GASIFICATION PLANS AND BUILDING HEATING OPTIONS IN MACEDONIA

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SKOPJE

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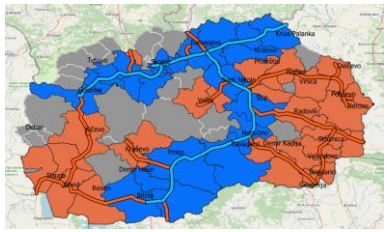
MODEL APPLIED

Household decision model: changing heating appliance

INPUTS AND PARAMETERS

MUNICIPALITY LEVEL DATASET

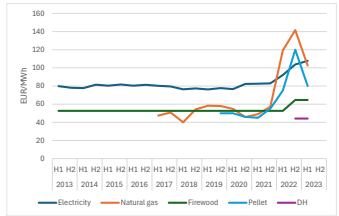


URBAN RURAL

HEATING TECHNOLOGIES

	CH Elec	CH firewood	CH pellet	CH gas
	Air-to-Air heat pump	Solid stove central	Pellet boiler cen-tral	Condensing gas boiler central
				
Efficiency (%)	300%	85%	90%	110%
Equipment cost EUR	10000	1200	5000	2000
Installation cost EUR	1000	1000	1000	1000
# units	1	1	1	1

FUEL COSTS



BUILDING TYPOLOGY

PARAMETERS

Discount rate
Switching rate
Investment costs
Under-heating
Fuel costs

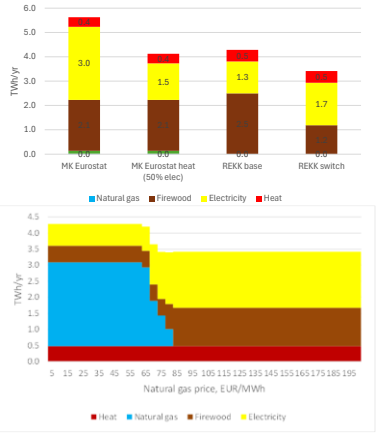
MODEL DECISION

INVESTMENT COST+ OPERATIONAL COST MINIMISATION

$$Min(CAPEX + OPEX)$$

MODEL OUTPUTS

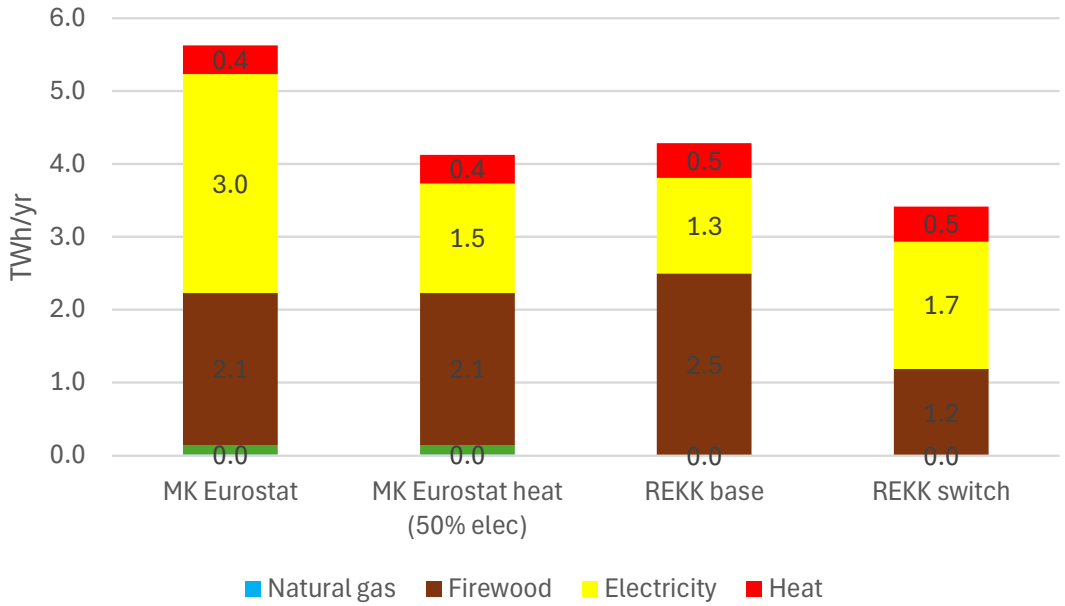
ENERGY BALANCE OF HOUSEHOLDS FOR HEAT INVESTMENT COST



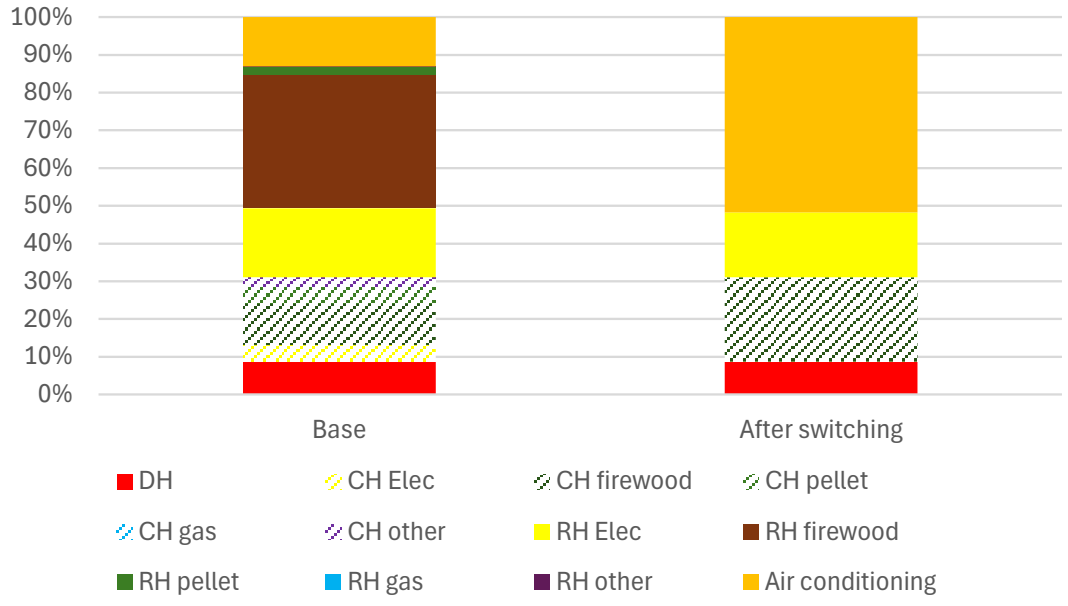
RESULTS

With 2023 H1 costs, households would choose electricity-based heating

HOUSEHOLD NATURAL FINAL ENERGY CONSUMPTION, TWh/yr



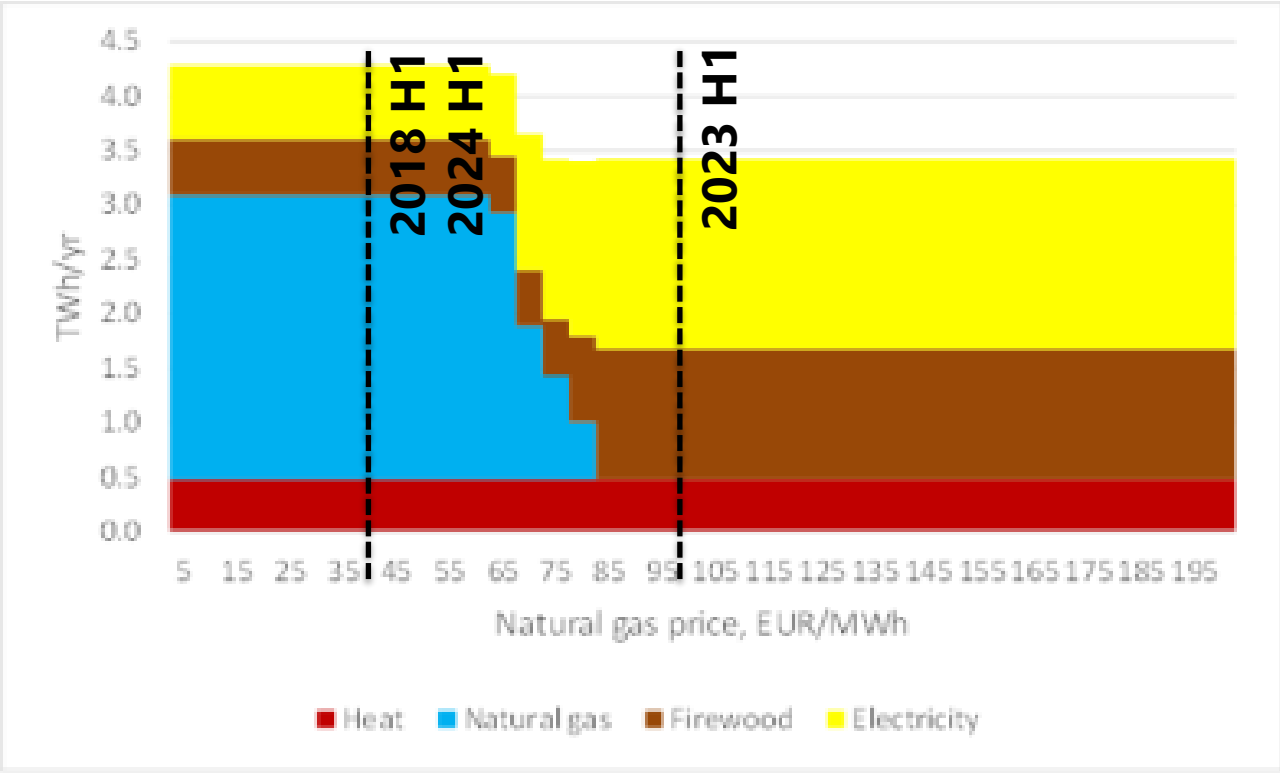
HOUSEHOLD SWITCHING BEHAVIOUR



- Natural gas- based heating is not preferred with the current (2023 H1 ~ 102 EUR/MWh) prices
- If households are not incentivised with other measures or policies, would not choose gas-based heating
- CH households would switch to firewood due to lower costs
- RH households would switch to air-to-air heat pumps and resistance heating
- Switching would cost 1460 MEUR for all households in total

Sensitivity on gas prices

HOUSEHOLD NATURAL GAS CONSUMPTION AS A FUNCTION OF PRICE



- Natural gas is only attractive if **end-user price is in the 30 EUR/MWh** range (**including DSO, TSO and VAT**)
- CAVEATS:
  - Electricity and other fuel prices were not adjusted („ceteris paribus" approach)
  - Household decision is based on total cost approach. Households may have more myopic decision method, e.g. minimising investment cost

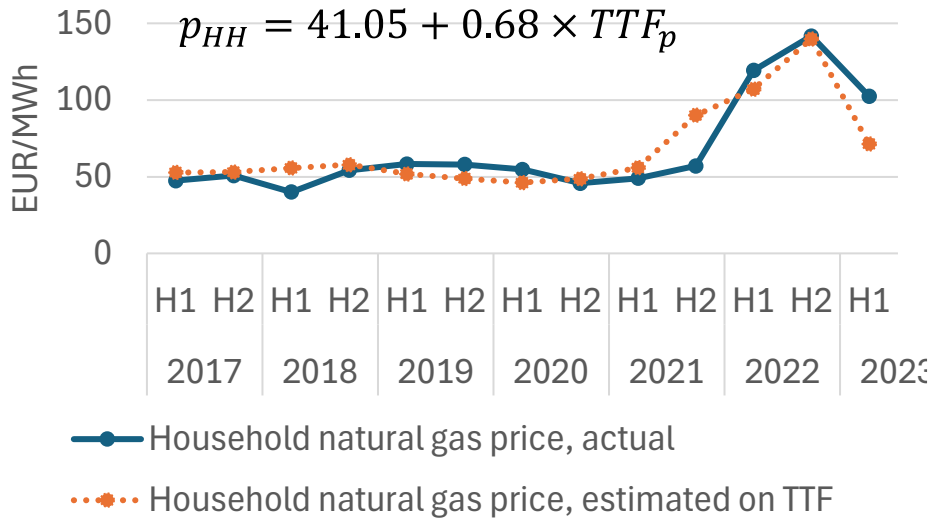
Conclusions

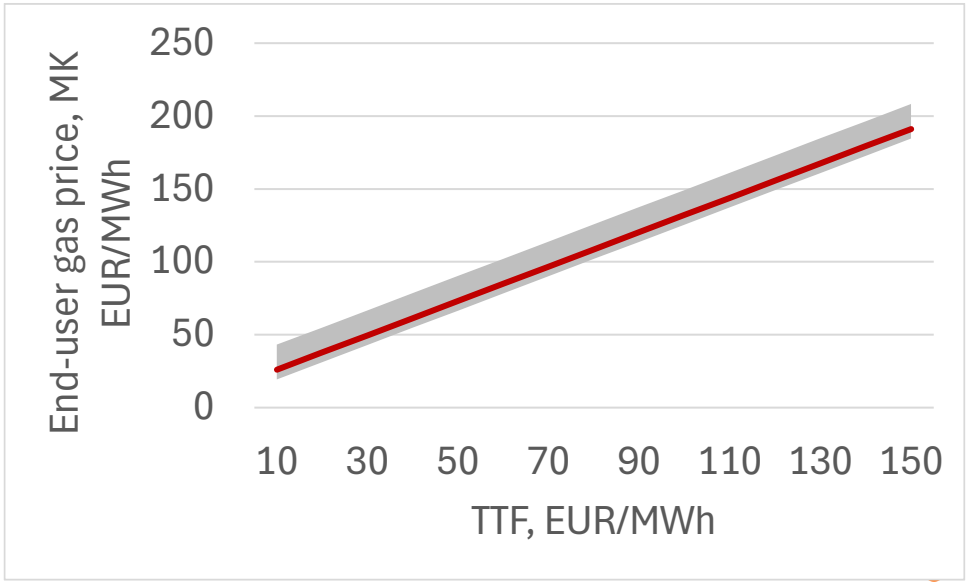
- **BASE CASE**:
  - applying the 2023 H1 prices and parameters, households would rather switch to electricity-based heating solutions than to natural gas
  - CAVEATS: only costs of households were considered
  - No detailed analysis on the effect on electricity networks
- **SENSITIVITIES**
  - **GAS PRICE:** at lower price levels to other fuels, 2.5 TWh/year gas demand is estimated
  - **PRE-CRISIS FUEL PRICES:** at pre-crisis price levels, gas is attractive to households, 2.4 TWh/year gas demand is estimated
  - **FIREWOOD PRICE:** if firewood would cost +50% compared to the base case, 0.2 TWh/year gas demand is estimated
  - **CO_2 TAX:** a 30/60/90 EUR/t CO2 tax on gas inhibits the gas use
  - **SWITCHING RATE:** 20% increase in switching rate increases gas demand by 0.5 TWh
  - **HIGHER ENERGY CONSUMPTION:** 30% increase in heating demand would raise gas demand to 3.4 TWh at lower gas prices
  - **POSSIBILITY FOR DH SWITCHING:** No significant change
  - **ONLY INVESTMENT/FUEL COST DECISION:** Households would either switch to electricity or firewood

Assessment of cost of gas for households (1.)

- Natural gas cost is made up of:
  - Wholesale price > strong correlation of MK gas price with TTF
  - Transmission fee > estimated as FCRT
  - Distribution fee > estimated as FCRT
  - Taxes and levies > no additional fee considered
  - VAT > 18% standard rate
- One-time cost of equipment
  - Installation of gas heaters (convectors) for room heating or gas boilers for central heating
- One-time connection costs
  - Full cost covered by FCRT, no one-time connection costs considered

Cost of gas is mainly driven by wholesale price
Network costs are under-estimated in current regulation
e.g. at 40 EUR/MWh TTF > 55-79 EUR/MWh depending on gasification scenario





How much does the gas infrastructure cost?

- EBRD already assessed the cost of medium and low-pressure gas networks in a 2021 study
- UIC were based on 2010-2015 data in EBRD study > these need to be updated
- UIC applied
  - Transmission: ENTSOG gas pipelines commissioned 2017-2021 Low: 400 EUR/m High: 1000 EUR/m
  - Distribution: Portuguese DSO costs 130 EUR/m
  - Other costs: identical as EBRD
- Costs driven by network size (i.e. conversion rate) and UIC assumptions
- Lower UIC estimate is more realistic for MK
- Due to higher UIC, CAPEX is 34-36% higher
- Higher estimate UIC 82-91% higher
- Annual OPEX: 3% of CAPEX (industry standard)

In the last few yrs, huge increase in gas infrastructure cost occured, therefore in our lower estimate **~+35%** CAPEX increase to be expected compared to the gas master plan

TOTAL CAPEX, MEUR

MEUR	EBRD base	REKK updated (low)	REKK updated (high)
Baseline	745	1016	1424
CAPEX30	551	739	1026
BA-FPOL	690	939	1296
BA_U50_R20	334	455	629
BA_combo	323	439	603
CAPEX30_COMBO	240	321	436
REKK estimate	-	791	1086

How can the infrastructure investment be financed?

TOTAL DEMAND, TWh/year

TWh	EBRD base	REKK upd (low)	REKK upd (high)
Baseline	9.1	7.2	7.2
CAPEX30	9.1	7.2	7.2
BA-FPOL	8.8	6.8	6.8
BA_U50_R20	4.2	3.2	3.2
BA_combo	4.1	3.1	3.1
CAPEX30_COMBO	4.1	3.1	3.1
REKK est.	-	4.5	4.5
REKK est. with Bitola	-	7.3	7.3

FCRT tariff, EUR/MWh

TWh	EBRD base	REKK upd (low)	REKK upd (high)
Baseline	9.0	15.6	21.9
CAPEX30	6.7	11.3	15.8
BA-FPOL	8.6	15.2	21.0
BA_U50_R20	8.8	15.6	21.5
BA_combo	8.6	15.4	21.1
CAPEX30_COMBO	6.4	11.2	15.3
REKK est.	-	19.4	26.6
REKK est. with Bitola	-	12.0	16.4

- REKK estimate: pre-war level low gas prices $\text{FCRT} = \frac{\text{NPV(CAPEX + OPEX)}}{\text{NPV (gas volume)}}$
- Costs to be recovered by system users (FCRT)
- What is the gas consumption associated with each scenario?
- FCRT: 20 yrs, 5% discount rate NPV
- Current gas consumption: avg 3.4 (2.7-4.5) TWh/year (2018-2022 avg)

Demand is estimated lower than EBRD (even if gas price at pre-war levels)
REKK Estimated tariff levels are 70-80% higher than EBRD estimate

Conclusions

- If the cost of gas is to be assessed, a full-system approach is needed:
  - Cost of gas from household perspective: fuel cost, installation cost, network tariffs, taxes and rates
  - For an estimation of network tariffs:
    - An indication on the total cost of investment network is needed
    - Level of total consumption
  - For an estimation of fuel costs, wholesale and retail price of gas is needed
  - Taxes and other rates are set up be regulation
- Due to increase in steel and material costs, the investment cost on the gas distribution system may increase by 35-36% CAPEX
- Tariffs are highly driven by potential consumption > at lower gas penetration, end-users would be paying high gas prices
- The same investment cost of building a medium pressure network may be spent on energy efficiency or RES projects targeting households
- Energy component of the gas price depends on the regional (BG, GR) prices, which correlate strongly with the TTF price index. On the long run, lower prices are to be expected than the energy crisis years, but higher volatility can be expected.

THANK YOU FOR YOUR ATTENTION

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Full study available on Eko-svest website