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Alternative and sustainable energy scenarios for Hungary

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Three scenarios
to explore possible alternative developments

- **NUCLEAR** scenario: current Hungarian policy (data and assumptions largely based on the 2013 EU Reference Scenario)

- **GREEN** scenario: an alternative scenario without the extension of NPP, increased use of renewables and strong energy efficiency development on the demand side

- **INTER** scenario: less ambitious energy strategy without Paks 5&6 (A & B)
  - INTER A: final energy demand as in NUCLEAR
  - INTER B: moderate but active savings policies

Modeling approach

Bottom-up technical simulation plus annual electricity system dispatch

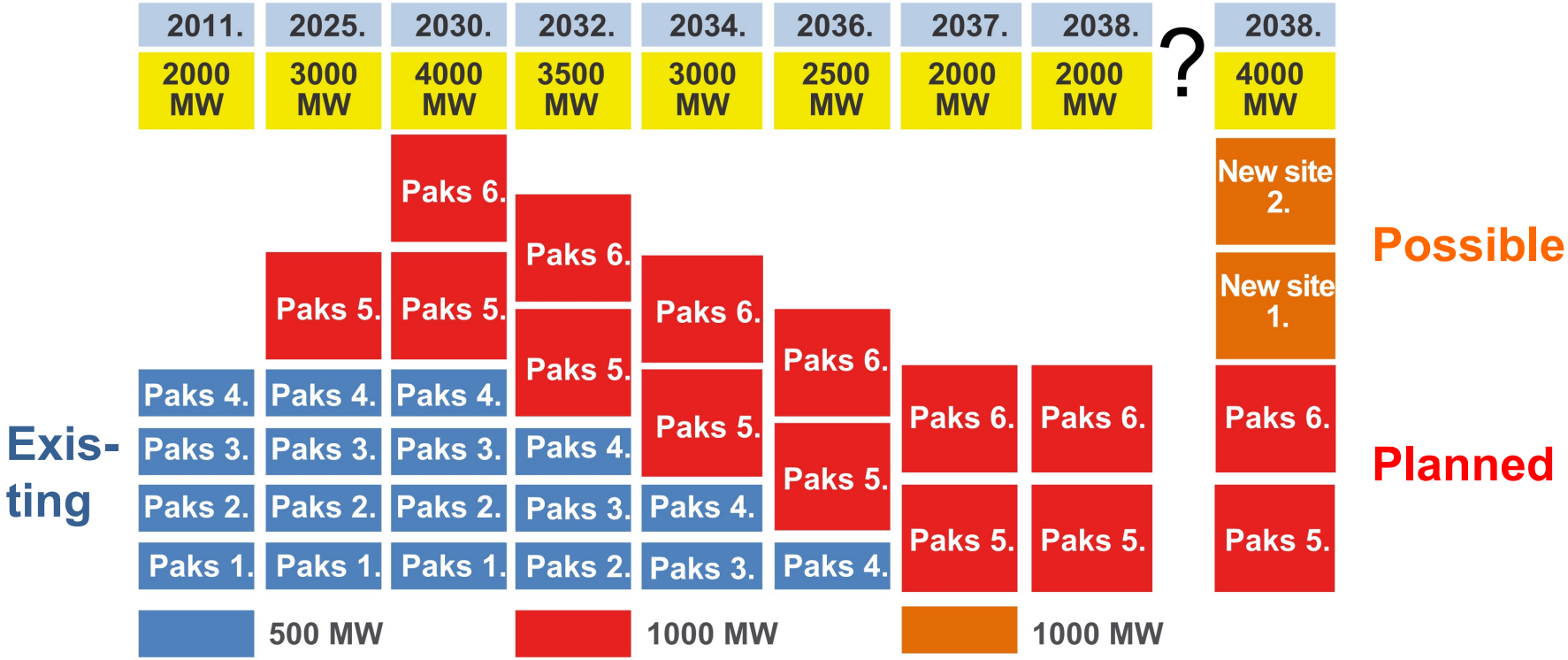
- **WISEE-model (by WI, used for modelling of the demand side)**
  - **Bottom-up simulation model**, with a very detailed representation of energy system technologies and a low degree of endogenization, *i.e.*, many parameters can be changed by bringing in experts or stakeholders' knowledge
  - **Focus** is on unveiling existing **energy efficiency and GHG mitigation potentials** rather than internal cost optimization to achieve a given target
  - WISEE-H: Adapted to Hungarian situation and combined with specific Hungarian sub-models (e.g. for buildings)
- **ENERGYPLAN-model (open source, used by EK, for supply side)**
  - User friendly modelling tool analysis of national energy-systems with a focus on the electricity and heat systems
  - Allows for **hourly balancing of supply and demand in electricity systems** and the optimisation of power plant dispatch, plus modelling of DSM and storage
  - ENERGYPLAN-H used as an easy to apply tool as WISEE-Dispatch would have needed larger adoption to Hungarian situation

NUCLEAR scenario
General assumptions

- NUCLEAR scenario **follows largely the 2013 EU Reference Scenario** (PRIMES model) for Hungary
- PRIMES is a partial equilibrium model for the EU energy markets that is used for forecasting, scenario construction and policy impact analysis
  - Mainly used for energy and environmental policy analysis, impacts of carbon emission trading, renewable and energy efficiency policies on energy markets
- **Difference** to the 2013 EU Reference Scenario: Future extension of Paks nuclear power plant
  - PRIMES assumes that further NPPs are going online, while the “official energy scenario” does not (Nuclear-Coal-Green).
  - We use in this case the data of the official national strategy, **no further extension after Paks 5&6 (→ no Paks 6 &7)**

Nuclear Capacity Development

Hungarian National Energy Strategy

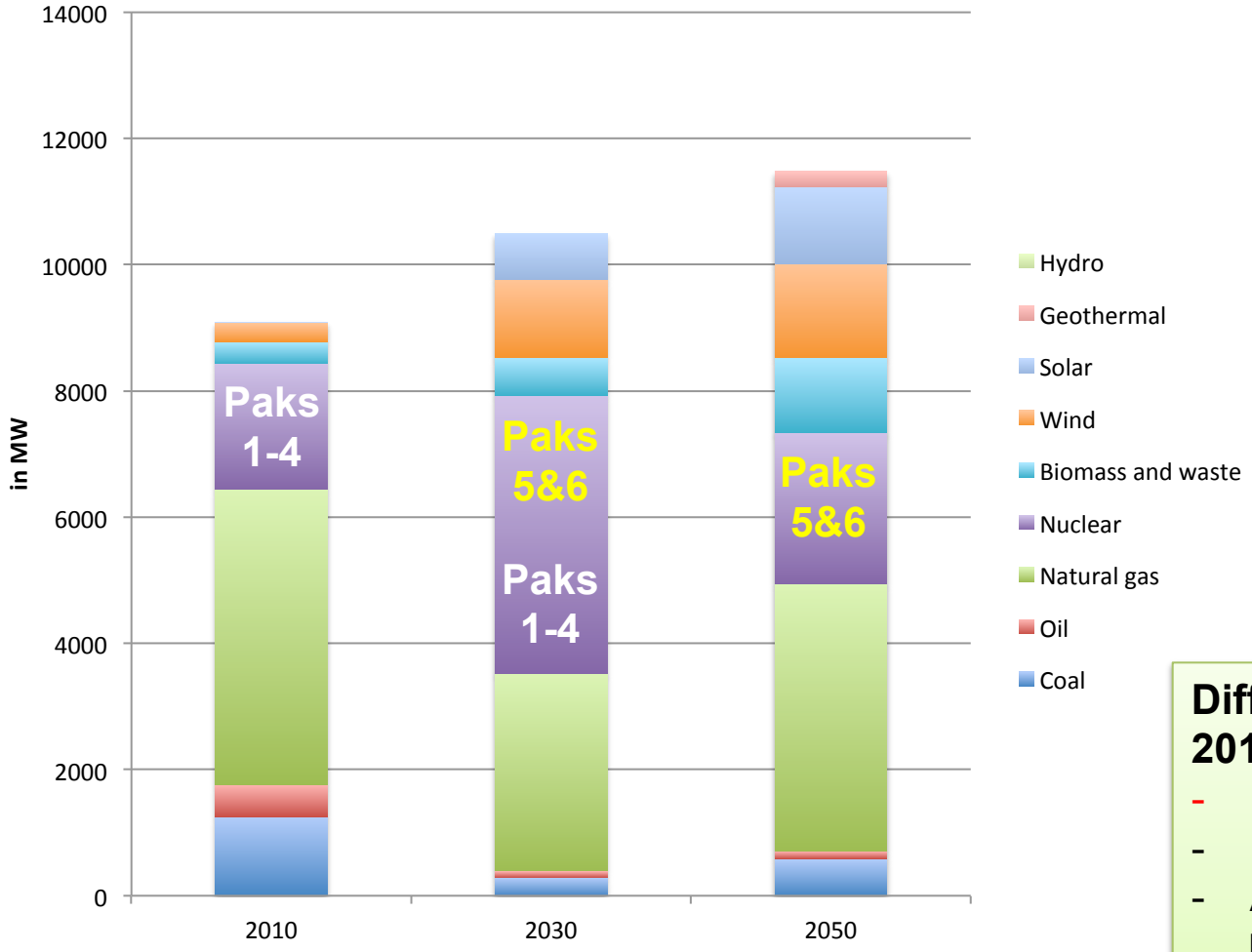


Source: National Energy Strategy of Hungaryhttp://www.terport.hu/webfm_send/2658

- From 2026, new nuclear capacities will be added to the network. Between 2032-37, 4200 MW nuclear capacity will run in Hungary; after this period, the old reactors of Paks I (2000 MW) will be phased out.

NUCLEAR Scenario

Power sector capacities



Difference to EU 2013 Reference:

- No Paks 7 & 8
- Instead: nat. Gas
- Assumption in line with National Energy strategy

GREEN Scenario
General assumptions

- **High-efficiency** strategy on the demand side:
  - Increased energy efficiency in every sector
  - H2-strategy in industrial and transport sectors
  - Electric mobility
  - Increased retrofitting in the building sector plus 10-15% electrical heat pumps

- **High renewable** energy strategy in order to cover the remaining energy need
  - Analysis of existing national and international literature to determine the technical potentials of renewable energy sources in Hungary
  - Definition of a high-RES scenario
    - 19% of PV potentials used, small share of ground mounted
    - 13% of Wind potential used, less than 2% of the country space for wind parks

- **Electricity system**
  - Demand slowly growing due to efficiency and new appliances
  - Demand side management in the industry, cooling, households and e-mobility
  - Strong expansion of the international transmission network (based on the Ten Year network development plan of ENTSO-E)

GREEN scenario: Demand side energy efficiency
Residential sector

- **Ramping up of refurbishment rates:**
  - 1,5 / 2 million households will refurbish their homes by 2030 / 2050
  - 310.000 / 510.000 flats will be completely re-built by 2030 / 2050

  → **66% of all buildings (2% per year) will be energetically upgraded** (25% recently built or renovated)
- **Increasing energetic standard of refurbishment / new builds:**
  - Until 2020: according to current legal standards (160 kWh/m2: -50 – -70%)
  - After 2020: according to "almost zero energy standard" (100 kWh/m2)
  - Increased share of comprehensive refurbishments (instead of only partial improvements of the buildings) (66% wall and windows or W&W&heating)
- **Increased efficiency of electric appliances**
  - Uptake of appliances increases (as in NUCLEAR)
  - Efficinency of new applineces increases by 2% everey 5 years on average
- **Results in:**

  → **Reduced** total **final energy consumption** for heating by 27 / 39 TWh (**50% / 70%**) by 2030 / 2050

  → **20% electricity savings** in spite of slight increases in electric heat pumps

GREEN scenario: Demand side energy efficiency
Transport sector

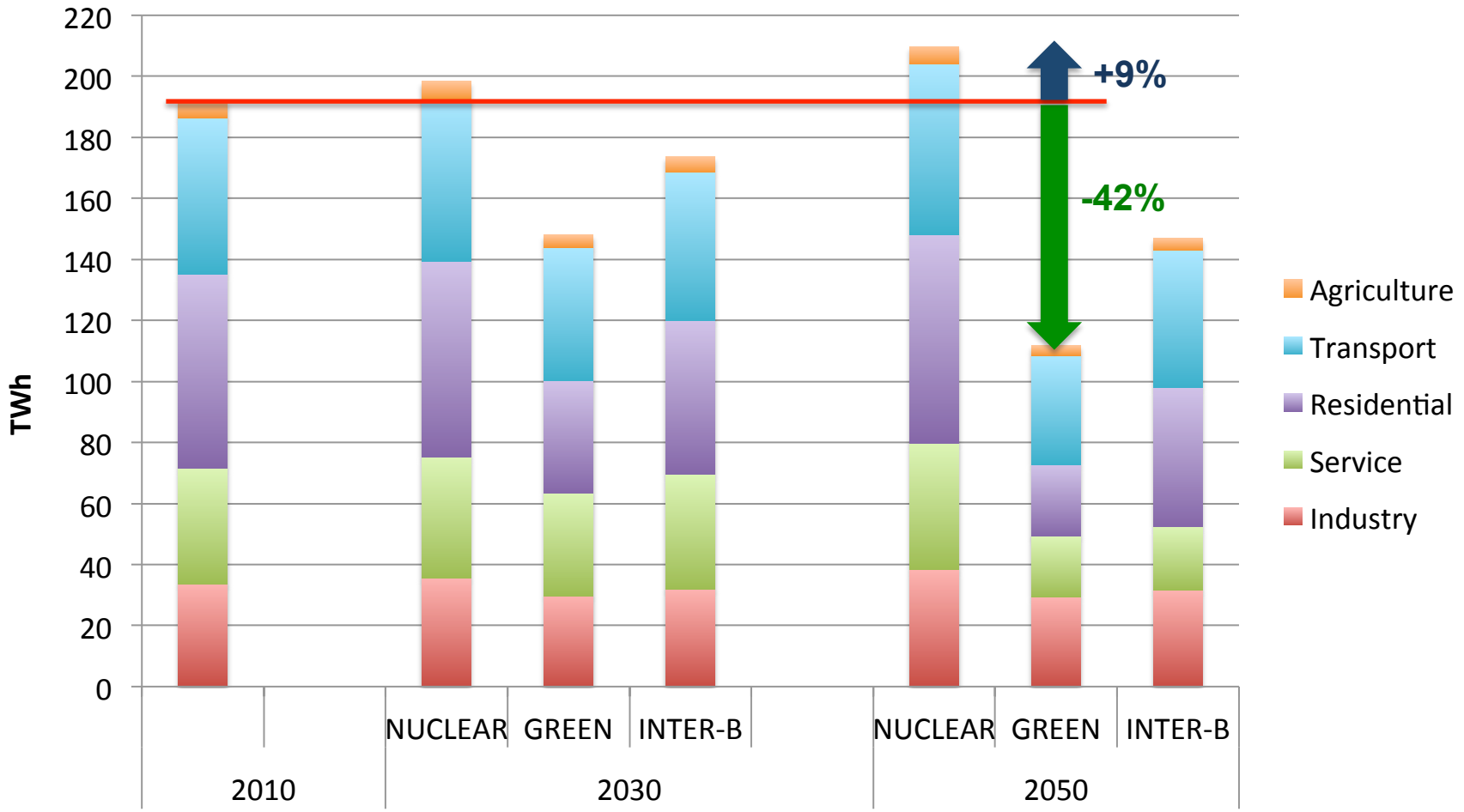
- **Stabilized transport demand and modal shift:**
  - Passenger transport remains stable at about current levels (rather low in international comparisons)
  - Share of Public transport further increases
  - Moderate increase of freight transports with high increases of rail shares
- **Increasing vehicle efficiency and switch to electric:**
  - Improving fuel efficiency of conventional ICE cars by 30% by 2030 and 43% by 2050 (avg. 7.3 → 4.2 l/100 km)
  - Increasing shares of EVs to 33% / 49% and H2-cars to 3% / 10%
- **Results in:**

  → Total **final energy** consumption reduced **by 30%** by 2050

  → **Oil product** use reduced **by 50%** by 2050

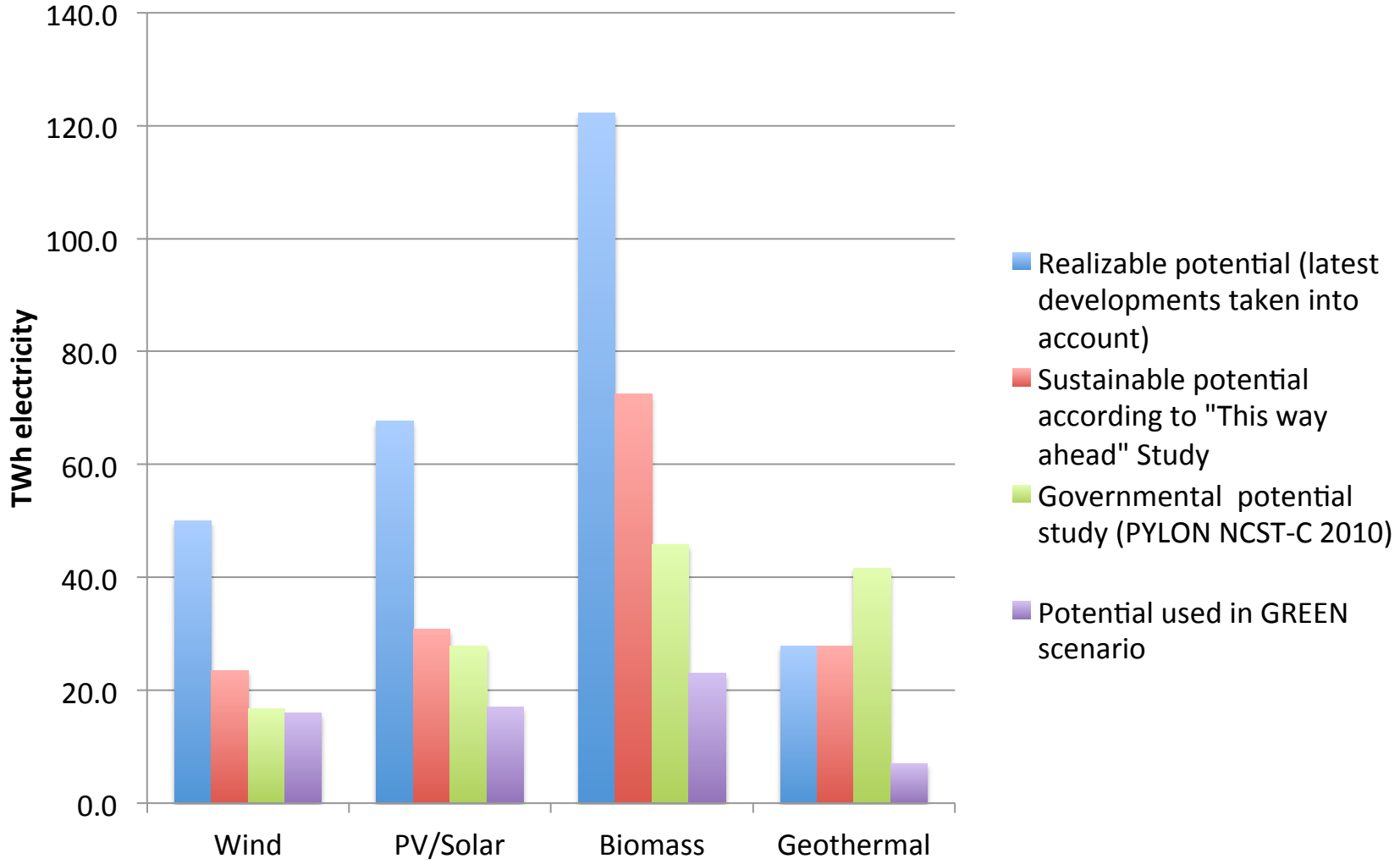
GREEN scenario: Potential for demand side energy efficiency

Final energy demand by sector (Green vs. NUCLEAR scenario)



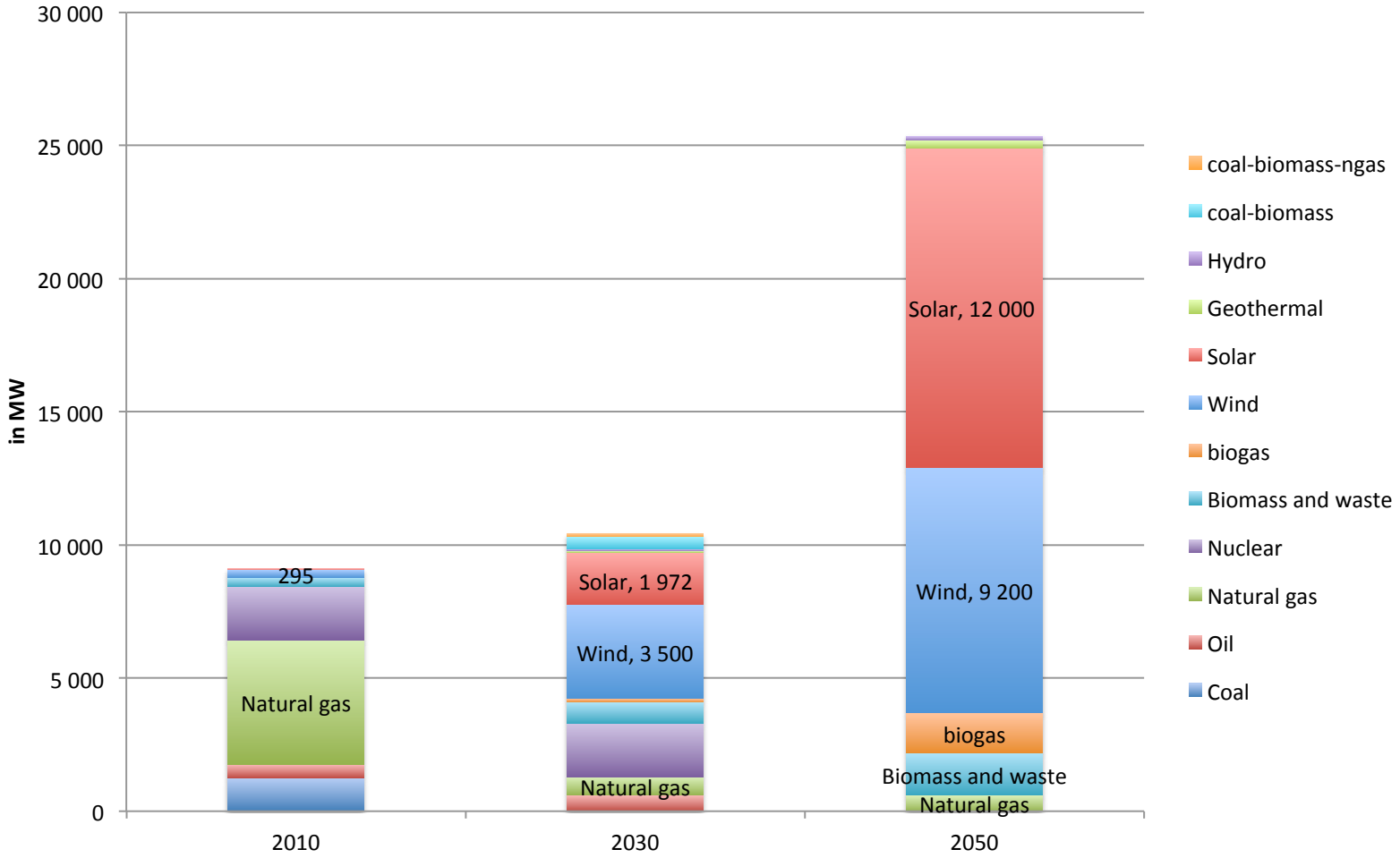
GREEN Scenario: RES electricity

New estimate of technical potential until 2050 compared to older results



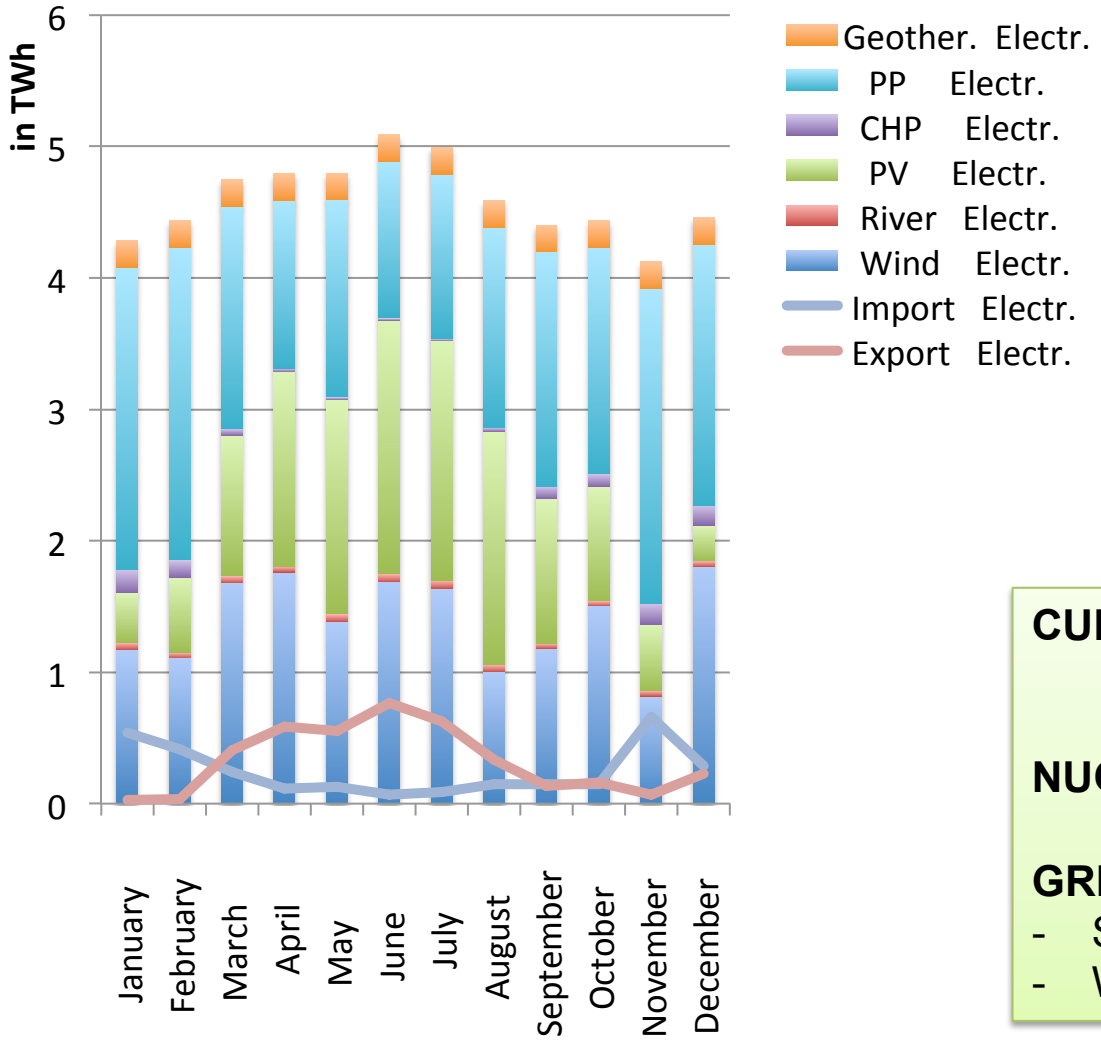
GREEN scenario: Conversion to a PV and wind based system with bioenergy and natural gas for load balancing

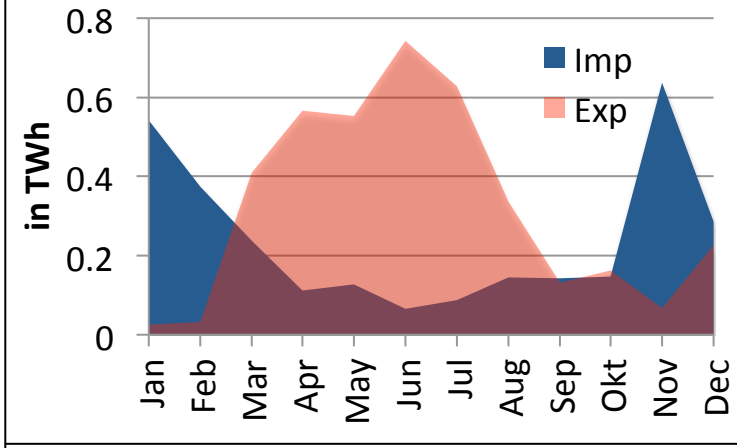
Power plant capacities GREEN scenario



The GREEN Scenario needs a new electricity balancing for surplus in summer and deficit in winter

Electricity generation and electricity import - export





CURRENT: net import ca. **12 TWh** (per year)

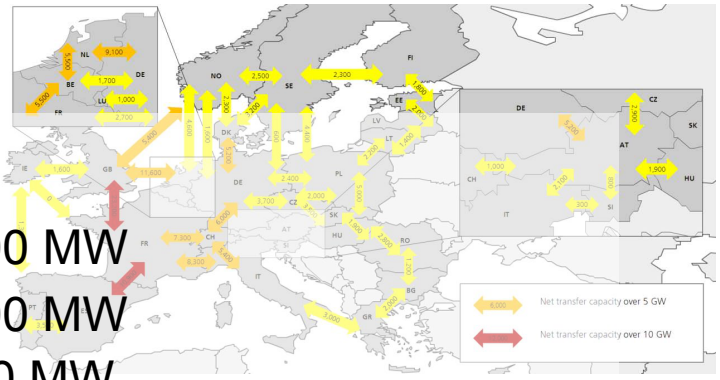
NUCLEAR: net import: ca. **5 TWh** (per year)

GREEN:

- Summer: net export of **2.5 TWh**
- Winter: net import of **1.5 TWh**

GREEN scenario: Regional cooperation for the balancing of capacities in the electricity system

(Estimates)

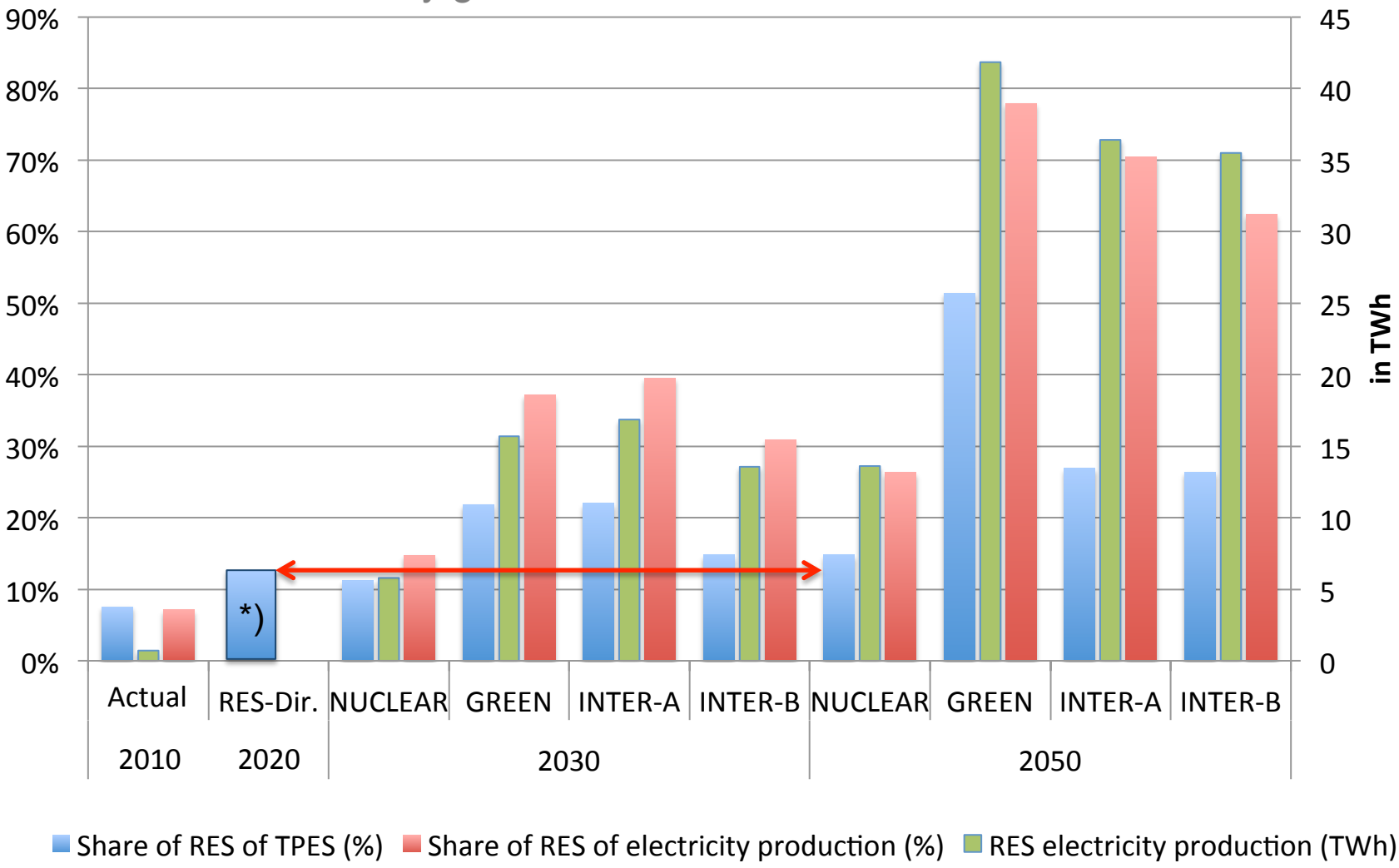


- Possible peak power, not used (summer sunday)
  - Installed PV-power (2050): 12,000 MW
  - PV-Peak (max): 8,200 MW
  - Installed Wind-power (2050): 9,200 MW
  - Combined Peak (est.): 15,000 MW
  - **Maximum residual Load: 12,000 MW**
- Export-grid-capacities
  - ENTSOE (2030): 6,500 MW
  - NTC-Study, ISI (2050) 20,000 MW (mainly North + West)
- Hydro-Power capacities neighbouring c. (NTC-Study 2050 / EREC 2050)
  - Romania 8,100 MW / 9,600 MW
  - SK, SL, HR 5,300 MW / 6,400 MW
  - Austria 10,400 MW / 12,400 MW

COMPARISON OF SCENARIOS

GREEN and INTER scenarios achieve high shares of RES while NUCLEAR has only small improvements over 2020 RES targets

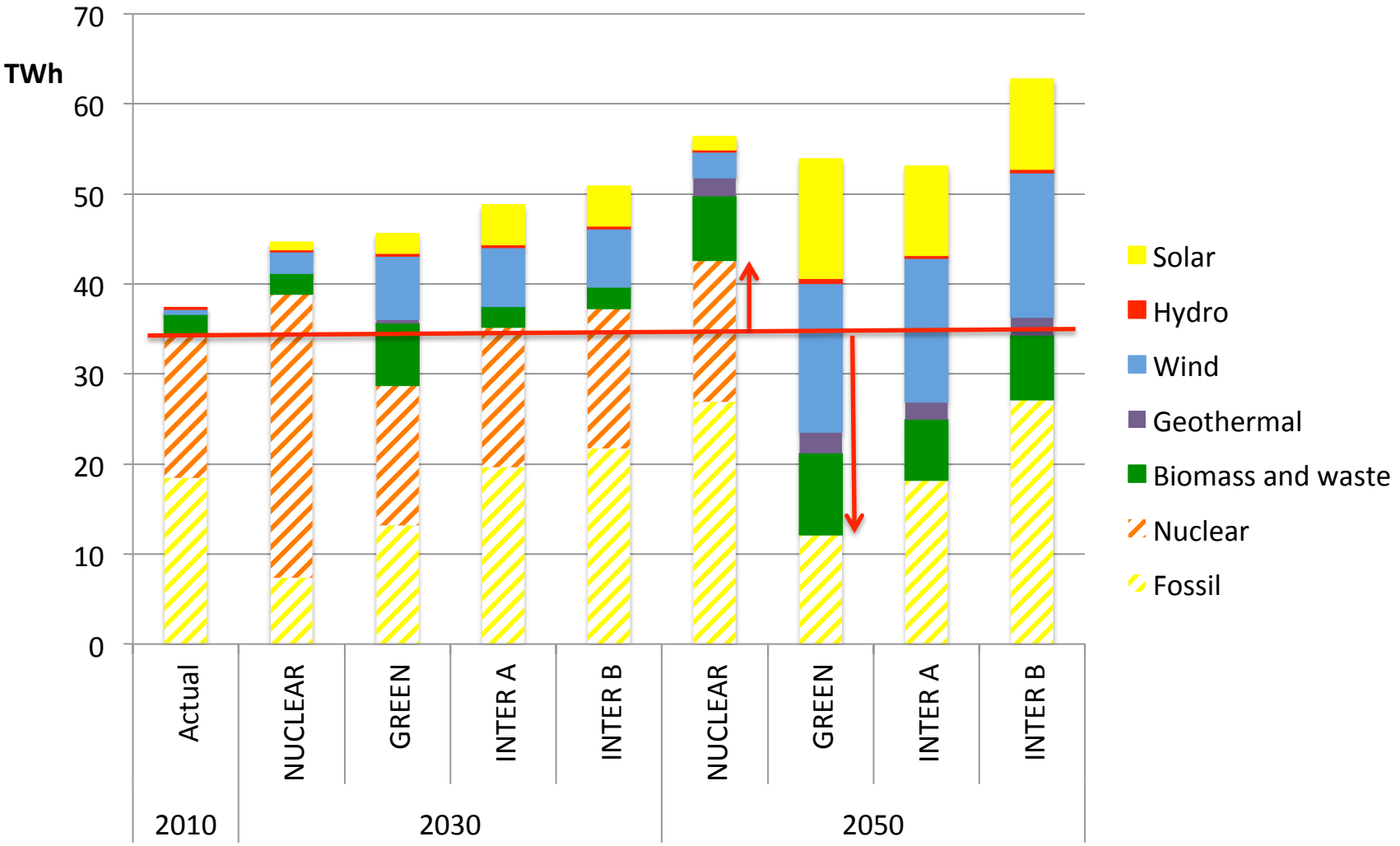
RES-shares in electricity generation and TPES



*) 13% of gross final energy demand (equals roughly TPES)

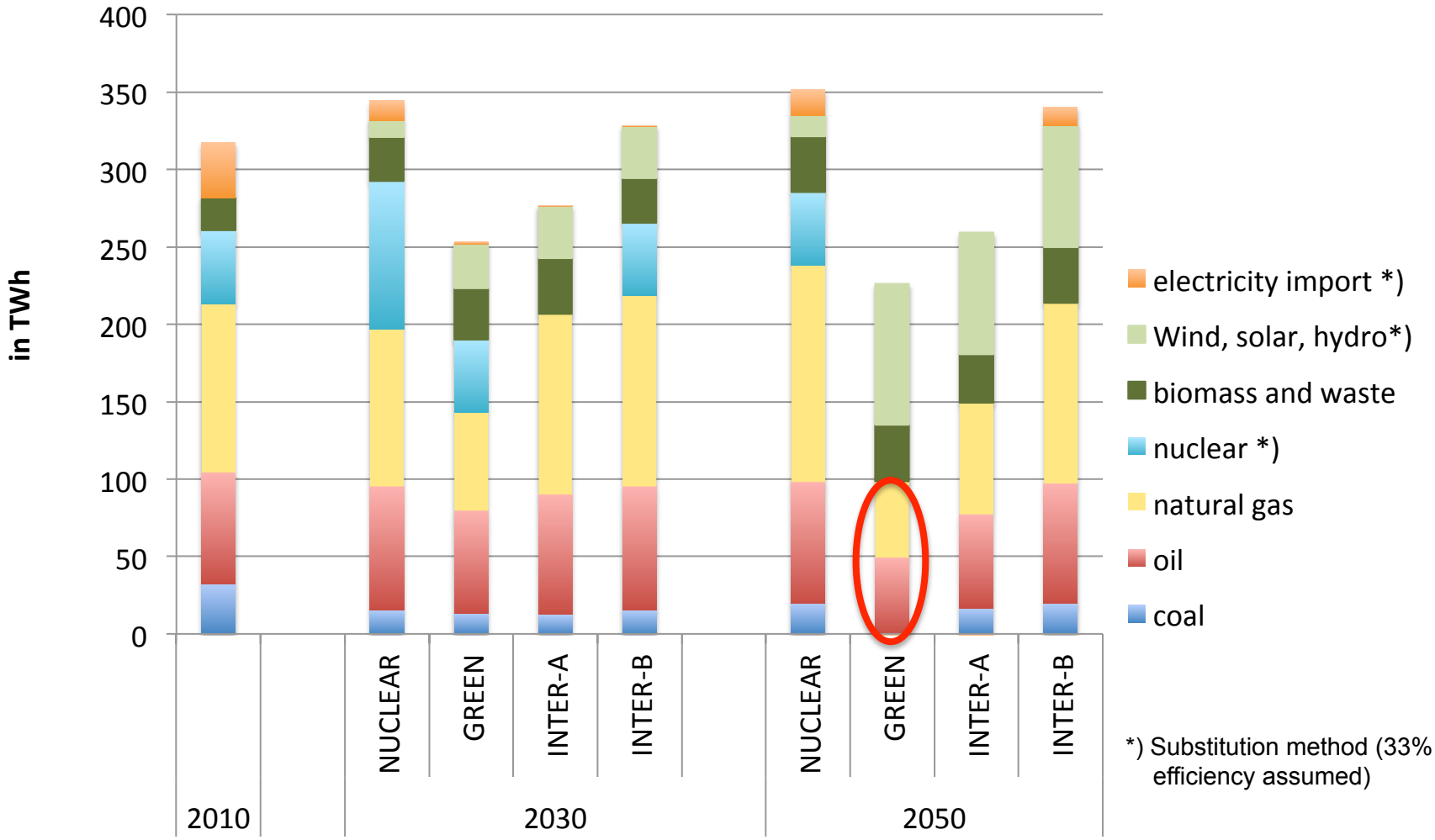
Long term phase out of fossil generation only with GREEN and INTER scenarios

Electricity generation in the different scenarios



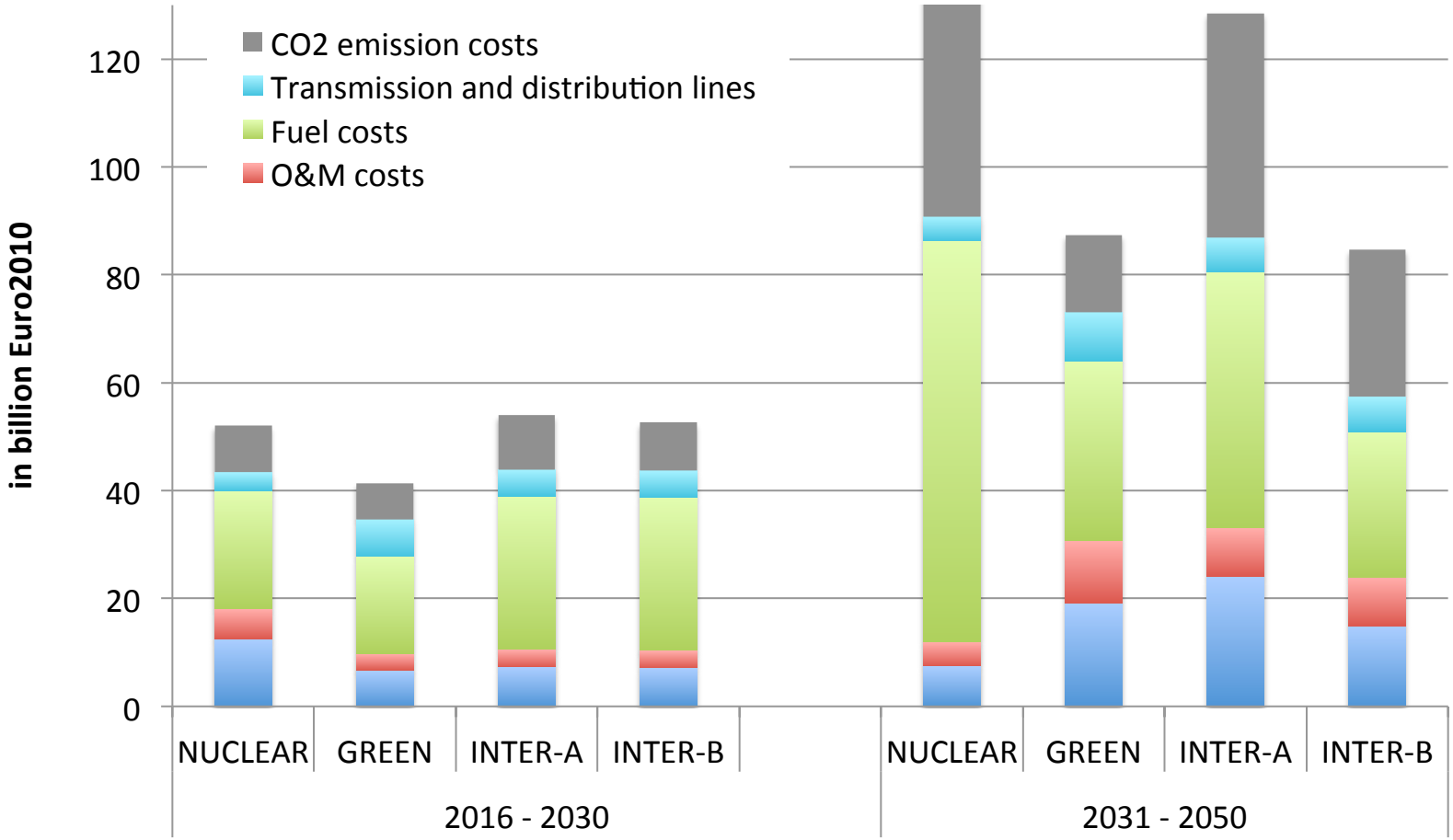
Substantial Reduction of oil and gas dependency only in GREEN scenario

TPES in different scenarios



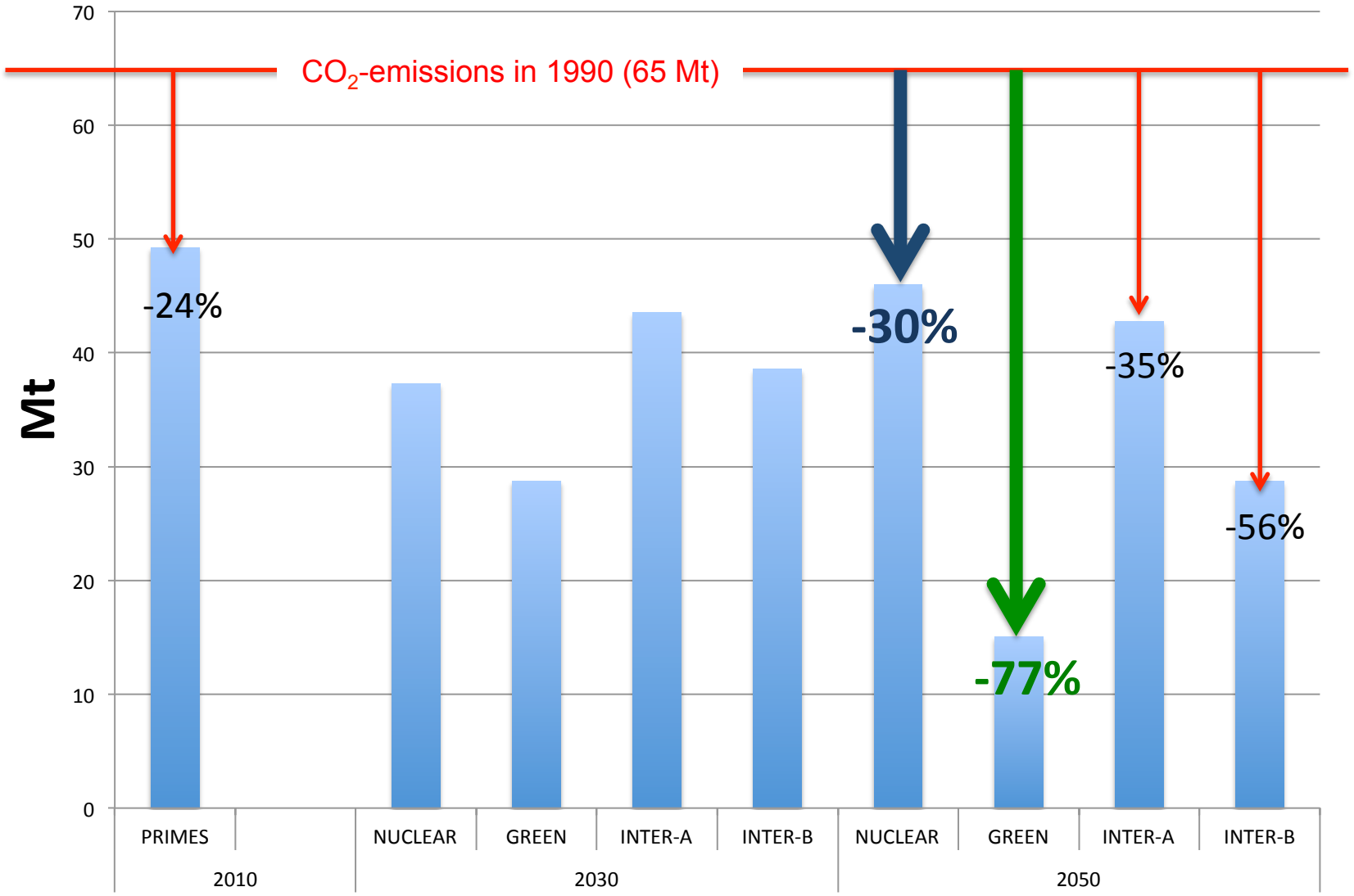
Costs depend on a large number of uncertain future developments **particularly the NUCLEAR scenario is very sensitive on future gas and CO_2-prices**

Total electricity system costs in different scenarios (estimate)



Only the GREEN scenario comes close to international long term GHG emission targets (for 2050)

CO_2 emissions of the scenarios



Conclusion

- **Particularly the GREEN scenario has many advantages over the conventional NUCLEAR (and the other two alternatives)**
  - Higher RES-shares
  - Lower import risks as well as price risks on fossil fuels
  - It could be even cheaper than a nuclear scenario
  - Better distribution of investment with potentially higher and more sustainable job creation
  - Long term significantly lower CO_2 emissions

- **However, the GREEN scenario needs high political efforts and a comprehensive policy program**
  - Support of demand side efficiency as the largest lever to a sustainable energy system → in all sub sectors of the energy system
  - Investment into a renewable electricity system (generation capacities, grid expansion and balancing capacities)

- **The potentials for a more sustainable energy system are definitely there. It would be worthwile to exploit them!**

Thank you!

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