Action C2 - Modelling for the Mid-Century Climate Strategy

# Models and tools for calculation of GHG emissions up to 2050: REES-SLO
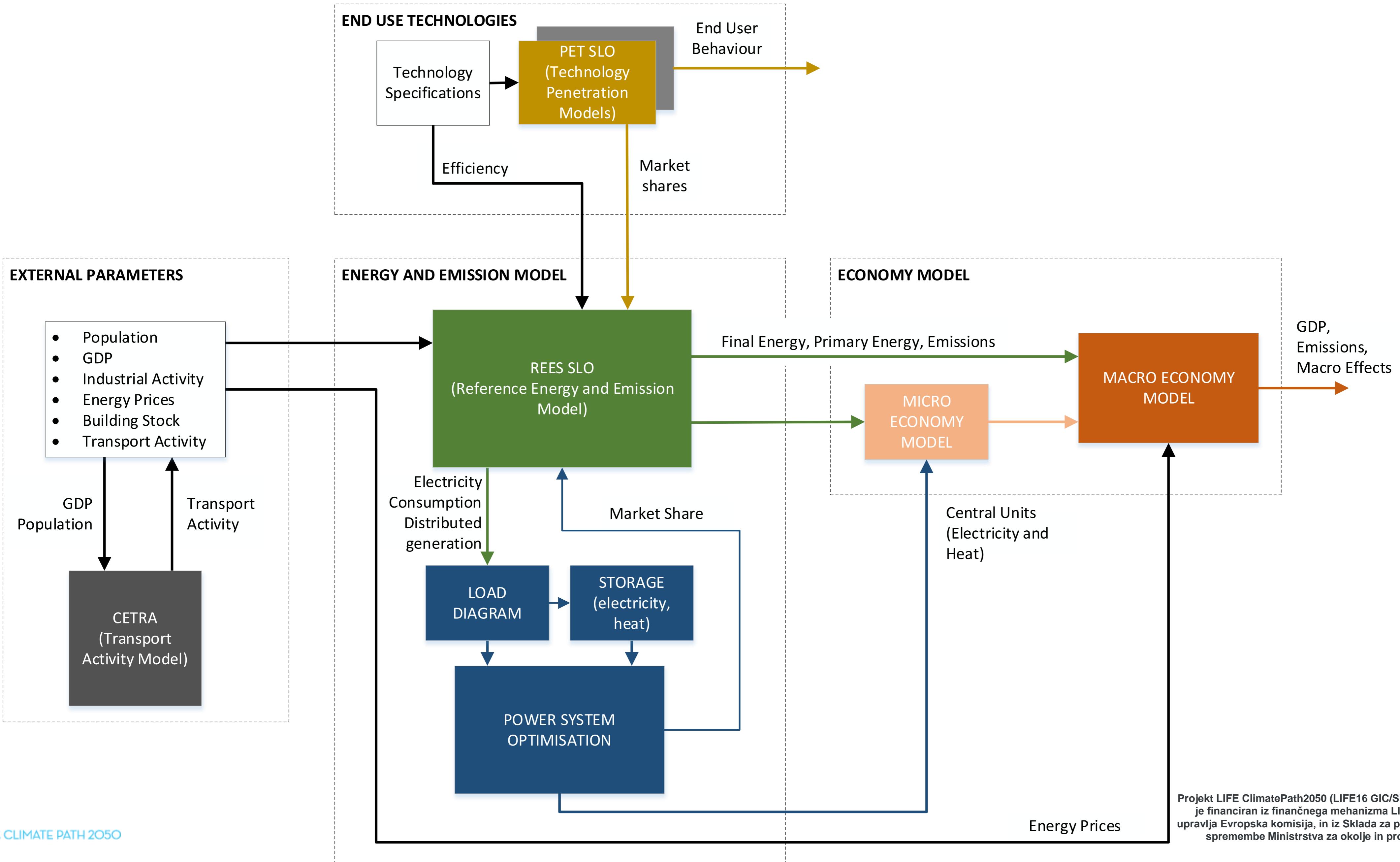
Matevž Pušnik, Andreja Urbančič, Matjaž Česen, Gašper Stegnar, Stane Merše, Marko Đorić
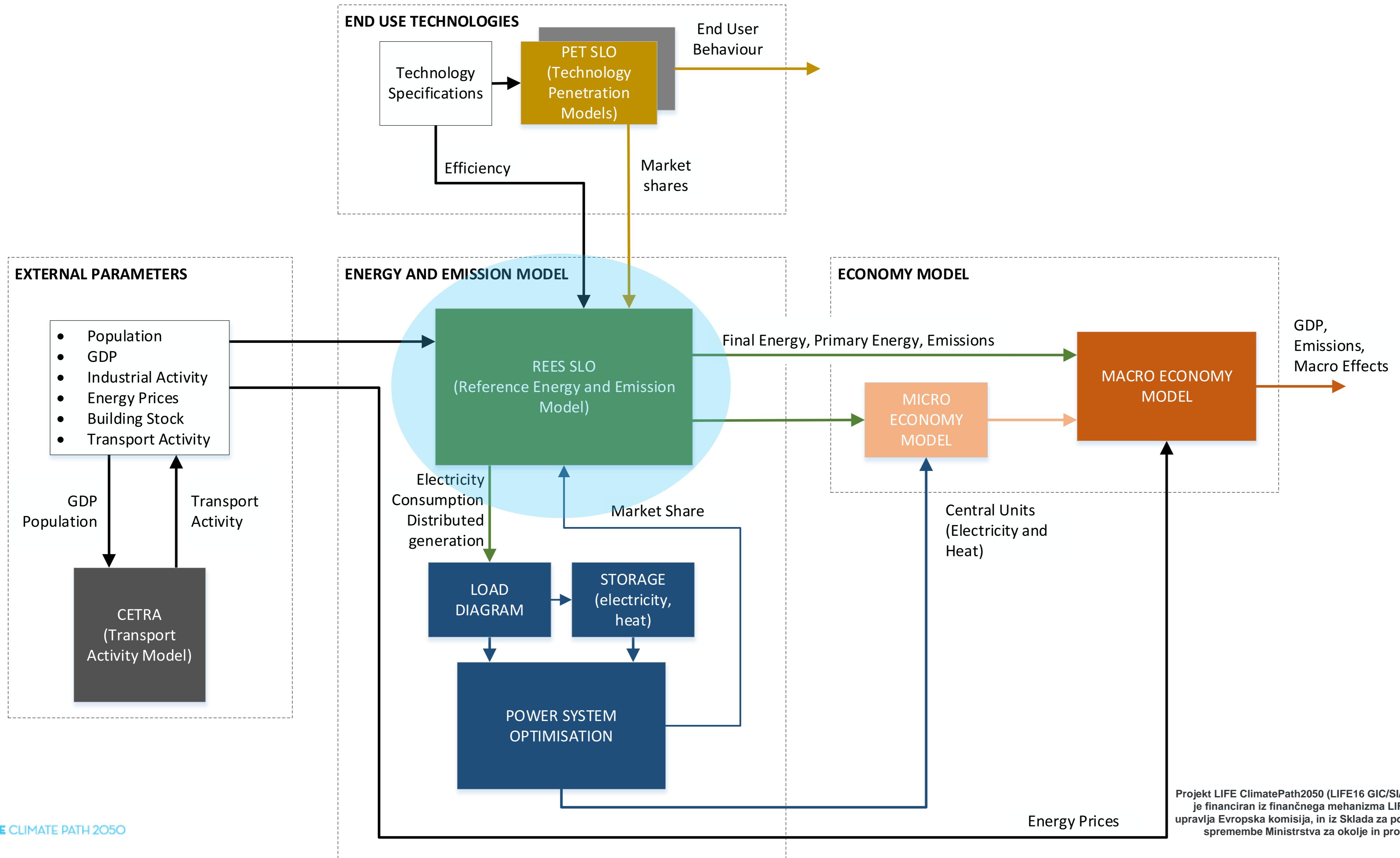
University of Ljubljana, Faculty for Social Sciences

Hybrid meeting, Ljubljana, 15. 9. 2021

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END USE TECHNOLOGIES

Technology Specifications

PET SLO (Technology Penetration Models)

End User Behaviour

Efficiency

Market shares

EXTERNAL PARAMETERS

- Population
- GDP
- Industrial Activity
- Energy Prices
- Building Stock
- Transport Activity

GDP Population

Transport Activity

CETRA (Transport Activity Model)

ENERGY AND EMISSION MODEL

REES SLO (Reference Energy and Emission Model)

Electricity Consumption Distributed generation

Market Share

LOAD DIAGRAM

STORAGE (electricity, heat)

POWER SYSTEM OPTIMISATION

ECONOMY MODEL

Final Energy, Primary Energy, Emissions

MICRO ECONOMY MODEL

MACRO ECONOMY MODEL

GDP, Emissions, Macro Effects

Central Units (Electricity and Heat)

Energy Prices

Projekt LIFE ClimatePath2050 (LIFE16 GIC/SI/000043) je financiran iz finančnega mehanizma LIFE, ki ga upravlja Evropska komisija, in iz Sklada za podnebne spremembe Ministrstva za okolje in prostor RS.

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Structure of REES-SLO model

- linear **simulation** model
- technology-oriented (**bottom up**) model
- designed in **MESAP**, a free structure system design tool
- **input parameters**: industrial activity, building stock, demography, transport work, energy prices,…

Leading parameters of the REES-SLO model

- The leading parameters of the **REES-SLO** model are **sector-specific**

- Industry sub-model - as a leading parameter **economic activity** of individual industries is used (for steel & cement **index of physical production**)

- Households sub-model - building **stock**, building **areas**

- Services sub-model - building **areas** and **employment rate**

- Transport sub-model - **transport work**

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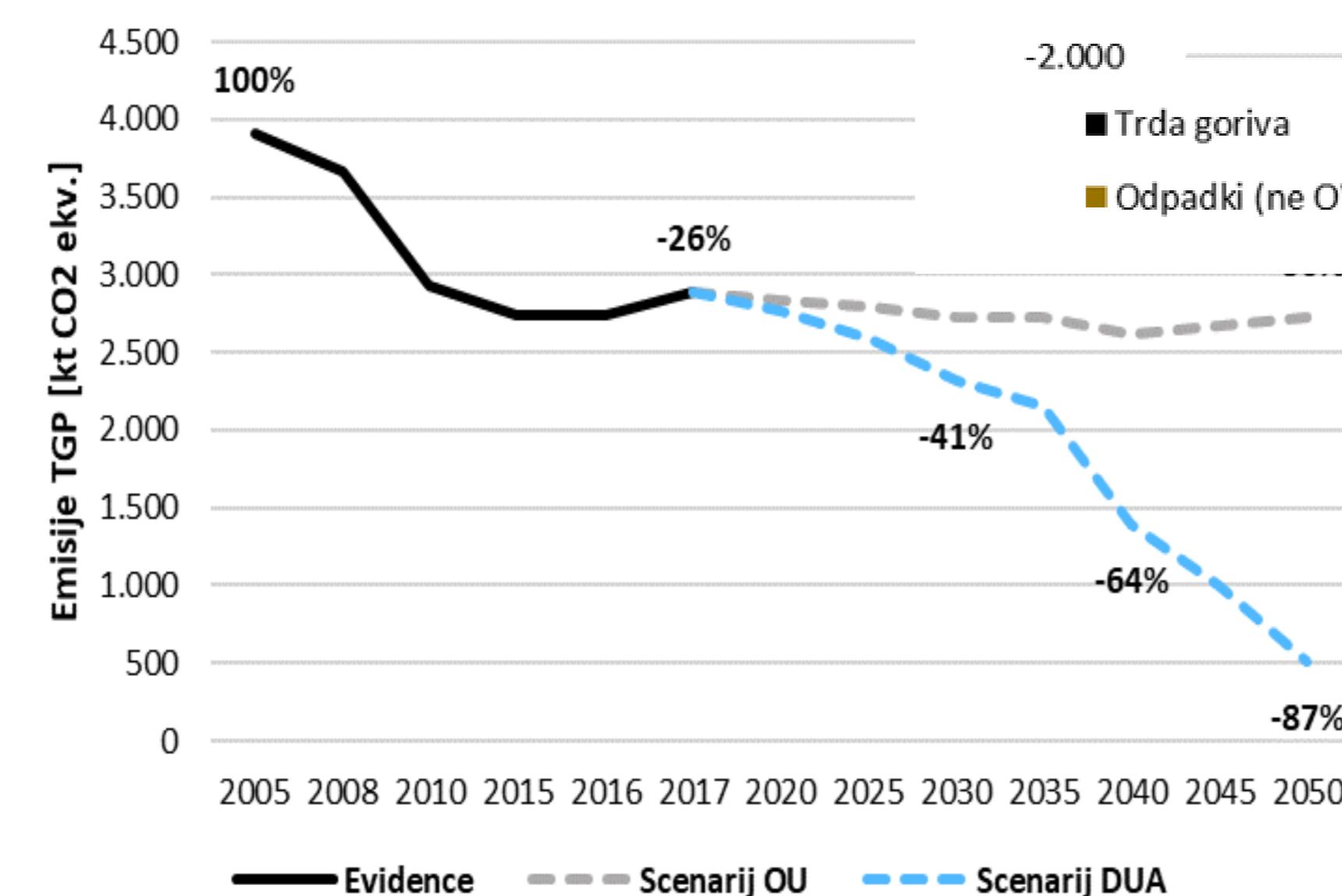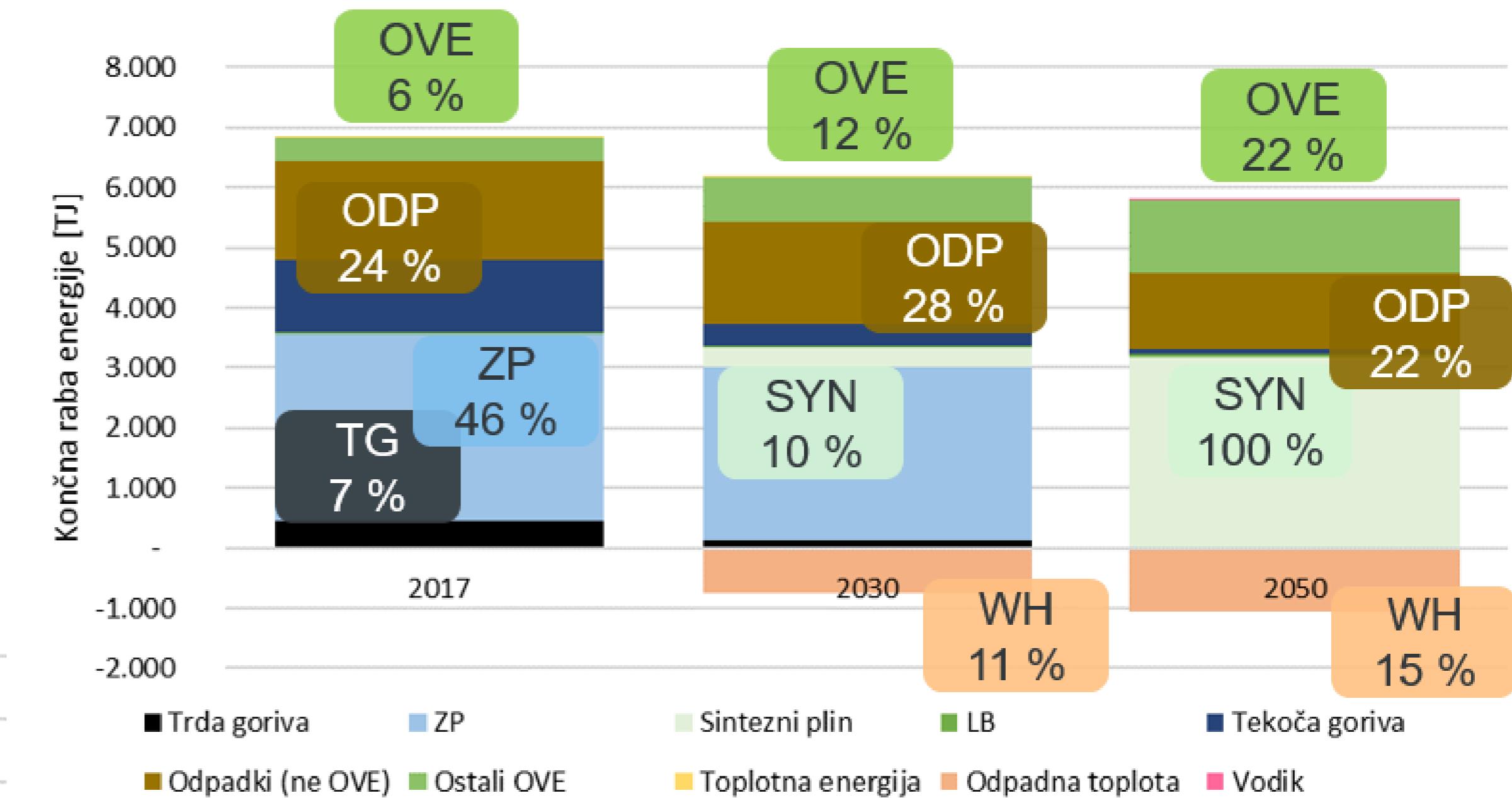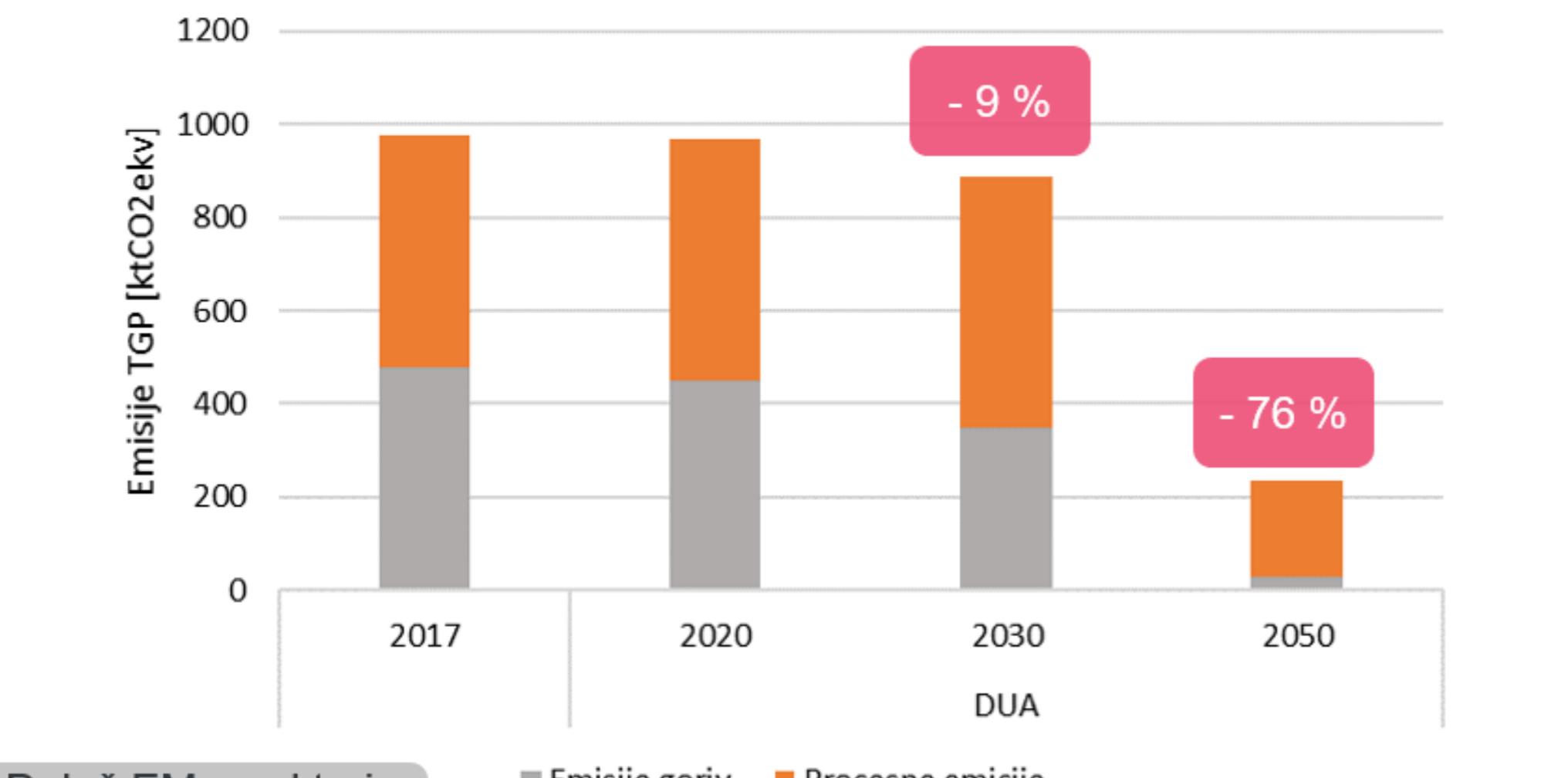
Technology database of REES-SLO model

- **Specific technologies** that are or will be relevant for an individual sector (efficiencies, emission factors, market shares) are modelled

- **Transport technologies, vehicle types** → transport sector

- **Heating, cooling, lighting technologies** → households, services, industry

- Industrial processes → **furnaces, electric motors, compressed air**

- Introduction of **parallel technologies** where fuel replacement or significant technology improvement is expected

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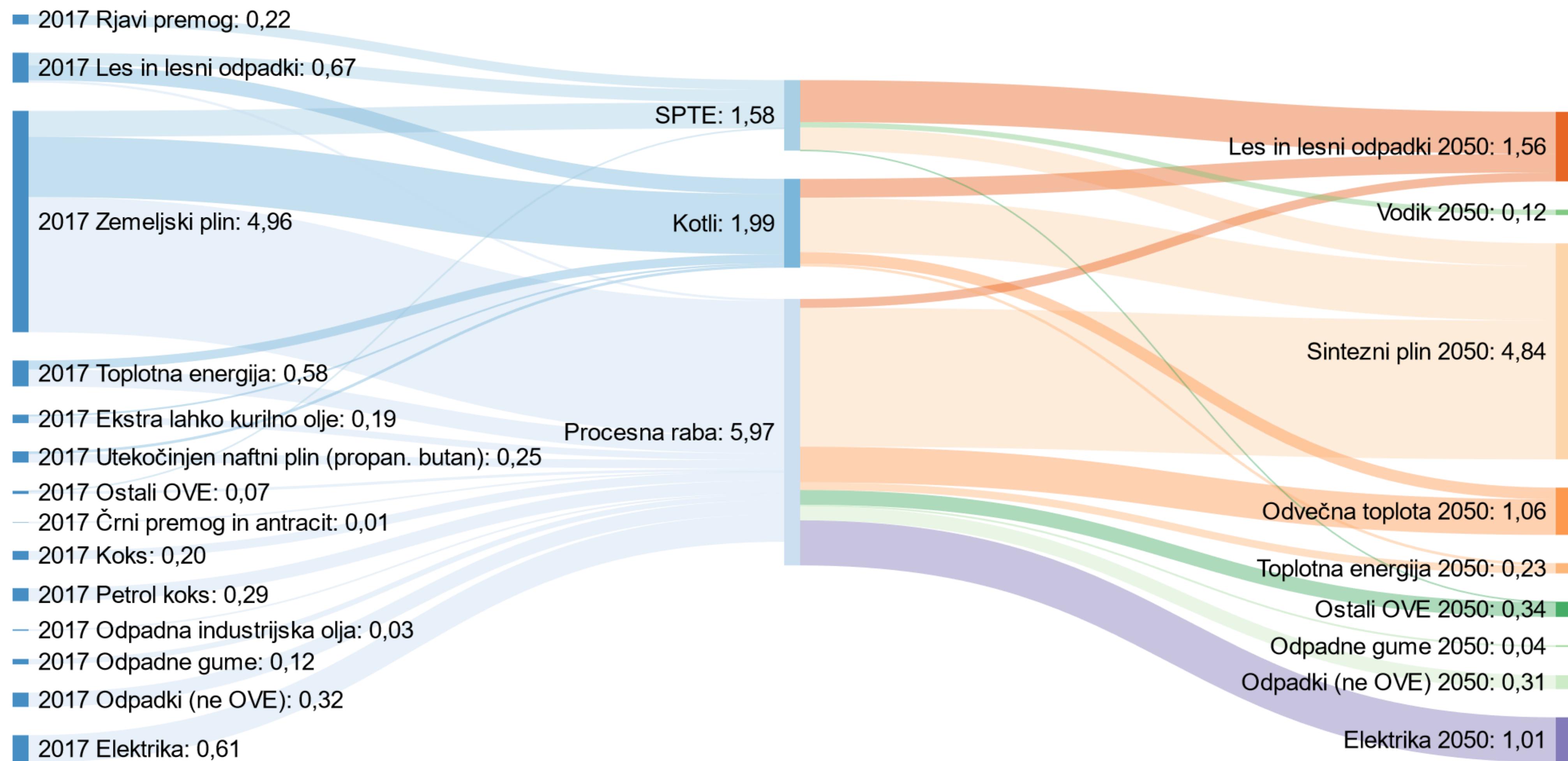
Key results of REES-SLO model

- **Energy balance** by sectors and fuels, final energy consumption, primary energy, domestic production, imports / exports

- **Selected energy indicators** - share of RES in final energy, import dependence, security of supply

- **Emissions** - GHG by sectors and by fuels and by technologies; other emissions, NOx, SO2, NMVOC, PM;

- **Costs** - by sectors and fuels, cost structure (price, network charges, taxes), **investments** - by sectors and technology groups

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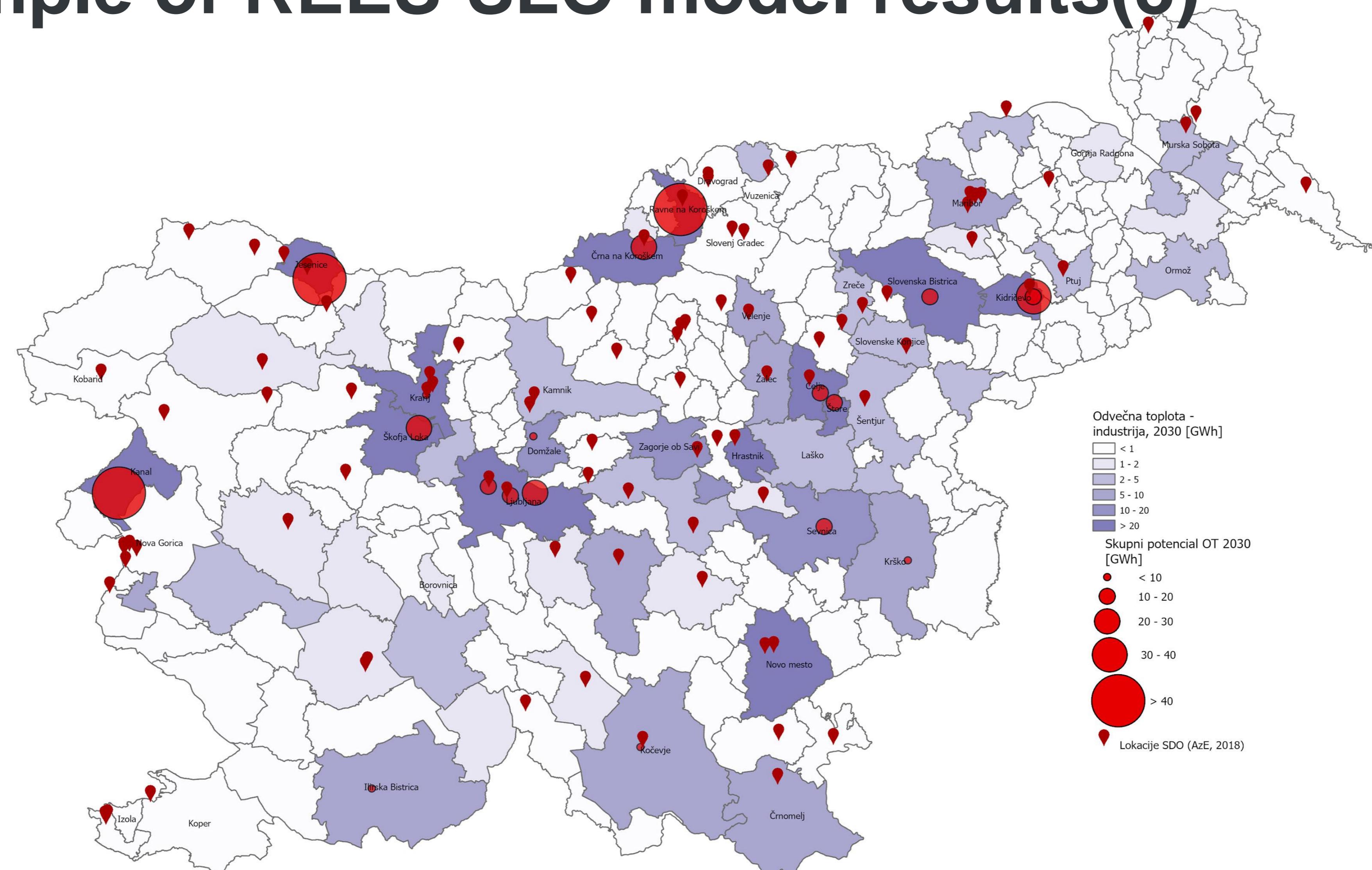
Example of REES-SLO model results

Example of REES-SLO model results(2)

2017 Rjavi premog: 0,22
2017 Les in lesni odpadki: 0,67
2017 Zemeljski plin: 4,96
2017 Toplotna energija: 0,58
2017 Ekstra lahko kurilno olje: 0,19
2017 Utekočinjen naftni plin (propan. butan): 0,25
2017 Ostali OVE: 0,07
2017 Črni premog in antracit: 0,01
2017 Koks: 0,20
2017 Petrol koks: 0,29
2017 Odpadna industrijska olja: 0,03
2017 Odpadne gume: 0,12
2017 Odpadki (ne OVE): 0,32
2017 Elektrika: 0,61

SPTE: 1,58
Kotli: 1,99
Procesna raba: 5,97

Les in lesni odpadki 2050: 1,56
Vodik 2050: 0,12
Sintezni plin 2050: 4,84
Odvečna toplota 2050: 1,06
Toplotna energija 2050: 0,23
Ostali OVE 2050: 0,34
Odpadne gume 2050: 0,04
Odpadki (ne OVE) 2050: 0,31
Elektrika 2050: 1,01

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Example of REES-SLO model results(3)

Odvečna toplota - industrija, 2030 [GWh]
- < 1
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- > 20

Skupni potencial OT 2030 [GWh]
- < 10
- 10 - 20
- 20 - 30
- 30 - 40
- > 40

Lokacije SDO (AzE, 2018)

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Challenges

- **Circular economy**, resource efficiency, product design and sustainability

- Evaluation of **socio-economic effects** (behavior, energy poverty)

- Addressing changes in the **economic and social paradigm** (energy efficiency vs. energy sufficiency)

- Evaluation of the **impact** of scenarios **on the structure of the economy** (national vision of economic development, strategies, policies, bases?)

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Conclusion

- The REES-SLO model represents the **methodological core** of the calculation of projections and scenario analyses

- Complex structure with **several sub-models** (DH, WH, PV)

- Models **have passed the applicability test** (NECP, Climate Strategy,…)

- **Constant update** of the models is required (baseline, structure, new technologies, input parameters, market environment, legislative framework, …)

- Very complex research field → requires **interdisciplinary approach** (technical, natural, social, behaveoral)
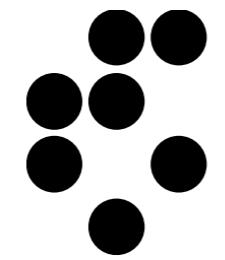
Thank you and stay safe.

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Vodilni partner projekta LIFE Climate Path 2050:

Institut "Jožef Stefan"
Center za energetsko učinkovitost

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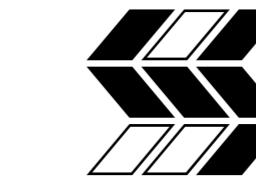
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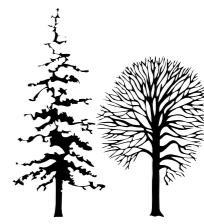
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