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FORECAST
FORecasting Energy Consumption Analysis and Simulation Tool

eLOAD
energy LOad curve ADjustment tool

Analysis of GB's future electricity demand: challenging National Grid's estimates

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1. Introduction

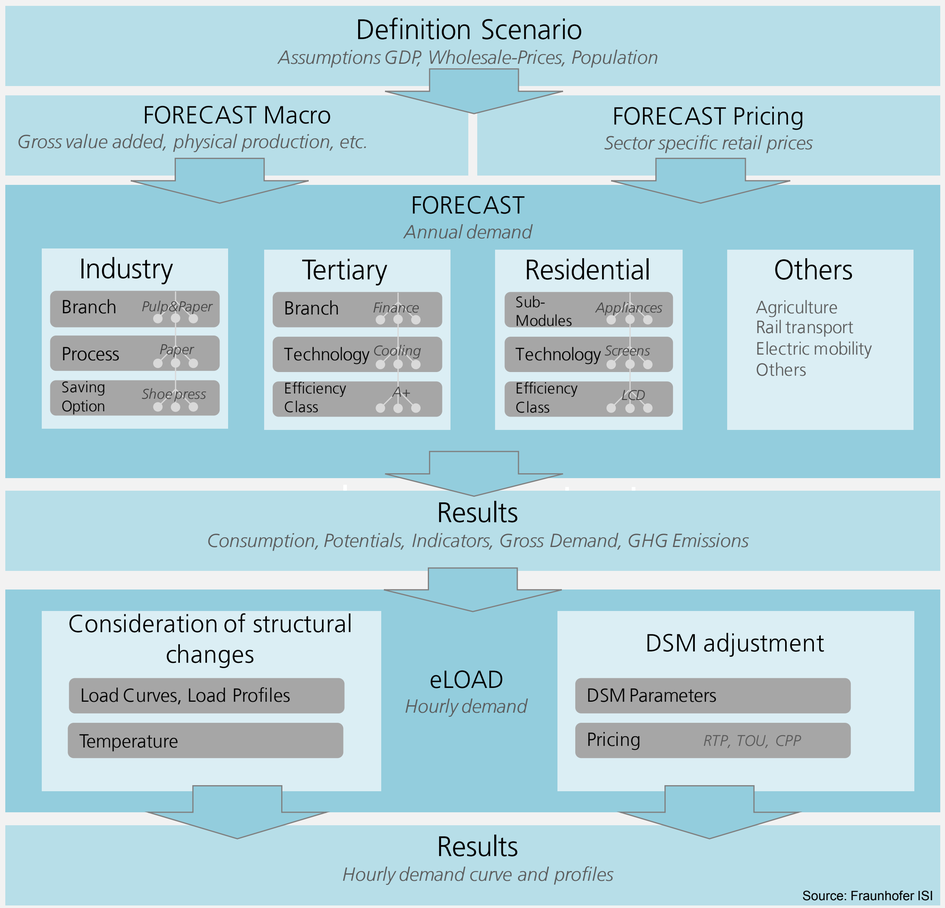
Long-term projections of electricity demand and peak load represent a major prerequisite for planning future electricity systems. **National Grid** (NG) as the UK's major transmission system operator annually publishes the **"Future Energy Scenarios"**, an estimate of Great Britain's demand evolution until **2035**. The residential sector is modelled based on a detailed bottom-up approach whereas the residual electricity demand is represented in a more aggregated manner. This study uses data published by NG for a sector overarching bottom-up analysis to benchmark our outcomes with those of NG's **Consumer Power** scenario.

2. Methodology

The used modelling platform consists of the models FORECAST and eLOAD.

FORECAST estimates the **long-term** evolution of **annual energy demand** in individual countries. It is based on a bottom-up modelling approach which considers the dynamics of **technologies** and **socio-economic drivers**, distinguished by the individual demand sectors on a high level of granularity. FORECAST considers factors with a **short-term influence** like the weather and the current economic situation as well as those with a more **long-term influenc**e like socio-economic trends, technology change and energy efficiency policies. The projections of final energy demand can be evaluated for individual energy carriers, for example electricity, gas, heating oil, solar or biomass.

FORECAST/eLOAD model structure



Source: Fraunhofer ISI

eLOAD estimates the long-term evolution of national **electricity system load curves** through structural changes on the demand side and the introduction of new appliances (e.g. electric vehicles). It builds upon a database comprising more than 1,000 end use specific hourly **load profiles**. Further, eLOAD simulates national **demand response** programs that aim for peak load shaving and the integration of renewables. By means of mixed-integer linear programming, it determines the **least-cost load scheduling** of the individual end uses, considering technical, economic and organizational constraints. The wholesale price at the spot market or a time-varying retail tariff serve as an hourly price signal.

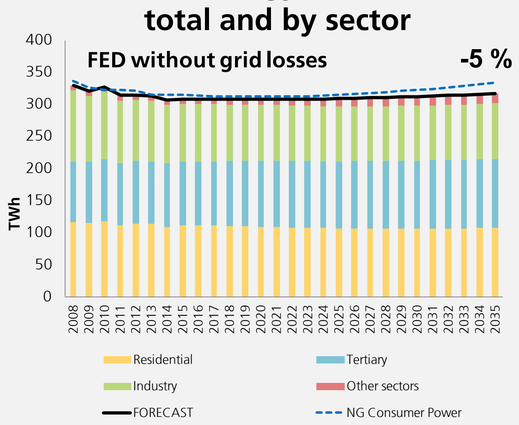
3. Selected Results

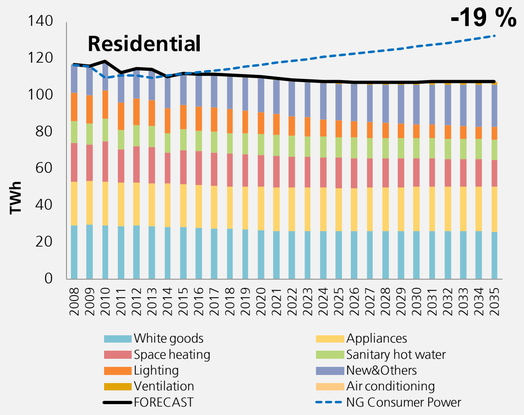
FORECAST bottom-up annual **final energy demand** projections are only **-5 %** lower in **2035** than National Grid projections.

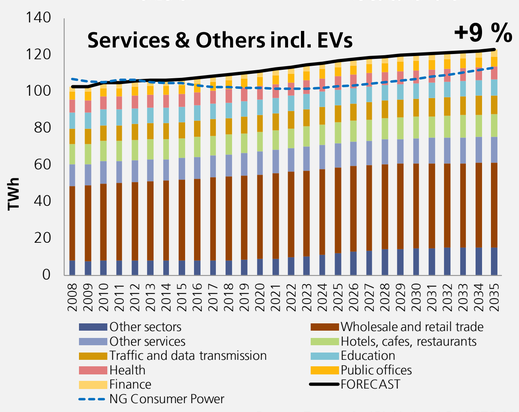
Major structural differences:

- **Stagnating** electricity demand in the **residential sector**
- Stronger **increase** in the **service and others sector**
- Similar results for industrial demand

Final energy demand: total and by sector







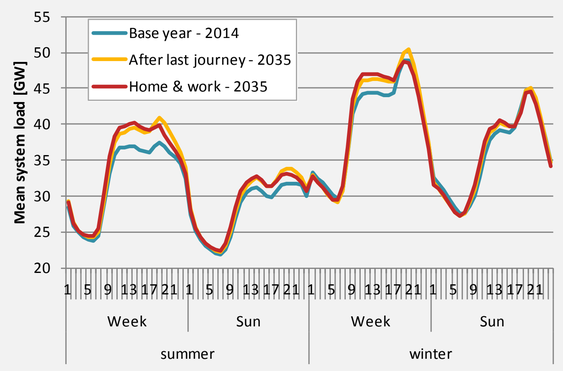
Source: Fraunhofer ISI, National Grid FES 2015

FORECAST results & statistics show a **structural break** of electricity demand **since 2005** in the **residential** sector, which has been caused by a **decoupling** of activity drivers (pop, hh) and electricity demand (e.g. **more ambitious autonomous efficiency** improvement ; recent past: ecodesign directive, lighting).

System load curve:

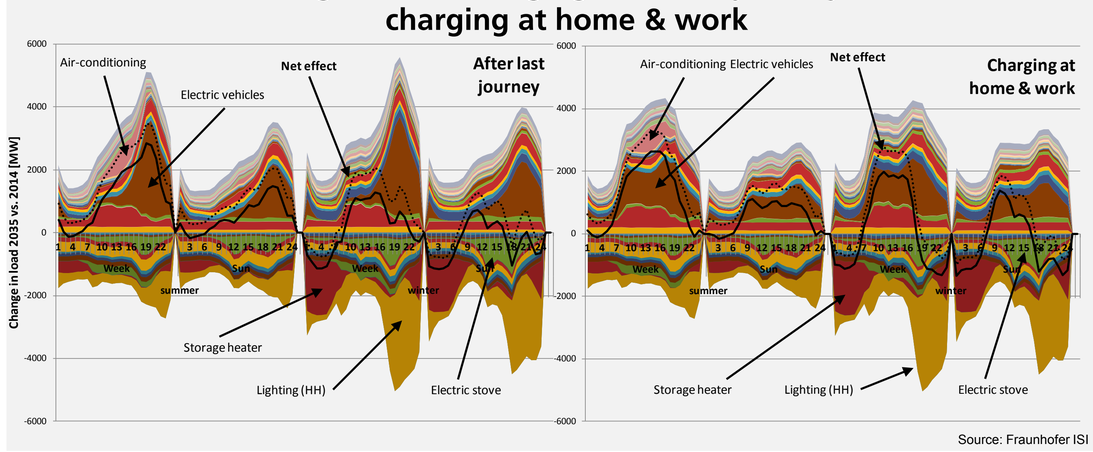
- Overall load shape **similar** to NG
- **More balanced load profile** from home & work charging => morning load level higher
- When charging after last journey peak load in 2035 is 54 GW (compared to 65 NG incl. losses)
- **Dampening of energy efficiency** on the load level partially compensates the additional increase from e-mobility

Mean system load curve



Source: Fraunhofer ISI

Change in load charging after last journey vs. charging at home & work



Source: Fraunhofer ISI

4. Conclusion

We explain the differences in results by five major reasons: The **impact of GDP** on demand depends on the **repartition across** the commercial and industry **sectors**. The **bottom-up methodology** we apply allows for a **technology specific assessment** (e.g. in industry). The dissemination of **new appliances** (e.g. in the residential sector) underlies substantial **uncertainty**. Assumptions on selected framework parameters are difficult to harmonise and thus imply diverging results. The resulting **hourly load** diverges due to the **unequal sector composition** of overall demand.

Potential complementary assessments:

- Constructing internally consistent scenarios of energy demand development in the EU and selected European countries up to 2050
- Analyses of individual energy carriers or sectors (e.g. heating demand)
- Constructing scenarios to explore individual factors of influence (e.g. stronger energy efficiency policies, changed energy prices)
- Assessment of application-specific load management potentials under different framework conditions
- Analyses of the effects of different tariff mechanisms on consumers' load management
- Investigations of long-term effects (up to 2050) of load management on the system load & integration of renewable energies
- Provision of hourly system load time series which have been adjusted for load management (input for electricity market models)

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