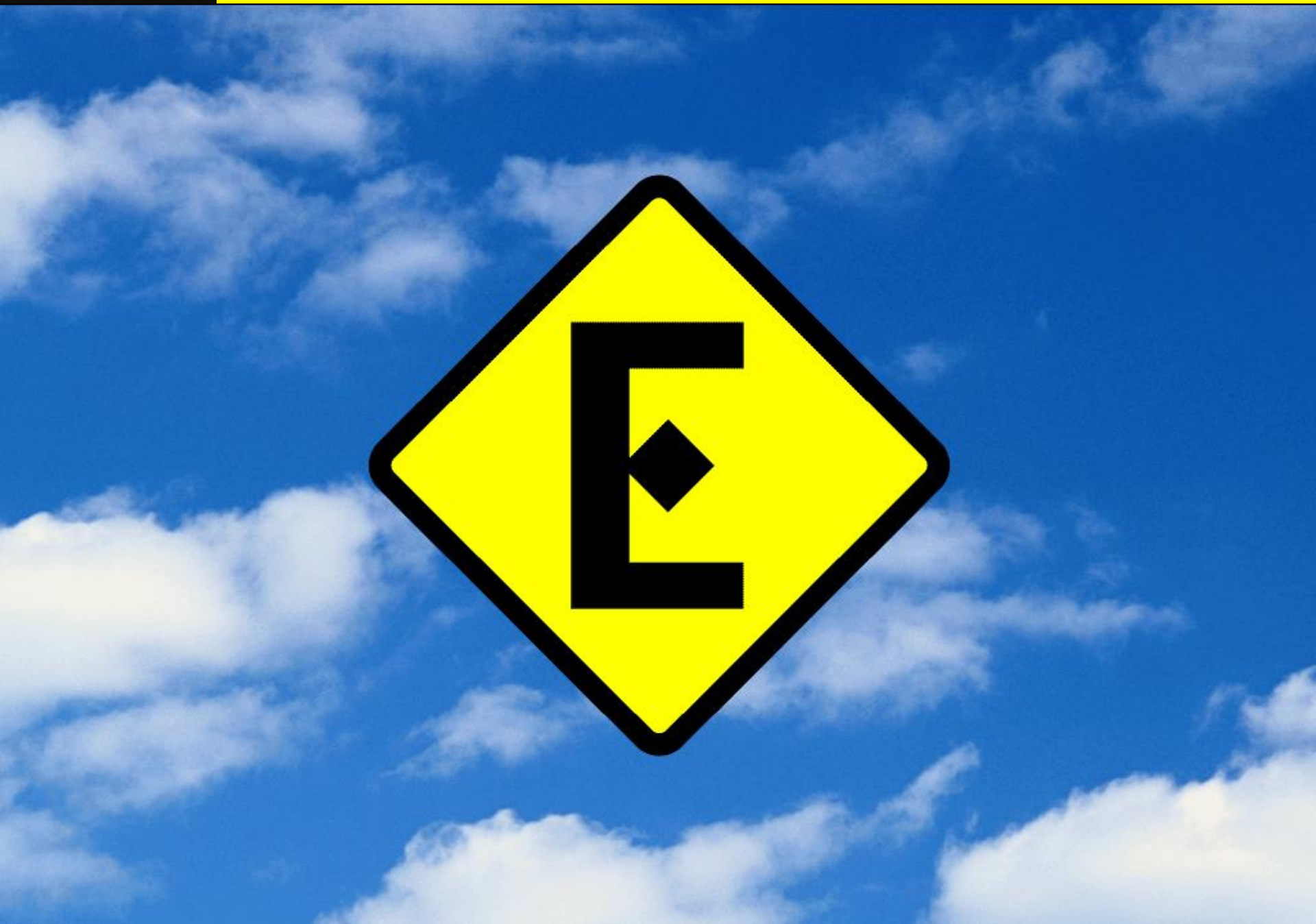

Methodology and approach in definition of CHP potential in the Czech Republic

Michael ten Donkelaar
& Jan Harnych

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Structure of CHP power plants in the Czech Republic

Range of installed capacity	Technology	Total electrical installed capacity [MWe]	Total thermal installed capacity [MWt]
Up to 1 MW_e	Steam power plants	13	537,4
	Combined cycle gas turbine power plants(CCGT)	0,0	0,0
	Gas engine power plants	296,6	341,9
	Total	309,6	879,4
1 MW_e up to 5 MW_e	Steam power plants	82,8	1266,9
	Combined cycle gas turbine power plants(CCGT)	0,0	0,0
	Gas engine power plants	239,0	283,4
	Total	321,8	1550,3
Above 5 MW_e	Steam power plants	9 792,2	18 080,0
	Combined cycle gas turbine power plants(CCGT)	118,0	119,9
	Gas engine power plants	5,4	7,9
	Total	9 915,6	18 207,8
Total	**Steam power plants**	**9 888,0**	**19884,4**
	Combined cycle gas turbine power plants(CCGT)	**118,0**	**119,9**
	Gas engine power plants	**541,0**	**633,1**
	Total	**10 547,0**	**20 637,4**

Status: December 2014

CHP power plants – electricity generation

	Electricity generation (GWh)	High efficiency cogeneration (GWh)	Incentives paid in 2014 (mil. EUR)
CHPs up to 5 MWe	3 269	886	28
CHPs above 5 MWe	9 561	5 943	33
Total	12 830	6 829	61

- The level of incentives varies between 2 to 60 EUR / MWh depending on the installed capacity, efficiency of electricity generation and no. of operating hours

Our approach in definition of CHP potential

- Replacement of boilers by cogeneration units
  - Only natural gas engines
- The main source was REZZO database (Register of Emissions and Air Pollution Sources)
  - Gathers on yearly basis data about 34,000 boilers
  - Only heat sources above 200 kWth

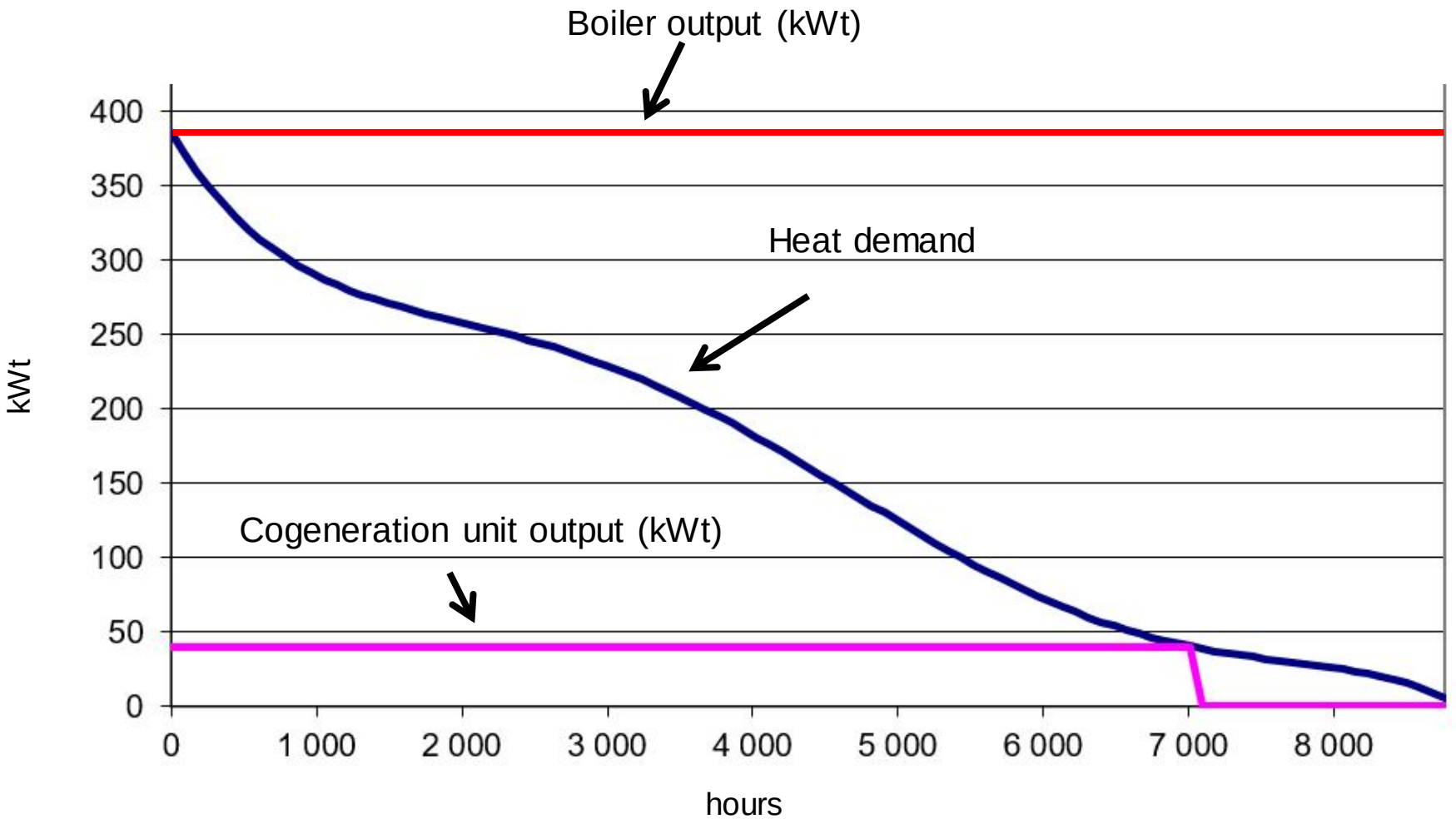
REZZO database 1/2

- What we know about these 34,000 boilers?
  - Thermal output
  - Type of fuel
  - Fuel consumption
  - Heat generation
  - Emissions (solid particles, CO, NO_x, SO_2, C_xH_y)

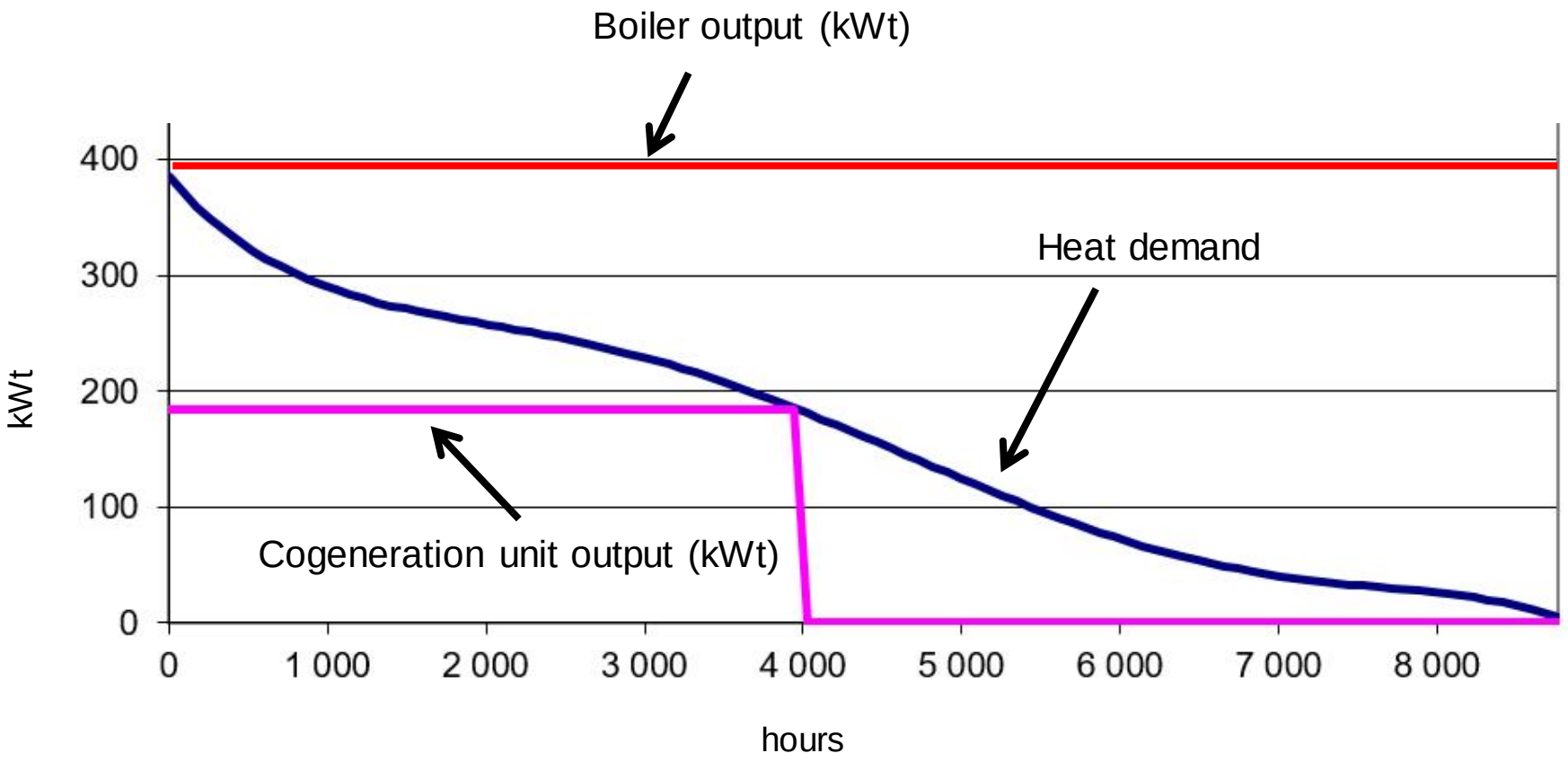
REZZO database 2/2

- What we don´t know about these 34,000 boilers?
  - Real operational mode – we don´t know if boilers operate for the whole year on half of the nominal thermal output or at full output for only half year -> very important aspect for design of optimal electricity output of cogeneration unit
    - Solved by two scenarios, which define borders of the real potential
      - Low scenario – with cogeneration units operating 7000h/year
      - High scenario – with cogeneration units operating 4000h/year
  - Technical limitations – lack of space in boiler room
  - Legislative restrictions – local increase of NOx emissions

Low scenario – 7,000 hours of operation



High scenario – 4,000 hours of operation



Methodology - What we do with REZZO database 1/2

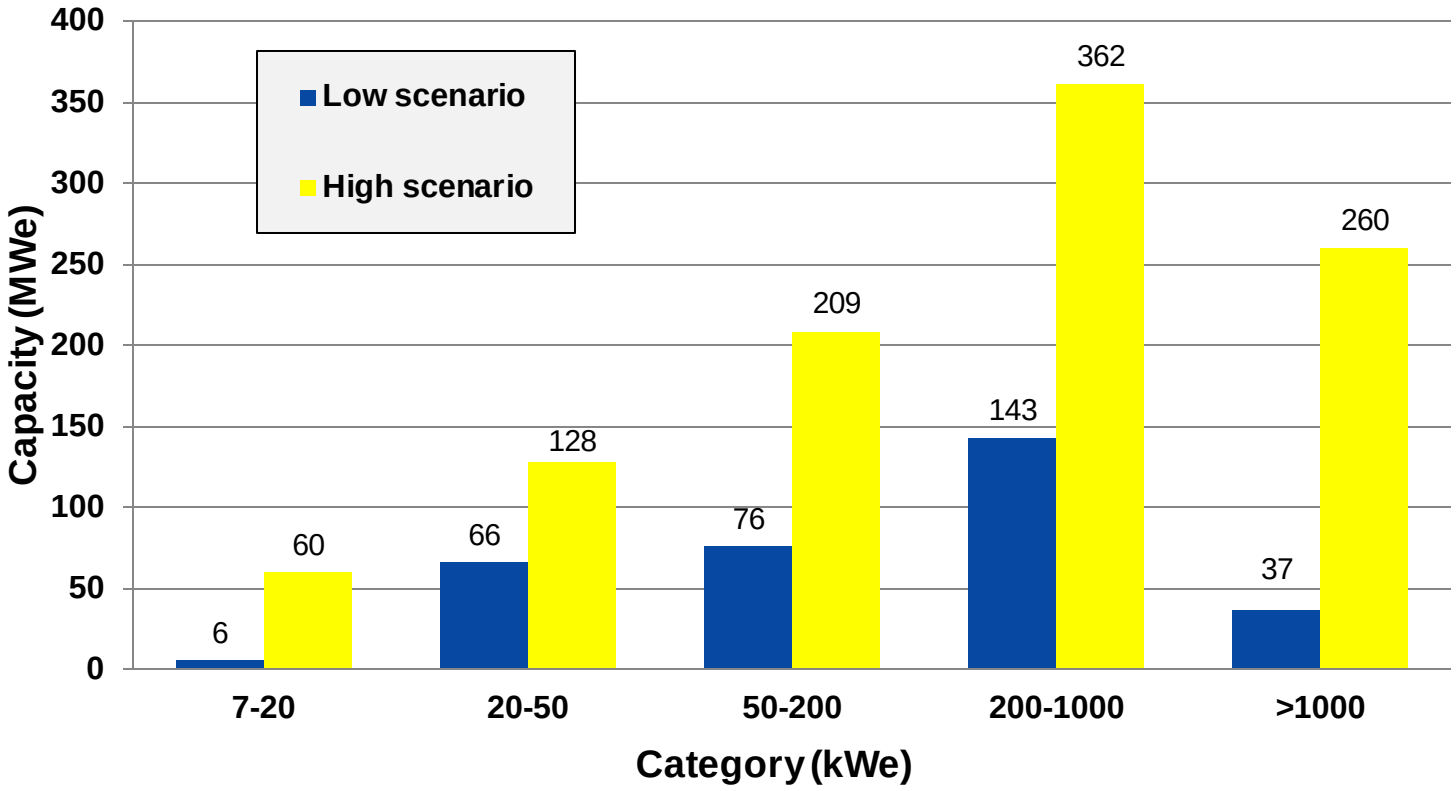
- 1. Dispose of all CHP
- 2. Dispose of all steam boilers
- 3. Dispose of all sources in which no gas engine can be installed (furnaces, driers, backup boilers in hospitals, …)
- Potential boilers for CHP
  - 34,000 → 15,500
- 4. Dispose of all sources, which are too small (low heating generation) for gas engine installation
  - The smallest cogeneration unit 7 kWe (no Stirling engines)
  - 15,500 → 11,000

Methodology - What we do with REZZO database 2/2

- 5. According to heat generation categories we defined 5 boiler categories:
  - Heat generation above 30000 GJ/year **>1000 kWe** (1200 kWt)
  - Heat generation 7000-30000 GJ/year **200-1000 kWe** (240-1200 kWt)
  - Heat generation 2500-7000 GJ/year **50-200 kWe** (70-280 kWt)
  - Heat generation 1200-2500 GJ/year **20-50 kWe** (42-105 kWt)
  - Heat generation 250-1200 GJ/year **7-20 kWe** (17,5-50 kWt)

  - The reason was that each output category of CHP has different electrical and thermal efficiency.

Results – total capacity (MWe)



- Low scenario 327,8 MWe
- High scenario 1017,8 MWe
- The real potential lies between 327,8 MWe and 1017,8 MWe.

Results – electricity generation

- Number of new installations of gas engines

	7-20 kWe	20-50 kWe	50-200 kWe	200-1000 kWe	> 1000 kWe	Total
Low scenario	294	2 182	836	343	22	3 677
High scenario	4 166	3 909	2 148	913	151	11 287

- Electricity generation (GWh)

	7-20 kWe	20-50 kWe	50-200 kWe	200-1000 kWe	> 1000 kWe	Total
Low scenario	40	462	532	1002	260	2295
High scenario	239	510	836	1446	1040	4071

Comparison of current situation and technical potential

	Electricity generation in 2014 (GWh)	Technical potential for gas engines (GWh)
Total	12 830	2 295 - 4071

Thank you for your attention!

Michael ten Donkelaar & Jan Harnych

ENVIROS, s.r.o.
Dykova 53/10
101 00 Praha 10-Vinohrady

Tel: (+420) 284 007 491
Mobile: (+420) 602 378 383
E-mail: michael.tendonkelaar@enviros.cz,
jan.harnych@enviros.cz
Web: www.enviros.cz