Policy brief: Assessment of the Role and Costs of Energy Grids

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POLICY BRIEF

Assessment of the Role and Costs of Energy Grids

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Key messages

- *Energy efficiency matters, and grid-related results strongly depend on the chosen energy efficiency scenarios in the European Union (EU).*
    - *Regarding the electricity grid, low-voltage distribution networks have to be reinforced to integrate residential low-carbon technologies such as heat pumps (HP) and photovoltaic systems (PV).*
    - *When it comes to thermal grids, the development of district heating, a technology that incorporates energy efficiency and resource synergy principles, can trigger important greenhouse gas emissions reduction.*
    - *The well-developed natural gas grid infrastructure can be used to distribute renewable gas (e.g. biogas, biomethane and hydrogen) and offer storage capacity.*
- *District heating requires an investment of 420 billion € and can unlock the potential of using cheaper heat sources.*
    - *Half of the heat demand (47%) is supplied by district heating in 2050, the remaining half is covered by individual heat pumps.*
    - *Excess heat and low-temperature heat sources such as industrial waste heat, geothermal, solar thermal, large-scale heat pumps and electrolysis, can supply 60% of district heating, while the remaining 40% is produced with CHP, waste incineration and boilers.*
    - *8,700 new district heating systems are needed by 2030 and more than 20,000 by 2050.*

Key findings and key recommendations

WP4 studies the transformation of energy grids of the EU in the frame of the energy transition. Three energy grid types are considered: electricity, thermal, and gas grids.

Regarding the **electricity** grids, a techno-economic methodology is developed to **estimate the low voltage grids reinforcement cost as a function of the residential low carbon technologies** (i.e., HP, PV) integration and dwelling insulation level scenarios in EU 27 countries + the UK. The key findings indicate that the increase of HP integration rates always tends to increase the grid reinforcement cost, whereas this is not the case with PV. In most cases, the grid reinforcement cost due to the low carbon technologies integration tends to decrease with the improvements of dwelling insulation levels. In general, with the improvement of dwelling insulation, the impact of HP integration on the grid reinforcement cost reduces faster than that of PV integration on the cost. Furthermore, the rural grids usually need more reinforcement costs than the urban grids in the same country group. The grid reinforcement cost per dwelling ranges from 60 to 450 € for the EU grids. Policymakers and distributed system operators should be aware of the costs of reinforcing the low-voltage grids due to the penetration of residential low-carbon technologies to make a better strategy for deploying these technologies in the EU.

For **thermal** grids, the **mapping of current and future heat demands and potentials of district heating** to EU27+UK is applied and extended. The representative thermal grids are studied, and **country-specific costs are included to identify district heating suitability across Europe**. At last, the **potential district heating by extent and cost is mapped, and excess heat and renewable energy potentials are allocated using online mapping**. The key findings indicate that the total marginal capital cost levels, thus representing investments both in distribution and service pipes, increase from a test reference case resembling the current year (2015) by approximately 40% by 2030 (from some 11.1 to 15.5 €/GJ) and by roughly 73% by 2050 (from 11.1 to 19.2 €/GJ). This general circumstance suggests a "window of opportunity" for investments in district heating systems in the EU in the coming 10-year period, a window that appears to begin closing during the years leading up to 2015. Although the general trend indicates relatively higher cost levels for district heating in

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the coming years, rich opportunities for network heat distribution are expected to prevail in highly dense inner-city districts, especially in larger coherent metropolitan areas. Two counteracting main trends, that of urbanisation and population growth on the one hand, and that of energy-saving measures in buildings on the other resulting in some cases in a remarkable status quo concerning heat demand densities in the modelled future year settings.

For **gas** grids, the **techno-economic data on existing European natural gas, biogas, biomethane, syngas, and hydrogen infrastructures** is presented. The potential to use the existing natural gas grids for biogas, biomethane, syngas, and hydrogen is also analysed. The key findings indicate that the natural gas infrastructure is well developed and interconnected and provides Europe with around 1,500 TWh of cross-Assessment of the role and costs of energy grids seasonal flexibility. Although it is expected that the existing grid can cope with the future gas demands, new deployments, retrofitting, or reinforcements may be required in some areas. So far, the greening of the gas system, based on biogas and biomethane, has proceeded to a share of about 4%. Green hydrogen from renewable sources such as renewable electricity (via electrolysis) or from biomass (via gasification) is also currently produced in small volumes. The production of renewable and its use should be promoted, which can significantly contribute to the reduction of greenhouse gas emissions.

The relevant **cost maps for different types of grids in the EU** can be accessed through the web map (https://s-eenergies-open-data-euf.hub.arcgis.com/)

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