# *Energy Systems Modelling & Long-Term Behaviour – Results from WP1*

## Mid-term event, June 2, 2021

TECNALIA – Diego García-Gusano

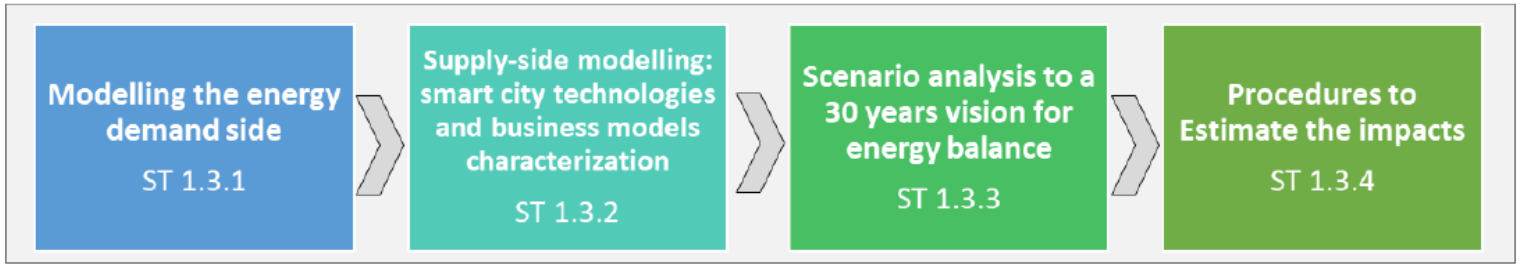
This project has received funding from the Horizon 2020 programme under grant agreement n°824418. The content of this presentation reflects only the author's view. The European Commission and INEA are not responsible for any use that may be made of the information it contains.

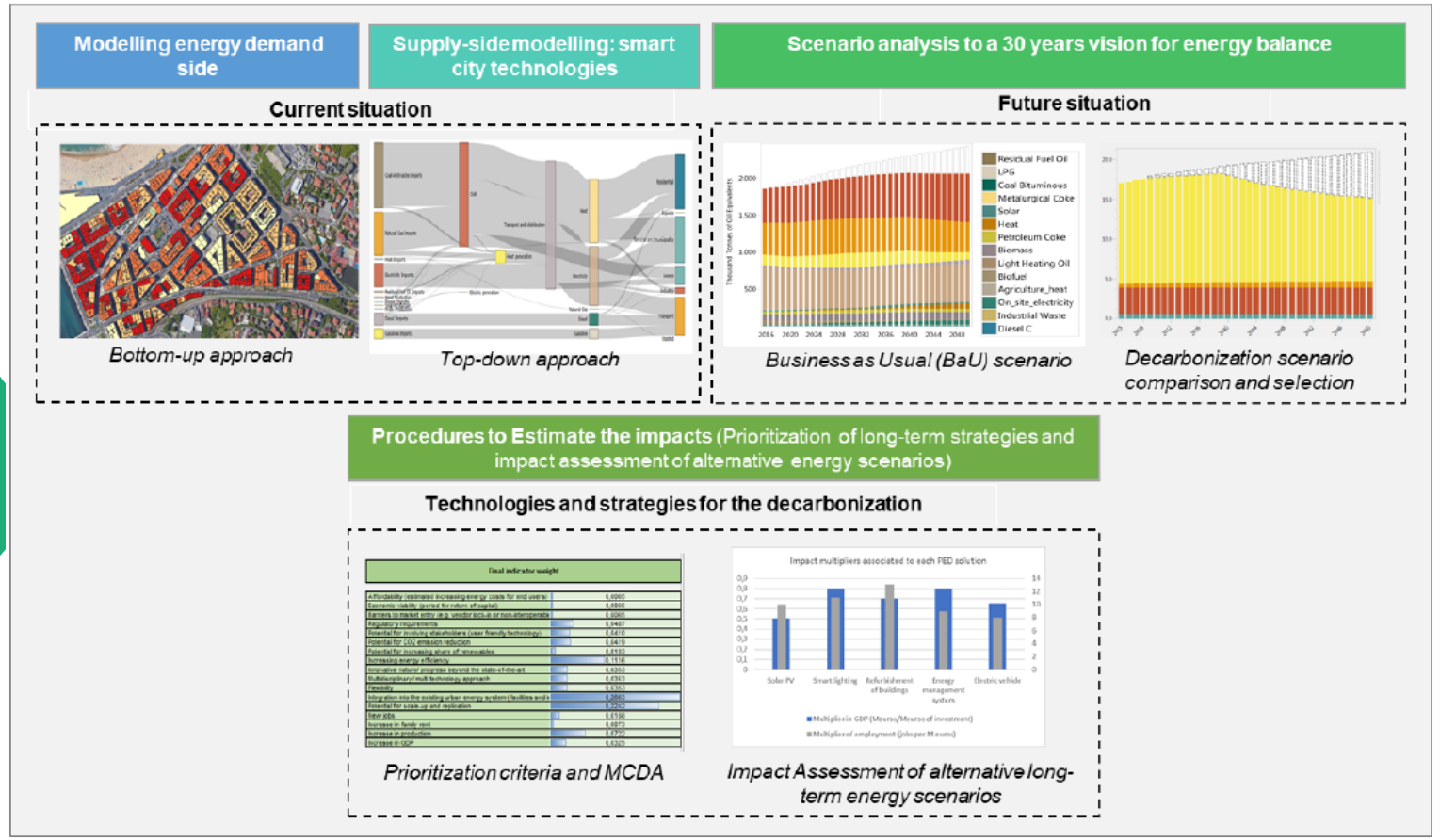
# AGENDA

- An approach to TECNALIA's methodology
- Demand side - Buildings' energy stock model
- City approach - Long-term energy modelling
- Envisioning futures - Scenario analysis
- Some findings & takeaway messages

Making City

# An approach to TECNALIA's methodology




## ❑ Demand in BUILDINGS

- Heating, electricity…
- GIS

## ❑ Modelling of the entire CITY

- Energy balances (demand in transport, residential, tertiary, public administration, industry…)

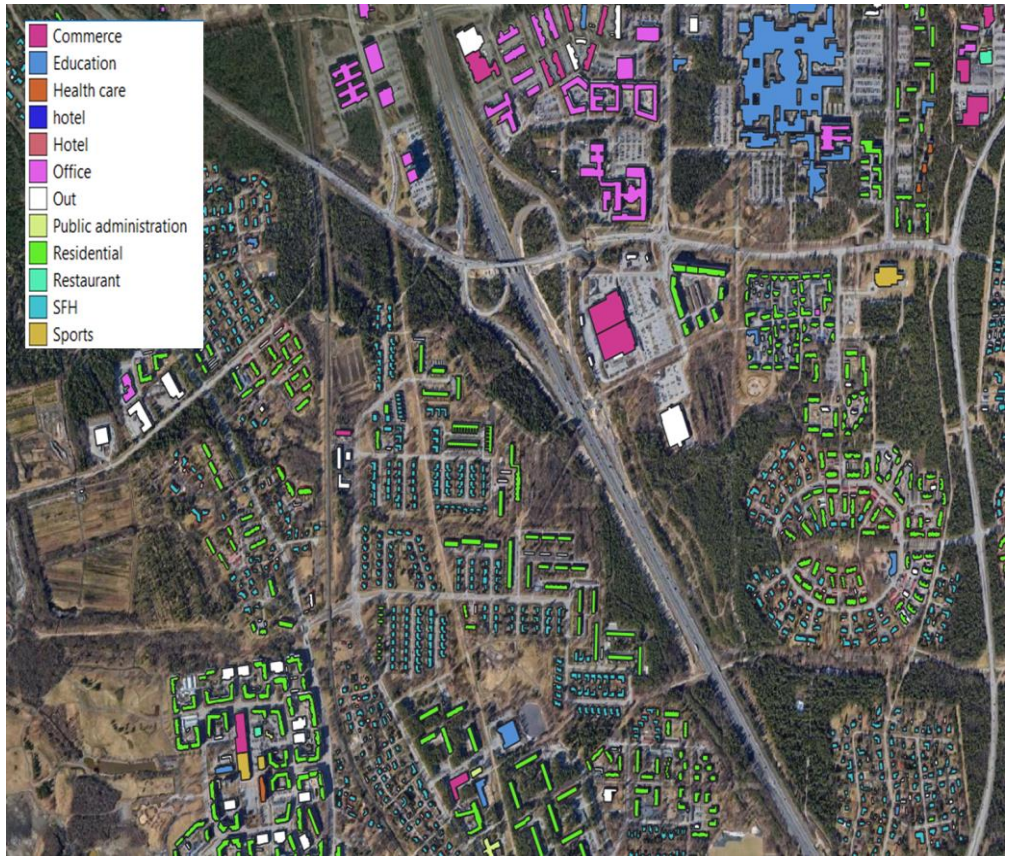
## ❑ Scenario analysis

- Projections of the energy system (city) up to 2050
- Based on trends and socioeconomic drivers (PIB, population…)

## ❑ Prioritisation & impact assessment

- Ranking measures/scenarios helps decision-making

# Demand side – Buildings' energy stock model

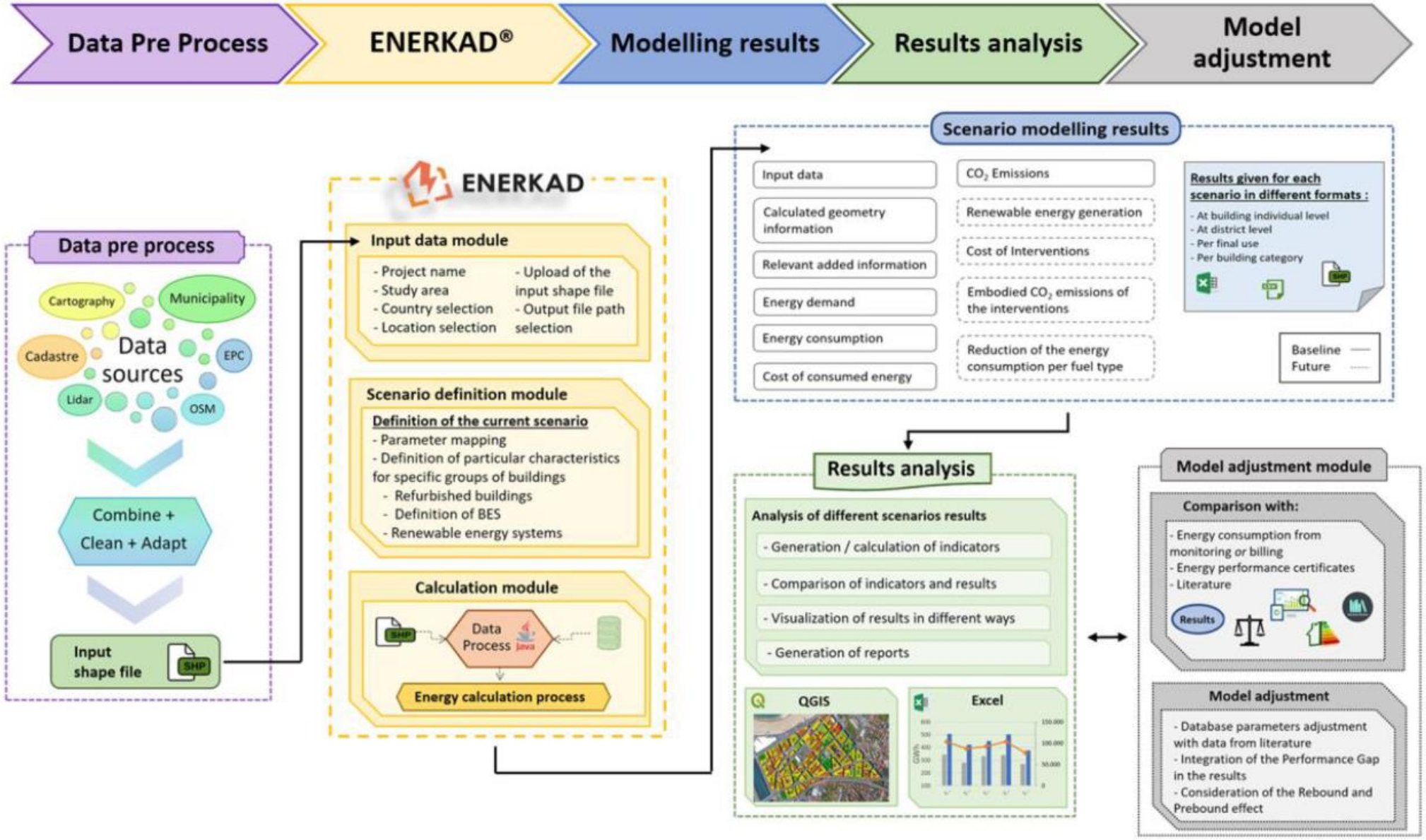

## ❑ Demand modelling in BUILDINGS

- Energy characterisation of building stock
- Based on ENERKAD

Making City

**Model results:** energy demand (kWh/m$^2$), emissions (kg $CO_2$/$m_2$), energy consumption (kWh/m$^2$) (heating, cooling, electricity, DHW) per building use type or category
**Outcomes:** GIS file, Excel database and CityGML

# Demand side – Buildings' energy stock model

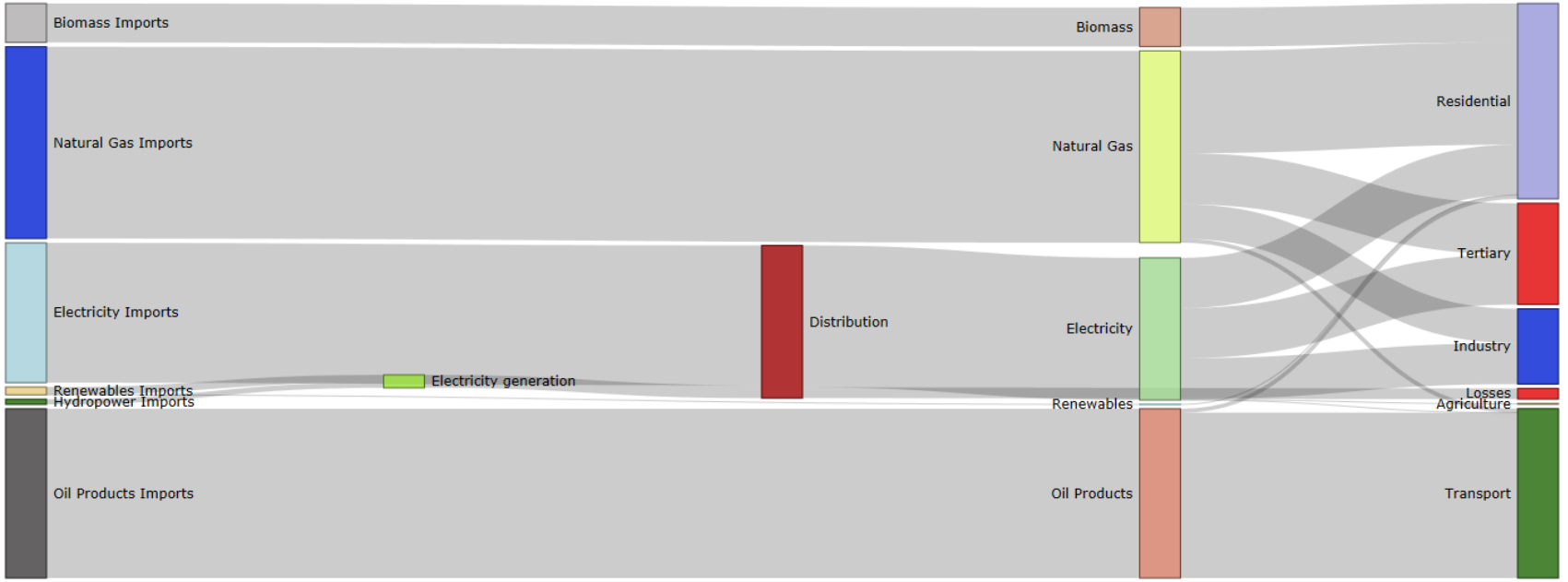



Making City

# City approach – Long-term energy modelling


## ❑ Modelling of the entire CITY

- Energy balances (demand in transport, residential, tertiary, industry…)
- Buildings' energy characterisation is an input
- Based on LEAP-OSeMOSYS (Energy Systems Modelling, ESM)

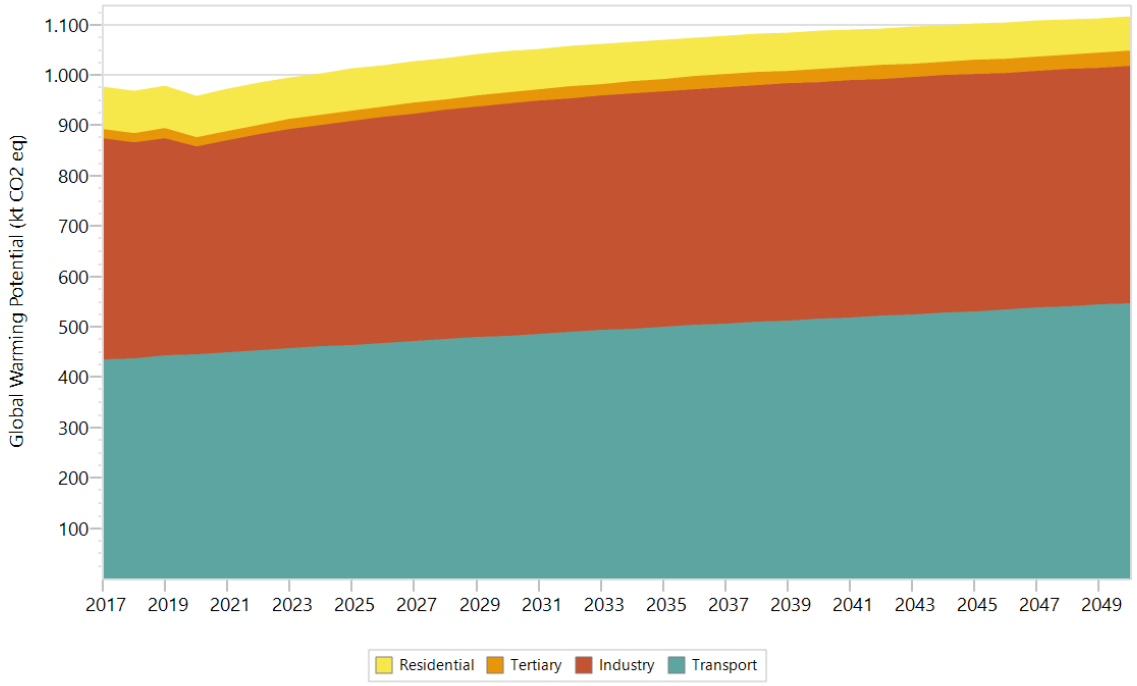



**Model results:** final energy demand by sector, by energy service, by fuel type; Sankey diagrams; $CO_2$ emissions by sector, by energy service, by fuel type; energy generation by technology; primary resources; energy imports/exports…

# Envisioning futures - Scenario analysis

## ❑ Scenario analysis

- Projections of the energy system (city) up to 2050
- Based on trends and socioeconomic drivers (PIB, population…)




**1. Creation of Business-as-Usual (BAU) scenario**

- BAU: *Baseline scenario that examines the consequences of continuing current trends in population, economy, technology and human behaviour* (EEA)

- Current trends are **nondesirable** → changes are needed

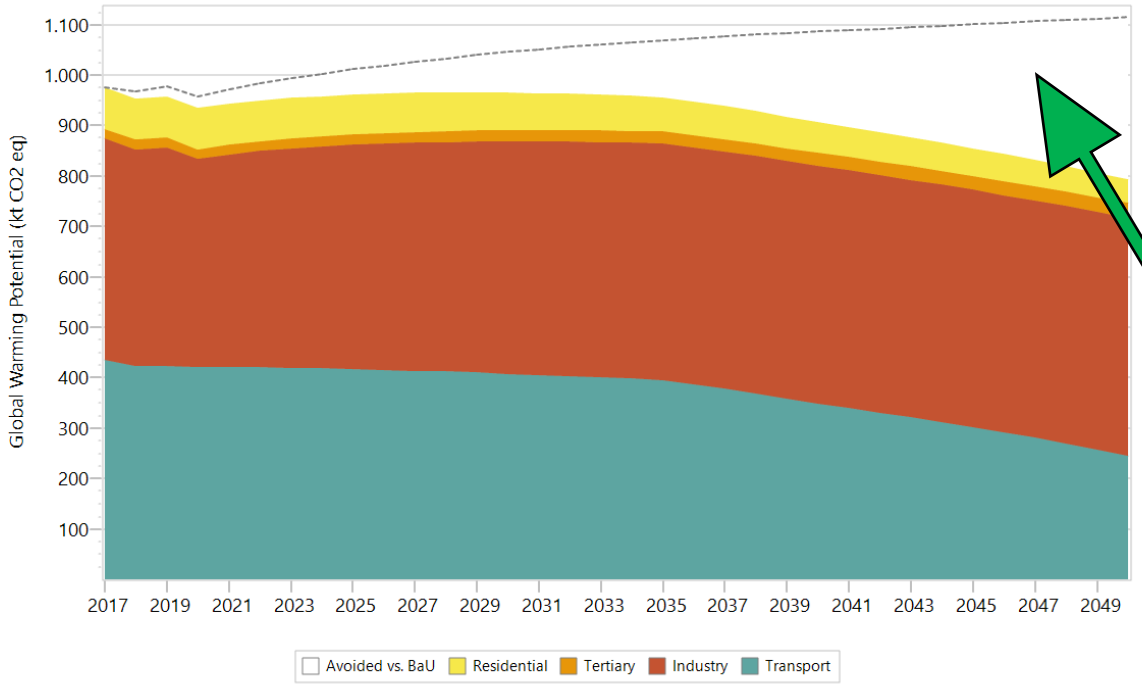
Making City

**Model results:** PROJECTIONS of final energy demand by sector, by energy service, by fuel type; Sankey diagrams; $CO_2$ emissions by sector, by energy service, by fuel type; energy generation by technology; primary resources; energy imports/exports…

# Envisioning futures - Scenario analysis

## ❑ Scenario analysis

- Projections of the energy system (city) up to 2050
- Based on trends and socioeconomic drivers (PIB, population…)



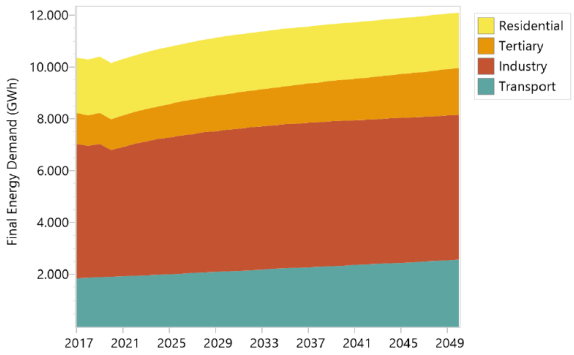

**2. Creation of ALTERNATIVE(s) scenario(s)**

- Current trends are undesirable → changes are needed
- Alternative scenarios **include actions / measures** to transform the energy system into a more sustainable / decarbonised one

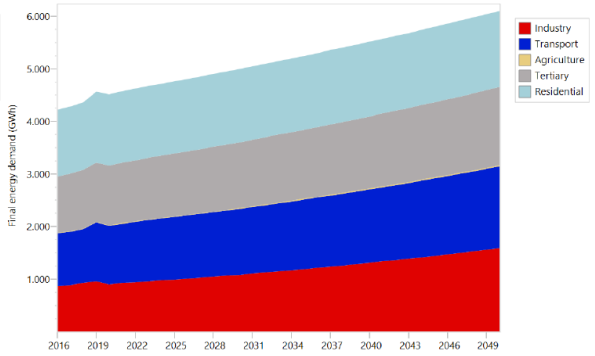
**$CO_2$ savings between scenarios**

**Model results:** PROJECTIONS of final energy demand by sector, by energy service, by fuel type; Sankey diagrams; $CO_2$ emissions by sector, by energy service, by fuel type; energy generation by technology; primary resources; energy imports/exports…

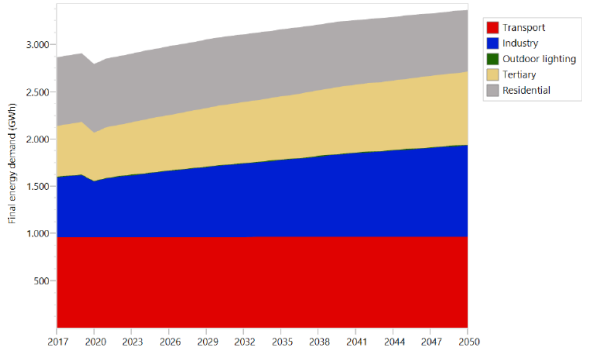
# Envisioning futures - Scenario analysis



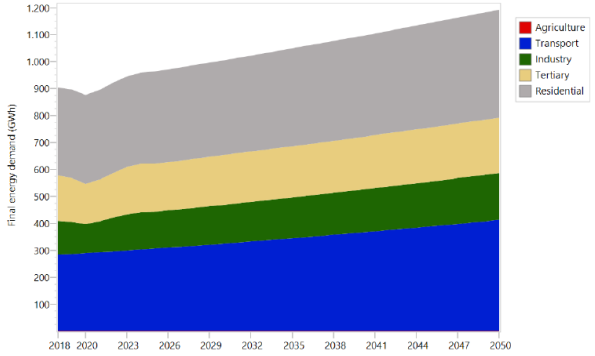

**OULU**




**GRONINGEN**



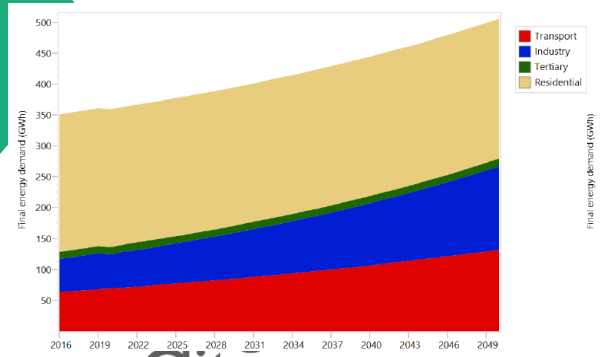

**LEÓN**



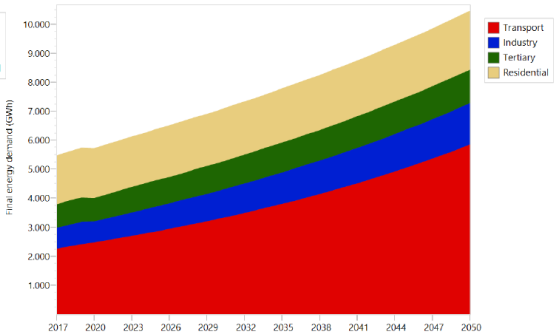

**BASSANO**

## FINAL ENERGY DEMAND – BAU SCENARIOS

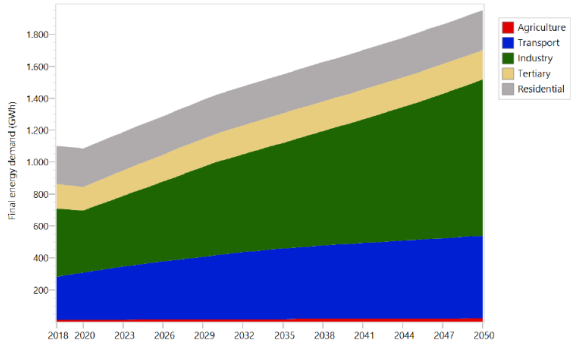
**VIDIN**



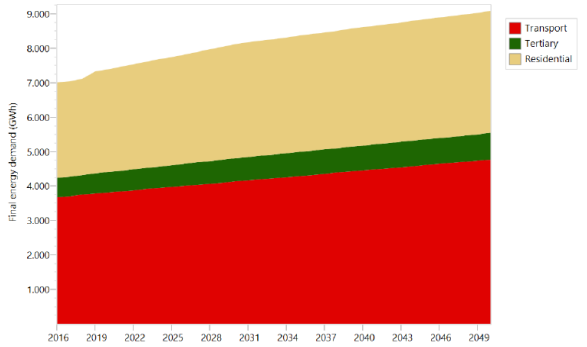

**LUBLIN**



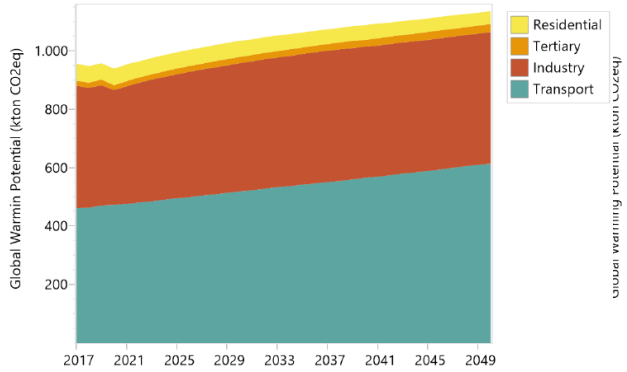

**TRENČIN**



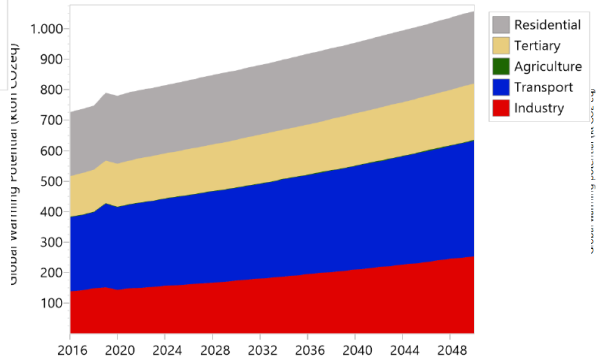

**KADIKÖY**



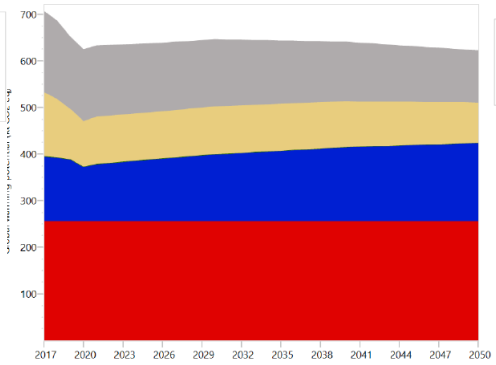
# Envisioning futures - Scenario analysis



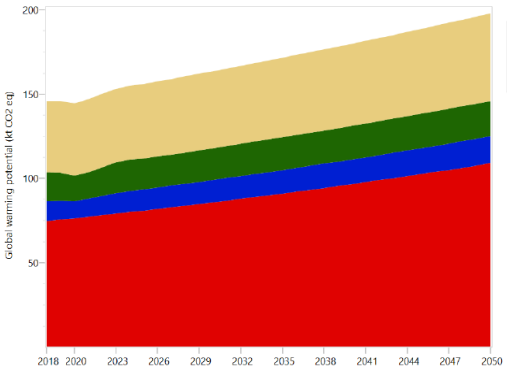

**OULU**




**GRONINGEN**



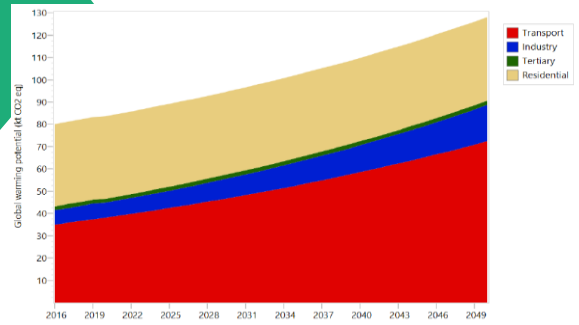

**LEÓN**



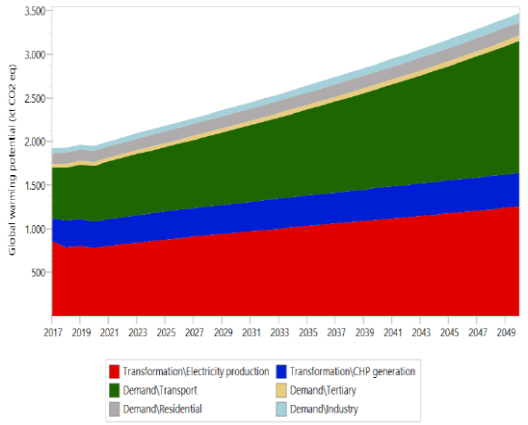

**BASSANO**

## $CO_2$ EMISSIONS (from demand) – BAU SCENARIOS

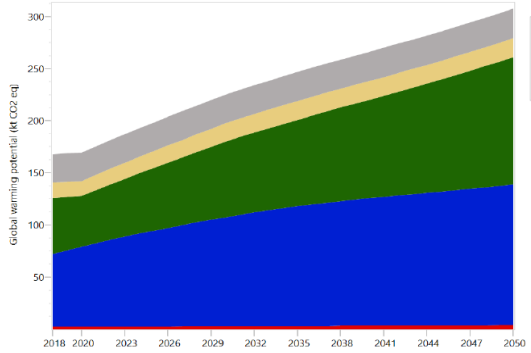
**VIDIN**



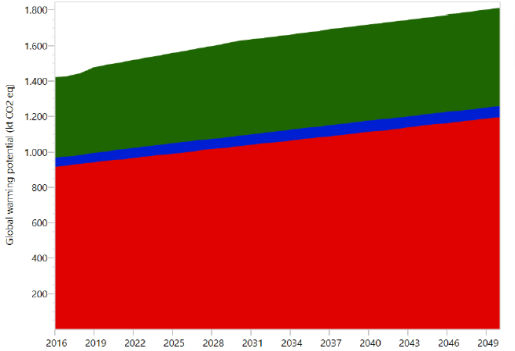

**LUBLIN**




**TRENČIN**




**KADIKÖY**




City

# Some findings & takeaway messages

## ❑ Demand in BUILDINGS

- Enerkad is a **tool** that provides general results for a wide range of buildings in a **quick and easy way**
- Comparison with real data or other studies shows a **good correlation with estimates**
- The **accuracy and quality of input data is a determining factor** when generating the model. Inaccurate geometry or incorrect building height data will cause the results to vary greatly when analysing individual buildings
- Comparisons with real monitored data show that **older and worse insulated buildings have a much lower energy consumption than theoretical**, while **new buildings** with a much better theoretical thermal performance **consume more energy than estimated**

## ❑ Modelling and Scenario analysis

- Energy system modelling (ESM) allows to model the **city as a whole**
- Scenario assessment allows to **explore futures** under the "what if…" rationale
- **Business-as-Usual scenario** is a baseline case, **nondesirable**, that projects the system to the future
- **Alternative scenarios explore the implementation of actions / measures**

Making City

- **Scenario assessment is the basis to draw a long-term vision as well as creating robust energy and climate plans (e.g. SECAP) oriented towards decarbonisation**

# Thank you

## Get in touch for more information!

Making City

**WPL Contact**

Follow us on Twitter & LinkedIn!
@MakingCity_EU

Project information available on the
MAKING CITY website: www.makingcity.eu
Contact us: contact@makingcity.eu