Article 14 of the Energy Efficiency Directive: Promotion of the efficiency of heating and cooling

Table of Contents

1. Description of heating and cooling demand

The report treats the determination of district cooling and district heating potential as separate subjects. At present, the district cooling infrastructure in Hungary is extremely small, and based on operational experiences to date; it is not worth operating it under market conditions. Therefore, the report deals first with the description of district cooling demand and infrastructure. However, due to its limited penetration, the report does not deal with the district cooling infrastructure and potential estimation later outside the following section.

1.1 Description of district cooling demand

The theoretical potential for the district cooling of residences can be estimated on the basis of the quantity of heat used for heating, which is sold to the general public. Compared to heating demand, setting both peak capacity demand and cooling energy demand at 50 %, the theoretical cooling energy potential can be estimated at 25 % of heating demand, i.e. exactly 4 PJ/year, in the case of the general public. In the case of consumers other than the general public, setting peak capacity demand at 80 % and cooling energy demand at 65 % of heating demand, the theoretical cooling energy potential can be estimated at 52 % of heating demand, i.e. exactly 3 PJ/year.

The technical potential of district cooling is lower than this, because for economic and security of supply reasons, it is not warranted to establish heat-driven liquid coolers to meet peak load demand. The heat-driven liquid cooler capacity installed at half of peak cooling capacity demand may provide for meeting 80 % of cooling energy demand. Therefore, the technical potential can be put at 80 % of the theoretical potential.

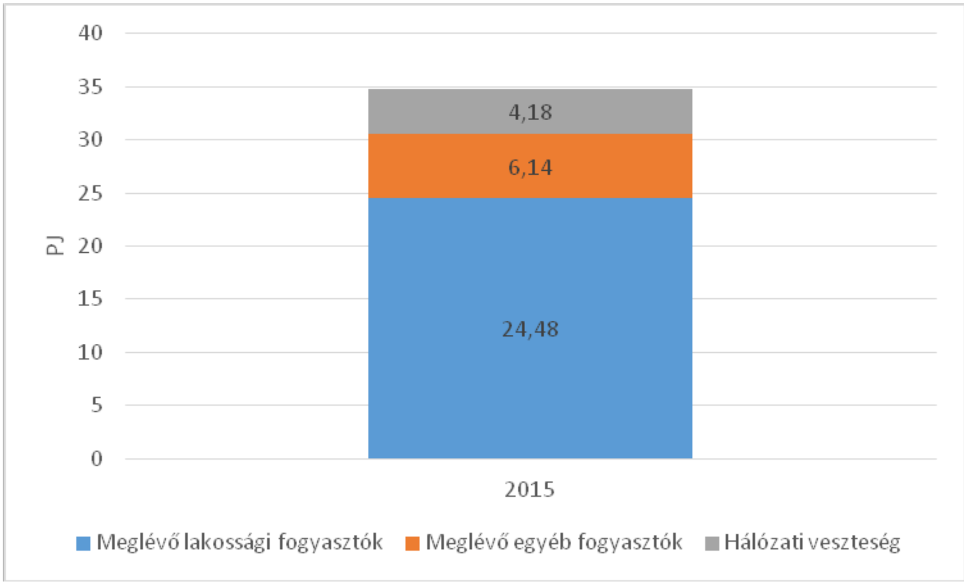
The economic potential of district cooling is currently zero, because the energy costs of only heat-driven cooling clearly exceed the energy cost of cooling energy generated with traditional electric-driven compressor liquid coolers, not to mention capital load differences due to significantly higher capital costs.

There is currently no example for local trigeneration (a cogenerating and heat-driven liquid cooler at the same 'site') in domestic district heating systems. Heat-driven ('sorption') liquid coolers are installed at one consumer of each of the Tiszaújváros, Szentendre and Csepel (Budapest) district heating systems and a few users of the Debrecen district heating systems, but this equipment does not operate or hardly operates due to a driving energy price that has multiplied compared to the period of installation. Instead, cooling energy is generated with electric-driven machines.

1.2 Description of district heating demand

In 2015, Hungary had a district heating demand of 34.8 PJ. A significant part of this demand came from the residential sector (70 %), while other consumers consumed 6.14 PJ. Other consumers include industrial consumers and the points of consumption of the public sector. The total network loss was 4.18 PJ.

Figure 1 – District heating demand broken down by residential and other sectors, with an indication of network loss



Meglévő lakossági fogyasztók	Existing residential consumers
Meglévő egyéb fogyasztók	Other existing consumers
Hálózati veszteség	Network loss

2. Change in district heating demand in the next ten years

2.1 Residential users

2.1.1 Current users

For estimating the development of the residential use of district heating, forecasts relating to present consumers and possible new entrants have been prepared separately.

The expected development of consumption by current users is primarily affected by energy renovations. In this respect, the forecast has been prepared on the basis of the following premises:

- At present, 30 % of homes supplied with district heating have undergone energy upgrading (this includes nearly 200 000 homes).
- This ratio will increase to over 95 % during the review period.
- The drop in consumption achievable through complete upgrading is 50 % in respect of district heating.
- At the same time, with regard to renovation schedules, two alternatives appear due to their uncertainty:
    - assuming a faster schedule, the proportion of upgraded homes will reach 95 % by 2032;
    - if a slower schedule is implemented, the above percentage will be achieved only six years later.

In the past period, basically in connection to the installation of water meters, the amount of district heat used for domestic hot water production has substantially decreased. On the basis of the information received from the industry, the rate of use may decrease by an additional 10 % over the next 10 years, while there is no more reserve in the system.

Taking into account the current competitive position of district heating and the trends in the past period, this forecast does not reckon with the disconnection of residential users.

The effect of global warming has not been displayed separately either; in this regard, at the same time, it can be taken into account that a 1 °C increase in the average temperature will reduce the amount of district heat used by about 6 %.

2.1.2 Inclusion of new users in district heating

A slow increase in the number of homes supplied with district heating, 0.5 % per year, is reckoned with as of 2020 (i.e. the number of homes supplied with district heating will approach 720 000 by 2040). The expansion may be generated by the fact that:

- at present, district heat supply can be considered a competitive, convenient and environmentally-friendly heating method, even though primarily due to a 5 % VAT charged on it;
- at present, large areas (e.g. the inner districts of Budapest) are not involved in district heating at all;
- in the case of newly built blocks of freehold flats (especially if they are near housing estates), district heating is still considered a realistic alternative.

With respect to newly connected users, the calculation takes the specific energy use of homes that have undergone energy upgrading and lower hot water consumption as a basis.

The expansion primarily depends on the competitive situation of the individual heating modes relative to each other, but influenced by administrative means (official pricing, VAT rate, etc.).

2.2 Non-residential users

In respect of non-residential users, the forecasts of consumption associated with separately managed institutions as defined in Act XVIII of 2005 on district heat supply and that of other users were separated. In connection with the residential segment, the estimated change in use by current users of the service and the forecast of a change in the number of consumers were taken into account independently here, too.

2.2.1 Current users

In respect of use for heating purposes by separately managed institutions currently provided with district heating, the forecast reckoned with a decrease of 0.63 PJ in total during the period on the basis of the following assumptions:

- 30 % of separately managed institutions currently provided with district heating have undergone energy upgrading.
- This ratio will increase to 96.5 % during the review period.
- The drop in consumption achievable through complete upgrading is 40 % in respect of district heating.
- 75 % and 95 % of the current institutions will be refurbished by 2025 and 2035, respectively.

With respect to other non-residential users, assuming that due to typically profit-oriented operation, the possible steps aimed at savings have already been taken, the forecast does not reckon with a decrease in consumption.

2.2.2 Change in the number of users

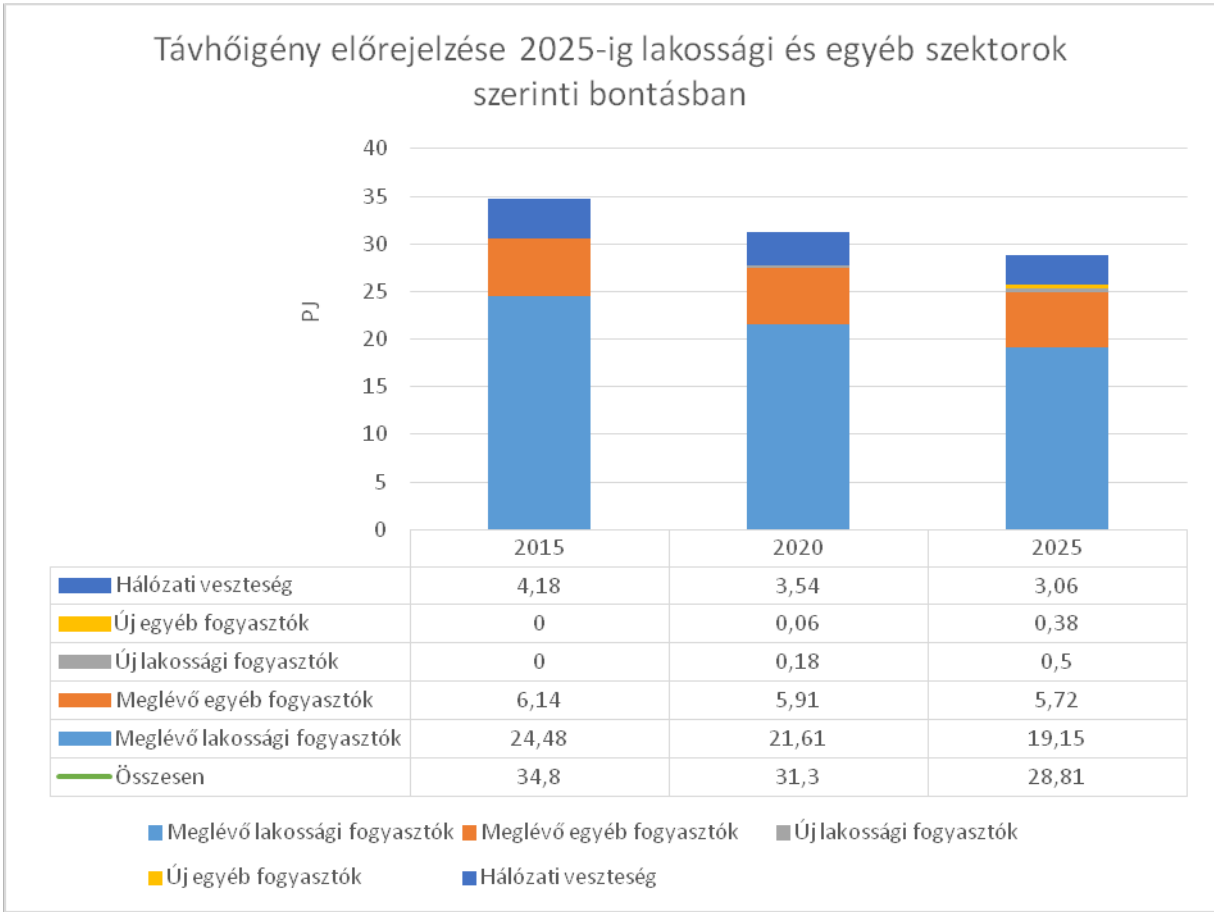
The number of non-residential users has been slightly but continuously increasing since 2016 (separately managed institutions and business users by 1 % and 0.5 %, respectively). With respect to separately managed institutions, this may be based on the owner/maintainer's intent (according to this assumption, a significant part of separately managed institutions will be connected to the district heating network by 2040), and in the case of commercial sales, on the successful marketing policy of service providers, which may affect both existing and newly built properties.

With respect to newly joined separately managed institutions, the calculation is based on specific energy use by consumers that have undergone energy upgrading.

2.2.3 Summary

In the light of this, as shown in the following figure, district heating demand is expected to decrease over the next ten years. While annual demand was 34.8 PJ in 2015, it will decrease to 31.3 PJ by 2020, then total district heating demand is expected to be 28.81 PJ in Hungary in 2025.

Figure 2 – Forecast of district heating demand by 2025 broken down by residential and other sectors



Hálózati veszteség	Network loss
Új egyéb fogyasztók	Other new consumers
Új lakossági fogyasztók	New residential consumers
Meglévő egyéb fogyasztók	Other existing consumers
Meglévő lakossági fogyasztók	Existing residential consumers
Összesen	Total
Meglévő lakossági fogyasztók	Existing residential consumers
Meglévő egyéb fogyasztók	Other existing consumers
Új lakossági fogyasztók	New residential consumers
Új egyéb fogyasztók	Other new consumers

Hálózati veszteség	Network loss

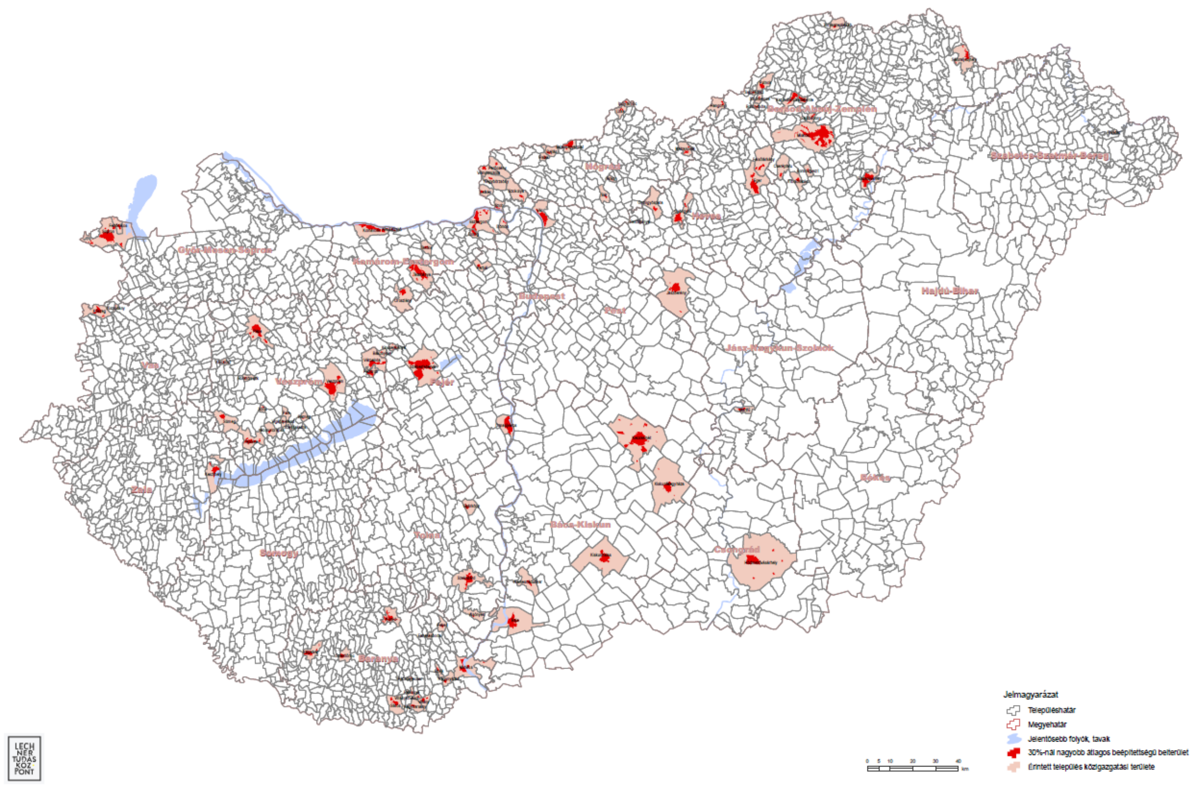
3. Maps of the country showing existing and planned district heating potential

3.1 Heating demand points

3.1.1 Municipalities and conurbations with a building coverage of at least 30 %

The following figure includes a map illustration of municipalities and conurbations where the criterion for a building coverage of at least 30 % is met.

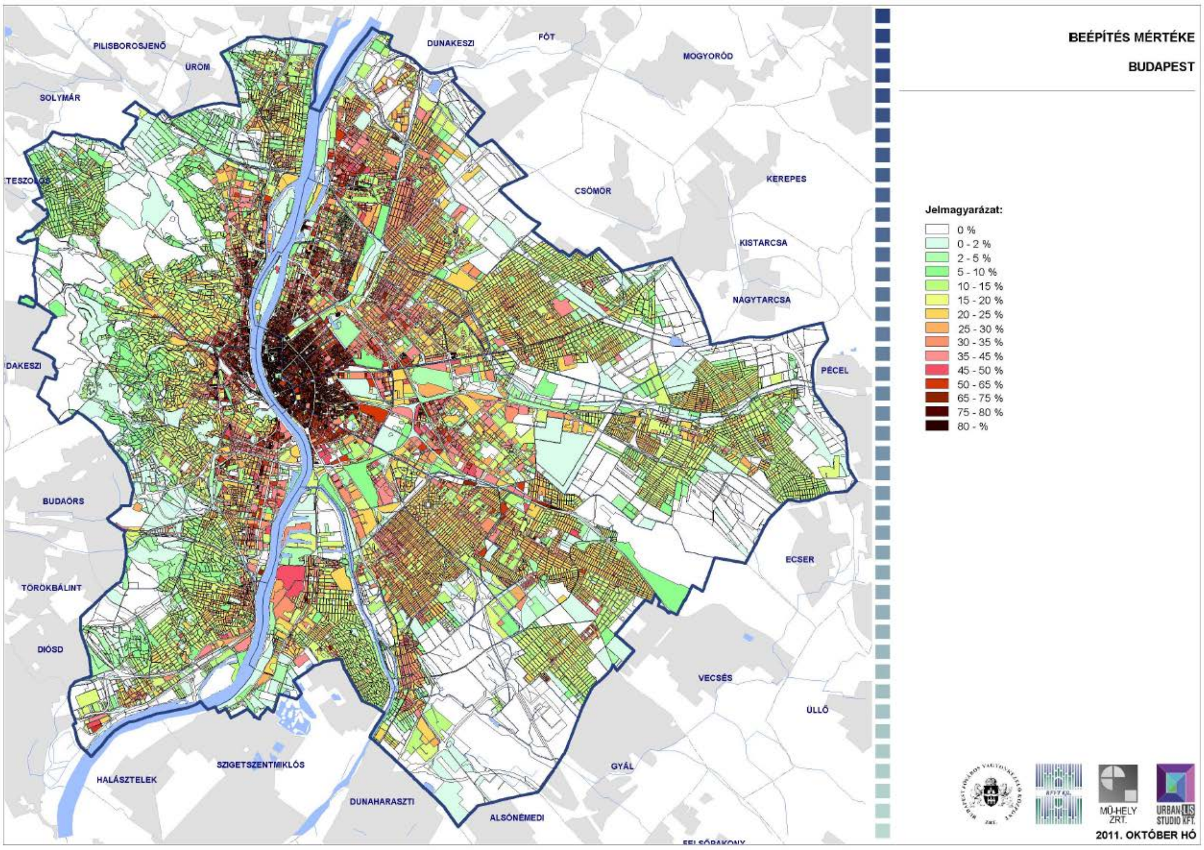
Figure 3 – Municipalities with a building coverage of more than 30 %



Jelmagyarázat	Legend
Településhatár	Municipal boundary
Megyehatár	County boundary
Jelentősebb folyók, tavak	Major rivers and lakes
30%-nál nagyobb átlagos beépítettségű belterület	Inner areas with an average building coverage of more than 30 %
Érintett település közigazgatási területe	Administrative area of a municipality concerned

This is specially supplemented by a building coverage map of the city of Budapest, on the basis of which it can be established that neighbourhoods with a building coverage higher than 30 % are located primarily in the inner districts and, of the outer districts, primarily in housing estate neighbourhoods.

Figure 4 – Building coverage map of Budapest



BEÉPÍTÉS MÉRTÉKE BUDAPEST	BUILDING COVERAGE, BUDAPEST
Jelmagyarázat:	Legend:
2011. OKTÓBER HÓ	OCTOBER 2011

3.1.2 Industrial zones with a total annual heating demand of more than 20 GWh

Under the Statistics Act, the exact amounts of heat consumed by the individual industrial zones are considered confidential business information in Hungary, and the nature of data collection does not allow such direct disclosure of data either. In order to eliminate this, units with a total rated heat input capacity of more than 20 MW_{th} are stated in the report for all firing equipment found at one facility as defined in Annex 1 to Act CCXVII of 2012 on participation in the Community greenhouse gas emissions trading system and the implementation of the Effort Sharing Decision.

Table 1 – Facilities with firing equipment over 20 MW_{th}

Name of facility	Address of facility	Street and street number	Rated capacity (MW)
WIENERBERGER Zrt., Kőszeg Brick Factory	Kőszeg	Csepregi út 2.	11.52
DUNAFIN Paper Mill	Dunaújváros	Papírgyári út 42-46.	12.52
HIGI Papírsoft ZRt., ‘f.a.’ (in liquidation)	Szolnok	Piroskai u. 16.	14.02
WIENERBERGER Zrt., Solymár Brick Factory No I	Budapest	Solymárvölgy, topographical lot No 142	16.568
WIENERBERGER Zrt., Balatonszentgyörgy Brick Factory	Balatonszent-györgy	Balatonszentgyörgy, topographical lot No 047	21.675
Leier Hungaria Kft., Mátraderecske Brick Factory	Mátraderecske	Baross Gábor út 51.	22.49

Hartmann Hungary Kft.	Ács	Hartmann u. 1.	24
Austria Juice Hungary Kft., Vásárosnamény Apple Juice Plant	Vásárosnamény	Nyíregyházi út 3.	25.828
Agrana-Juice-Magyarország Kft., Anarcs Apple Juice Plant	Anarcs	Széchenyi út 72.	25.83
Dunacell Dunaújvárosi Cellulózgyár Kft.	Dunaújváros	Papírgyári u. 42-46.	26
STRABAG Általános Építő Kft., Illatos út Mixing Plant	Budapest	Illatos út 8.	26.09
Szarvas Sowing Seed Plant	Szarvas	Industrial Estate, topographical lot No 0718/18	26.093
Dreher Sörgyárak Zrt.	Budapest	Jászberényi út 7-11.	27.45
TEVA Gyógyszergyár Zrt., Gödöllő Boiler Building	Gödöllő	Táncsics Mihály út 82.	27.575
ESZAT Kft., Apple Processing Plant	Mátészalka	Jármi út 57.	28
EGIS Gyógyszergyár Zrt., Körmend Factory Unit	Körmend	Mátyás király u. 65.	28.706
Szada Compressor Station	Szada	topographical lot No 0107/977	30
WIENERBERGER Zrt., Tiszavasvári Brick Factory	Tiszavasvári	Nánási út, topographical lot No 0194/10	30.311
BE-Optimum Kft.	Budapest	Budafoki út 52.	31.2
ROCKWOOL Hungary Kft., Tapolca Factory	Tapolca	Keszthelyi u. 53.	32.06
Creaton Hungary Kft.	Lenti	Cserépgyár u. 1.	33.124
Nestlé Hungária Kft.	Bük	Darling u. 1.	35
INOTAL Zrt., Inota Site	Várpalota	Fehérvári út 26.	35.33
Csaba Factory Unit	Békéscsaba	Kétegyházi út 2631.	37.25
MÁV VASJÁRMŰ Járműjavító és Gyártó Kft. ‘cs.a.’ (in bankruptcy)	Szombathely	Szövő u. 85.	39.731
SAPA Profiles Kft.	Székesfehérvár	Verseci u. 1–15.	41
Rókus I Heating Plant	Szeged	Fűtőmű u. (topographical lot No 16297/33)	41.834
Univer-Product Zrt.	Kecskemét	Szolnoki út 35.	42.345
Pick Szeged Szalámigyár és Húsüzem Zrt., Central Site	Szeged	Szabadkai út 18.	42.38
Győri Szeszgyár és Finomító ZRt., Boiler Building	Győr	Budai u. 7.	44.14
EGIS Gyógyszergyár Zrt., Central Site	Budapest	Keresztúri út 30-38.	44.258
Ózdi Acélművek Kft.	Ózd	Kovács Hagyó Gyula út 7.	47
Richter Gedeon Nyrt.	Budapest	Gyömrői út 19-21.	49.2
Borsodi Sörgyár Kft., Factory Site	Bocs	Rákóczi Ferenc u. 81.	51.4864
SzBT-1 Compressor and Gas Conditioning Plant	Algyő	Outer areas, topographical lot No 884/18	52.691
Algyő Gas Plant	Algyő	topographical lot No 01884/27	53.063
TEVA Gyógyszergyár Zrt. Boiler Building and Small Gas Turbine Power Plant	Debrecen	Pallagi út 13.	61.44
Báta Compression Station	Báta	topographical lot Nos 020/7, 020/8, 020/9 and 020/10	64.77
MOL Nyrt., Zala Refinery	Zalaegerszeg	Zrínyi M. u. 6., topographical lot No 1871/7	66.084
Villeroy & Boch Magyarország Kft.	Hódmezővásár-hely	Erzsébeti út 7.	67.308

Hankook Tire Magyarország Kft., Tyre Factory	Rácalmás	Hankook tér 1.	67.813
FALCO Zrt., Szombathely Site	Szombathely	Zanati u. 26.	68.005
Mercedes-Benz Manufacturing Hungary Kft.	Kecskemét	Mercedes út 1.	68.05
Rába Futómű Kft., Airport Site	Győr	Martin u. 1.	70.102
Mosonmagyaróvár Compressor Station	Mosonmagyar-óvár	Outer areas	70.208
Airport boiler plant	Győr	Martin u. 1.	71.2
Magyar Földgáztároló Zrt., Hajdúszoboszló South Natural Gas Storage Site	Nagyhegyes	Nagyhegyes, outer areas, topographical lot No 0159/1	78.909
Magyar Földgáztároló Zrt., Hajdúszoboszló South Natural Gas Storage Site	Nagyhegyes	Nagyhegyes, outer areas, topographical lot No 0159/1	79.569
Zoltek Zrt.	Nyergesújfalu	Varga József tér 1.	83.087
Nemesbikk Compression Station	Nemesbikk	Outer areas	87.68
Budapest Airport Zrt.	Budapest	BUD International Airport	88
FGSZ Földgázszállító ZRt., Hajdúszoboszló Compressor Station	Hajdúszoboszló	Balmazújváros, roadside	89.6
Hungarian Suzuki Zrt., Esztergom Factory	Esztergom	Schweidel J. u. 52.	96.2
EVONIK Agroferm Zrt., Energy supply	Kaba	Nádudvar, half road	102.42
Audi Hungaria Motor Kft., Vehicle Factory	Győr	Kardán u. 1.	103.127
Bioethanol Plant – Dunaföldvár	Dunaföldvár	Sas u. 7.	124.1
Magyar Cukor Zrt., Kaposvár Sugar Factory	Kaposvár	Pécs u. 10-14.	128
Magyar Cukor Zrt., Kaposvár Sugar Factory	Kaposvár	Pécs u. 10-14.	128
Dunaferr Blast Furnace and Converter Steelworks	Dunaújváros	Vasmű tér 1-3.	129.73
Nitrogénművek Zrt.	Pétfürdő	Hősök tere 14.	140
MAL Zrt. 'f.a.' (in liquidation), Ajka Site	Ajka	Factory Site, topographical lot No 598/15	141.266
FGSZ Földgázszállító Zrt., Városföld Compressor Station	Városföld	Outer areas	155.1
Danube Heat Generation Centre	Százhalombatta	Olajmunkás u. 2.	172
Alcoa-Köfém Székesfehérvári Könnyűfémmű Kft.	Székesfehérvár	Verseci u. 1-15.	211.34
Hungrana Kft.	Szabadegyháza	Industrial Estate, topographical lot No 0351/26	213.1
FGSZ Földgázszállító Zrt., Beregdaróc Compressor Station	Beregdaróc	Outer areas	288.592
DUNAFERR Hot Rolling Mill	Dunaújváros	Vasmű tér 1-3.	386.168
MOL Nyrt., Danube Refinery	Százhalombatta	Olajmunkás u. 2.	843.734
MOL Nyrt., Danube Refinery	Százhalombatta	Olajmunkás u. 2.	941.7
MOL Nyrt., Danube Refinery	Százhalombatta	Olajmunkás u. 2.	941.7
TVK	Tiszaújváros	Gyári út 1.	1 044.43

3.2 Existing and planned district heating infrastructure

The existing district heating infrastructure broken down by city/town is available under the link below. We note that even more than one district heating area may operate within one city (e.g. in the case of Miskolc and Szeged). The report of the Hungarian Energy and Public Utility Regulatory Authority is available at the following link:

http://www.mekh.hu/download/e/8a/10000/a_magyar_tavho_szektor_2014_evi_statisztikai_adatai.xlsx

Figure 5 – Cities and towns provided with district heating supply in Hungary

3.3 Potential heating distribution points

3.3.1 Electricity generation facilities with a total annual electricity output of over 20 GWh and existing energy generation and district heating facilities listed in Part II of Annex I

The exact electricity output of the individual installations is considered a trade secret, thus the report outlines approximate values. Electricity generation units subject to a licence, including central heating plants, are shown in Annex 1, together with the exact geographical coordinates of the facilities. The list has been cleaned, since facilities with no heat generation during the process have been deleted (e.g. hydropower plants, wind power plants). Small, about 2 MW power plants are included in the list; their output may only exceed 20 MW per year if they have a very high utilisation rate. In many cases, this is not likely; at the same time, because the smallest ones also include gas-fired heating power plants, they have not been deleted from the list. On the basis of the GPS coordinates in the table, the facilities can be shown in a map, and the table also includes the technologies applied, thus it also meets the reporting obligation in connection with the technologies listed in Part II of Annex I to the Directive.

3.3.2 Waste incineration plants

Only one waste plant that verifiably incinerates only municipal waste and does not incinerate hazardous waste during its operation operates in Hungary. This facility is the Metropolitan Waste-to-energy Plant, which has the following exact geographical coordinates: 47°34’56.9”N 19°08’03.4”E.

4. Determination of the heating demand that may be met by high-efficiency cogeneration and district heating and determination of the supplementary high-efficiency cogeneration potential (points D and E)

They are determined on the basis of the study in Annex 2.

5. Determination of the energy efficiency potential of the district heating infrastructure

5.1 Replacement of primary pipelines

According to the district heating annals, the total route length of pipelines is 2 177 km, of which, calculating proportions on the basis of data sent for price regulation by the Professional Federation of Hungarian District Heating Suppliers, the route length of primary pipelines is estimated at 1 827 km, including about 55 % laid in protective ducts and about 7 % running overhead.

With respect to the replacement of primary pipelines, only the replacement of pipelines laid in reinforced concrete protective ducts have been reckoned with. Their service life is more than 30 years everywhere.

The reduction of heat loss depends on the condition of the pipelines and the primary schedule. In addition, the savings also depend on the fee for the heat generated/purchased.

In the case of network optimisation, it was cautiously assumed that the dimension could be reduced by one size in the case of half of the pipelines.

5.2 Separation of heating centres

The number of heat reception stations was approximated using the difference between the number of buildings and heating centres. Payback highly depends on the length of the primary pipelines to be constructed along with separation.

5.3 Insulation and laying underground of overhead pipelines

Re-insulation and laying underground were reckoned with for 90 % and 10 % of overhead pipelines, respectively. In this case, too, payback depends on the primary temperature gradient and the fee for the heat generated/purchased.

5.4 Connection of new consumers to district heating

The connection of new consumers corresponding to 10 % of current peak heat demand was taken into account.

5.5 Establishment of a telemechanical system

Our approximation considered that no telemechanical system or telemonitoring is established yet in one third of the heating centres.

5.6 Heat source upgrading (natural gas-fired peak load boilers)

Only the boilers of district heating providers were taken into account, with the assumption that about 50 % of the boilers have to be refurbished.

5.7 Connection of heat sources

Our calculations were based on the pilot project of FŐTÁV Zrt.

5.8 Installation of biomass boilers

Our calculations included new installations with a capacity of 250 MW.

Table 2 – Energy efficiency potential of the district heating system in Hungary

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
Replacement of primary pipeline with original diameter	Route length	1 014 289	m	182 572	5 521 037	452 199		33.1	403.7	5.8 %	It depends on the primary schedule and the fee for the heat purchased/ generated.
Replacement of the primary pipeline (in	Route length	1 014 289	m	167 358	6 073 141	497 419		27.6	336.5	7.4 %	

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
the case of reducible diameters for half of the pipelines)											
Separation of heating centres	Number of heat reception stations	6 861	qty	45 279	1 503 059	103 126		30.1	439.1	4.9 %	It highly depends on the length of the primary pipelines to be constructed.

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
Heat insulation of overhead pipelines	Route length	120 045	m	20 721	683 294	40 764		30.3	508.3	12.4 %	
Laying of overhead pipelines in the ground	Route length	13 338	m	2 387	82 654	4 931		28.9	484.1	12.7 %	Only where it is also recommended from the point of view of cityscape or property protection

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
Connection of new consumers to district heating	Heating capacity demand	405 162	kW	21 616	525 232	50 752		41.2	425.9	12.1 %	
Establishment of a telemechanical system	Number of heat centres	4 251	qty	3 903	137 139	8 284		28.5	471.1	6.6 %	
Heat source upgrading (with a gas-fired boiler)	Installed heat capacity	426 545	kW	6 790	256 817	12 490		26.4	543.6	14.3 %	

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
Increasing and optimisation of the utilisation rate of heat sources by connecting heating districts	Capacity growth	200	MW	35 572	684 531	192 197		52.0	185.1	14.0 %	It depends on the fee for the heat produced by the heat source(s).
Installation of a gas engine heat storage tank	Storage tank size	100 000	m^3	5 822	691 375	39 147		8.4	148.7	11.3 %	

Activity	Quantity			Capital cost	Fuel heat input saved	Reduction in green-house gas emissions	Increase in the use of renewable energy sources	Capital cost requirement of saving 1 GJ/year of fuel heat input	Capital cost requirement of 1 tonne/ year reduction in green-house gas emissions	Ave-rage BMR	Note
				HUF million	GJ/year	tonne/ year	GJ/year	HUF thousand/ GJ/ year	HUF/ tonne/ year		
Installation of a biomass boiler	Installed heat capacity	250 000	kW	28 838		247 561	3 756 704	7.7	116.5	13.7 %	

6. In order to meet the demand referred to in point D and to reach the potential stated in point E, strategies, specialist policies and measures acceptable until 2020 and 2030

6.1 Increasing the proportion of cogeneration within heating energy and electricity generation

6.2 Development of an efficient district heating infrastructure that is compatible with the development of high-efficiency cogeneration ...

6.3 Encouraging the construction of new heat-based electricity generation facilities and industrial plants generating waste heat generating at sites where ...

6.4 Specialist policies to ensure that residential areas and industrial heat consumers are established where waste heat is available

6.5 Specialist policies to encourage that electricity generation facilities, waste recovery facilities and other industrial facilities generating waste heat are connected to the district heating system

6.6 Specialist policies to ensure that residential areas and heat-consuming industrial facilities are connected to the district heating network

7. Proportion of high-efficiency cogeneration and potential and progress specified under Directive 2004/8/EC

The report on high-efficiency cogeneration sent by the Hungarian Energy and Public Utility Regulatory Authority to the Commission under Directive 2004/8/EC contains the following information for 2013.

Table 3 – Report of the MEKH on CHP generation in Hungary sent to the Commission in connection with Directive 2004/8/EC

Completely CHP Units (Efficiency > 75%)									
Type of cycle		Maximum capacity			Production			Fuel Input	Number of Units
		Electricity		Heat	Electricity		Heat		
		CHP	Gross	Net	CHP	Gross	CHP		
		MW	MW	MW	GWh	GWh	TJ	TJ (NCV)	n
		A	B	C	D	F	G	H	I
Combined cycle (eff > 80%)	1	317.8	317.8	391.3	778.337	778.337	4 220.782	8 538.668	6
Gas turbine with heat recovery	2	269.53	269.53	410.46	833.2887	833.2887	4 741.238	9 142.117	13
Internal Combustion engine	3	350.136	350.136	369.065	1 123.048	1 123.048	4 260.362	10 250.28	195
Steam: backpressure turbine	4	118	118	619.5141	226.2326	226.2326	5 976.549	7 691.289	13
Steam: condensing turbine (eff > 80%)	5	96.1	96.1	174.5	94.03291	94.03291	1 220.261	1 862.024	3
Others	6	0	0	0	0	0	0	0	0
Subtotal (1 +2+3+4+5+6)	**7**	**1 151,566**	**1 151,566**	**1 964,839**	**3 054,939**	**3 054,939**	**20 419,19**	**37 484,37**	**230**
Units with a non-CHP component (Efficiency < 75%)									
Type of cycle		Maximum capacity			Production			Fuel Input	Number of Units
		Electricity		Heat	Electricity		Heat		
		CHP	Gross	Net	CHP	Gross	CHP		
		MW	MW	MW	GWh	GWh	TJ	TJ (NCV)	n
Combined cycle (eff > 80%)	8	250.7	534	303.2	400.6922	1 225.691	2 200.799	4 546.41	3
Gas turbine with heat recovery	9	4.455	4.875	8.1	5.327667	5.769	34.872	71.38649	1
Internal Combustion engine	10	84.90194	100.171	105.447	177.2702	257.1563	745.2918	1 961.799	84
Steam: backpressure turbine	11	47.1446	47.547	347.7836	81.76446	102.0324	2 170.604	3 025.62	6
Steam: condensing turbine (eff > 80%)	12	133.2388	1 258.2	426.2	159.8822	8 336.17	1 426.417	3 430.04	15
Others	13	0	0	0	0	0	0	0	0
Subtotal (8+9+10+11+12+13)	**14**	**520.4403**	**1944.793**	**1 190.731**	**824.9368**	**9 926.818**	**6 577.984**	**13 035.25**	**109**
Total (7+14)	**15**	**1 672.006**	**3 096.359**	**3 155.57**	**3 879.876**	**12 981.76**	**26 997.17**	**50 519.63**	**339**
of which Autoproducers	16	129.9502	136.927	333.3008	422.083	480.3089	4 711.39	7 837.751	96

8. Estimation of required primary energy savings

9. Estimate for possible State aid measures to be taken for heating purposes

The tables presented in this chapter reckon with a model for the establishment of renewable heat generation capacities, which is financed through 40 % of non-reimbursable aid. Due to the uncertainty of the future, three scenarios were outlined in total. They differ in the extent to which district heating demand will change in the future.

9.1 Scenario 1: Minimum district heating

It is the alternative assuming the lowest overall rate of use of district heating, according to which:

- the district heating demand of current users will decrease along with a faster pace of upgrading;
- the number of users will remain at the current level in all reviewed segments.

The results of model calculations are shown in Table 4**.**

It can be established that if demand is met and the energy mix is realised in accordance with Scenario 1, the financiers of the district heating sector will realise savings of HUF 14 057 million in 2020 compared to 2015, which will increase about 2.5-fold (HUF 34 104 million) by 2040. It can be seen that, although significantly decreasing, the baseline of district heating aid may not be eliminated even in 2040 if Scenario 1 is implemented. The demand for the development of geothermal capacity is 150 MW in total until 2019 (HUF 45 billion), and an additional 216 MW until 2039 (HUF 64.8 billion).

In the case of the required biomass-based sources, it will be necessary to establish a capacity of 215 MW before 2020 (HUF 25.8 billion), which will continue to increase by about 199 MW by 2040 (HUF 23.8 billion).

If all savings in financing were spent on reducing the district heating cost of the general public (continuing utility rate cuts), it would allow a reduction of the initial HUF 3 900/GJ by HUF 651/GJ (16.7 %) in 2020 and HUF 2 034 (52.1 %) in 2040. If the projects do not receive any support, the price reduction potential for 2020 and 2040 will decrease to HUF 598/GJ and HUF 1 881/GJ, respectively.

Interpolating the value of district heating aid relative to residential consumption to 2021 (HUF 1 760/GJ), it can be established that when the aid will be removed as of 2022, the residential price of heat (if there is no change in the prices payable by other users) should be increased by about 45 % compared to today's price level in order to ensure lossless district heating.

Table 4 – Calculations of the scenario assuming minimum use of district heating

Description	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
Scenario 1										
Heat sold to residential consumers (PJ)	24.48	24.17	23.69	23.05	22.33	21.61	19.15	17.33	16.94	16.77
Residential sales revenue (HUF million)	95 472	94 263	92 391	89 895	87 087	84 279	74 685	67 587	66 066	65 403
Heat sold to KKKIs (PJ)	2.45	2.42	2.39	2.34	2.28	2.21	2.03	1.91	1.83	1.82
KKI sales revenue (HUF million)	14 333	14 157	13 982	13 689	13 338	12 929	11 876	11 174	10 706	10 647
Commercial sales (PJ)	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69
Commercial sales revenue (HUF million)	20 003	20 003	20 003	20 003	20 003	20 003	20 003	20 003	20 003	20 003
Total consumer energy demand (PJ)	30.62	30.28	29.77	29.08	28.3	27.51	24.87	22.93	22.46	22.28
Total consumer sales revenue (HUF million)	***129 808***	***128 423***	***126 376***	***123 587***	***120 428***	***117 211***	***106 564***	***98 764***	***96 775***	***96 053***
Network loss (PJ)	4.18	4.08	3.95	3.81	3.66	3.51	2.95	2.72	2.67	2.64
Total heat output (PJ)	34.8	34.36	33.72	32.89	31.96	31.02	27.82	25.65	25.13	24.92
Natural gas-based district heat generation (PJ)	29.79	26.81	25.72	23.94	22.05	20.05	11.34	8.47	6.14	5.72
cogenerated (PJ)	13.41	12.8	12.28	11.43	10.53	9.57	5.41	4.65	3.37	3.14
energy cost of cogenerated heat (HUF million)	54 981	52 480	50 348	46 863	43 173	39 237	22 181	19 065	13 817	12 874
generated by boilers (PJ)	16.38	14.01	13.44	12.51	11.52	10.48	5.93	3.82	2.77	2.58
energy cost of heat generated by boilers (HUF million)	72 891	62 345	59 808	55 670	51 264	46 636	26 389	16 999	12 327	11 481
Energy cost of natural gas-based district heat generation (HUF million)	127 872	114 825	110 156	102 533	94 437	85 873	48 570	36 064	26 144	24 355
Total of renewable-based district heat generation (PJ)	4.00	6.60	7.10	8.10	9.10	10.20	15.88	16.72	18.63	18.93
geothermal district heat (PJ)	1.00	2.00	2.20	2.70	3.20	3.70	5.72	6.19	7.39	7.59
energy cost of geothermal district heat (HUF million)	2 600	5 200	5 720	7 020	8 320	9 620	14 872	16 094	19 214	19 734
biomass-based district heat (PJ)	2.50	3.70	4.00	4.50	5.00	5.60	7.66	8.03	8.41	8.46
energy cost of biomass-based district heat (HUF million)	8 500	12 580	13 600	15 300	17 000	19 040	26 044	27 302	28 594	28 764
waste-based district heat generation (PJ)	0.50	0.90	0.90	0.90	0.90	0.90	2.50	2.50	2.83	2.88
energy cost of waste-based district heat generation (HUF million)	500	900	900	900	900	900	4 100	4 100	4 760	4 860
Energy cost of renewable-based district heat generation (PJ)	11 600	18 680	20 220	23 220	26 220	29 560	45 016	47 496	52 568	53 358
Other district heat generation (PJ)	1.00	0.95	0.90	0.86	0.81	0.77	0.60	0.46	0.36	0.28
Energy cost of other district heat generation (HUF million)	2 200	2 090	1 980	1 892	1 782	1 694	1 320	1 012	792	616
Total energy cost of district heat generation (HUF million)	***141 672***	***135 595***	***132 356***	***127 645***	***122 439***	***117 127***	***94 906***	***84 572***	***79 504***	***78 329***

Cost of district heat generation without energy costs (HUF million)	***42 136***	***41 334***	***41 150***	***40 789***	***40 427***	***40 027***	***38 551***	***38 250***	***37 706***	***37 620***
Total cost of district heat generation (HUF million)	***183 808***	***176 929***	***173 506***	***168 433***	***162 866***	***157 154***	***133 456***	***122 822***	***117 209***	***115 949***
Applications for district heat supply aid (HUF million)	***54 000***	***48 505***	***47 130***	***44 846***	***42 438***	***39 943***	***26 892***	***24 058***	***20 434***	***19 896***
Change in applications for district heat supply aid (HUF million/year)	***0***	***-5 495***	***-6 870***	***-9 154***	***-11 562***	***-14 057***	***-2 7108***	***-29 942***	***-33 566***	***-34 104***
Decrease in aid applications relative to residential heat consumption (HUF/GJ)	***0***	***-227***	***-290***	***-397***	***-518***	***-651***	***-1 416***	***-1 728***	***-1 981***	***-2 034***
Capital costs of renewable capacities										
Renewable capacities to be newly established										
geothermal capacity (MW)		56	11	28	28	28	112	26	67	11
cumulative geothermal capacity (MW)		56	67	94	122	150	262	288	355	366
geothermal capacity development cost (HUF million)	16 667	3 333	8 333	8 333	8 333		33 667	7 833	20 000	3 333
cumulative geothermal capacity development cost (HUF million)	16 667	20 000	28 333	36 667	45 000	45 000	78 667	86 500	106 500	109 833
biomass capacity (MW)		83	21	35	35	42	143	26	26	3
cumulative biomass capacity (MW)		83	104	139	174	215	358	384	410	414
biomass capacity development cost (HUF million)	10 000	2 500	4 167	4 167	5 000		17 167	3 083	3 167	417
cumulative biomass capacity development cost (HUF million)	10 000	12 500	16 667	20 833	25 833	25 833	43 000	46 083	49 250	49 667
Change in costs other than energy costs										
Savings on non-energy costs due to VNT (HUF million/year)										
geothermal capacities (HUF million/year)	0	267	53	133	133	133	539	125	320	53
biomass capacities (HUF million/year)	0	160	40	67	67	80	275	49	51	7
Savings on non-energy costs due to scaled-back capacities (HUF million/year)	0	375	91	161	161	188	663	126	174	26
Change in home equivalents (qty)		0	0	0	0	0	0	0	0	0
Increase in non-energy costs due to the entry of new users (HUF million/year)	0	0	0	0	0	0	0	0	0	0

9.2 Scenario 2: balanced use of district heating

In the balanced scenario:

- the district heating demand of current users will decrease along with a faster pace of upgrading;
- the number of users will continuously increase in all reviewed segments.

The results of model calculations are shown in Table 5**.**

It can be established that if demand is met and the energy mix is realised in accordance with Scenario 2, the financiers of the district heating sector will realise savings of HUF 14 124 million in 2020 compared to 2015, which will significantly (HUF 35 776 million) increase by 2040. This means that, although significantly decreasing, the baseline of district heating aid may not be eliminated even in 2014 if Scenario 2 is implemented. The demand for the development of geothermal capacity is 150 MW in total until 2019 (HUF 45 billion), and an additional 274 MW until 2039 (HUF 82.3 billion).

In the case of the required biomass-based sources, it will be necessary to establish a capacity of 215 MW before 2020 (HUF 25.8 billion), which will continue to increase by about 265 MW by 2040 (HUF 31.8 billion).

If all savings in financing were spent on reducing the district heating cost of the general public (continuing utility rate cuts), it would allow a reduction of the initial HUF 3 900/GJ by HUF 651/GJ (16.7 %) in 2020 and HUF 1 924 (49.3 %) in 2040.

Interpolating the value of district heating aid relative to residential consumption to 2021 (HUF 1 747/GJ), it can be established that when the aid will be removed as of 2022, the residential price of heat (if there is no change in the prices payable by other users) should be increased by about 44.7 % compared to today’s price level in order to ensure lossless district heating.

Table 5 – Calculations of the scenario assuming minimum use of district heating

Description	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
Scenario 2										
Heat sold to residential consumers (PJ)	24.48	24.17	23.69	23.05	22.33	21.69	19.65	18.26	18.31	18.59
Residential sales revenue (HUF million)	95 472	94 263	92 391	89 895	87 087	84 591	76 635	71 214	71 409	72 501
Heat sold to KKKIs (PJ)	2.45	2.44	2.42	2.4	2.35	2.31	2.21	2.19	2.22	2.32
KKI sales revenue (HUF million)	14 333	14 274	14 157	14 040	13 748	13 514	12 929	12 812	12 987	13 572
Commercial sales (PJ)	3.69	3.71	3.73	3.75	3.77	3.79	3.88	3.98	4.08	4.18
Commercial sales revenue (HUF million)	20 003	20 112	20 220	20 329	20 437	20 546	21 033	21 576	22 118	22 660
Total consumer energy demand (PJ)	30.62	30.32	29.84	29.2	28.45	27.79	25.74	24.43	24.61	25.09
Total consumer sales revenue (HUF million)	***129 808***	***128 649***	***126 768***	***124 264***	***121 272***	***118 650***	***110 597***	***105 601***	***106 514***	***108 733***
Network loss (PJ)	4.18	4.08	3.96	3.83	3.68	3.54	3.06	2.9	2.92	2.98
Total heat output (PJ)	34.8	34.4	33.8	33.03	32.13	31.33	28.8	27.33	27.53	28.07
Natural gas-based district heat generation (PJ)	29.79	26.85	25.8	24.06	22.22	20.35	12.15	9.18	6.58	6.8
cogenerated (PJ)	13.41	12.82	12.32	11.49	10.61	9.72	5.8	5.04	3.61	3.73
energy cost of cogenerated heat (HUF million)	54 981	52 562	50 512	47 109	43 501	39 852	23 780	20 664	14 801	15 293
generated by boilers (PJ)	16.38	14.03	13.48	12.57	11.61	10.63	6.35	4.14	2.97	3.07
energy cost of heat generated by boilers (HUF million)	72 891	62 434	59 986	55 937	51 665	47 304	28 258	18 423	13 217	13 662
Energy cost of natural gas-based district heat generation (HUF million)	127 872	114 996	110 498	103 046	95 166	87 156	52 038	39 087	28 018	28 955
Total of renewable-based district heat generation (PJ)	4.00	6.60	7.10	8.10	9.10	10.20	16.05	17.70	20.60	21.00
geothermal district heat (PJ)	1.00	2.00	2.20	2.70	3.20	3.70	5.75	6.72	8.52	8.64
energy cost of geothermal district heat (HUF million)	2 600	5 200	5 720	7 020	8 320	9 620	14 950	17 472	22 152	22 464
biomass-based district heat (PJ)	2.50	3.70	4.00	4.50	5.00	5.60	7.80	8.48	9.13	9.41
energy cost of biomass-based district heat (HUF million)	8 500	12 580	13 600	15 300	17 000	19 040	26 520	28 832	31 042	31 994
waste-based district heat generation (PJ)	0.50	0.90	0.90	0.90	0.90	0.90	2.50	2.50	2.95	2.95
energy cost of waste-based district heat generation (HUF million)	500	900	900	900	900	900	4 100	4 100	5 000	5 000
Energy cost of renewable-based district heat generation (PJ)	11 600	18 680	20 220	23 220	26 220	29 560	45 570	50 404	58 194	59 458
Other district heat generation (PJ)	1.00	0.95	0.90	0.86	0.81	0.77	0.60	0.46	0.36	0.28
Energy cost of other district heat generation (HUF million)	2 200	2 090	1 980	1 892	1 782	1 694	1 320	1 012	792	616
Total energy cost of district heat generation (HUF million)	***141 672***	***135 766***	***132 698***	***128 158***	***123 168***	***118 410***	***98 928***	***90 503***	***87 004***	***89 029***

Cost of district heat generation without energy costs (HUF million)	***42 136***	***41 346***	***41 173***	***40 823***	***40 473***	***40 117***	***38 800***	***38 444***	***37 833***	***37 928***
Total cost of district heat generation (HUF million)	***183 808***	***177 111***	***173 871***	***168 981***	***163 641***	***158 526***	***137 727***	***128 947***	***124 837***	***126 956***
Applications for district heat supply aid (HUF million)	***54 000***	***48 462***	***47 103***	***44 717***	***42 369***	***39 876***	***27 130***	***23 346***	***18 323***	***18 224***
Change in applications for district heat supply aid (HUF million/year)	***0***	***-5 538***	***-6 897***	***-9 283***	***-11 631***	***-14 124***	***-26 870***	***-30 654***	***-35 677***	***-35 776***
Decrease in aid applications relative to residential heat consumption (HUF/GJ)	***0***	***-229***	***-291***	***-403***	***-521***	***-651***	***-1 367***	***-1 679***	***-1 949***	***-1 924***
Capital costs of renewable capacities										
Renewable capacities to be newly established										
geothermal capacity (MW)		56	11	28	28	28	114	54	100	7
cumulative geothermal capacity (MW)		56	67	94	122	150	264	318	418	424
geothermal capacity development cost (HUF million)	16 667	3 333	8 333	8 333	8 333		34 167	16 167	30 000	2 000
cumulative geothermal capacity development cost (HUF million)	16 667	20 000	28 333	36 667	45 000	45 000	79 167	95 333	125 333	127 333
biomass capacity (MW)		83	21	35	35	42	153	47	45	19
cumulative biomass capacity (MW)		83	104	139	174	215	368	415	460	480
biomass capacity development cost (HUF million)	10 000	2 500	4 167	4 167	5 000		18 333	5 667	5 417	2 333
cumulative biomass capacity development cost (HUF million)	10 000	12 500	16 667	20 833	25 833	25 833	44 167	49 833	55 250	57 583
Change in costs other than energy costs										
Savings on non-energy costs due to VNT (HUF million/year)										
geothermal capacities (HUF million/year)	0	267	53	133	133	133	547	259	480	32
biomass capacities (HUF million/year)	0	160	40	67	67	80	293	91	87	37
Savings on non-energy costs due to scaled-back capacities (HUF million/year)	0	375	91	161	161	188	701	238	282	80
Change in home equivalents (qty)		1 134	1 143	1 152	1 161	4 410	22 435	23 091	23 768	24 468
Increase in non-energy costs due to the entry of new users (HUF million/year)	0	11	11	12	12	44	224	231	238	245

9.3 Scenario 3: Scenario assuming maximum use of district heating

According to the alternative assuming the highest overall rate of use of district heating:

- the district heating demand of current users will decrease along with a slower pace of upgrading;
- the number of users will continuously increase in all reviewed segments.

The results of model calculations are shown in Table 6**.**

It can be established that if demand is met and the energy mix is realised in accordance with Scenario 3, the financiers of the district heating sector will realise savings of HUF 13 673 million in 2020 compared to 2015, which will significantly (HUF 35 941 million) increase by 2040. This means that, although significantly decreasing, the baseline of district heating aid may not be eliminated even in 2014 even if Scenario 3 is implemented. The demand for the development of geothermal capacity is 150 MW in total until 2019 (HUF 45 billion), and an additional 278 MW until 2039 (HUF 83.3 billion).

In the case of the required biomass-based sources, it will be necessary to establish a capacity of 215 MW before 2020 (HUF 25.8 billion), which will continue to increase by about 276 MW by 2040 (HUF 33.2 billion).

If all savings in financing were spent on reducing the district heating cost of the general public (continuing utility rate cuts), it would allow a reduction of the initial HUF 3 900/GJ by HUF 616/GJ (15.8 %) in 2020 and HUF 1 910/GJ (49 %) in 2040.

Interpolating the value of district heating aid relative to residential consumption to 2021 (HUF 1 725/GJ), it can be established that when the aid will be removed as of 2022, the residential price of heat (if there is no change in the prices payable by other users) should be increased by about 44.2 % compared to today's price level in order to ensure lossless district heating.

Table 6 – Calculations of the scenario assuming the highest rate of use of district heating

Description	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
Scenario 3										
Heat sold to residential consumers (PJ)	24.48	24.17	23.77	23.3	22.74	22.19	20.55	19.25	18.79	18.82
Residential sales revenue (HUF million)	95 472	94 263	92 703	90 870	88 686	86 541	80 145	75 075	73 281	73 398
Heat sold to KKKIs (PJ)	2.45	2.44	2.42	2.4	2.35	2.31	2.21	2.19	2.22	2.32
KKI sales revenue (HUF million)	14 333	14 274	14 157	14 040	13 748	13 514	12 929	12 812	12 987	13 572
Commercial sales (PJ)	3.69	3.71	3.73	3.75	3.77	3.79	3.88	3.98	4.08	4.18
Commercial sales revenue (HUF million)	20 003	20 112	20 220	20 329	20 437	20 546	21 033	21 576	22 118	22 660
Total consumer energy demand (PJ)	30.62	30.32	29.92	29.45	28.86	28.29	26.64	25.42	25.09	25.32
Total consumer sales revenue (HUF million)	***129 808***	***128 649***	***127 080***	***125 239***	***122 871***	***120 600***	***114 107***	***109 462***	***108 386***	***109 630***
Network loss (PJ)	4.18	4.08	3.97	3.86	3.73	3.6	3.16	3.02	2.98	3.01
Total heat output (PJ)	34.8	34.4	33.89	33.31	32.59	31.89	29.8	28.44	28.07	28.33
Natural gas-based district heat generation (PJ)	29.79	26.85	25.9	24.34	22.68	20.91	13.13	9.65	7.68	6.82
cogenerated (PJ)	13.41	12.82	12.37	11.62	10.83	9.98	6.27	5.3	4.22	3.74
energy cost of cogenerated heat (HUF million)	54 981	52 562	50 717	47 642	44 403	40 918	25 707	21 730	17 302	15 334
generated by boilers (PJ)	16.38	14.03	13.53	12.72	11.85	10.93	6.86	4.35	3.46	3.08
energy cost of heat generated by boilers (HUF million)	72 891	62 434	60 209	56 604	52 733	48 639	30 527	19 358	15 397	13 706
Energy cost of natural gas-based district heat generation (HUF million)	127 872	114 996	110 926	104 246	97 136	89 557	56 234	41 088	32 699	29 040
Total of renewable-based district heat generation (PJ)	4.00	6.60	7.10	8.10	9.10	10.20	16.08	18.33	20.03	21.23
geothermal district heat (PJ)	1.00	2.00	2.20	2.70	3.20	3.70	5.75	7.00	8.00	8.70
energy cost of geothermal district heat (HUF million)	2 600	5 200	5 720	7 020	8 320	9 620	14 950	18 200	20 800	22 620
biomass-based district heat (PJ)	2.50	3.70	4.00	4.50	5.00	5.60	7.83	8.83	9.28	9.58
energy cost of biomass-based district heat (HUF million)	8 500	12 580	13 600	15 300	17 000	19 040	26 622	30 022	31 552	32 572
waste-based district heat generation (PJ)	0.50	0.90	0.90	0.90	0.90	0.90	2.50	2.50	2.75	2.95
energy cost of waste-based district heat generation (HUF million)	500	900	900	900	900	900	4 100	4 100	4 600	5 000
Energy cost of renewable-based district heat generation (PJ)	11 600	18 680	20 220	23 220	26 220	29 560	45 672	52 322	56 952	60 192
Other district heat generation (PJ)	1.00	0.95	0.90	0.86	0.81	0.77	0.60	0.46	0.36	0.28
Energy cost of other district heat generation (HUF million)	2 200	2 090	1 980	1 892	1 782	1 694	1 320	1 012	792	616
Total energy cost of district heat generation (HUF million)	***141 672***	***135 766***	***133 126***	***129 358***	***125 138***	***120 811***	***103 226***	***94 422***	***90 443***	***89 848***

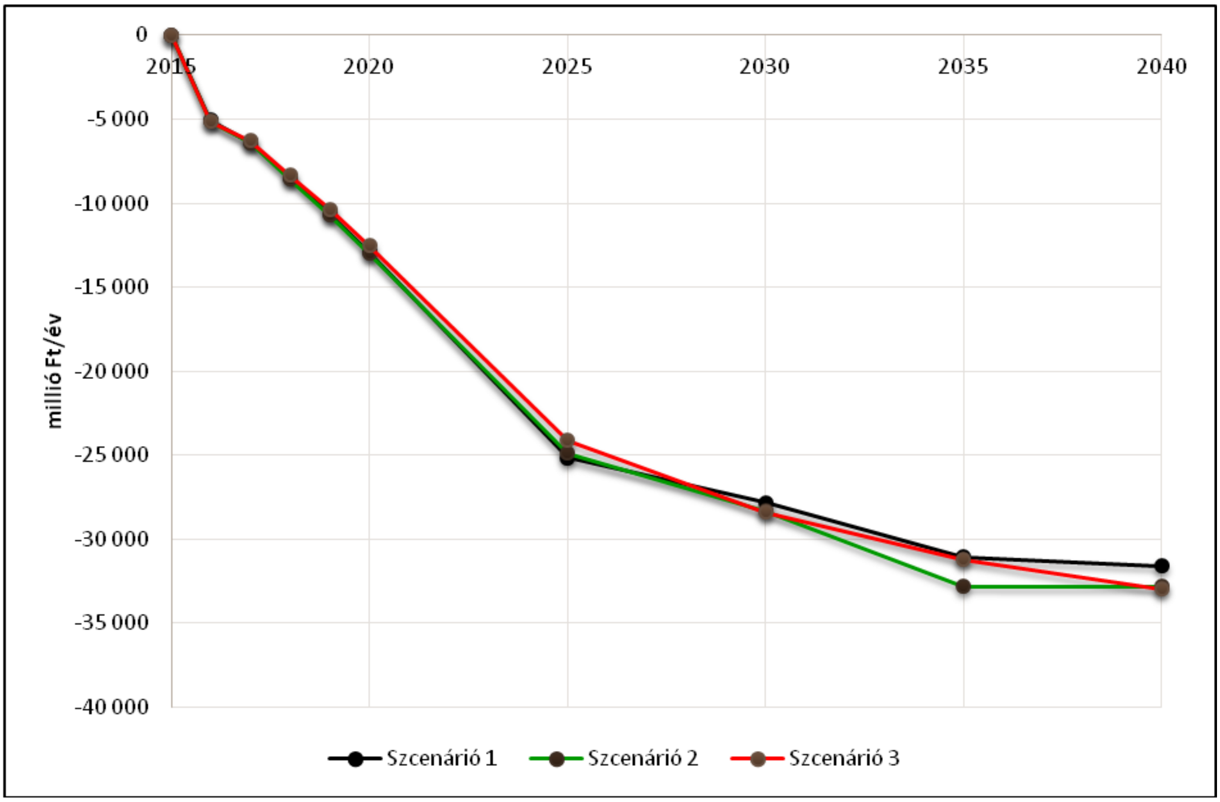
Cost of district heat generation without energy costs (HUF million)	***42 136***	***41 346***	***41 173***	***40 823***	***40 473***	***40 117***	***38 788***	***38 214***	***37 945***	***37 841***
Total cost of district heat generation (HUF million)	***183 808***	***177 111***	***174 299***	***170 181***	***165 611***	***160 927***	***142 014***	***132 635***	***128 388***	***127 689***
Applications for district heat supply aid (HUF million)	***54 000***	***48 462***	***47 218***	***44 942***	***42 740***	***40 327***	***27 907***	***23 173***	***20 002***	***18 059***
Change in applications for district heat supply aid (HUF million/year)	***0***	***-5 538***	***-6 782***	***-9 058***	***-11 260***	***-13 673***	***-26 093***	***-30 827***	***-33 998***	***-35 941***
Decrease in aid applications relative to residential heat consumption (HUF/GJ)	***0***	***-229***	***-285***	***-389***	***-495***	***-616***	***-1 270***	***-1 601***	***-1 809***	***-1 910***
Capital costs of renewable capacities										
Renewable capacities to be newly established										
geothermal capacity (MW)		56	11	28	28	28	114	69	56	39
cumulative geothermal capacity (MW)		56	67	94	122	150	264	333	389	428
geothermal capacity development cost (HUF million)	16 667	3 333	8 333	8 333	8 333		34 167	20 833	16 667	11 667
cumulative geothermal capacity development cost (HUF million)	16 667	20 000	28 333	36 667	45 000	45 000	79 167	100 000	116 667	128 333
biomass capacity (MW)		83	21	35	35	42	155	69	31	21
cumulative biomass capacity (MW)		83	104	139	174	215	370	440	471	492
biomass capacity development cost (HUF million)	10 000	2 500	4 167	4 167	5 000		18 583	8 333	3 750	2 500
cumulative biomass capacity development cost (HUF million)	10 000	12 500	16 667	20 833	25 833	25 833	44 417	52 750	56 500	59 000
Change in costs other than energy costs										
Savings on non-energy costs due to VNT (HUF million/year)										
geothermal capacities (HUF million/year)	0	267	53	133	133	133	547	333	267	187
biomass capacities (HUF million/year)	0	160	40	67	67	80	297	133	60	40
Savings on non-energy costs due to scaled-back capacities (HUF million/year)	0	375	91	161	161	188	709	339	180	122
Change in home equivalents (qty)		1 134	1 143	1 152	1 161	4 410	22 435	23 091	23 768	24 468
Increase in non-energy costs due to the entry of new users (HUF million/year)	0	11	11	12	12	44	224	231	238	245

9.4 Comparison of scenarios

Figure 6 and Figure 7 show the change in the total volume of district heating aid for the three reviewed scenarios, assuming the cases of 0 % and 40 % of non-reimbursable investment grant aid. It can be seen that the three scenarios show similar results in both reviewed alternatives of the project VTN in terms of effect on the development of the total district heating aid. The results of the three scenarios hardly differ until 2025. The decrease in aid demand will slow down in the last 15 years.

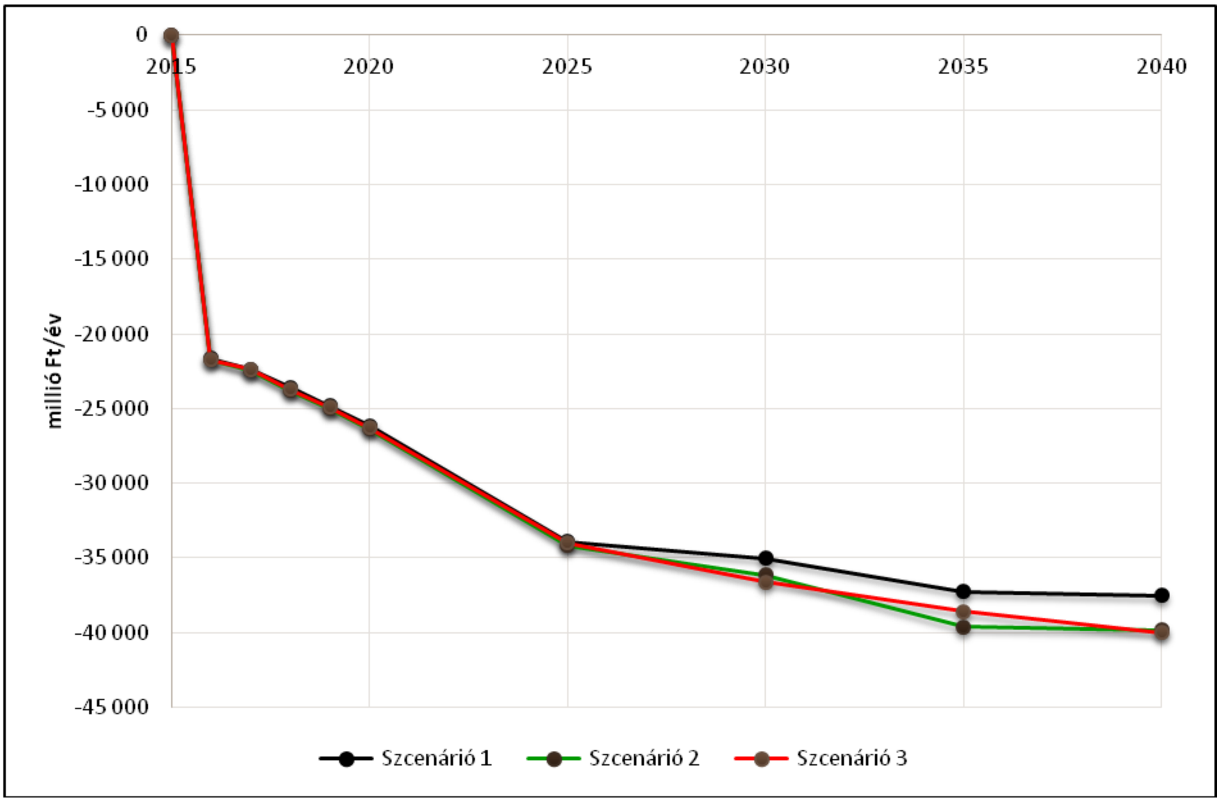
The fundamental reason for a slower than expected pace of aid needs is that the capital and energy costs of new renewable technologies result in a rather high cost to generate district heat compared to the prices of natural gas-based technologies to be replaced, which grant aid available for the project can only alleviate.

Figure 6 – Change in applications for district heat supply aid compared to the base year 2015, ignoring non-refundable aid for renewable projects



millió Ft/év	HUF million/year
Szcenárió 1	Scenario 1
Szcenárió 2	Scenario 2
Szcenárió 3	Scenario 3

Figure 7 – Change in applications for district heat aid compared to the base year 2015, reckoning with 40 % of non-refundable aid for projects



millió Ft/év	HUF million/year
Szcenárió 1	Scenario 1
Szcenárió 2	Scenario 2
Szcenárió 3	Scenario 3

Annexes

Annex 1: Electricity generation facilities potentially exceeding an electricity output of 20 GWh

Annex 2: Estimation of high-efficiency cogeneration and efficient district heating potential