Mini skup „LJUDI I PROCESI – Energija: dostupna, jeftina i barem zelenkasta?“

Decarbonization of existing refinery units

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AGENDA

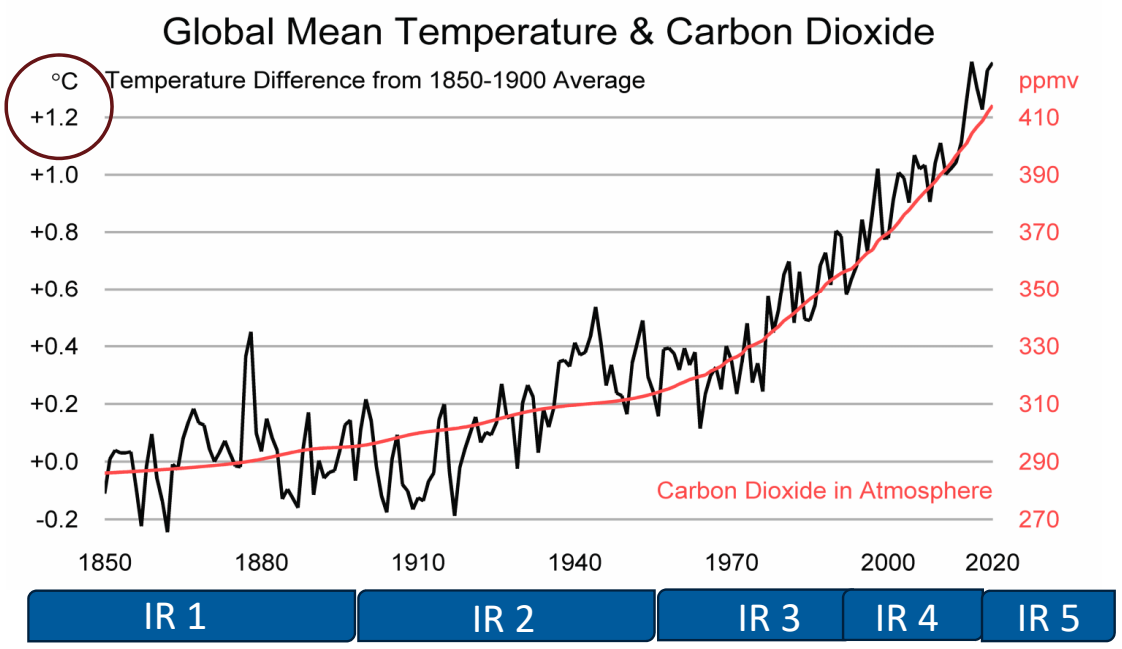
1 WHAT LED TO EU GREEN DEAL?

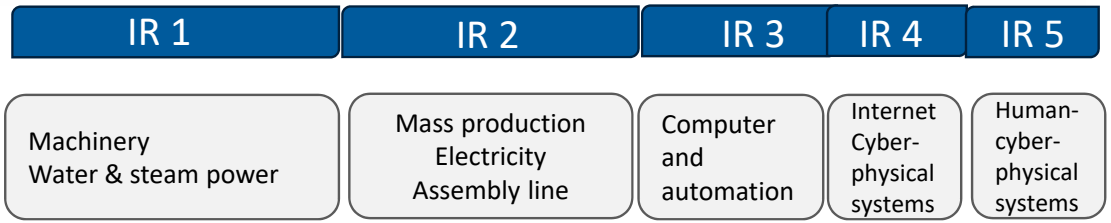
3 REFINING CARBON FOOTPRINT: WHAT ARE SCOPE 1, 2 AND 3 EMISSIONS?

4 FOUR PILLARS OF INDUSTRIAL DECARBONIZATION

5 ENERGY EFFICIENCY / ELECTRIFICATION / RENEWABLE ENERGY / CARBON CAPTURE

WHAT LED TO EU GREEN DEAL?





The Paris Agreement calls to keep the global average temperature rise below 2° C compared to pre-industrial levels, specifically aiming to limit it to 1.5 C.

ENERGY TRANSITION

In December 2019, the European Commission announced the **European Green Deal - package of policy initiatives, which aims to set the EU on the path to a green transition**, with the ultimate goal of reaching climate neutrality by 2050.

- ✓ 30-year action plan focused on the energy transition, circular economy, protecting biodiversity, and stopping pollution

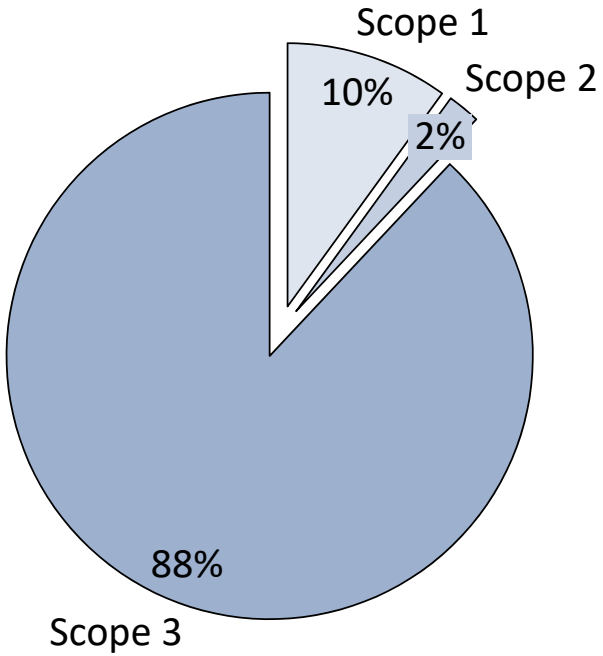
FIT FOR 55 package

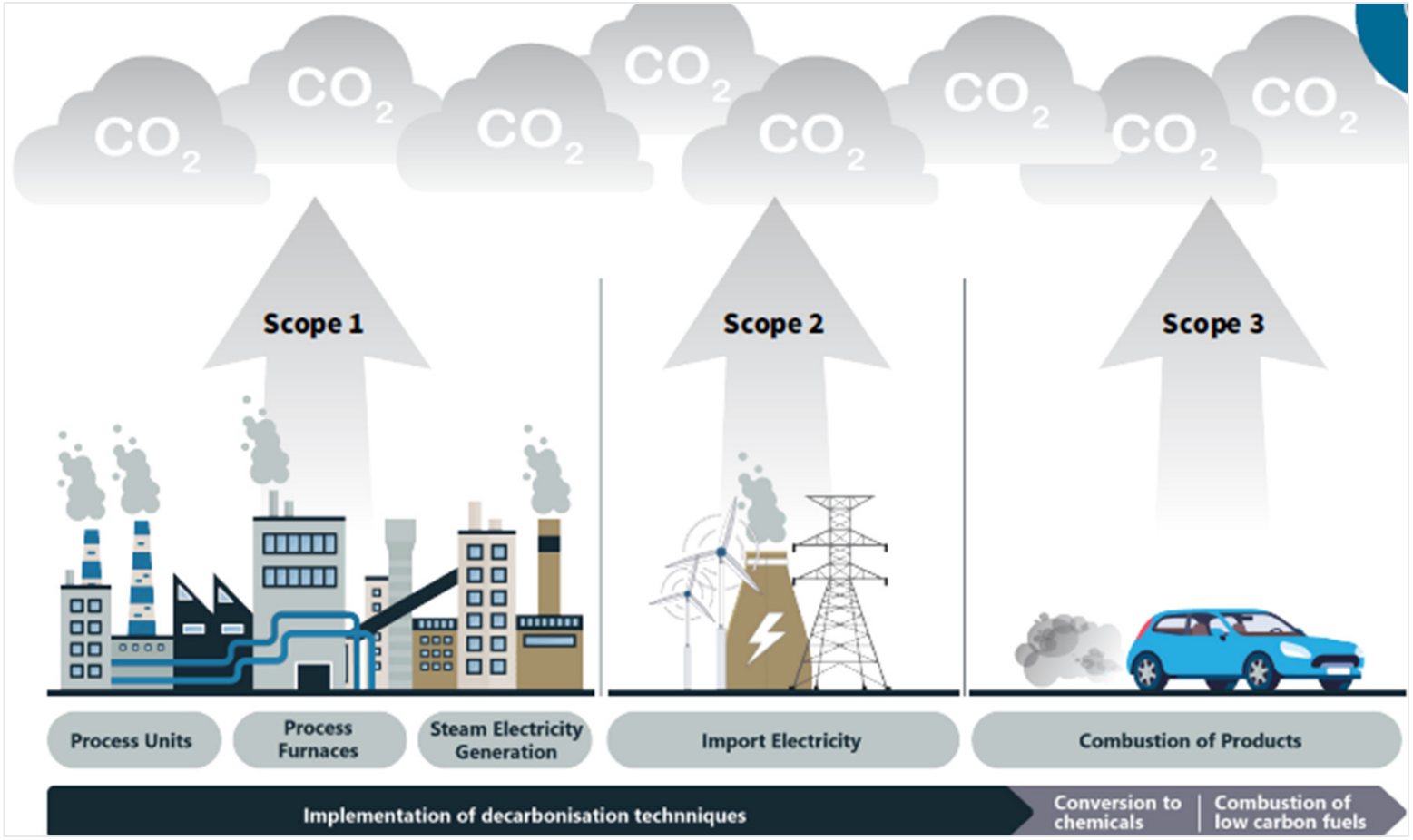
- ✓ aims to translate the climate ambitions of the Green Deal into law
- ✓ set of proposals to revise **climate-, energy- and transport-related legislation** and put in place new legislative initiatives to align EU laws with the EU's climate goals.
- ✓ refers to the EU's target of **reducing net greenhouse gas emissions by at least 55% by 2030**

FINAL TARGET: reach climate neutrality by 2050

REFINING CARBON FOOTPRINT: WHAT ARE SCOPE 1, 2 AND 3 EMISSIONS?

TYPICAL REFINERY EMISSION SHARE



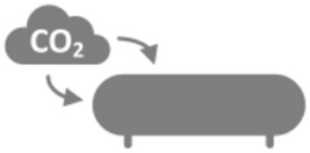


FOUR PILLARS OF INDUSTRIAL DECARBONIZATION

ENERGY EFFICIENCY
(near term)

ELECTRIFICATION
(medium- to long-term)

RENEWABLE AND LOW-CARBON FUELS
(medium- to long-term)



CARBON CAPTURE, UTILIZATION AND STORAGE
(long-term)

Energy efficiency improvement

SCOPE 1

Heat integration

"Can we recover energy before it is lost?"

Direct lines between units, crude preheat trains, waste heat recovery, flue gas heat recovery

Monitoring, controlling and optimization of energy use

"Are we using energy as efficiently as possible right now?"

Real-time energy cost optimization system, energy KPIs, digital twins, AI optimization

Improving process efficiency

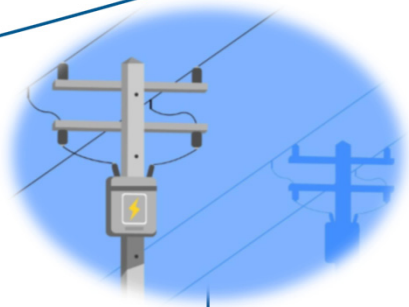
"Can we produce the same output with less energy?"

Fuel gas/hydrogen system optimization, catalyst improvements, pressure drop reduction, yield improvement

Electrification

SCOPE 1

SCOPE 2



Direct electrification of processes

"What refinery equipment can be converted from fuel-fired to electric?"

E-boilers, electric heaters, electric reboilers, electric drives, electric compressors, electric pumps, electric steam generation

Decarbonize electricity consumed by the refinery

"How can electricity be supplied with the lowest carbon footprint?"

Solar Power plants, wind power, low-carbon grid electricity, battery storage, green hydrogen integration possibility

Optimize electricity use, reliability, flexibility and cost

"How can electrified assets operate in the most efficient and economical way?"

Real-time energy cost optimization system, energy KPIs, digital twins, AI optimization, demand response

Renewable and low carbon fuels

SCOPE 3

SCOPE 1

Sustainable Feedstock & Supply Chain

Development of technology for low-carbon fuels production

Development of biofuel infrastructure

"How do we secure sustainable feedstocks?"

Waste oils and fats, used cooking oil (UCO), animal fats, Palm Oil Mill Effluent (POME), and other advanced biofeedstocks

"What low-carbon fuels can we produce?"

Renewable diesel (HVO), Sustainable Aviation Fuel (SAF), bio-ethanol, renewable hydrogen, e-fuels, biomethane integration

„How to ensure storage capacities and logistics?"

Feedstock storage and handling facilities, pretreatment units, production units, blending systems, product storage tanks, logistics, and distribution assets

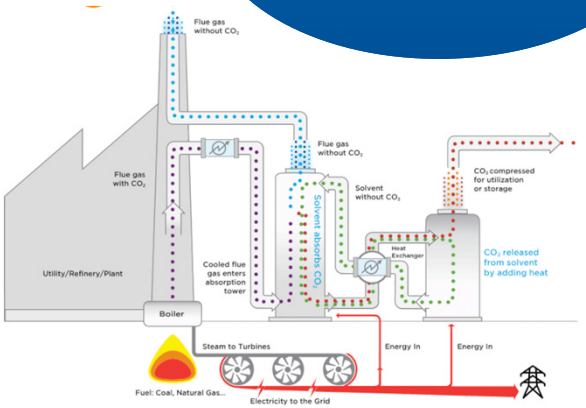
Carbon capture, utilization and storage

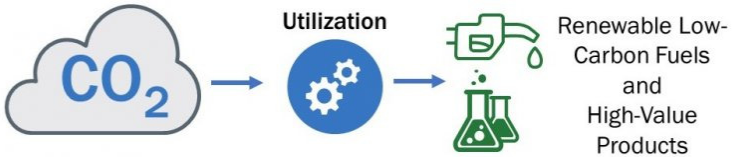
SCOPE 1

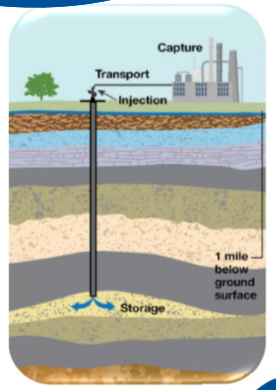
Capture technology

Utilisation technologies

CO_2 storage







Conclusions

There is no single solution for refinery decarbonization

The largest share of a refinery's carbon footprint lies in Scope 3 emissions

The key challenge is no longer technology, but economics

The energy transition is not only a technological shift but a transformation of the entire industrial ecosystem, with chemical engineers playing a critical role in designing, integrating and implementing the solutions required to achieve climate neutrality.

THANK YOU!

CO2 utilisation