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Energy Efficiency 2050 Roadmap

Romania

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ROMANIA

Final energy

Final energy

TWh

- Baseline2050
- sEE2050

100% renewable energy transition overview

➢ Romania can reduce its final energy demand cost-effectively following the Energy Efficiency First Principle by 43% from the 2050 baseline scenario

➢ The annual energy system cost remains similar to today even with massive electrification of transport and industry and new energy storages

➢ The population in Romania is expected to decrease from 19.9 million to 16.3 million inhabitants in 2050
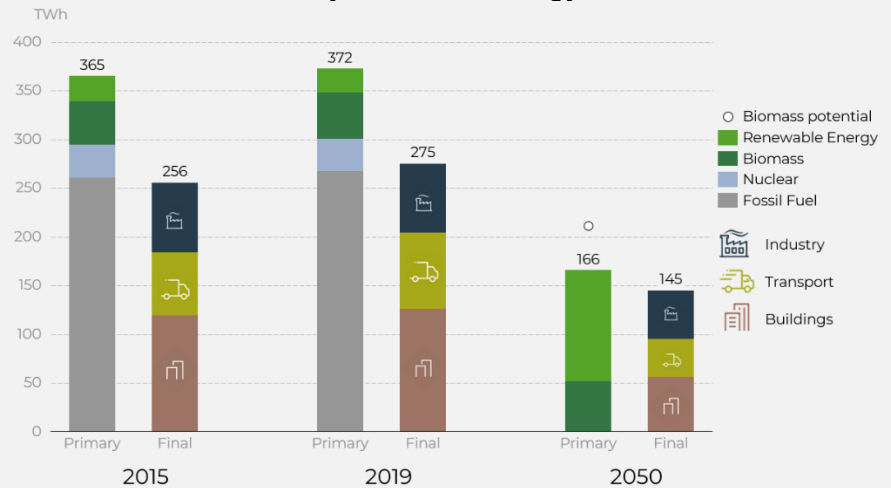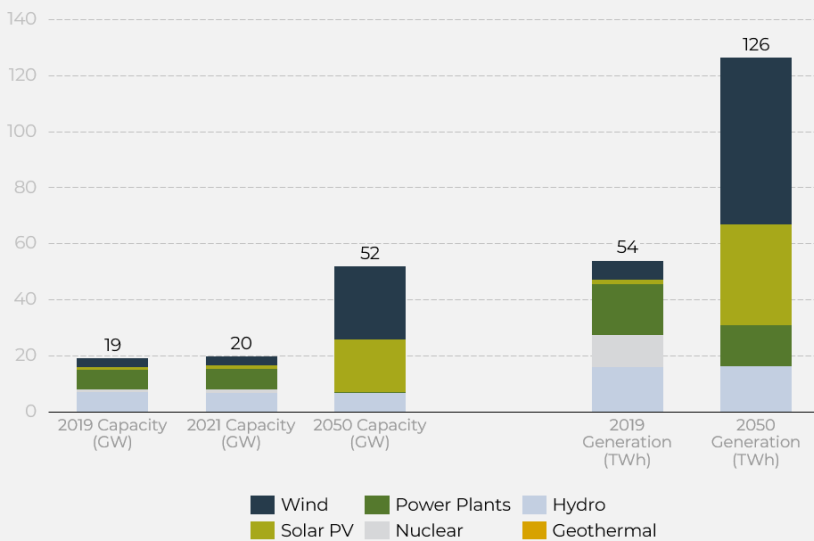
➢ The Energy Efficiency First Principle can reduce the final energy demand by 47% from 2019 to 2050

➢ Primary energy supply can be reduced by around 55% from 2019 to 2050

➢ The bioenergy consumption per capita is 12 GJ per person which is lower than the EU sustainable level of 22 GJ per capita

Primary and final energy demand

Primary and final energy demand

Legend:
- ○ Biomass potential
- Renewable Energy
- Biomass
- Nuclear
- Fossil Fuel
- Industry
- Transport
- Buildings

Electricity capacity and generation

Electricity capacity and generation

Legend:
- Wind
- Solar PV
- Power Plants
- Nuclear
- Hydro
- Geothermal

Electricity demand

➢ Total electricity demand increases by 126% to 126 TWh in 2050 as compared to 2019

➢ New investment in wind and solar PV is 31 billion euros from 2019 to 2050

➢ Renewable electricity capacity is within the low potential of 227 GW for wind (onshore and offshore) and 381 GW for solar photovoltaics

➢ The energy system is balanced with high security of supply where new demands are situated with new supply and short-term thermal storages balance the district heat supply and demand

➢ Hydrogen production, heat pumps and electrics vehicles are used to balance the electricity supply and demand

Heating in buildings

➤ The total heat demand in the residential and service building stock can be reduced cost effectively by 44% at a cost of 30 billion euros by 2050

➤ District heating share of the heat supply for the residential and service building stock can cost effectively be increased from 23% to 45%
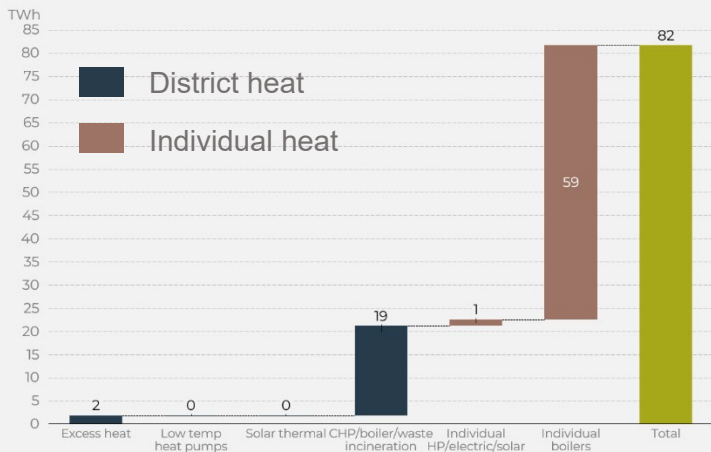
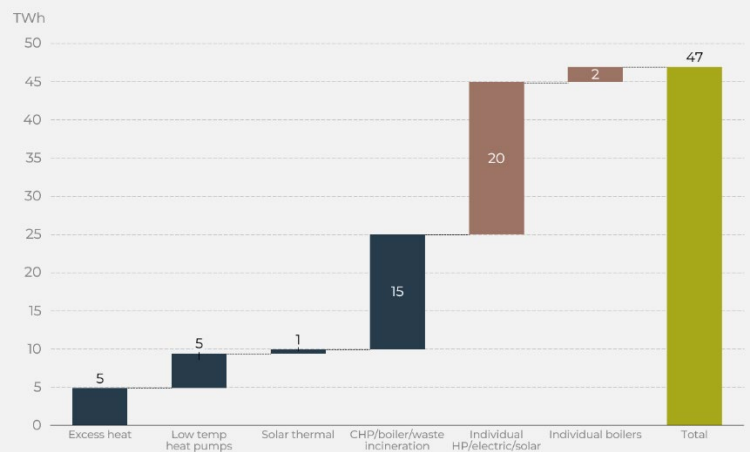➤ Excess heat from industry and low temperature heat can supply over 44% of the district heating

Heat supply in buildings

Heat supply in buildings chart (TWh). 2015: Ind. Heating 60, DH 11, total 71, Excess heat+low temp ~1. 2050: Ind. Heating 22, DH 18, total 40, Excess heat+low temp ~8.

Legend: ○ Excess heat+low temp ■ Ind. Heating ■ DH
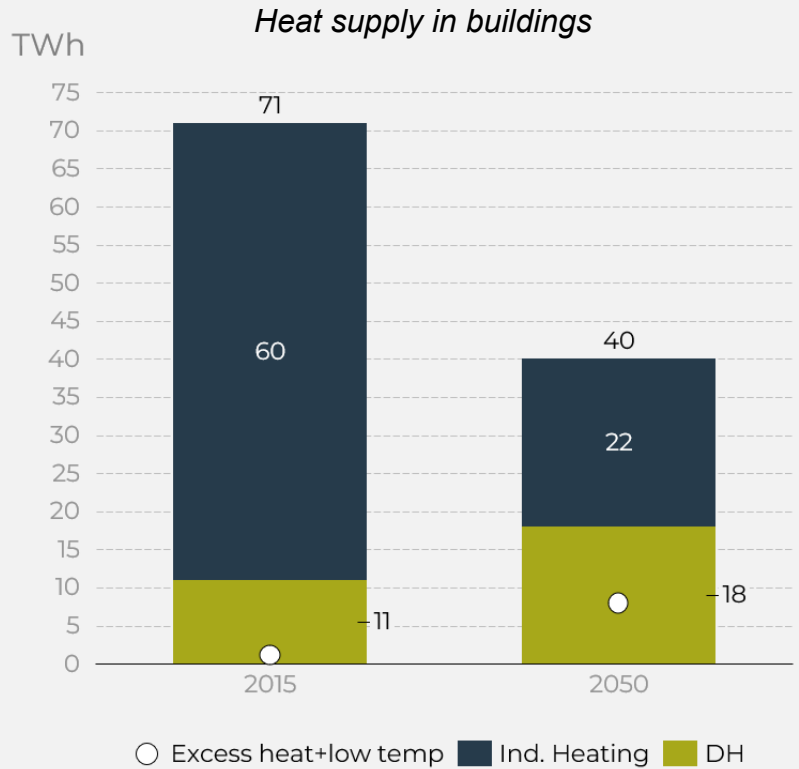
Heat supply for buildings

2015

Waterfall chart (TWh), District heat vs Individual heat: Excess heat 2, Low temp heat pumps 0, Solar thermal 0, CHP/boiler/waste incineration 19, Individual HP/electric/solar 1, Individual boilers 59, Total 82.

2050

Waterfall chart (TWh): Excess heat 5, Low temp heat pumps 5, Solar thermal 1, CHP/boiler/waste incineration 15, Individual HP/electric/solar 20, Individual boilers 2, Total 47.

Legend: ■ District heat ■ Individual heat

*District heat supply for industry is also included in these charts. In 2050 the majority of heat supply is for buildings (97%)
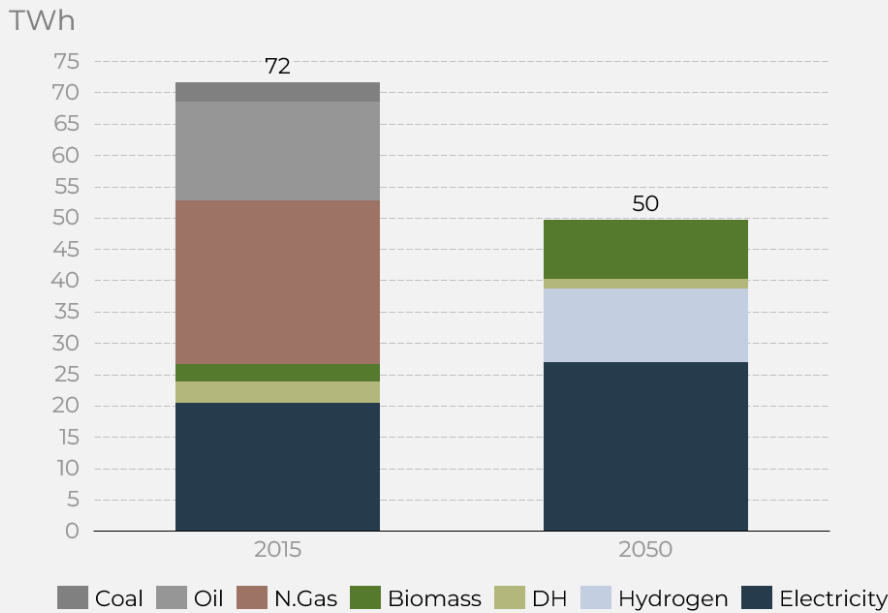
➤ District heat sources become more diversified in 2050 due to less electricity and heat from combined heat and power plants

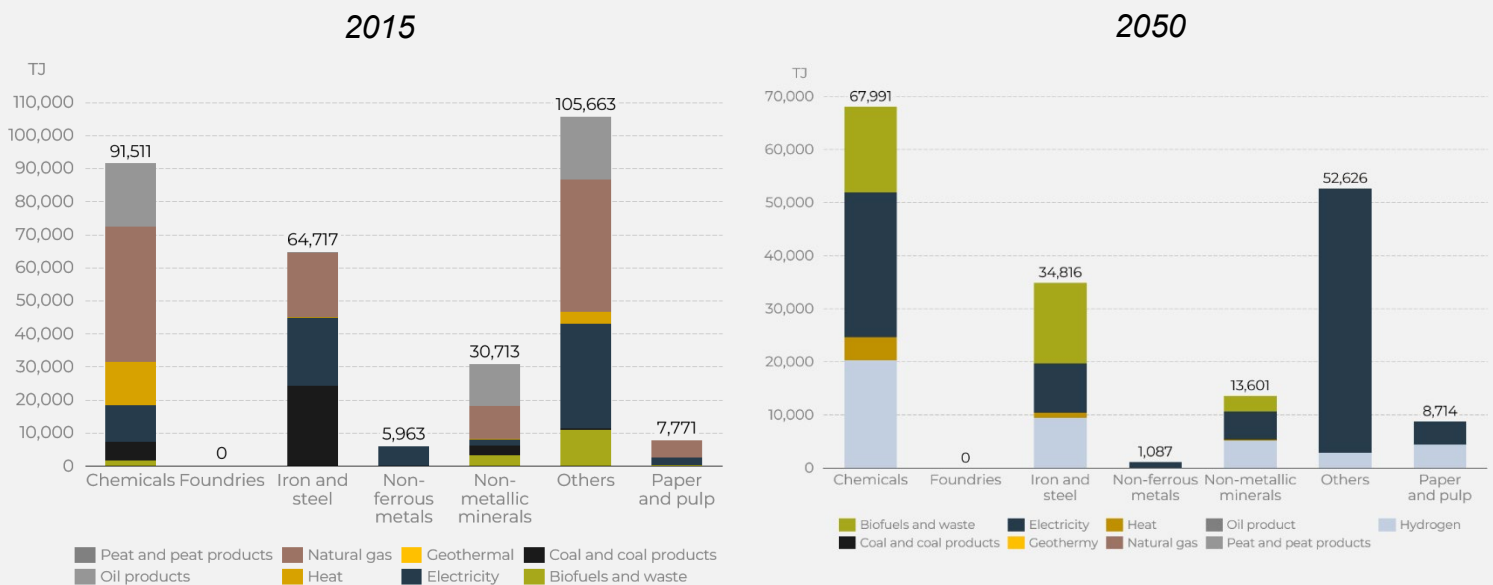➤ Individual heat pumps and solar thermal replace the majority of boilers in buildings

sEEnergies

Industry final energy

TWh

Legend: Coal | Oil | N.Gas | Biomass | DH | Hydrogen | Electricity

- ➤ Energy supply in industry can be transitioned from 2015 to 2050 at a cost of 4 billion euro

- ➤ 54% of the industrial final energy in 2050 can be electrified

- ➤ A mix of bioenergy and hydrogen can supply the majority of the remaining 46% of final energy demand

Industry fuel types by

2015

TJ

Chemicals 91,511 · Foundries 0 · Iron and steel 64,717 · Non-ferrous metals 5,963 · Non-metallic minerals 30,713 · Others 105,663 · Paper and pulp 7,771

Legend: Peat and peat products | Natural gas | Geothermal | Coal and coal products | Oil products | Heat | Electricity | Biofuels and waste

2050

TJ

Chemicals 67,991 · Foundries 0 · Iron and steel 34,816 · Non-ferrous metals 1,087 · Non-metallic minerals 13,601 · Others 52,626 · Paper and pulp 8,714

Legend: Biofuels and waste | Electricity | Heat | Oil product | Hydrogen | Coal and coal products | Geothermy | Natural gas | Peat and peat products

➤ The others sub-sector is a grouping of the food/drink, engineering, textiles

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Transport final energy

➢ The final energy demand in 2050, can be reduced by around 48% via a combined effect of electrification and energy efficient urban development as compared to 2019

➢ Energy efficient urban development such as densification and modal shifts contribute to a reduction of around 15% as compared to traditional urban development in 2050

➢ Direct electrification of heavy-duty trucks via e-roads can decrease the overall transport energy demand by 18% as compared to electro-fuels

Legend:
- Gas
- Electrofuels
- Ammonia
- Petrol
- Biofuels
- Electricity (BEV + Rail)
- Jetfuel
- Diesel
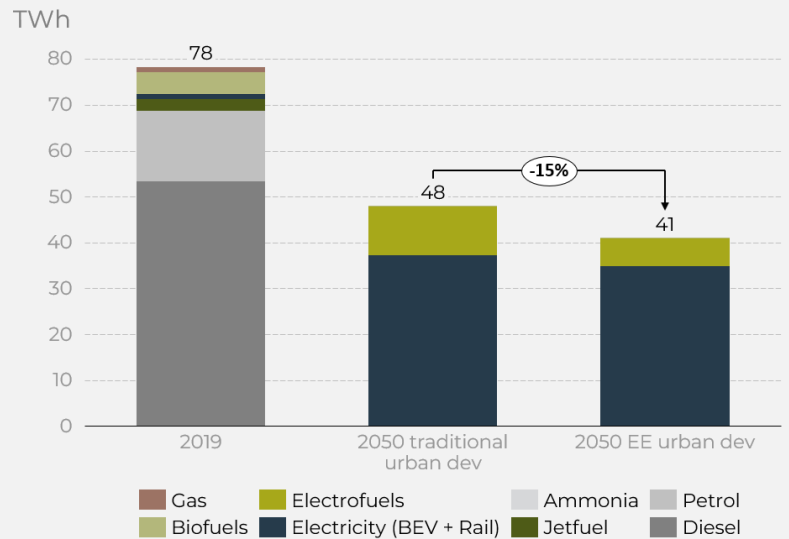
Light vehicle transition

➢ The number of passenger cars increase from 6.5 million to 7.9 million from 2017 to 2050 but 1.36 million are avoided in the energy efficient urban planning scenario as compared to traditional development

➢ The per capita passenger cars increase from 0.32 to 0.41 from 2017 to 2050

➢ The energy efficient growth trajectory reduces the pkm travelled by passenger cars by around 17% as compared to traditional growth trajectory in 2050

➢ The modal shifts from passenger cars and aviation cause the pkm travelled by rail to an increase by 337% in 2050 as compared to 2017

- Passenger Cars and Vans - Traditional Growth (Mpkm)
- Passenger Cars and Vans - EE Growth (Mpkm)
- Passenger Cars and Vans per capita

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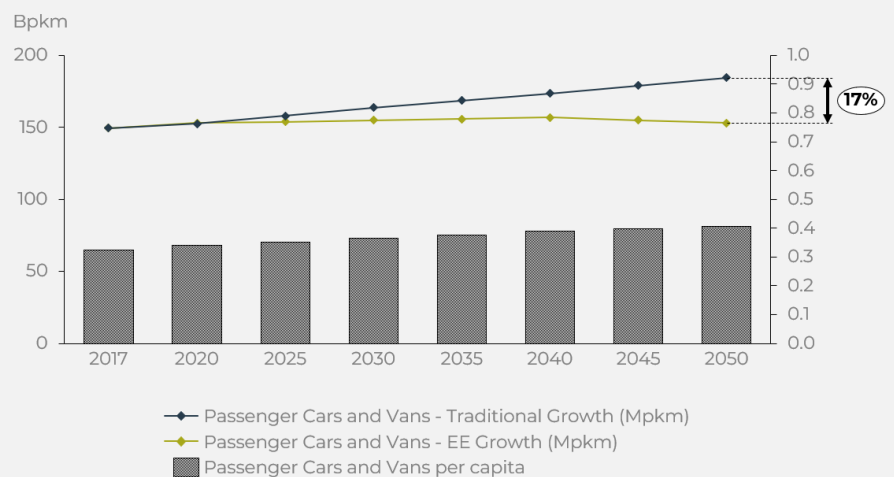
Methods

Eight separate analyses developed bottom-up results for Romania

Romania 100%
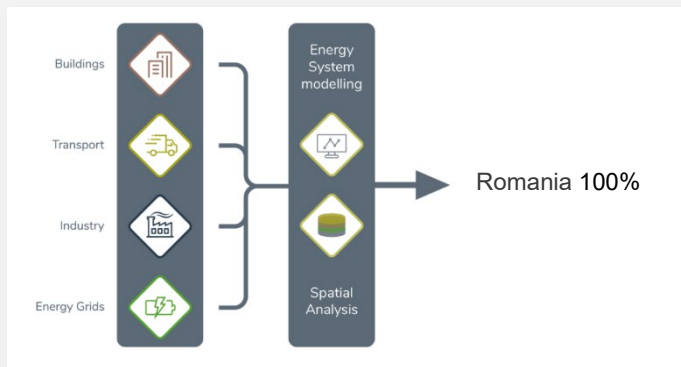
Buildings

Aggregated investment cost curves for building envelope measures per building type and building age class in Romania for additional savings beyond the baseline

Transport

Detailed decomposition of the entire transport sector in Romania

Industry

Energy efficiency potentials in every industrial sub-sector in Romania, and the spatial location of industrial excess heat

Energy grids

Electric grid - Cost of reinforcing distribution grids for allowing low-carbon technologies integration in Romania

Thermal grid - Potential for district heating and associated infrastructure cost in Romania

Gas grid - Potential for power-to-gas and the transmission of new energy vectors (e.g. hydrogen) and associated infrastructure cost in Romania

Spatial analytics

Combining spatially distributed information on energy efficiency to identify local synergies

Energy system analysis

100% renewable energy-efficient energy system in

Single and multi-family houses

5 different age classes

Measures for 4 different building elements in building packages (1 to 16, mutually exclusive)

- Wall
- Window
- Roof
- Basement

Adjusted transport behaviour for each mode of transport related to trip distance

Quantified the energy efficiency potentials related to the implementation of alternative transport technologies, both in terms of energy consumption and costs

Future material production per product in Romania

Energy intensities per product, energy carrier and temperature level

Details on Best Available Technologies and Deep Decarbonisation Technologies

- Investment costs, Change in Operation & Maintenance costs, Current diffusion rates, Future Implementation rates

Waste heat availability from industrial flue gases per process and temperature level, with and w/o waste heat

Electric grid - Computing the reinforcement cost per dwelling for representative grids

Thermal grid - Spatial modelling and assessment of thermal grids

Gas grid - Assessment of the role and costs of existing gas grids and future role of gas grids and types of gases

Mapping of localised energy system data for the EU27+UK (including population change to 2050)

Highly detailed information down to the 1 -hectare level

Integration of building, industrial and transport sectors

Analysed energy supply system based on renewable electricity potentials, and thermal and bioenergy resource availability

Reports and outputs related to Romanian results
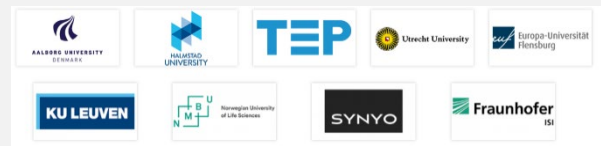
Click here for WP1: Energy Efficiency and Refurbishment Strategies in Buildings

**Click here** for WP2: Comprehensive Energy Efficiency Potentials in Transport and Mobility

Click here for WP3: In-depth Quantification of Industrial Energy Efficiency Potentials

Click here for WP4: Assessment of the Role and Costs of Energy Grids

Click here for WP5: Spatial Analyses of Energy Efficiency potentials and Development of the GIS Visualisation Platform

Click here to access Peta5.2
Click here to access the Open Data

Click here for WP6: Modelling Energy System Synergies and Quantification of Energy Efficiency Impacts
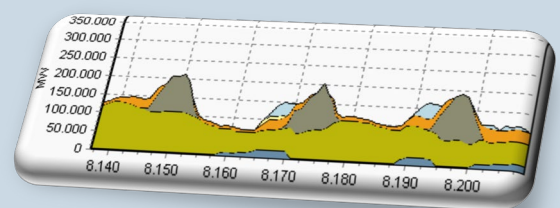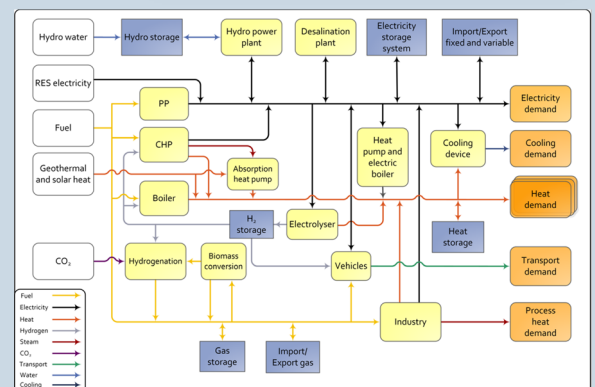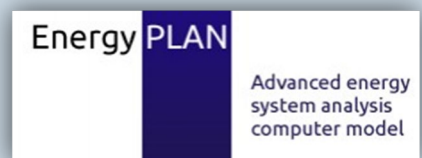
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