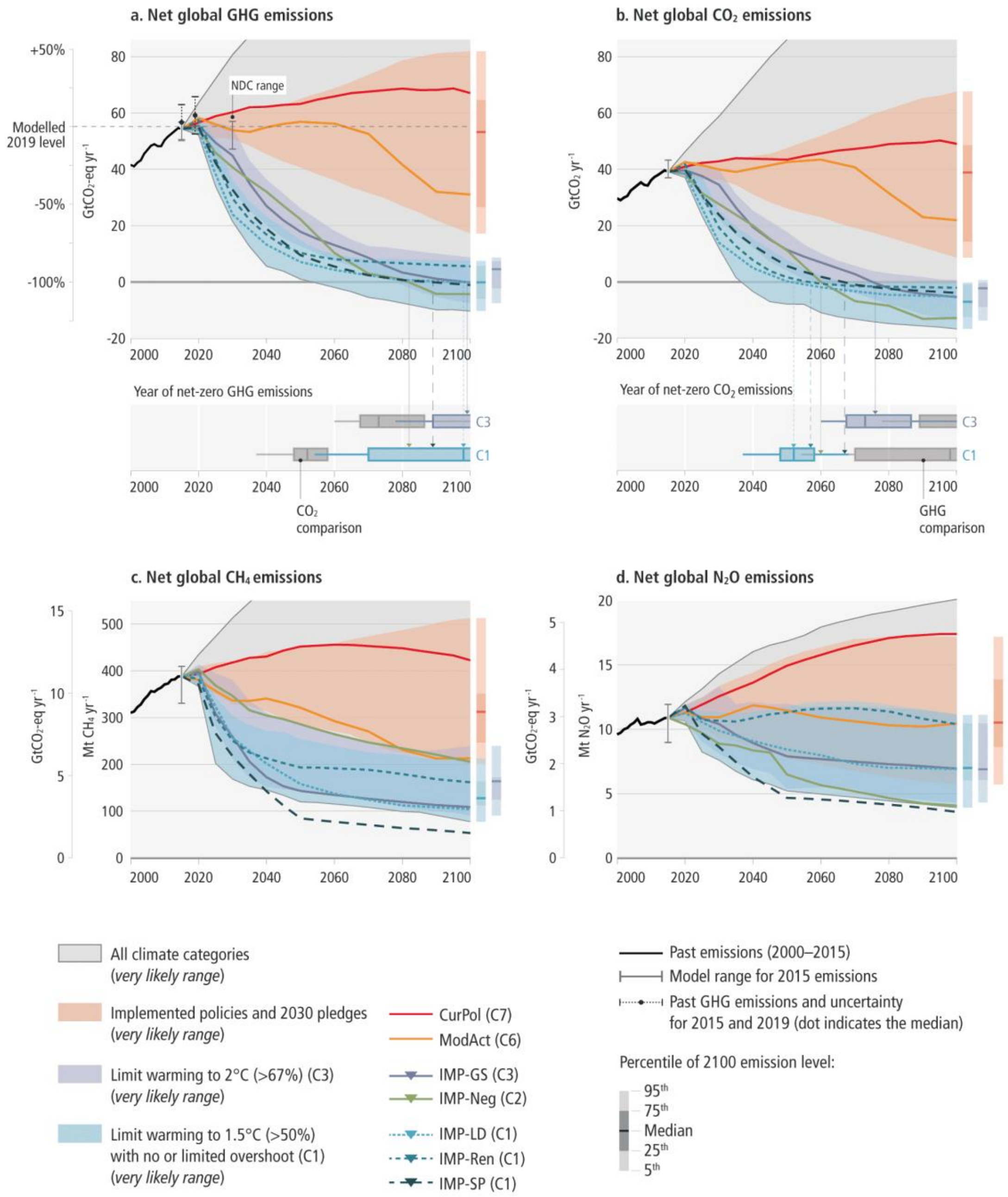
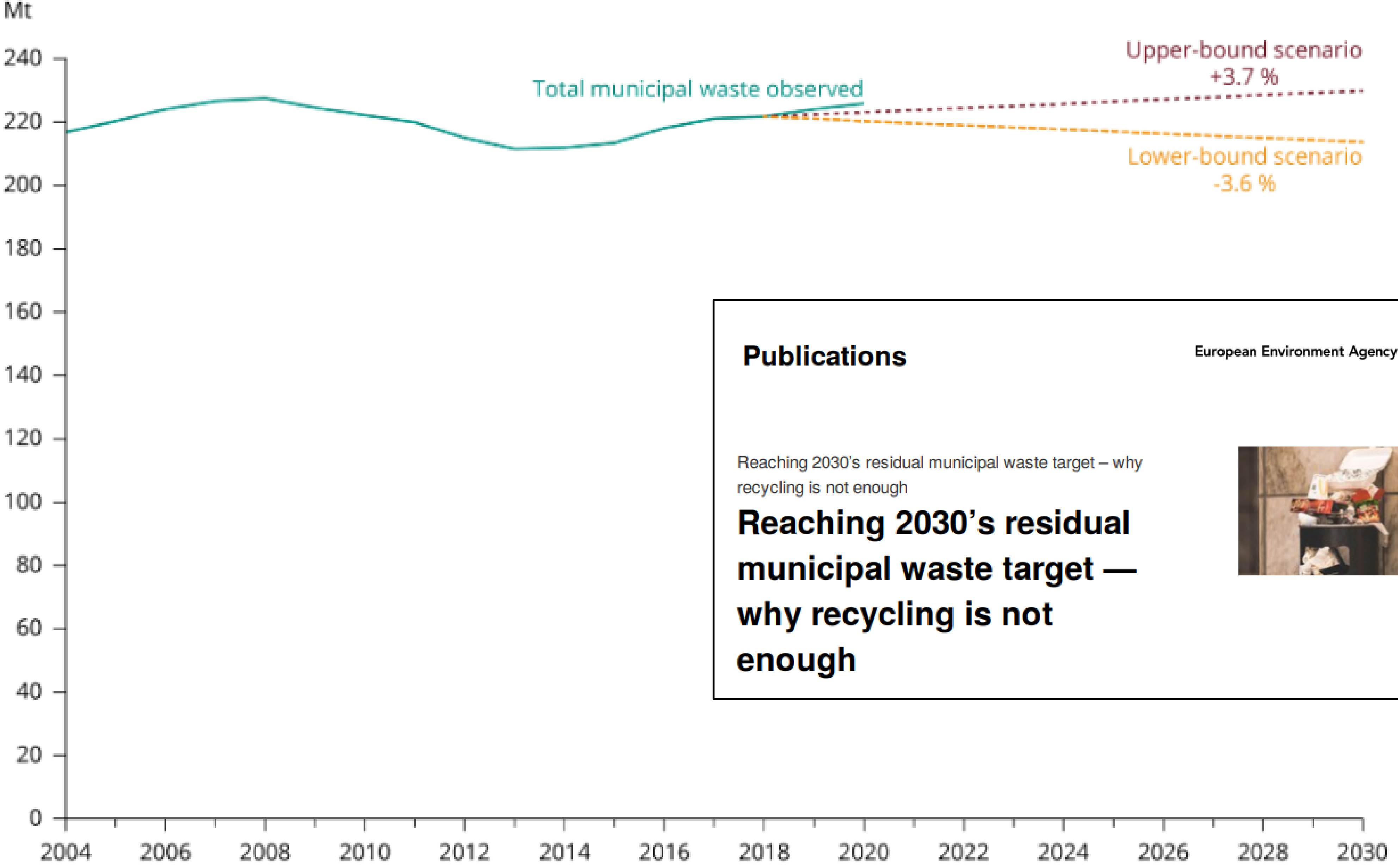


Figure 4. Total municipal waste generated in the EU-27 during the period 2004-2020 and projections for the period 2019-2030



Publications

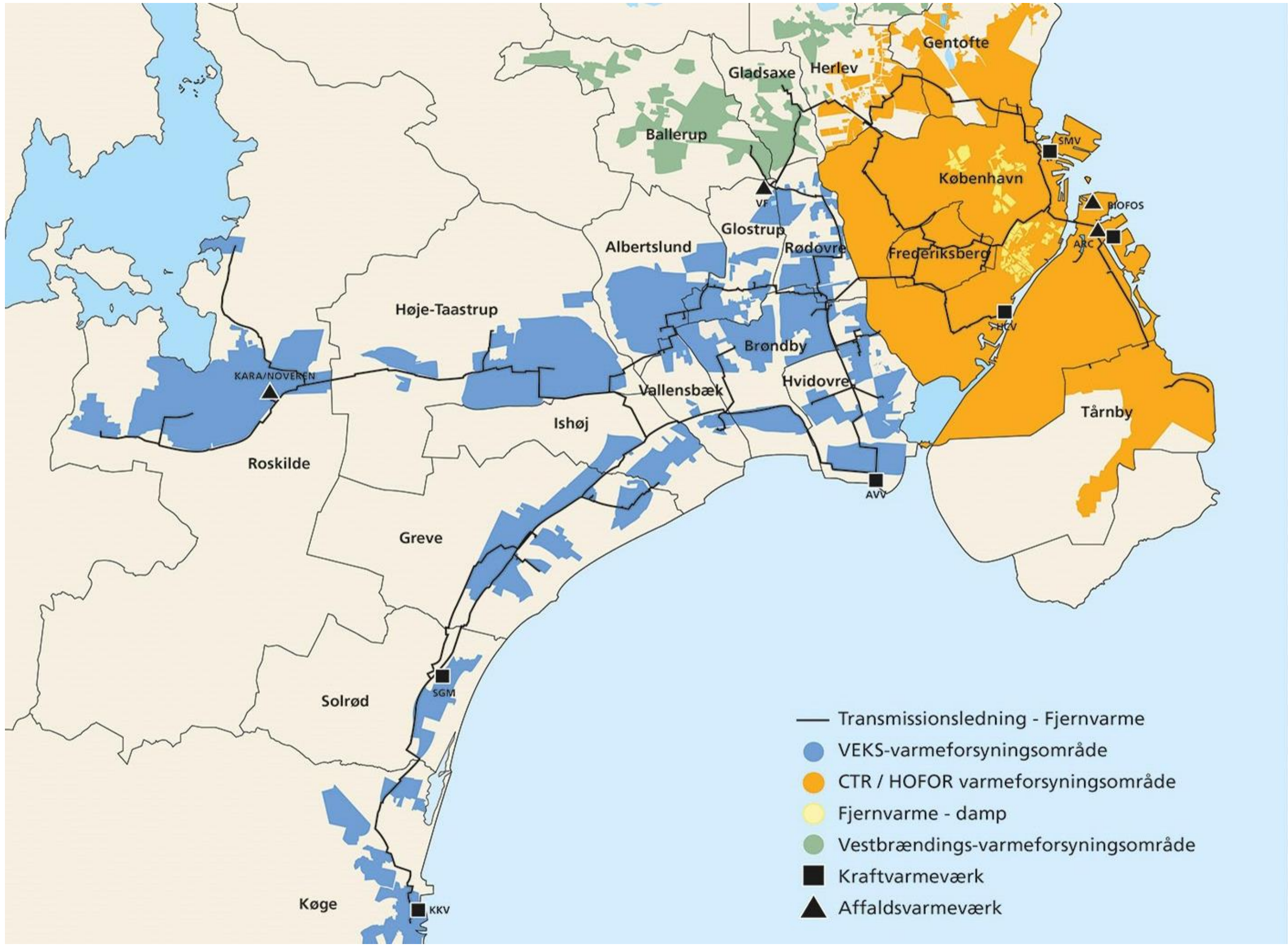
European Environment Agency

Reaching 2030's residual municipal waste target – why recycling is not enough

Reaching 2030's residual municipal waste target — why recycling is not enough

Junkies of consumption

400.000 households will need to change their gas boiler – District heating is relevant for 260.000



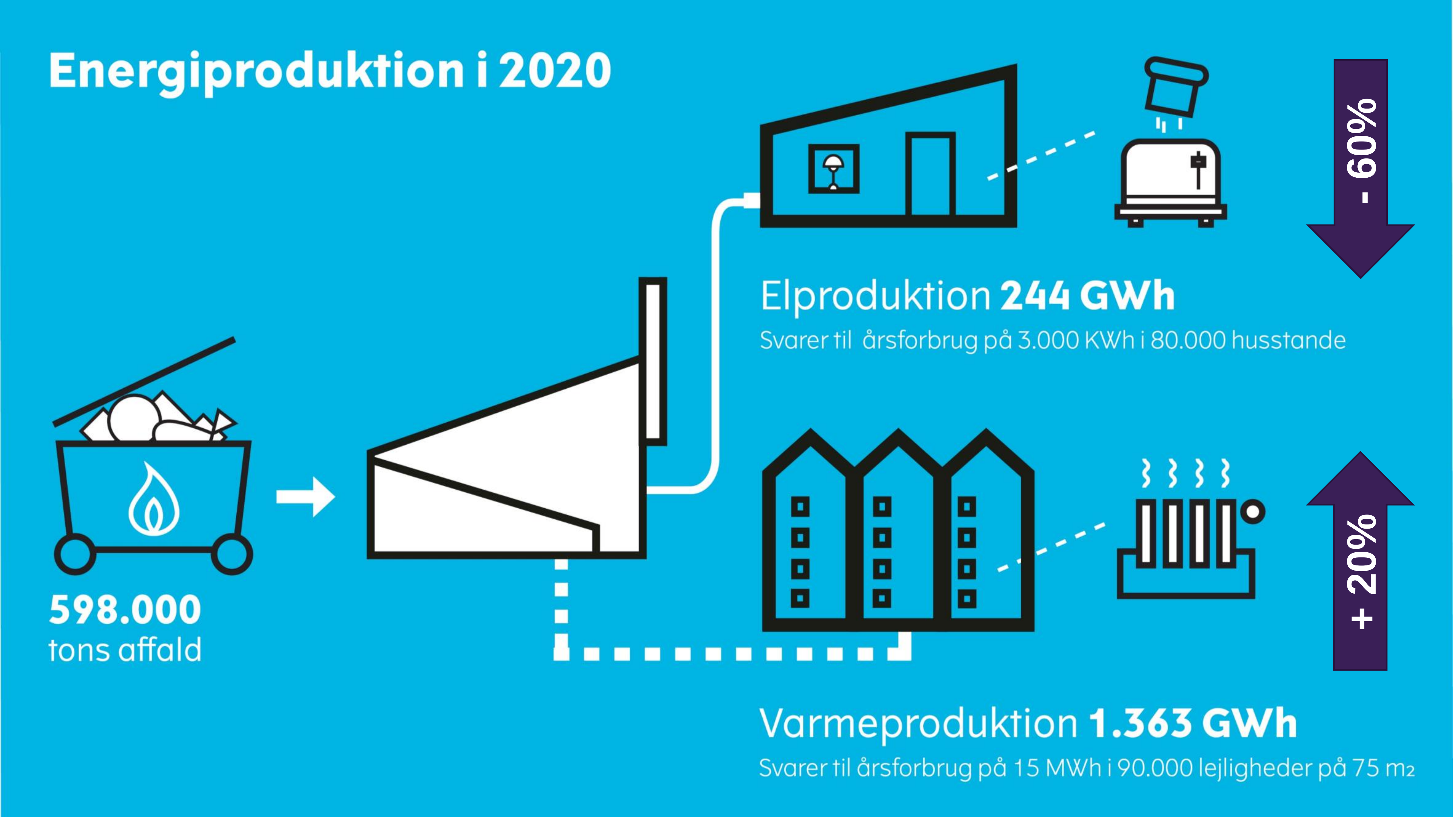
1 ton

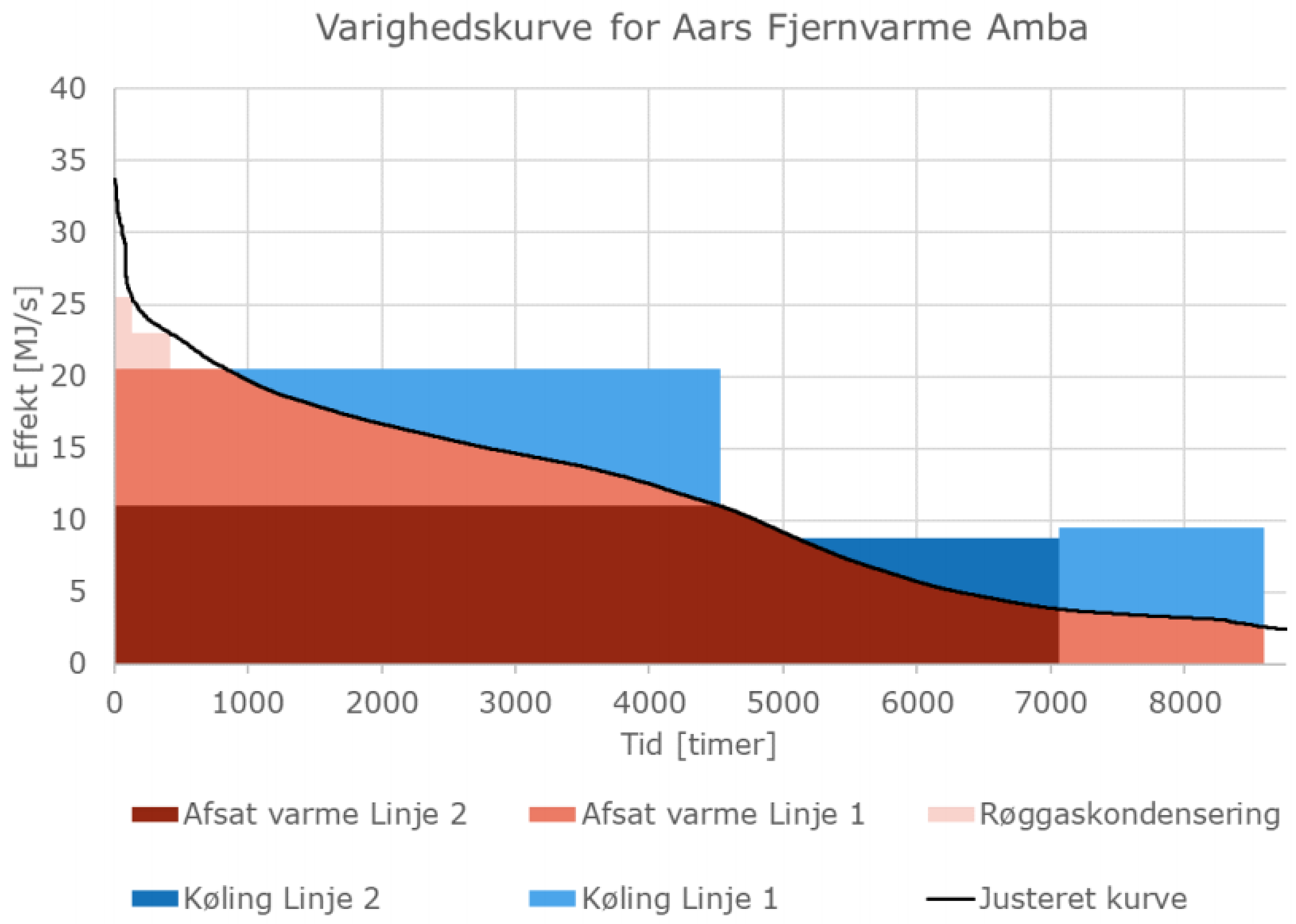
=

280 L

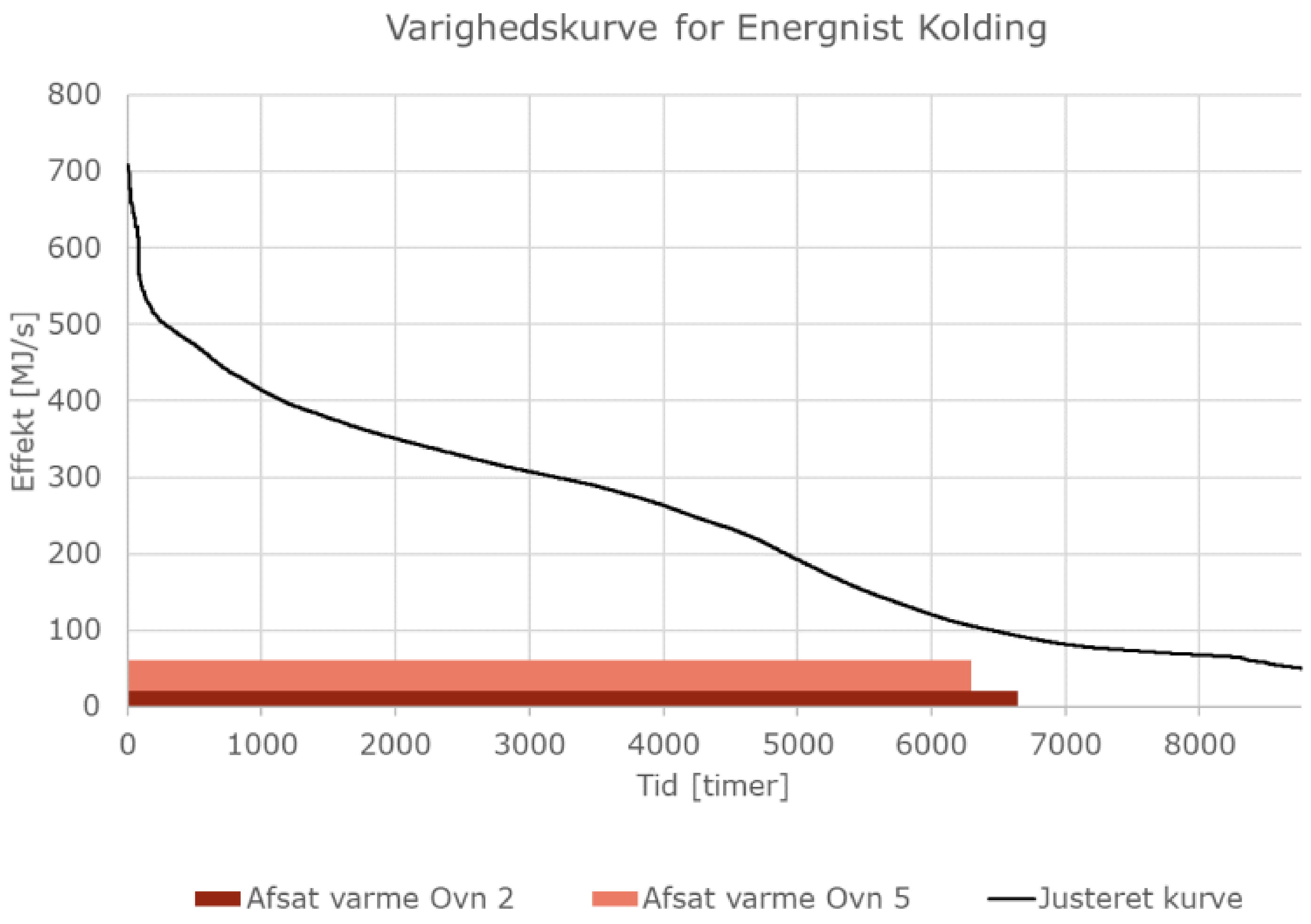
Or

262 m^3

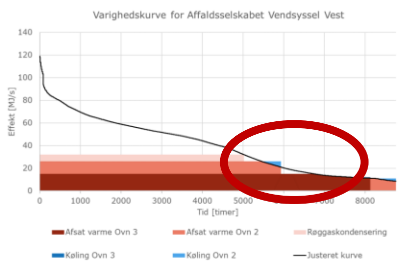

Energiproduktion i 2020
- 60%
Elproduktion 244 GWh
Svarer til årsforbrug på 3.000 KWh i 80.000 husstande
598.000
tons affald
+ 20%
Varmeproduktion 1.363 GWh
Svarer til årsforbrug på 15 MWh i 90.000 lejligheder på 75 m2



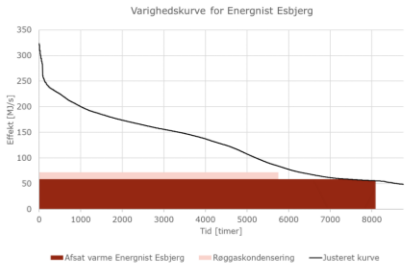
Figur 20 Varighedskurve der viser den andel af fjernvarmenettet, som Aars Fjernvarme leverer varme til.



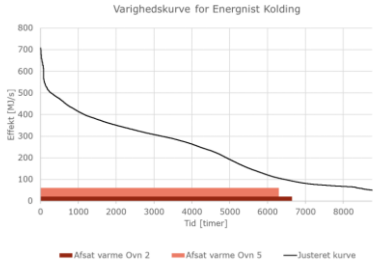
Figur 9 Varighedskurve der viser den andel af fjernvarmenettet, som Energnist Kolding leverer.



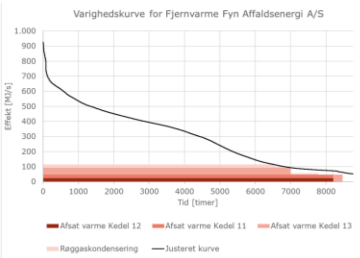
Figur 7 Varighedskurve der viser den andel af fjernvarmenettet, som Affaldsselskabet Vendsyssel Vest leverer varme til.



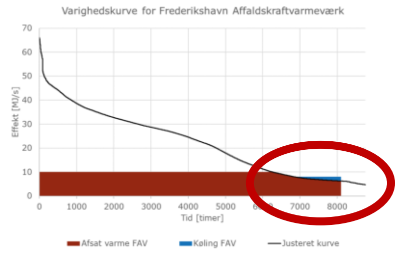
Figur 8 Varighedskurve der viser den andel af fjernvarmenettet, som Energnist Esbjerg leverer.



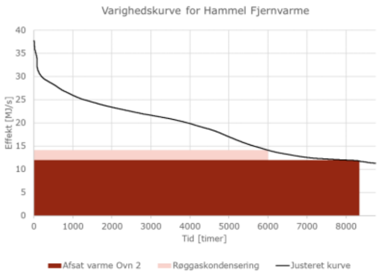
Figur 9 Varighedskurve der viser den andel af fjernvarmenettet, som Energnist Kolding leverer.



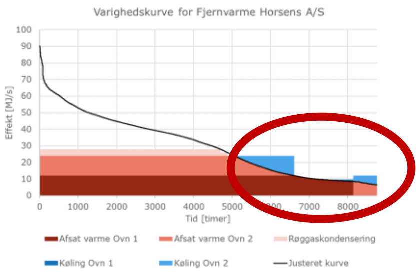
Figur 10 Varighedskurve der viser den andel af fjernvarmenettet, som Fjernvarme Fyn Affaldsenergi A/S leverer.



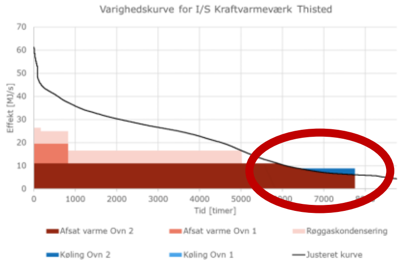
Figur 11 Varighedskurve der viser den andel af fjernvarmenettet, som Frederikshavn Affaldskraftvarmeværk leverer.



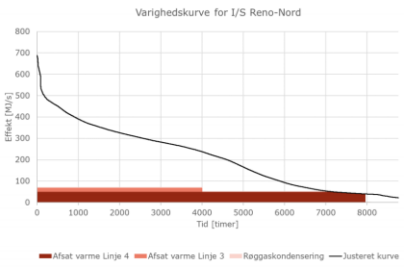
Figur 12 Varighedskurve der viser den andel af fjernvarmenettet, som Hammel Fjernvarme leverer.



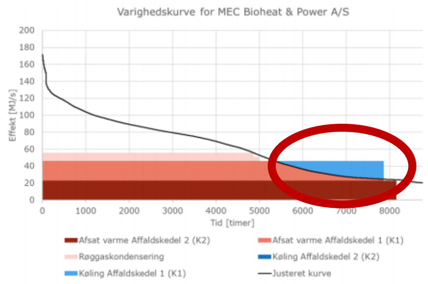
Figur 13 Varighedskurve der viser den andel af fjernvarmenettet som Fjernvarme Horsens A/S leverer.



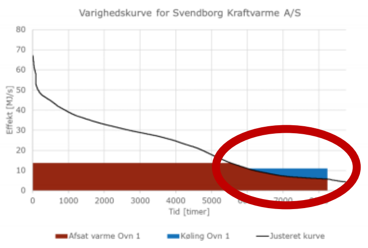
Figur 14 Varighedskurve der viser den andel af fjernvarmenettet, som I/S Kraftvarmeværk Thisted leverer.



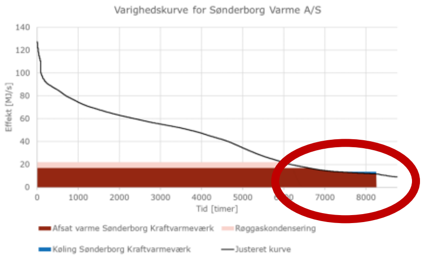
Figur 15 Varighedskurve der viser den andel af fjernvarmenettet, som I/S Reno-Nord leverer.



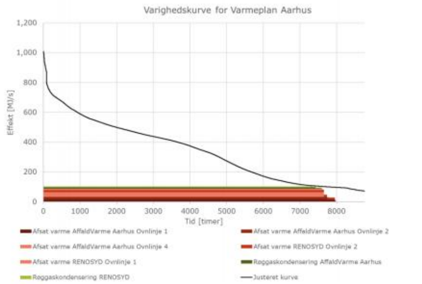
Figur 16 Varighedskurve der viser den andel af fjernvarmenettet som MEC Bioheat & Power A/S leverer.



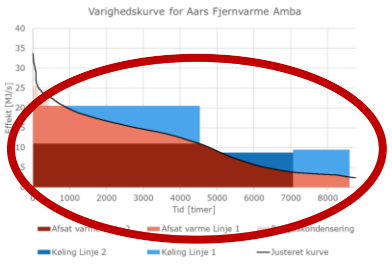
Figur 17 Varighedskurve der viser den andel af fjernvarmenettet, som Svendborg Kraftvarme A/S leverer.



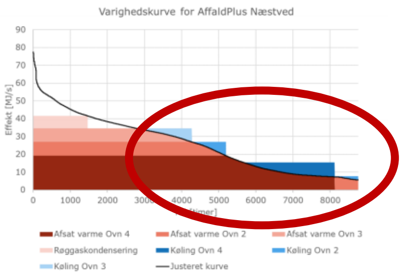
Figur 18 Varighedskurve der viser den andel af fjernvarmenettet som Sønderborg Varme A/S leverer.



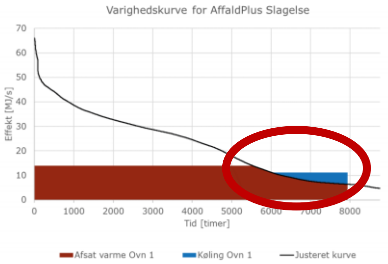
Figur 19 Varighedskurve der viser den andel af fjernvarmenettet Varmeplan Aarhus, som AffaldVarme Aarhus og RENOSYD leverer.



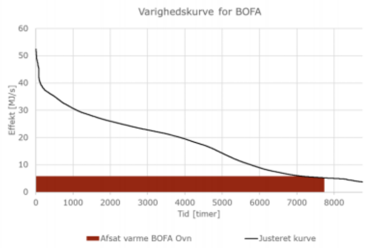
Figur 20 Varighedskurve der viser den andel af fjernvarmenettet, som Aars Fjernvarme leverer varme til.



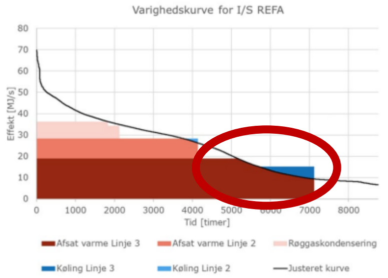
Figur 21 Varighedskurve der viser den andel af fjernvarmenettet, som AffaldPlus Næstved leverer.



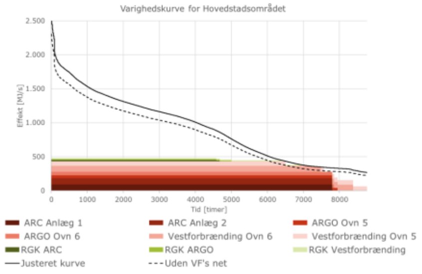
Figur 22 Varighedskurve der viser den andel af fjernvarmenettet som AffaldPlus Slagelse leverer.



Figur 23 Varighedskurve der viser den andel af fjernvarmenettet som BOFA leverer.

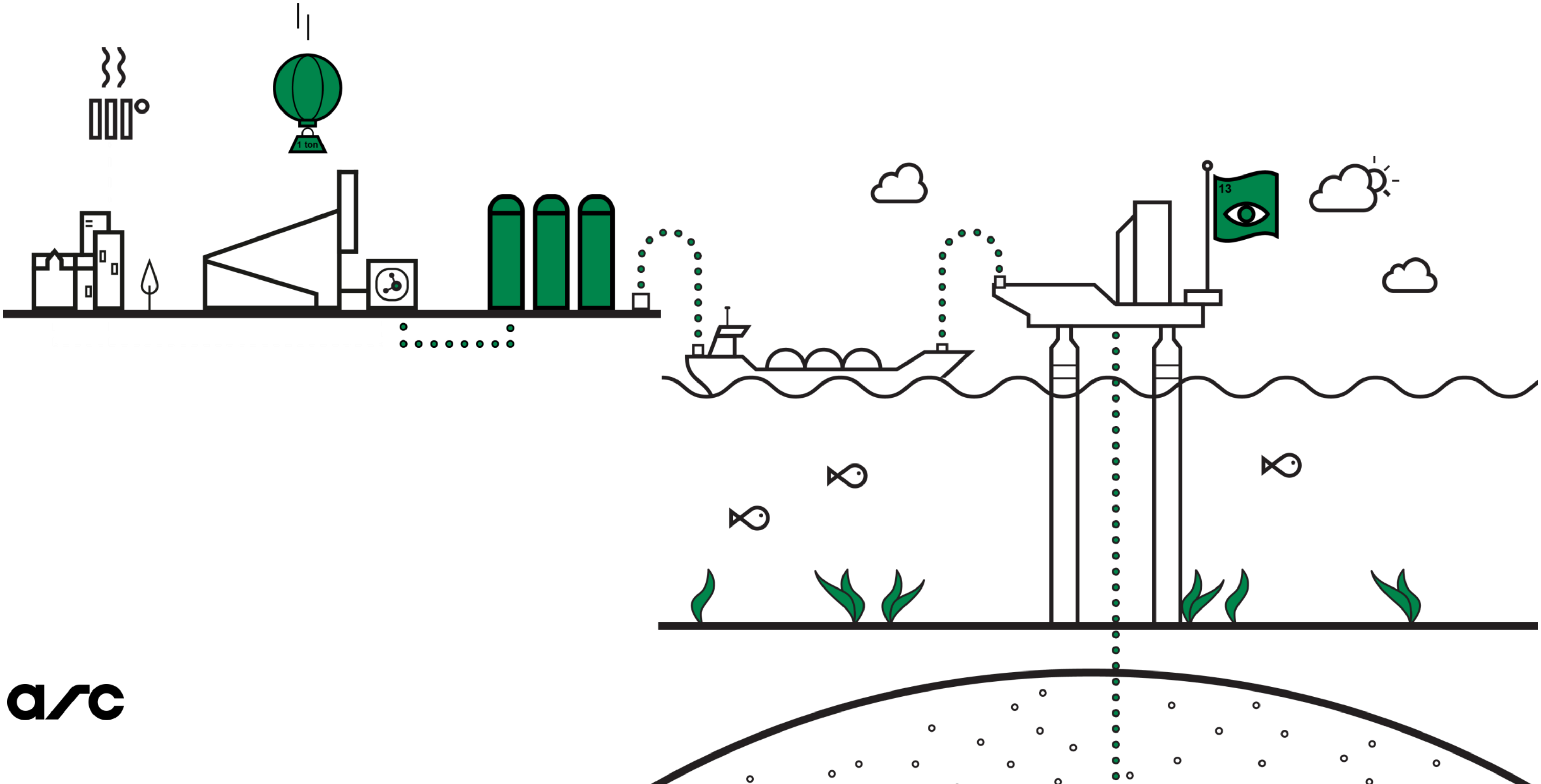


Figur 24 Varighedskurve der viser den andel af fjernvarmenettet, som I/S REFA leverer.



Figur 25 Varighedskurve der viser den andel af fjernvarmenettene i Storkøbenhavn, som ARC, ARGO Roskilde Kraftvarmeværk og Vestforbrænding leverer.

Valuechain



a/c

Thank you

Jacob H. Simonsen, Direktør/CEO

✉ jhs@a-r-c.dk

@JacobAffald

☏ +45 22 51 66 61

arc

PATH TO NET-ZERO:
Is Waste-to-Energy part of the solution?

THANK YOU FOR YOUR PARTICIPATION!

Organised by:

CEWEP

ESWET