SRG

STAKEHOLDER REFERENCE GROUP

FOR THE TYNDP SCENARIOS

ENHANCING TRANSPARENCY IN DEMAND MODELING: LESSONS FROM THE CLEVER SCENARIO FOR TYNDP

This document builds on insights from a workshop organized by the SRG Working Group 2 on demand modelling, where the negaWatt team presented their approach with CLEVER scenario. The discussion highlighted that negaWatt provides exemplary transparency in documenting its demand modelling methodology and underlying assumptions—an aspect from which the TYNDP scenarios could draw valuable inspiration. The following sections compare **how demand modelling assumptions are presented** in the TYNDP and CLEVER scenarios across the three main demand sectors—industry, residential, and transport—and illustrate how the TYNDP's documentation could further evolve to enhance clarity and traceability. For the full details, Negawatt's documentation on industry, residential and transport sectors should be referred.

INDUSTRIAL SECTOR DEMAND FORECAST

In the TYNDP scenario study, industrial demand projections are developed using the ETM (Energy Transition Model). The ETM shows how industrial production evolves over time, together with shifts in technology and fuel use.

For example, in the steel sector, production today is set at 100% and projected to reach x% in 2040. The current technology mix (about 70% blast furnace and 30% electric arc furnace)

evolves towards a broader combination of low-carbon options by 2040. At a second level, the ETM provides the corresponding fuel shares, such as coal, coal gas, electricity, network gas, and hydrogen.

However, the ETM and TYNDP reports do not clarify the assumptions behind industrial growth or decline, nor the sources or rationale for technology shares. It remains unclear whether these projections are policy-based, scenario-driven, or expert-defined.

In the next section, we describe how Negawatt has documented its industrial demand projection assumptions.

Negawatt's approach

Negawatt applies a top-down modelling approach, defining energy consumption corridors (numerical ranges) and technology share corridors for all industrial sectors. The study transparently reviews major European, French, and German modelling exercises (Fig. 2) to establish these ranges based on technical feasibility.

The energy consumption corridors (Fig. 1) combine two elements: production levels, influenced by sufficiency and circularity, and energy intensity, influenced by circularity and efficiency. Negawatt argues that energy savings in industry can be achieved by integrating sufficiency, circularity, and efficiency measures, thereby reducing both production needs and energy intensity.

Industrial sector	Production *(index 2015: % of the 2015 value in 2050)* Based on sufficiency and circularity assumptions	Energy intensity *(MWh/kt)* Based on circularity and efficiency assumptions	Final energy consumption *(index 2015: % of the 2015 value in 2050)*
Cement	52 – 99	560 – 800	31-64
Steel	74 – 92	2060* – 2690*	42*-52*
Pulp & paper	58 – 110	1890* – 3780*	31*-64*
Chemicals (aggregated value for simplified approach)			70 – 75
Chemicals – Ammonia (detailed approach)	58 – 80	1580 – 2500	
Chemicals – HVC (detailed approach)	59 – 98	3140 – 5680	
Chemicals – Others (detailed approach)			69- 89
Glass	61 – 95	700 –2190	23 –68
Food			42 – 64
Non-ferrous metals			39 – 87
Others			63 – 85

Fig 1: Energy consumption corridor

Organism	Name and link of the scenario	Scale	Reference used
EU Calculator	Module on industry: key behaviours pathway	Europe	EUCALC
Climact, ECF, ClimateWorks	EU CTI 2050 Shared effort scenario	Europe	EU CTI 2050
Fraunhofer ISI, ICF	Pathways to deep decarbonisation of Industry	Europe	FhISI
Material Economics	Industrial Transformation 2050	Europe	Material Economics
negaWatt association	negaWatt 2022 scenario	France	negaWatt
ReINVENT Decarbonisation	Climate innovation in the climate industry: demand scenario	Germany	ReINVENT
Umwelt Bundesamt	Resource-Efficient Pathways towards Greenhouse-Gas-Neutrality (RESCUE)	Germany	RESCUE

Fig 2: Scenarios used by Negawatt's CLEVER scenario study to define the corridors

For technology share corridors, seven scenarios were assessed and tested for robustness using parameters such as technology readiness, share of high-temperature processes, electrification potential, and biomass availability (Fig. 3)

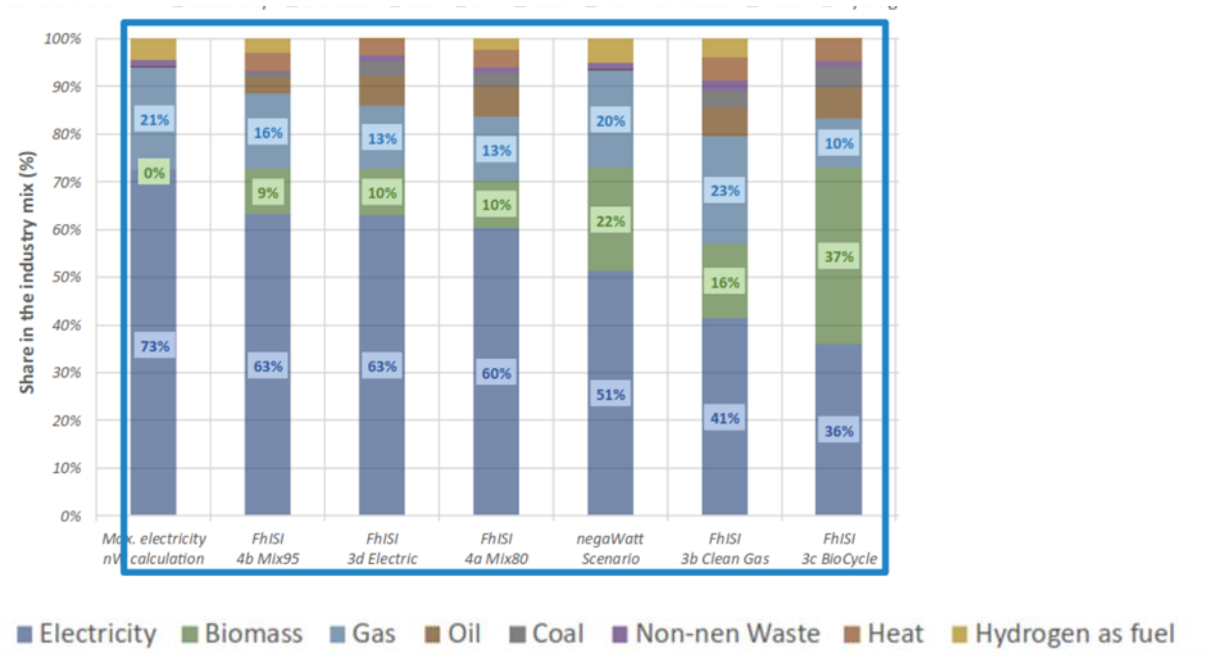

Fig3: Scenarios used to define technology share corridors

Finally, Negawatt outlines the policy frameworks and technical assumptions underpinning each sector, providing transparent documentation of how industrial demand projections were derived — an aspect largely missing in the TYNDP.

RESIDENTIAL SECTOR DEMAND FORECAST

In the TYNDP scenario study, residential demand projections are developed through the ETM (Energy Transition Model). The model breaks down total energy demand into components such as space heating, cooling, hot water, and specific electricity use.

For space heating, demand is derived from the type of housing stock, expected efficiency improvements, and heating system types (including fuels used for hot water). Cooling demand is based on the development of cooling technologies. Specific electricity demand is detailed across cooking, appliance efficiency, and lighting types. In addition, behavioral aspects such as changes in temperature settings or conscious energy savings are included.

While this provides a structured view of total annual energy demand, the methodology behind individual component forecasts is not clearly documented. Moreover, although hourly demand profiles are derived from annual figures and technology mixes, the assumptions used remain opaque.

Negawatt's approach

Negawatt applies a transparent, multi-step approach to forecasting residential energy demand, dividing it into key components:

- Space heating and cooling demand – based on floor area and renovation level (building heat loss)
- Hot water demand
- Specific electricity demand
- Efficiency and market share of heating system types

Each component is developed through several steps:

1. Analysis of historical and current data by country.
2. Exploration of possible future developments using external studies and scenario analysis.
3. Definition of corridors of development (ranges) reflecting technical and policy feasibility.
4. Expert consultation within each country to validate assumptions.
5. Identification of supporting policies and measures to stay within the defined corridors.
6. Aggregation of component results into an annual demand corridor.

Learnings to improve TYNDP modelling

1. **Transparency:** Negawatt's documentation of assumptions and data sources is far clearer than the ETM approach, where components of demand building are given, but actual values sources are not explained and cross-checkable and demand projection development methodology is not explained. Cross-comparing component results with other studies would strengthen the TYNDP's credibility.
2. **Methodological approach:** It remains unclear whether the TYNDP's "building type" approach or a "living space" approach to heat demand provides greater flexibility for long-term projections. A comparative assessment would be valuable.

3. **Detail vs. uncertainty:** While the TYNDP's detailed treatment of appliance electricity use reflects Ecodesign policies, such granularity may offer limited value given unpredictable future changes in household electricity use from digitalization, IT, and AI technologies.

TRANSPORT SECTOR DEMAND FORECAST

The TYNDP scenarios currently do not provide detailed transparency on how key transport demand indicators—such as future passenger kilometers, modal shares, or public transport shares—are derived. In contrast, the CLEVER scenario, developed by the negaWatt Association, presents a transparent and well-documented approach that establishes a clear methodological framework and harmonized convergence corridors for each mobility indicator. In the CLEVER scenario, transport demand (expressed in passenger-kilometers) was projected based on a careful assessment of multiple stakeholder scenarios and seven key indicators: distance travelled per capita, air distance travelled per capita, active mobility share, collective transport share, car occupancy, car motorization share, and car efficiency. The planned consumption corridor for each of these indicators is shown in Figure 4. This structured and traceable methodology offers valuable lessons for improving transparency, consistency, and credibility in the TYNDP's future scenario documentation.

Indicator	Definition	Unit	Planned consumption corridor
Distance travelled per capita	Number of passenger-kilometres travelled per person and per year within the national territory. Excluding: Aviation, active mobility.	pkm/cap/year	**9500-13500 pkm/cap/year**
Air distance travelled per capita	Total annual air traffic per capita.	pkm/cap/year	Domestic flights: **0 pkm/cap/year** International flights: **600-1500 pkm/cap/year**
Active mobility share	Share of active mobility (walk and bike) in total passenger mobility. Excluding: Aviation	%	**7%-15%** of total passenger mobility
Collective transport share	Share of collective transport in total passenger mobility. Excluding: Aviation, active mobility.	%	**15%-40%** of total passenger mobility
Car occupancy	Average number of passengers per car while travelling.	person/car	**1.8 to 2.3 person/car**
Car motorisation share	Share of car traffic by motorisation	%	**95-100% full electric car** **0-5% fuel-cell car**
Car efficiency	Energy efficiency of new cars assessed through the energy consumption per unit of distance travelled.	l/100km or kWh/100km	Per type of fuels: • **Liquid fuel: 0,43 kWh/km** reached in 2035 (banned thereafter) • **Electricity: 0,13 kWh/km** reached in 2045 • **Fuel-cell: 0,22 kWh/km** reached in 2045

Fig 4: Proposed Corridors for indicators deciding the mobilty demand in CLEVER scenarios

1. Distance travelled per capita

Defined as total annual passenger-kilometers (excluding aviation and active modes) per person, CLEVER used historical Odyssee data (2000–2018) and found convergence among EU countries, with higher-mobility nations stabilizing and lower-mobility ones catching up. Correlations with GDP per capita and teleworking potential guided assumptions. Future demand was benchmarked against national and EU scenarios (negaWatt, RESCUE, CACTUS, EUCALC), resulting in a 2040–2050 convergence corridor of 9,500–13,500 pkm/cap. This assumes reductions in work-related travel via teleworking and moderation of leisure travel growth.

2. Air distance travelled per capita

Including domestic, intra-EU, and extra-EU flights, this indicator was informed by ICAO (2019) and national data, adjusted for hub-related biases. CLEVER highlighted income-driven disparities and assumed that reductions would depend on rail alternatives ('no train, no plane'). It proposed 0 pkm/cap for domestic flights and 600–1,500 pkm/cap for international flights by 2040, requiring strict regulation, flight levies, and modal shifts to rail.

3. Active mobility share

Covering walking and cycling, this indicator was assessed using Eurostat, ECF, and CACTUS data. CLEVER set an ambition corridor of 7–15% of total active passenger mobility by 2035, supported by evidence from high-performing cities like Copenhagen. The scenario assumes rapid infrastructure deployment, new e-mobility options, and strong policy support to normalize active mobility.

4. Collective transport share

Measured as the share of land passenger mobility via public transport, CLEVER based its assessment on Eurostat and Odyssee modal data. With national variation around an 18% average, the final convergence corridor of 15–40% depends on public transport affordability, infrastructure expansion, and service integration across regions.

5. Car occupancy

Derived from EUCALC (TRACCS) and national surveys, CLEVER harmonized the EU average of 1.0–2.1 passengers/car toward a 2050 target corridor of 1.8–2.3 passengers/car. Policy levers include car-sharing, car-pooling incentives, and infrastructure redesign (e.g., HOV lanes).

6. Car motorisation share

Representing the share of car traffic by energy carrier, CLEVER aligned divergent national assumptions to a 95–100% full-electric target by 2050, allowing up to 5% hydrogen. It balanced resource constraints with EU policies such as the 2035 combustion engine phase-out, ensuring coherence with long-term renewable energy goals.

7. Car efficiency

Based on Odyssee and EUCALC data, CLEVER adopted efficiency targets of 0.13 kWh/km for electric, 0.22 kWh/km for hydrogen, and 0.43 kWh/km for liquid fuels (phased out by 2035). These align with technology maturity trajectories and the project's 100% renewable energy vision.

The CLEVER scenario's transparent documentation—detailing assumptions, data sources, and socio-behavioral drivers—offers a replicable model for TYNDP's future scenario development. Adopting similar openness around demand assumptions would enable stakeholders to better assess feasibility, equity, and sufficiency in transport decarbonization pathways.

SUMMARY OF RECOMMENDATIONS

Though CLEVER scenario prepared by negaWatt and international team shows alternative approach to individual sectors modelling that can be considered in future TYNDP demand model development, the intention of this document is to show a good approach to **documentation and transparency of modelling** that can be applied in the TYNDP demand model development.

⇒ Recommendation 1: Each modelling step for both the reference demand and the projected demand is described and documented as comprehensively as possible, including all input data and parameter selections. All sources should be appropriately and accurately referenced.

⇒ Recommendation 2: Where feasible, assumptions and results are cross-checked against available publications and models, and the corresponding documentation is provided to ensure full transparency.

Note:

- The SRG members voted on two recommendations derived from the findings summarized in this document.
- The voting period was open from December 5 to December 19, 2025, during which the 26 SRG members were invited to vote separately on each recommendation.
- Both recommendations were approved, with 19 members voting in favor of each recommendation and one member formally abstaining.