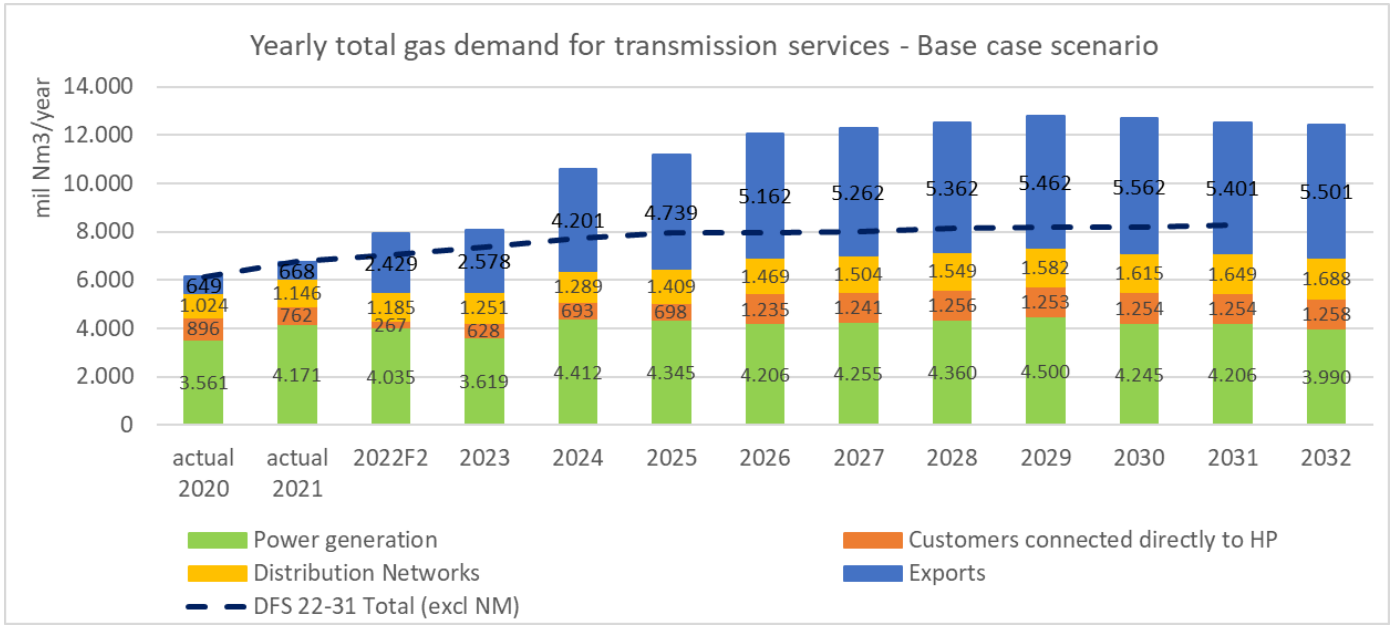
Demand Forecast Study 2023-2032

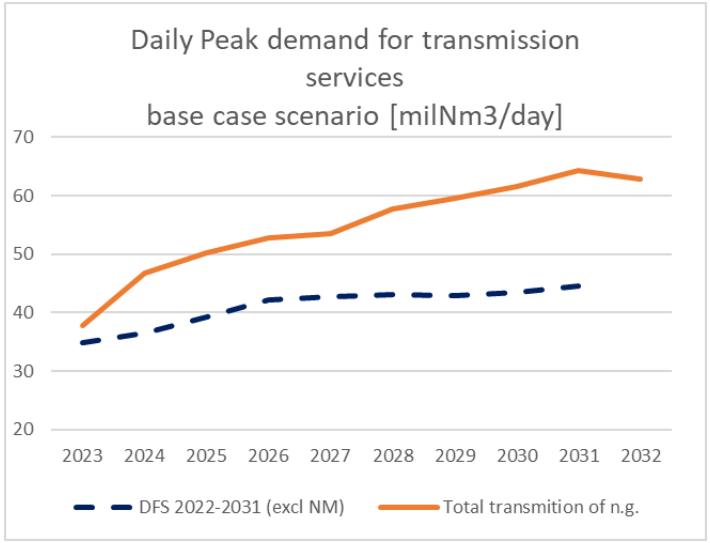
September 2022

Executive Summary I/II

OVERVIEW

- Demand Forecast Study 2023-2032 (DFS 2023-2032) foresees an overall increase in the quantity of gas transmitted through the δesfa system in the reference period, compared to the previous study. This is because the foreseen decrease in gas demand compared to previous DFS (primarily in the power generation and secondarily in the industrial sector) will be more than offset by a foreseen increase in gas exports
- Daily peak demand is expected to increase substantially throughout the reference period, this increase mainly attributed to the demand for power generation and for exports
- The extraordinary market conditions under which the study is carried out and the increased uncertainty regarding gas demand in the forthcoming years -especially in the power generation sector that represents 65-70% of the domestic quantities- is reflected in the increased spread between the foreseen demand in the high and low scenarios, compared to previous DFS studies



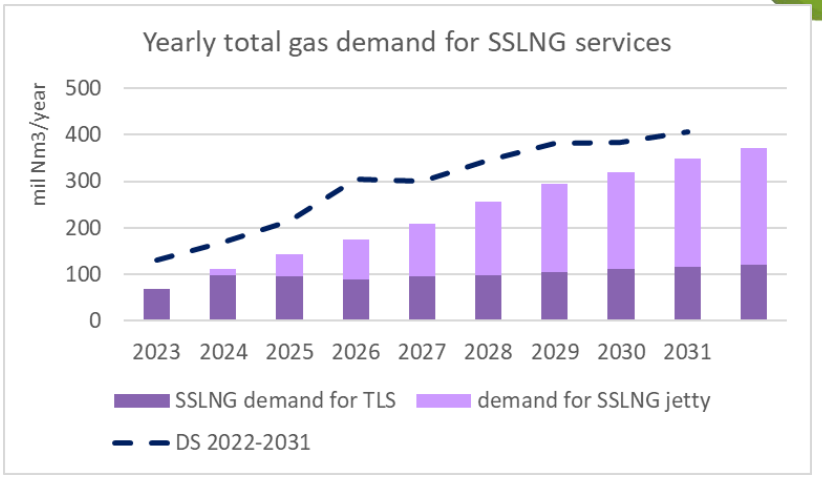


Note: This study is not based on hydraulic simulations

Executive Summary II/II

DOMESTIC DEMAND

- Gas demand for **Power Production** varies throughout the period from 3,6 to 4,5 bcm. Due to the extraordinary conditions, a delay in the lignite units decommissioning date is considered compared to previous DFS. The delayed delignitisation plan along with the high RES penetration rate results to a notable decrease in the forecasted demand for power generation
- Gas demand in the **Distribution Networks** is expected to grow from 1,2bcm @2023 to 1,7bcm @2032 (+40%)
- Gas demand for **Consumers directly connected to the HP network** is expected to overcome the sharp decline realized this year. Assuming that prices and market will be more stabilized from 2026 onwards, the expected growth foreseen is from 0,68bcm @2022 to 1,25bcm @2032 (≈100%)

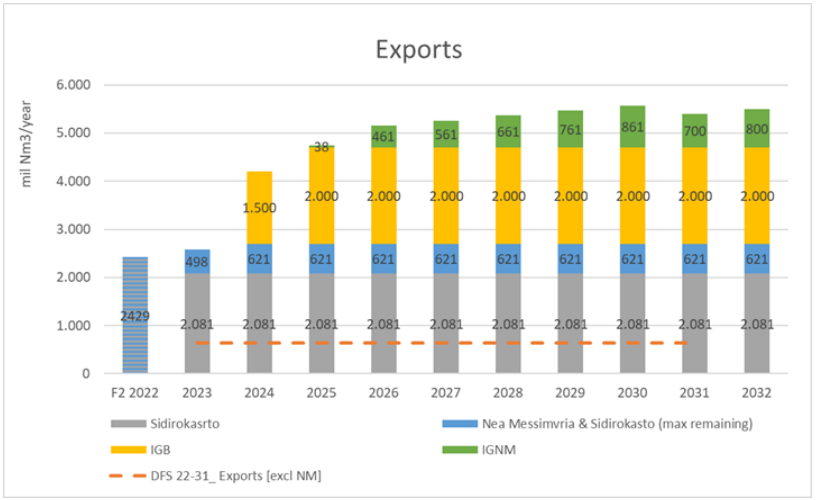


SSLNG

- SSLNG services demand is expected to begin with a level of 70 mil Nm3 in year 2023 up to 372 mil Nm3 in year 2032, where both TLS and SSLNG jetty will be operational

TRANSIT

- A significant increase in exports reflecting the impact of Russia's invasion of Ukraine is foreseen for the first years of the reference period. The exporting potential is calculated for the rest of the period reflecting the EU target on reducing dependency on Russian gas
- Transit flows through the new exit points Komotini (IGB) and Evzoni (IGNM) are foreseen within the reference period of the study



1. Gas demand forecast for Power Generation

Methodology / Scenario Building

- Gas demand forecast for power generation is based on the simulation of the Greek power market for the period 2023-2032
- The scenario building process for the power market simulation takes into consideration all available information at a certain cut-off time (March 2022). The simulation is performed by Global Consulting Services (GCS), in close cooperation with DESFA

Different simulation scenarios (a "Scenario Matrix", as shown below) are developed by **a combination of the following parameters**, the values of which are presented in detail in the following slides:

- System Load
- RES share in system load
- Gas prices
- CO2 prices
- Withdrawal plan of lignite-fired power plants

2 values (Base value/High value) are considered for each parameter, in order to formulate the different scenarios of gas demand for power generation

- New gas-fired power plants
- Interconnection with neighboring countries
- Interconnection dates of the islands

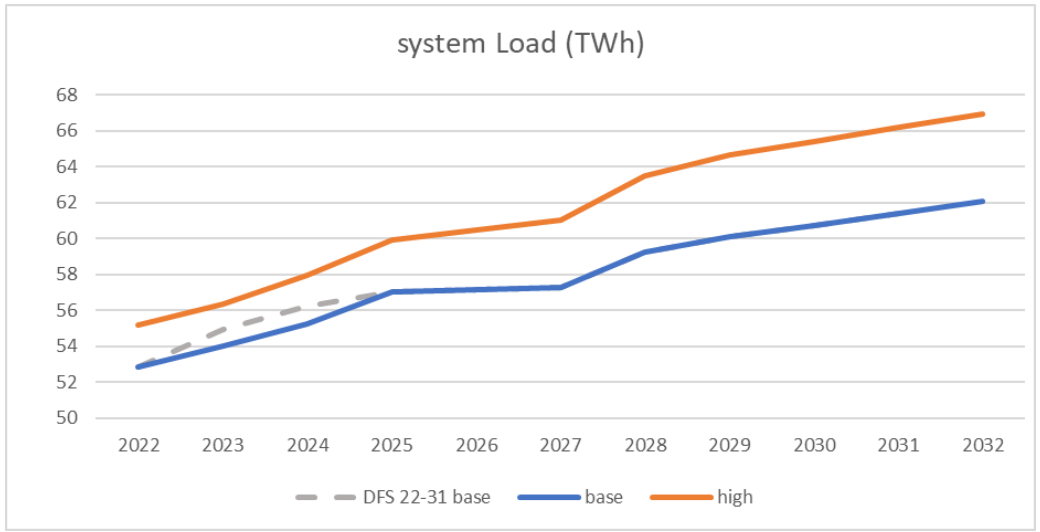
one single value is considered for each parameter across all scenarios of gas demand for power generation

Scenario Matrix

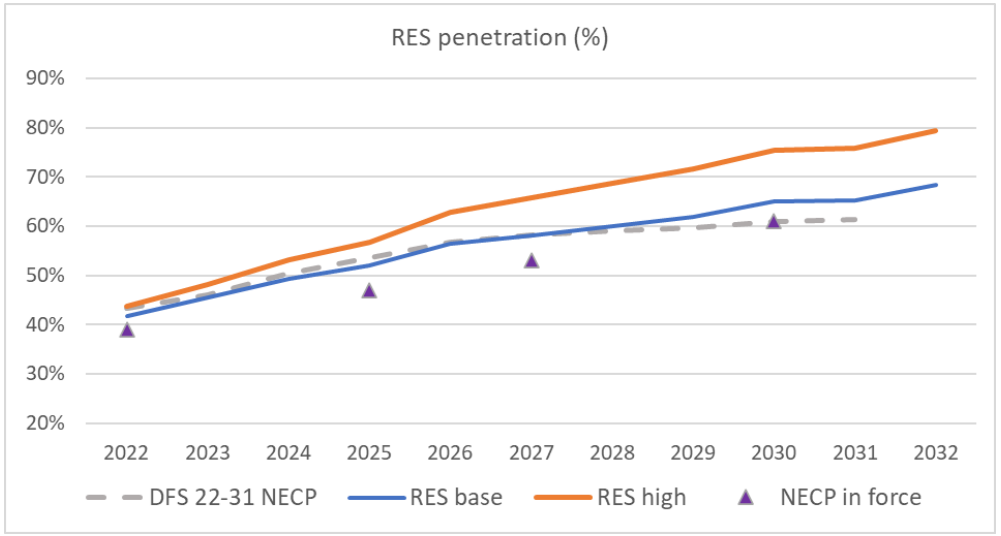
Scenario name	System load	Gas price	CO2 price	RES %	Lignite units decommissioning
Base case	High value*	Base value	Base value	Base value	Mid
Low gas demand	Base value*	High value	Base value	High value	Late
High gas demand	High value*	Base value	High value	Base value	Early

*Base value corresponds to IPTO NECP (NECP,2019) and High value corresponds to IPTO high scenarios. Both load scenarios are developed by IPTO (ADMIE)

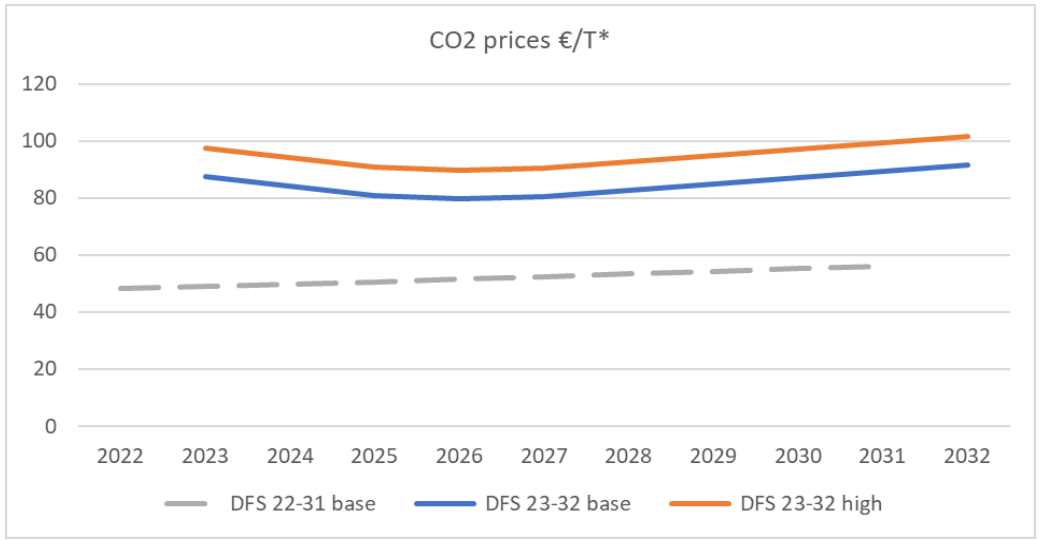
Parameter values (I/II)



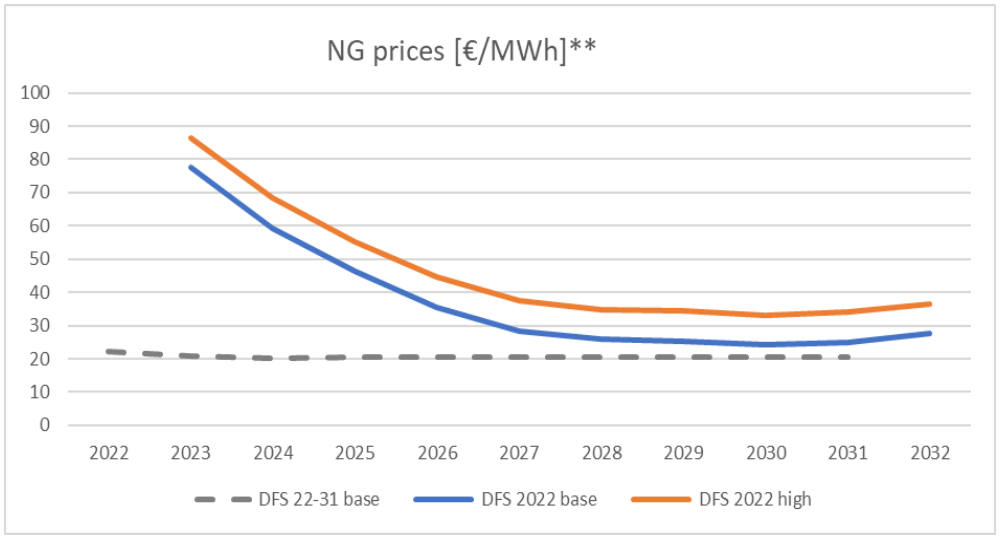
Source: IPTO



Source: NECP, DESFA estimates



Source: IHS Markit, DESFA estimates



Source: HIS Markit, DESFA estimates

* prices presented as yearly averages

** average price of gas delivered at the power plant

Parameter values (II/II)

Decommissioning of power plants in 2023-2032 period

Lignite power plants	Capacity (MW)	Decommissioning Year		
		Late	Mid	Early
Agios Dimitrios 1	274	Apr 2023	Apr 2023	Dec 2022
Agios Dimitrios 2	274	Apr 2023	Apr 2023	Dec 2022
Agios Dimitrios 3	283	Apr 2023	Apr 2023	Dec 2022
Agios Dimitrios 4	283	Apr 2023	Apr 2023	Dec 2022
Agios Dimitrios 5	342	Dec 2024	Dec 2023	Dec 2023
Megalopoli 4	256	Dec 2023	Dec 2023	Dec 2023
Meliti	289	Dec 2023	Dec 2023	Dec 2023
Ptolemaida 5	615	Dec 2028	Dec 2028	Dec 2025

Due to current situation and based on the latest discussions for the SoS of winter 2022-2023, a slower decommission for year 2023 is taken into consideration for low demand and base case scenarios.

Commissioning of new power plants in 2023-2032 period

Lignite power plants	Capacity (MW)	Commissioning Year
Ptolemaida 5	615	End 2022

Natural gas power plants	Capacity (MW)	Commissioning Year
Mytilinaios	New total expected capacity ~4000MW	All new units are expected to be operational the latest by the beginning of 2029
New CCGT 1		
New CCGT 2		
Ptolemaida 5		

Interconnections in 2023-2032 period

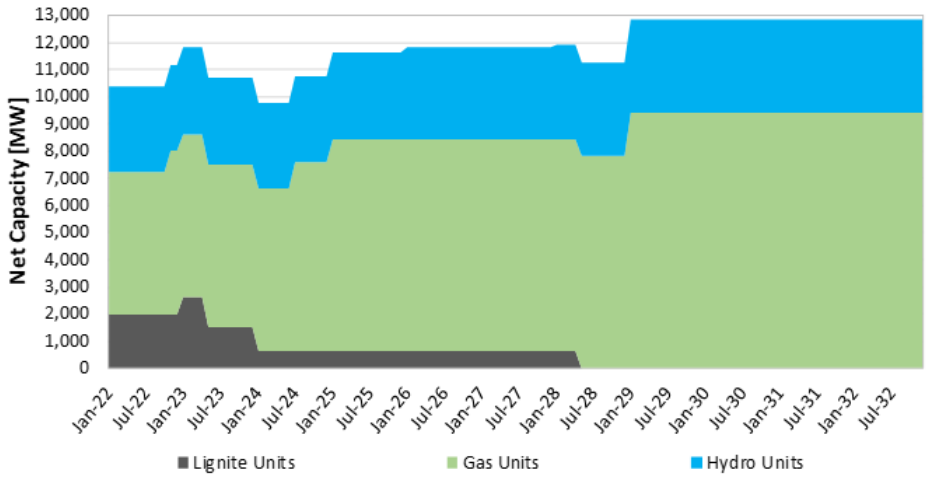
with neighboring countries

- ❑ a new interconnection line is scheduled to become operational between Greece and Bulgaria (early 2023)
- ❑ the Net Transfer Capacity of the existing Greek-Turkey interconnection line is planned to increase from 2025 onwards

with islands

- ❑ Crete by mid-2024
- ❑ West Cyclades by 2025
- ❑ Dodecanese and North Aegean by 2028-2029

Conventional generation capacity in mainland in 2023-2032 period (base case scenario)



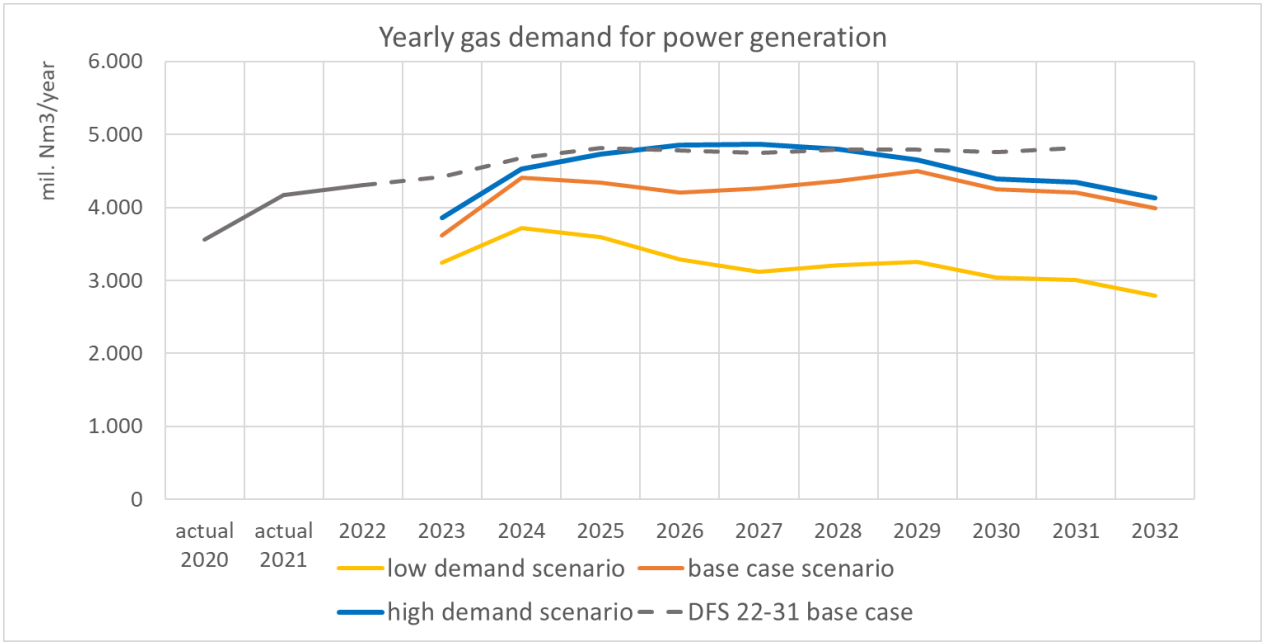
Annual gas demand

Remarks

- A delay on the lignite units decommissioning date is considered for year 2023 to align with EU targets on reduction of natural gas use for next winter and security of supply reasons
- Two scheduled electricity interconnections are expected to be operational; the second interconnection with Bulgaria by early 2023 and the increase of Net Transfer Capacity of the existing Greece-Turkey interconnection line (from current value of 218 MW to 660 MW) from 2025 onwards
- A front-loaded integration of new RES capacities has been considered reflecting current market trend of increased investment interest for the construction and operation of new RES plants
- Over the current decade the interconnection of the islands with mainland Greece will result to an increase in the system load [Crete:mid-2024, West Cyclades:2025, Dodecanese and North Aegean islands:2028-2029]

Results

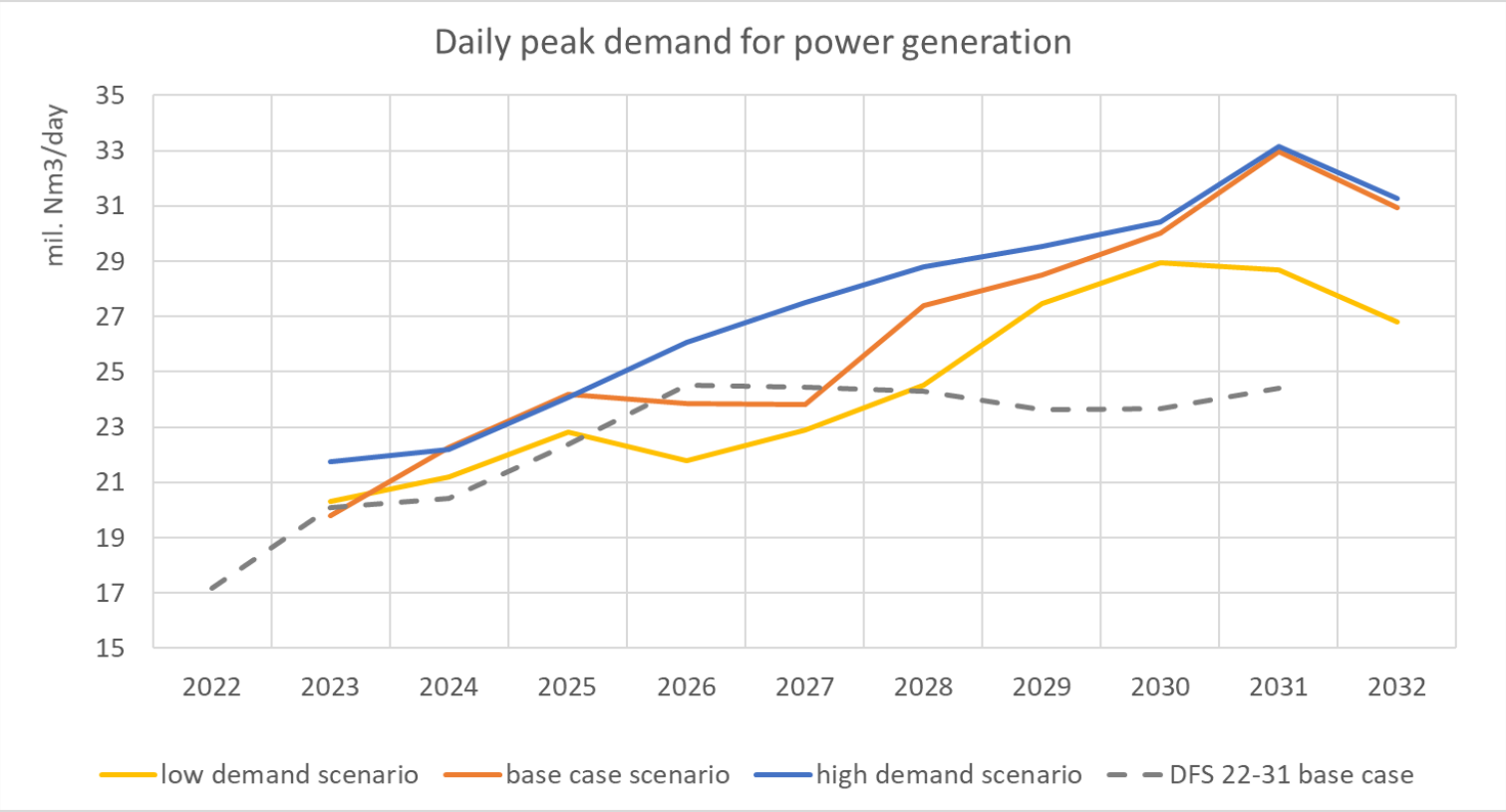
- Despite the increasing RES generation and the slight postponement of the lignite decommissioning plan, the increase of electrical system load due to the completion of the Crete interconnection leads to an increase in gas demand for power generation in year 2024
- This increase slows down in the following period, mainly due to the increasing RES penetration
- The big spread of the simulation results in the 3 scenarios reflect the high uncertainty on the energy developments on the years ahead



Daily peak demand

Remarks

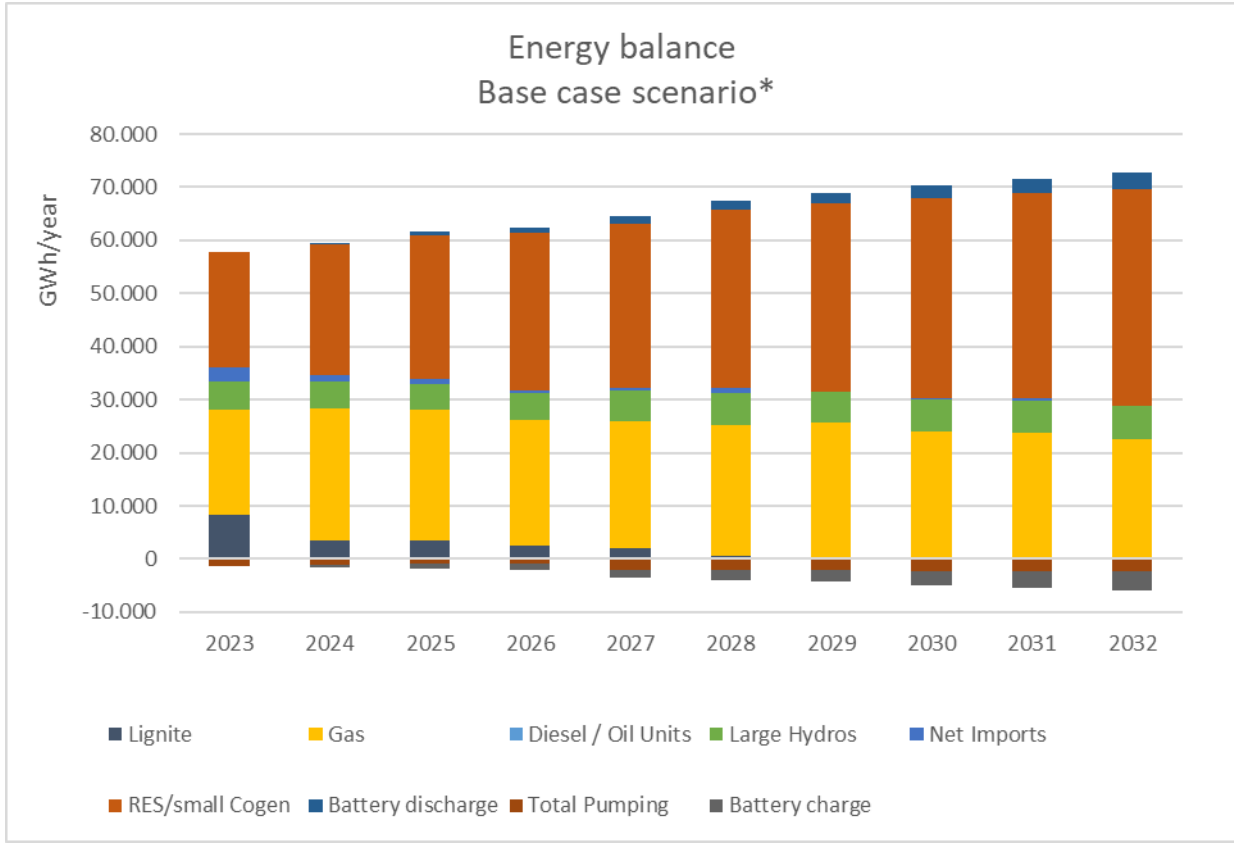
- A significant increase of the forecasted peak demand for power generation is observed throughout the reference period, compared to last year's forecast. This is more prominent in the last years of the reference period



Energy mix of the electricity system - base case scenario

Remarks

- The assumed system load of the interconnected system is increasing from 56,3 TWh in year 2023 up to 66,9 TWh in year 2032
- Specifically, gas-fired power plants generation is expected to increase from 19,9 TWh in 2023 to 22,6 TWh in 2032, however by dropping its percentage over total power injections from 34,5% to 31% respectively
- The increasing RES production is the key factor that mainly determines the energy generation mix in each year of the study period
- The assumed penetration of RES leads to an increasing percentage of RES generation (including large hydros) over total power injections from 46,5% in 2023 to 64,5% in 2032
- Lignite-fired power plants are expected to cover 14,3% in year 2023, this percentage decreases every year until the completion of the de-lignitisation plan (2028)
- It is expected that net imports will start being limited throughout the reference period and Greece will become a marginal net exporter in 2032



*energy mix for low and high gas demand scenarios are included in the Appendix

2. Gas demand forecast for distribution networks and customers connected directly to NNGTS

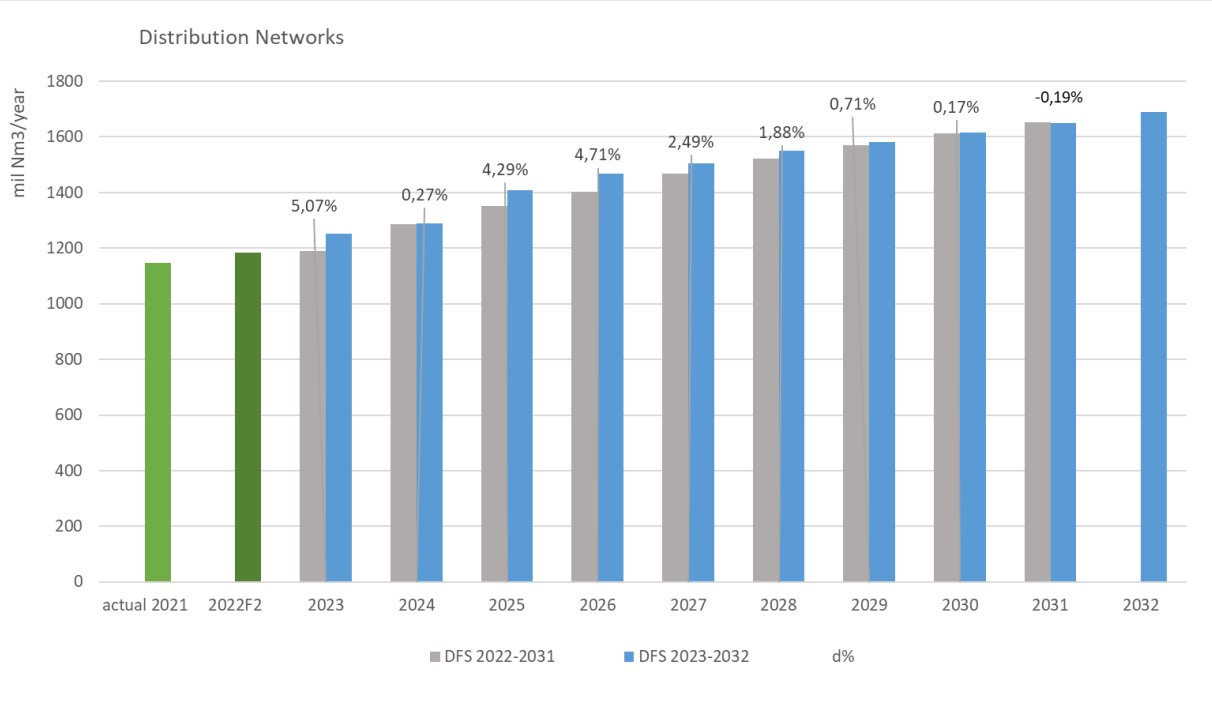
Distribution networks

Assumptions

- Gasification of new areas is considered in the regions of West Macedonia, West Greece, Peloponnese, Ioannina and is expected to have been initiated in all areas by the beginning of year 2026
- Annual demand on distribution networks is aligned with data submitted by DSOs (EDA Attikis, EDA THESS, DEDA, HENGAS)*
- For the regions of West Macedonia and West Greece the supply of natural gas will be initiated via SSLNG services
- For Ioannina and some areas in West Macedonia the gasification of natural gas is expected to be supplied via SSLNG on a permanent way
- Quantities expected to be supplied via SSLNG services are attributed to the SSLNG demand category

Results

- A slight increase of gas demand is expected compared to last years' data mainly in the first years of the reference period
- Up to year 2032 the gas demand for distribution networks is expected to be increased by 47% compared to year 2021 and be equal to 1,68 bcm

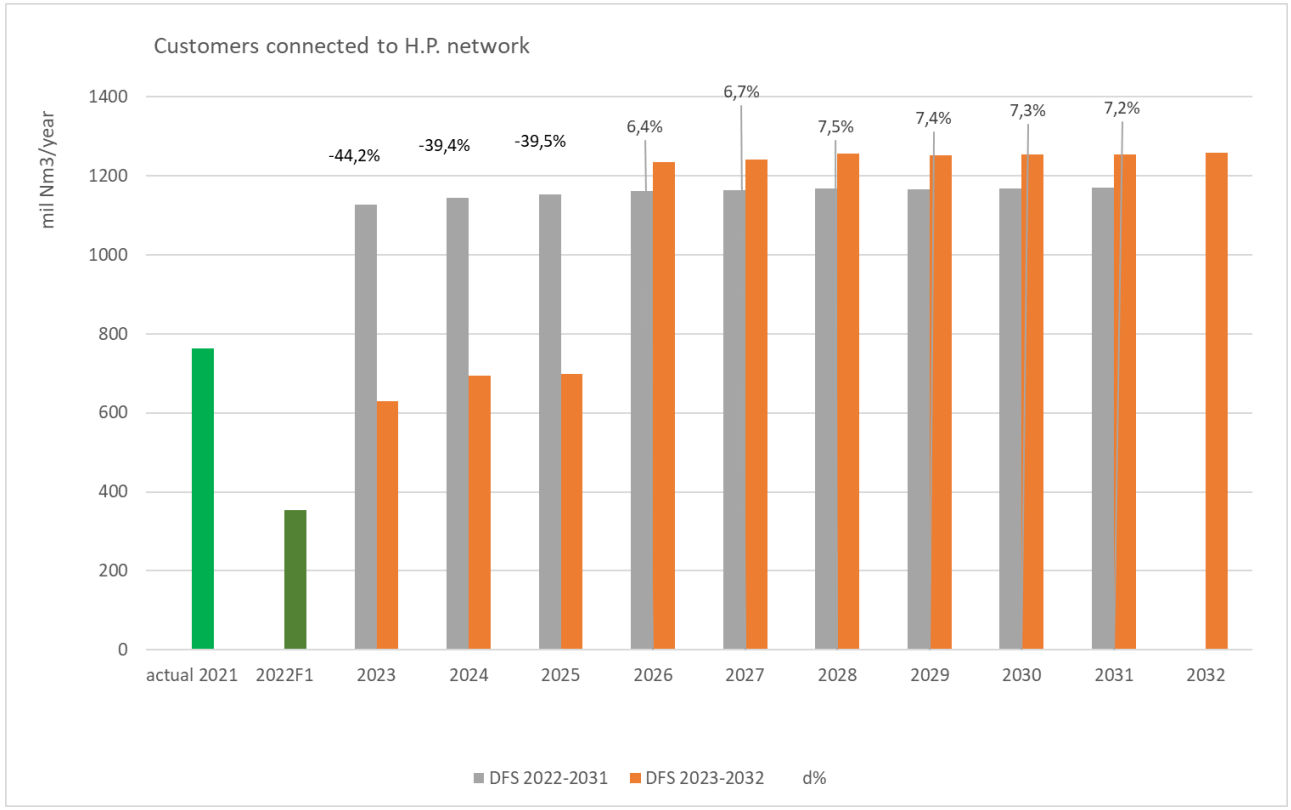


* when necessary, data for new areas are offset according to the expected COD of the relevant project included in the TYDP

Customers connected directly to High Pressure network

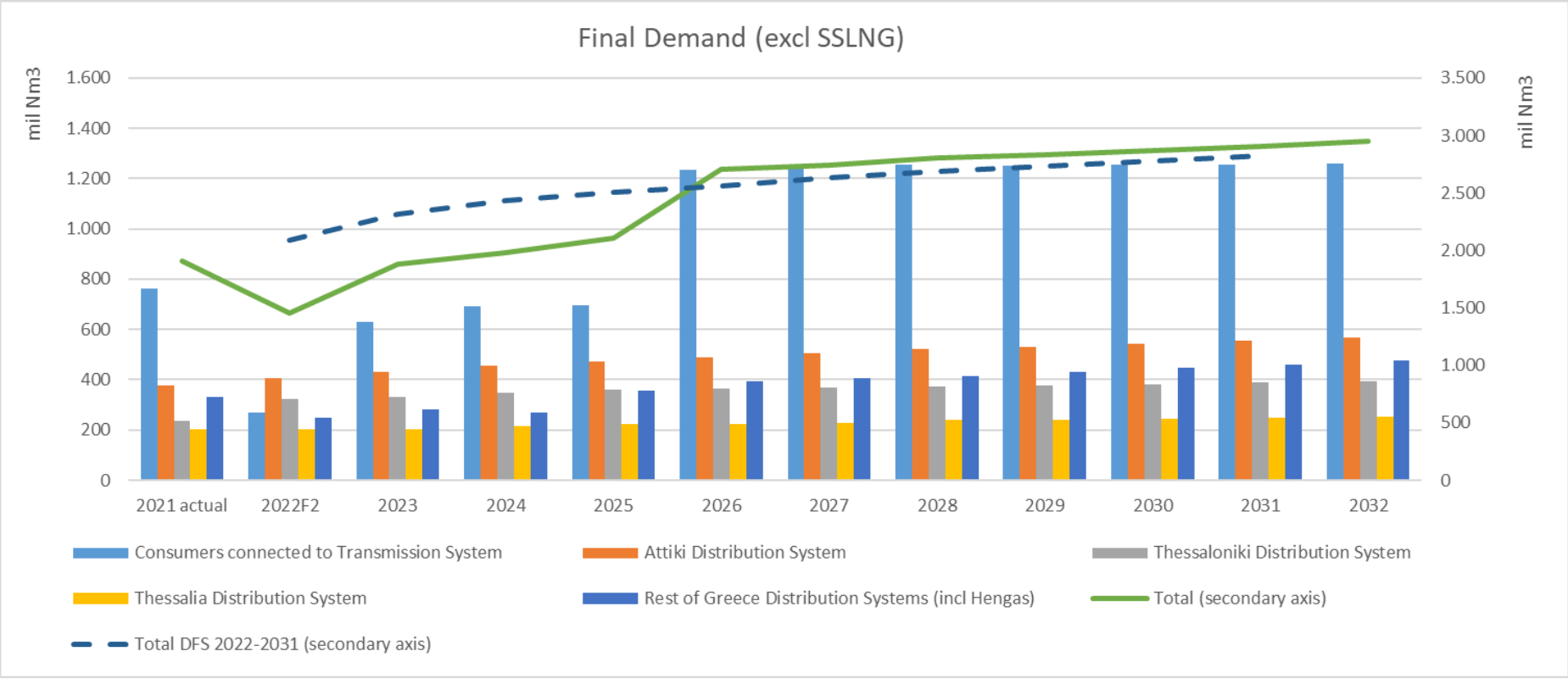
Remarks

- The gas consumption in year 2022 is highly affected by the natural gas extreme prices observed within the year
- This situation is expected to continue in the following years and to return to “business-as-usual” conditions in year 2026
- This decrease in demand observed due to natural gas high prices is mainly attributed to the gas demand of the oil refinery sector
- One new customer connected directly to H.P. is included from 2024 onwards (ELVAL), however relevant demand was already supplied via distribution network
- Increased gas prices will affect the gas demand in the first years of the reference period. However, gas demand of customers directly connected to H.P. is expected to increase in the long run by 65% compared to year 2021 and be equal to 1,26 bcm.



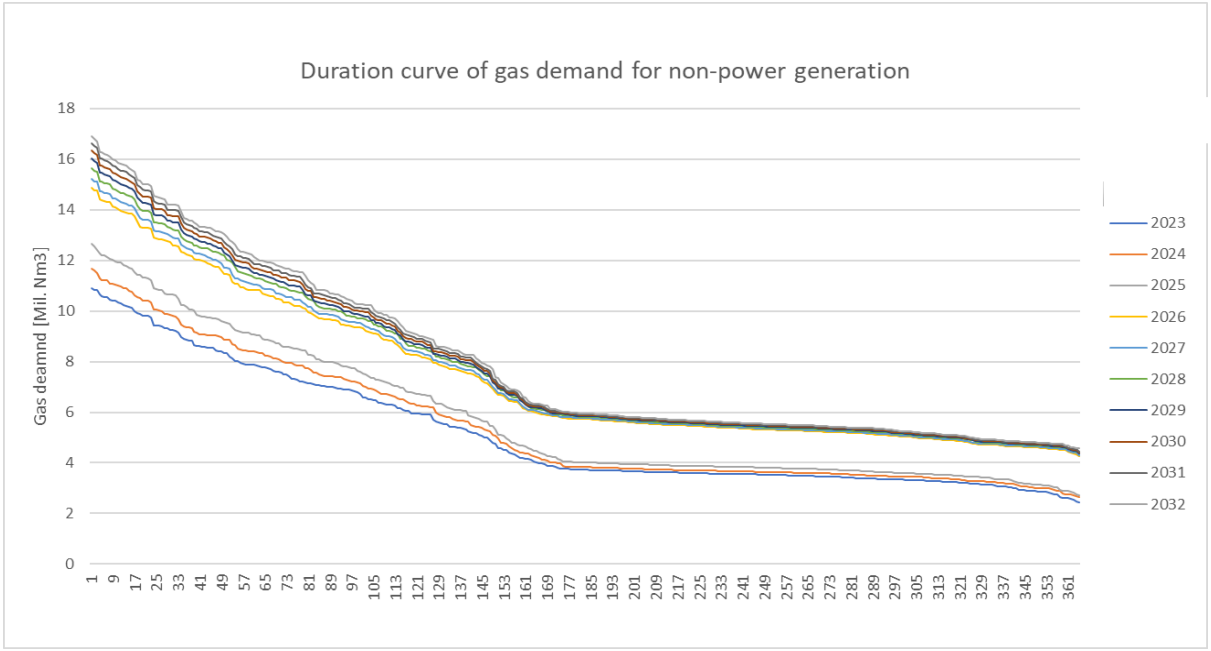
Distribution networks & Customers connected directly to NNGTS - aggregated results

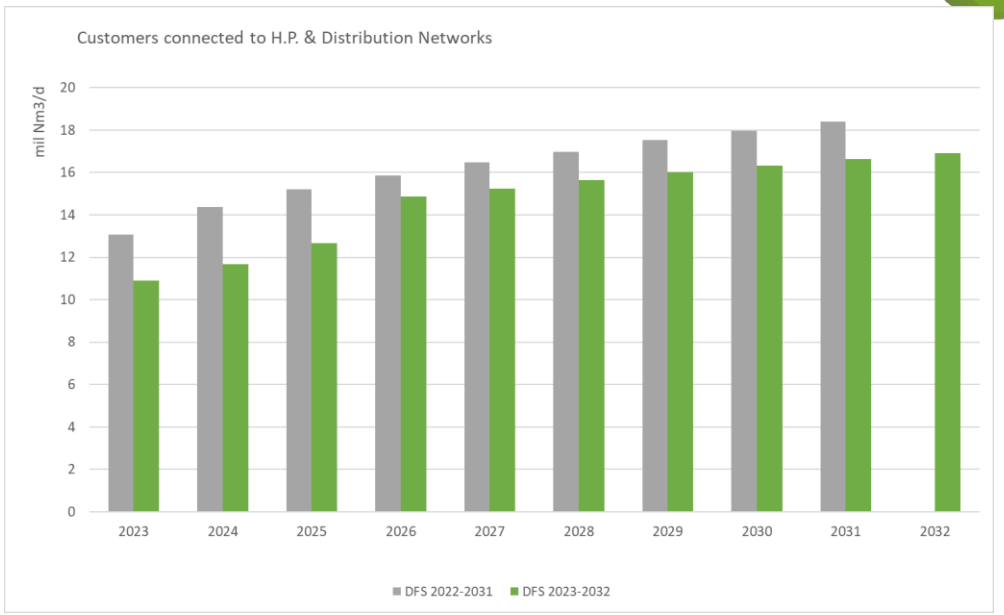
- The uncertainty of the market due to the high volatility in natural gas prices is evident compared to DFS 2022-2031 results, mainly due to the expected lower demand of customers connected to H.P. network in the first years of the reference period

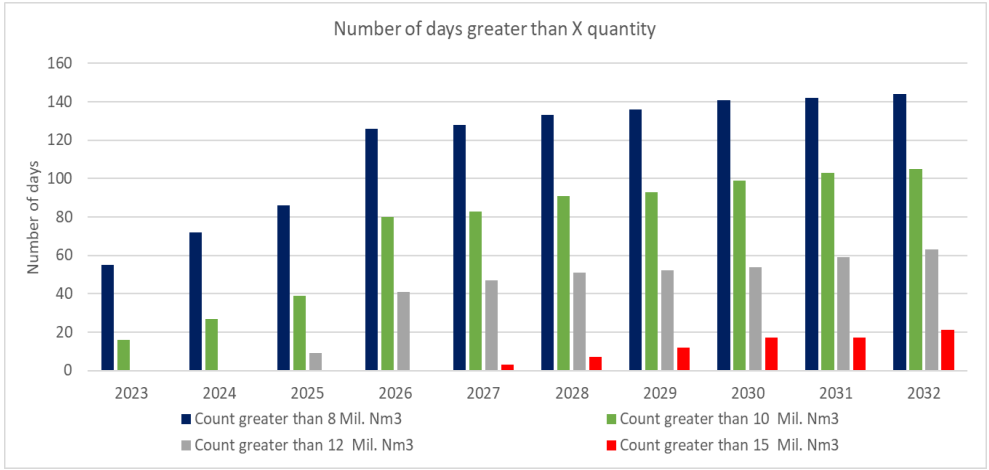


Distribution networks & customers connected directly to NNGTS - aggregated daily peak results

- The peak presented in the graph is the maximum daily total demand forecasted per year for both demand categories on the same day
- The duration curve indicates the variations of daily demand throughout the year. The base load vs seasonal increase for residential & commercial demand is shown in the graph below





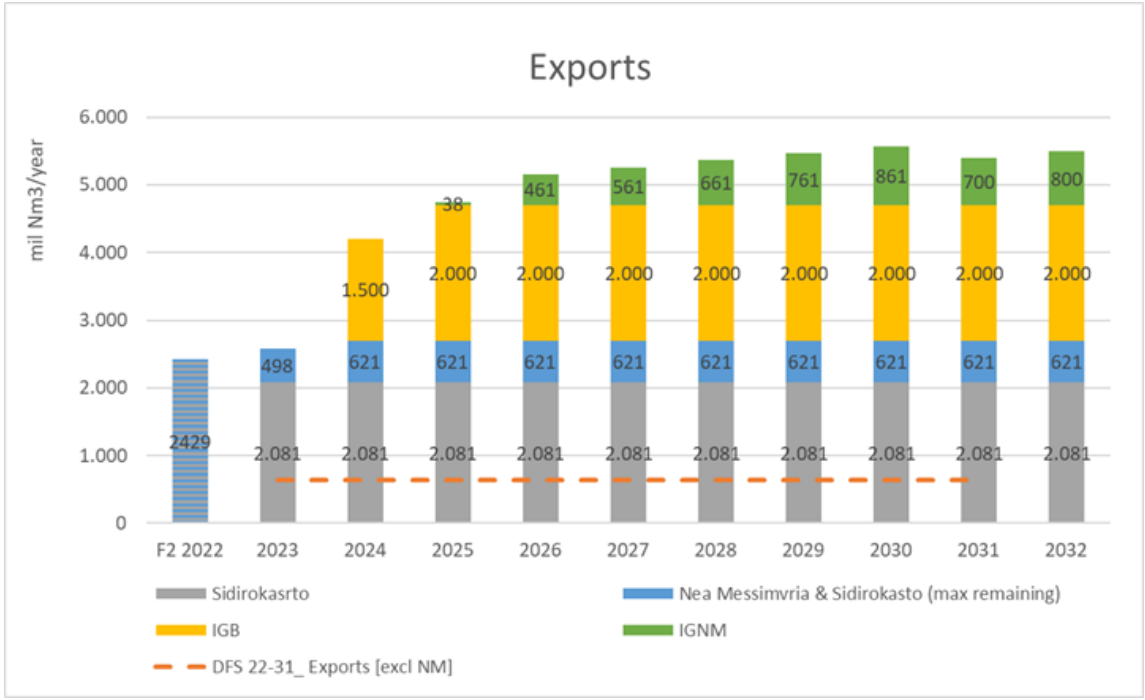


3. Gas demand forecast for Exports

Exports

Remarks

- Exports forecast is a combination of market intelligence, known bookings, supply estimations and policy directions. Exports forecast in this DFS has the scope to capture the exporting potential of Greece to neighboring countries based on their supply gap as redefined following the Russian invasion to Ukraine.
- In the foreseeable future the limitation of Russian gas supplies could lead to a supply gap of the wider region of up to 7,7bcm*. In the long run, increased exports reflect the EU target of reducing dependency on Russian gas
- Under this scope the exporting potential presented in the graph is inline with the exporting technical availability of our system
- Exports through Nea Mesimvria IP in year 2023 are directed to both Italy and Bulgaria. From year 2024 onwards, exports related to IGB are directly allocated to the IGB exit point
- Exports towards Bulgaria are expected higher than the historical values, reflecting the impact of Russia's invasion in Ukraine
- Exports via IGB are based on the maximum technical and commercially available capacity
- Exports to North Macedonia are based on the performed market test



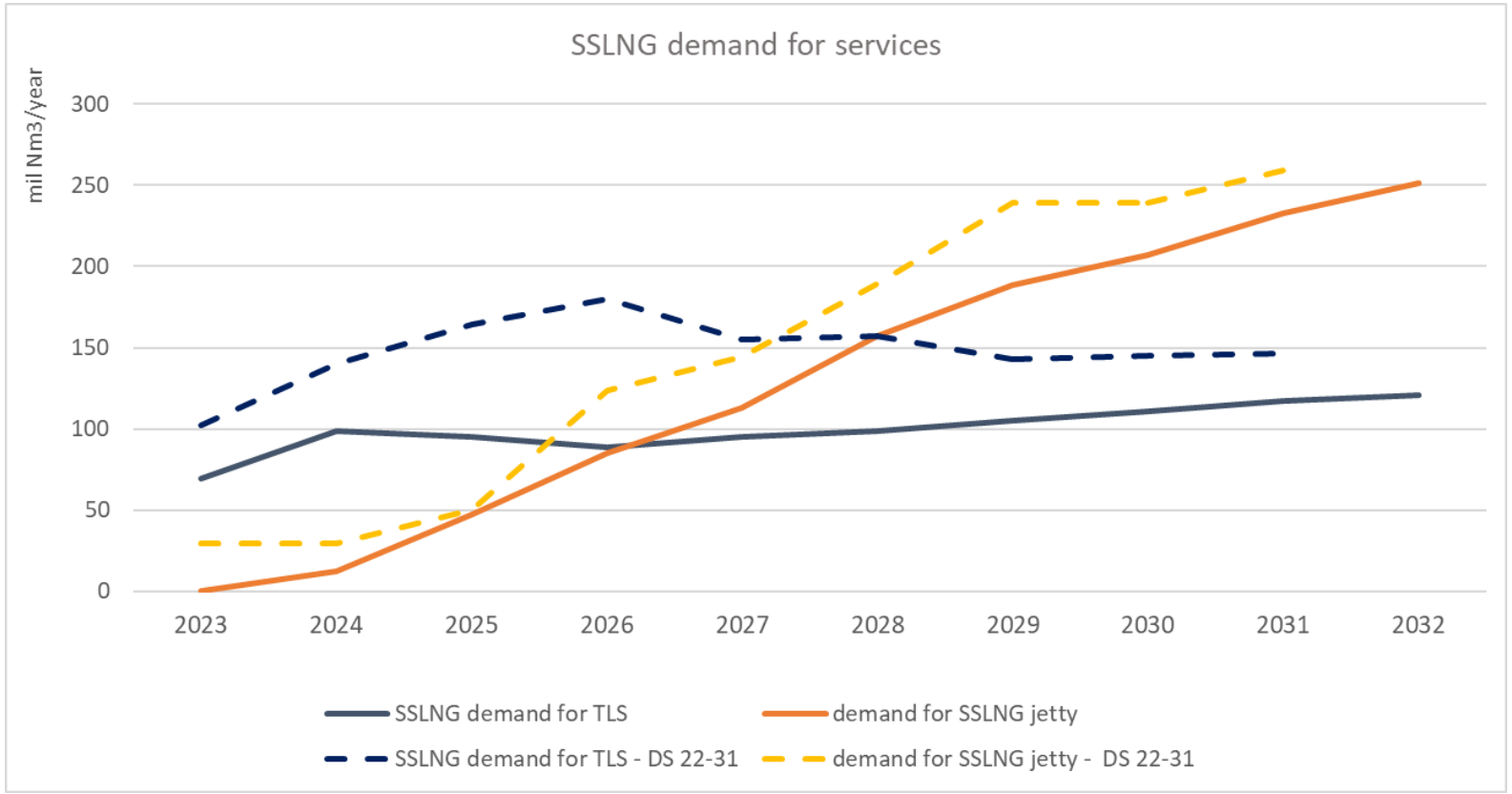
*IHS Markit data analysis, July 2022

4. Gas demand forecast for SSLNG services

SSLNG services

Remarks

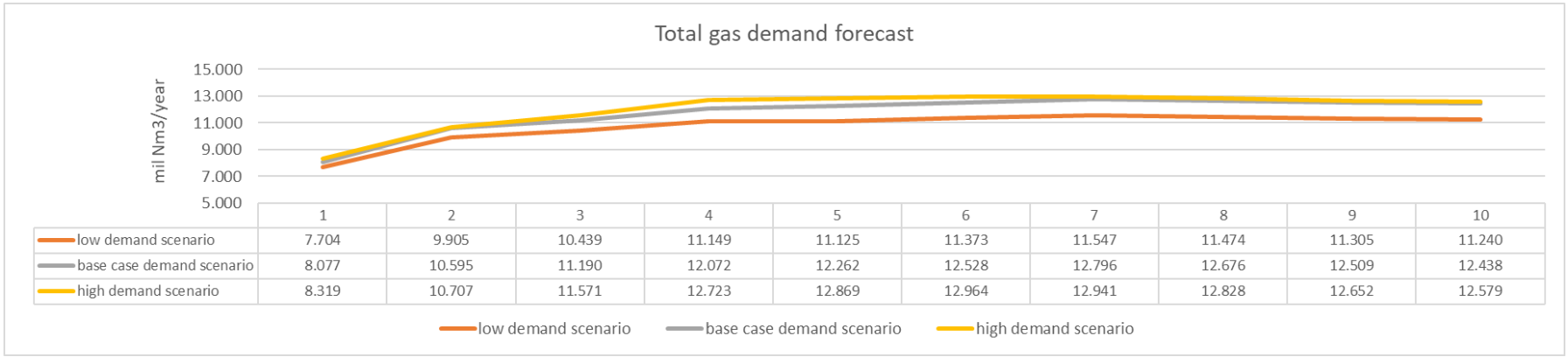
- A separate demand scenario is established for the two SSLNG services:
  - pilot Truck Loading Station (TLS)
  - new SSLNG jetty
- Gas demand forecast for SSLNG jetty and TLS service are based on information provided by Users



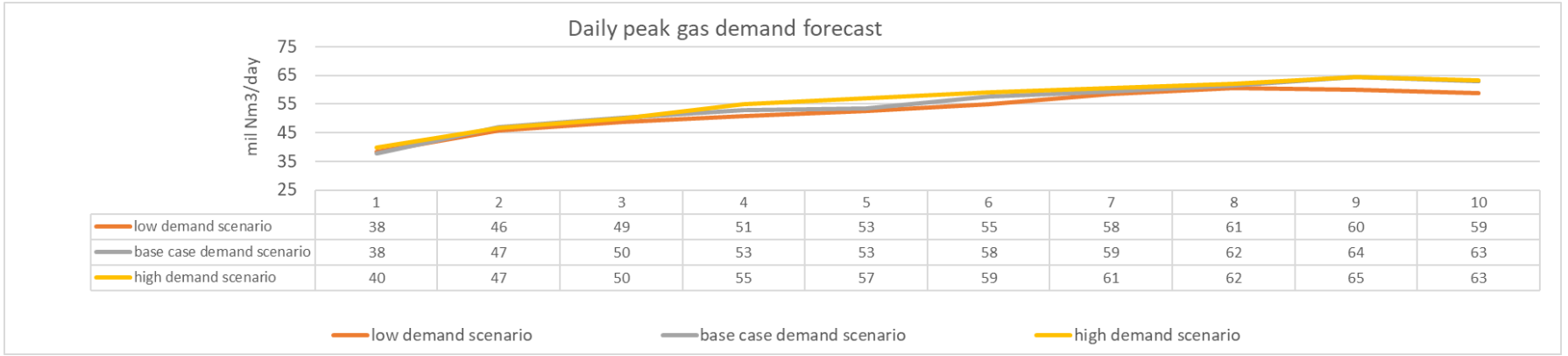
*the graph presents the potential demand for the SSLNG services without considering the limitations of the infrastructures yet

5. Demand Forecast 2023-2032 for all categories

Gas demand forecast for transmission services – all scenarios

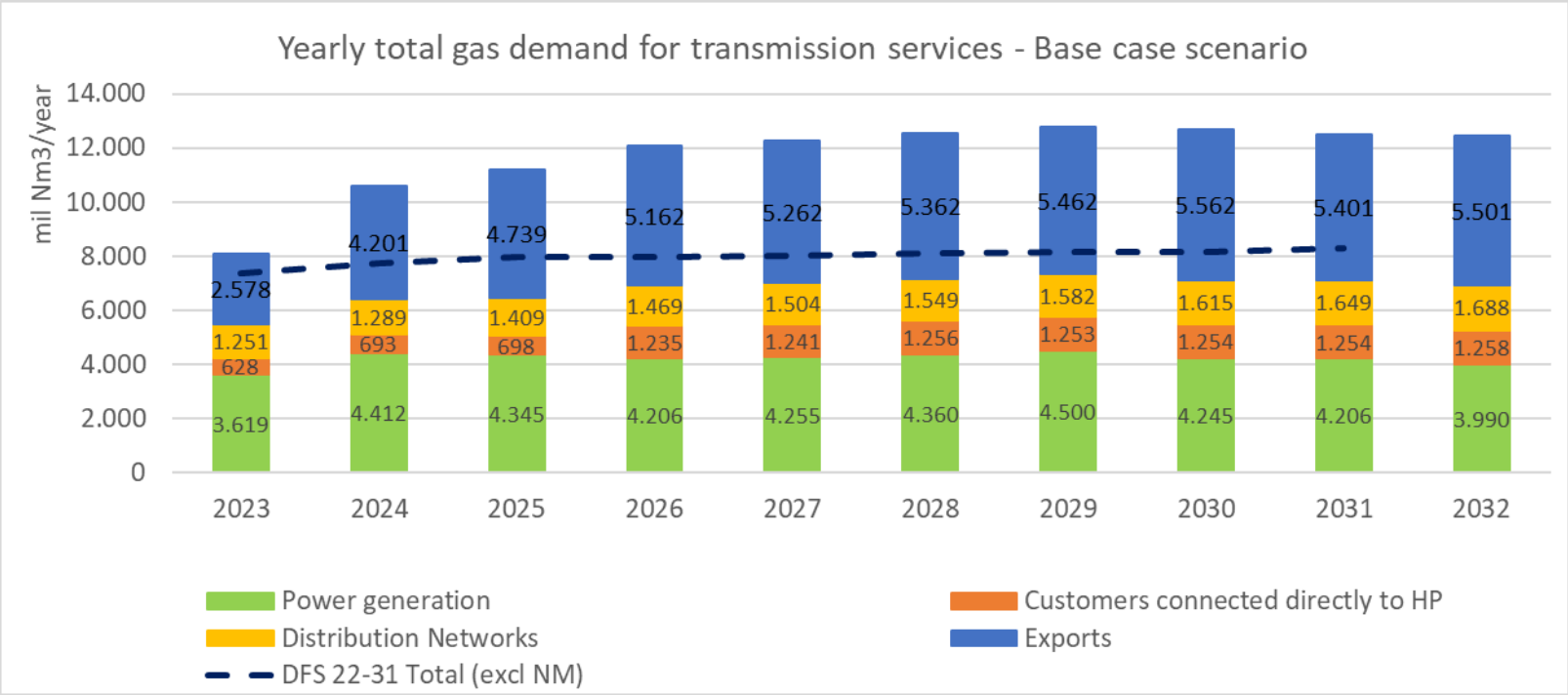


	1	2	3	4	5	6	7	8	9	10
low demand scenario	7.704	9.905	10.439	11.149	11.125	11.373	11.547	11.474	11.305	11.240
base case demand scenario	8.077	10.595	11.190	12.072	12.262	12.528	12.796	12.676	12.509	12.438
high demand scenario	8.319	10.707	11.571	12.723	12.869	12.964	12.941	12.828	12.652	12.579

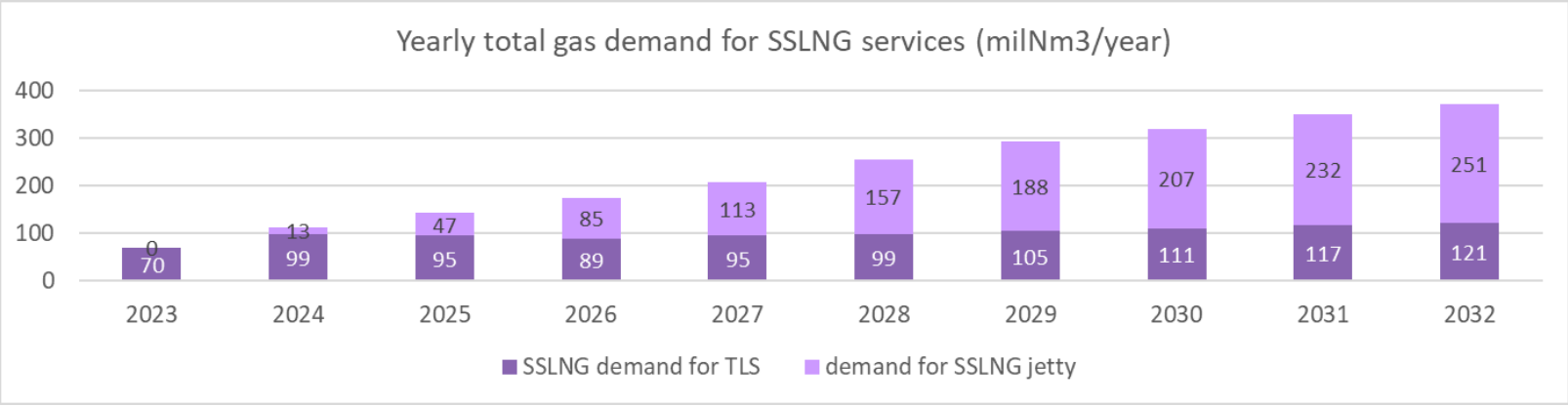


	1	2	3	4	5	6	7	8	9	10
low demand scenario	38	46	49	51	53	55	58	61	60	59
base case demand scenario	38	47	50	53	53	58	59	62	64	63
high demand scenario	40	47	50	55	57	59	61	62	65	63

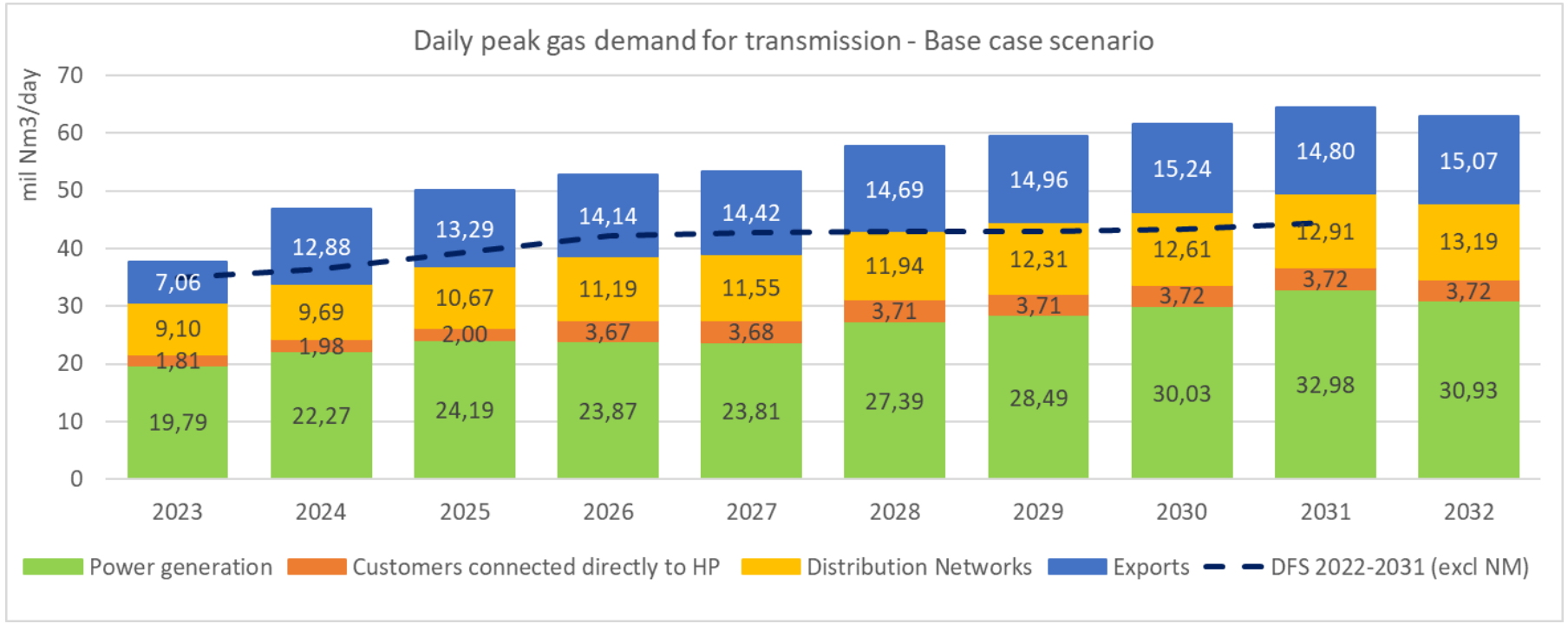
Total gas demand forecast breakdown – base case scenario



*results for low and high demand scenario are presented in appendix



Daily peak gas demand forecast breakdown – base case scenario



*results for low and high scenario are presented in appendix

Notes

- Daily peak for power generation is the sum of the expected demand per unit on the day of maximum demand in the winter period
- Daily peak for final demand is the sum of the expected demand per exit point foreseen in the day of maximum demand
- The daily peak demand for power generation and for final demand are calculated independently. Methodologically the daily peak at a forecast level results from the sum of those two
- Daily peak for exports is calculated on a basis of LF=1

6. Assessment of the NNGS according to demand analysis

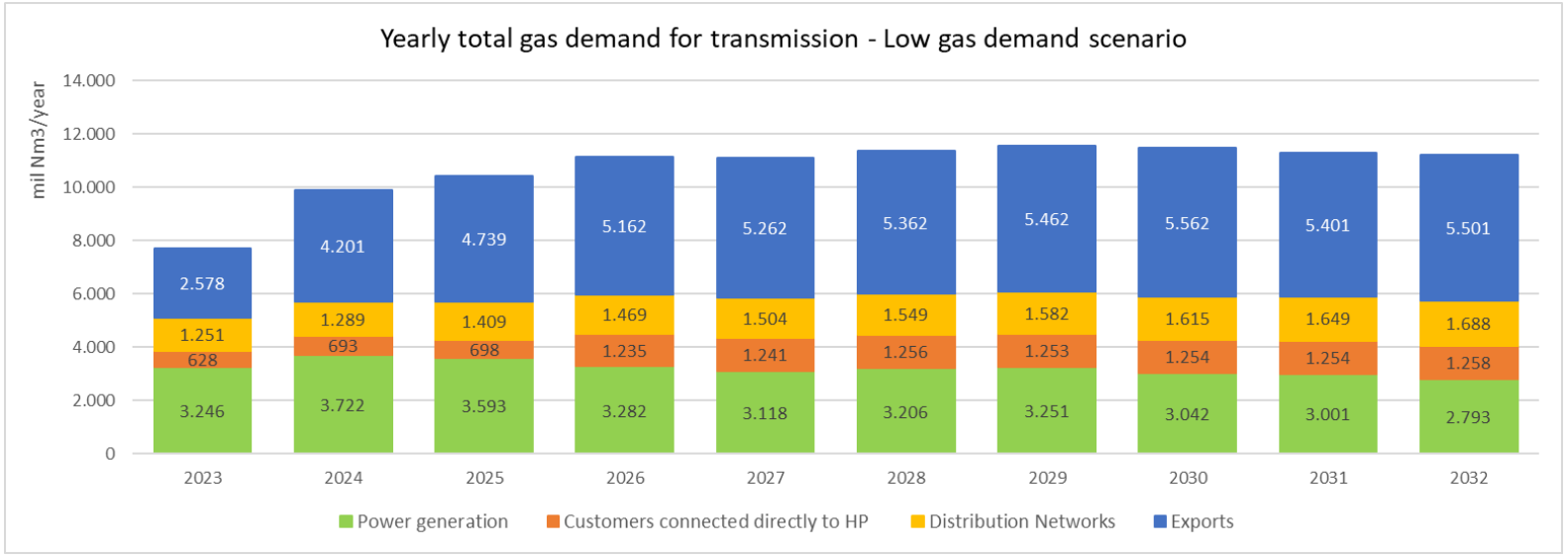
Based on the hourly peak gas demand forecast of the high demand scenario, the assessment of the NNGS takes place indicating the ways the mass deficit can be accommodated.

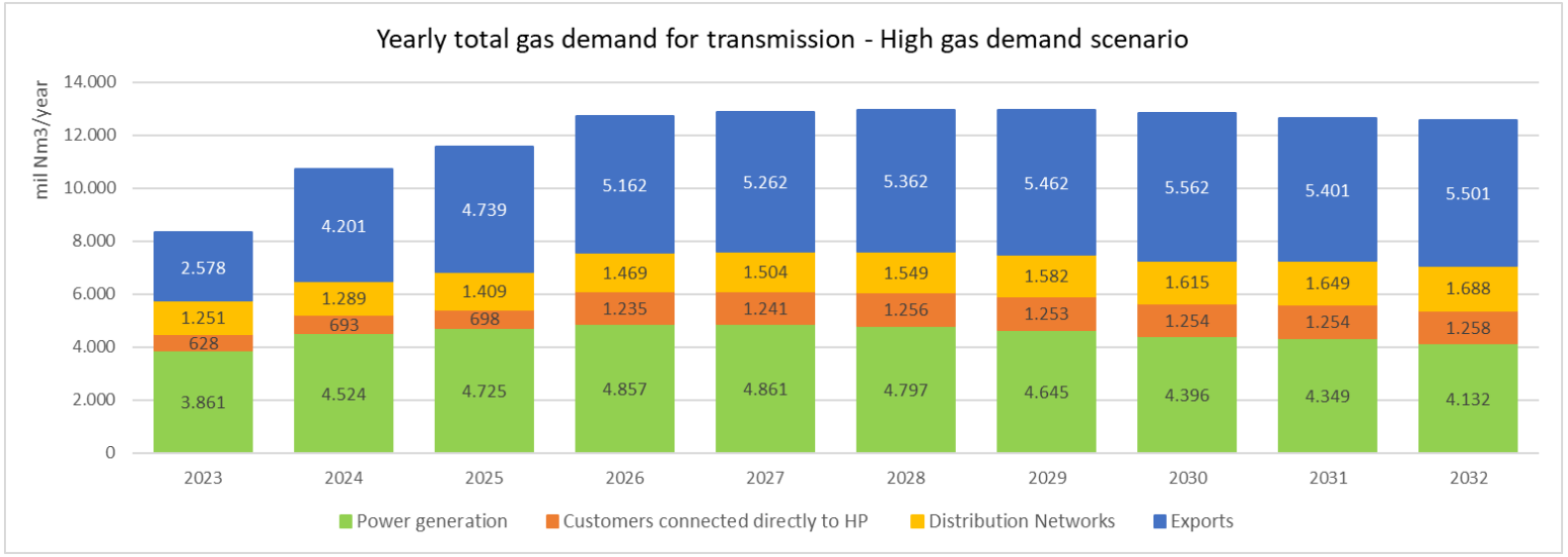
Following the hydraulic simulation of the NNGS, the following physical constraints of the Transmission System are derived:

- In case of forward flow (N→S), the sum of the daily flows from the northern and eastern entry points cannot exceed 15,1 mil.Nm^3/day until 2024 (operation only of Nea Messimvria CS) and 19,9 mil. Nm^3/day after 2024 (operation of Ambelia CS and upgrade of Nea Messimvria CS, both currently under construction).
- In case of physical reverse flow (S →N), with the introduction of new Entry Point (under the operation of the aforementioned CSs upgrade) in the southern part of NNGTS on top of Revithoussa Terminal, the maximum daily flow from these two entry points cannot exceed 20,4 mil. Nm^3/day.
- The above figures represent the firm capacities of the considered NNGS entry points. and result to a total firm entry capacity of the NNGS of 40,3 mil. Nm^3/day.
- Considering the mass balance of the System, mass deficit occurs for the period 2024-2032, according to the estimated peak day evolution the NNGTS and the total firm entry capacity.
- The mass deficit can be accommodated with the following ways:
  - ❑ **Implementation of conditional capacity products for new entry points**
  - ❑ **Reinforcement of the NNGTS in order to overcome the existing physical constraints of the Transmission System**

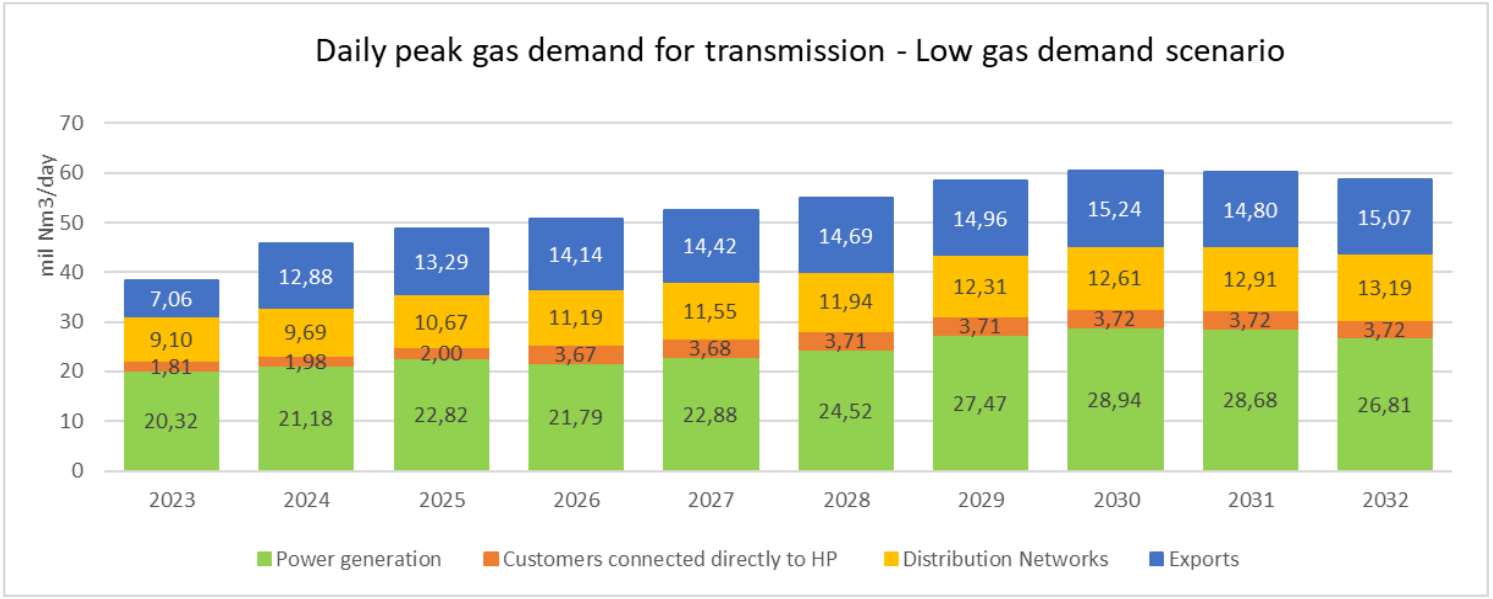
7. Appendix

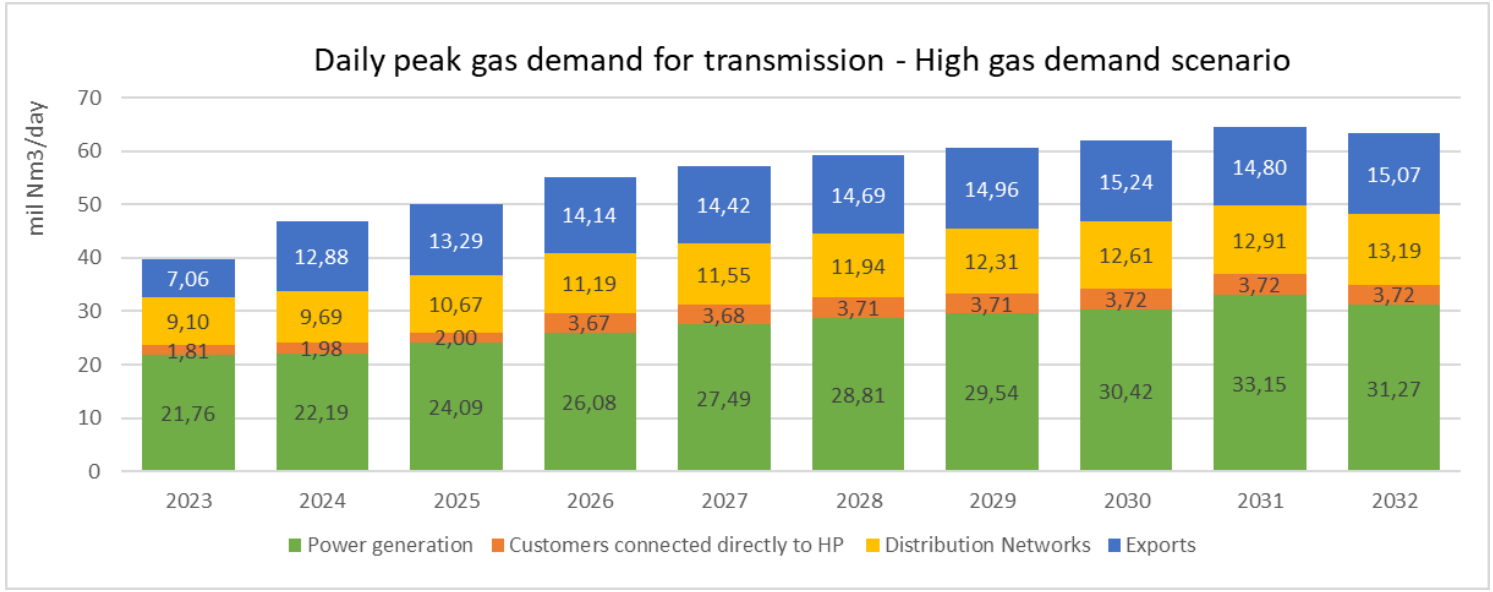
Total gas demand forecast breakdown – low & high gas demand scenario





Daily peak gas demand forecast breakdown– low & high gas demand scenario





Energy mix of the electricity system – low & high gas demand scenarios