

#### DHexpPOT: A SENSITIVITY ANALYSIS MODEL ON DH POTENTIALS & COSTS

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Strukturänderungen - Wie?

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Veranstalter: Energy Economics Group - Institut für Energiesysteme und Elektrische Antriebe der TU Wien AAEE (Austrian Association for Energy Economics)



The EnerMaps project has received funding from the European Union's Horizon 2020 research and innovation programme under <u>grant agreement N°884161</u>



# WHAT TO EXPECT FROM DHexpPOT?

#### Identification of the DH potential in large scale areas

- Suitable areas for implementing a DH system
  - Size and extent of the Potential DH area
  - Average and total heat demand in the potential DH area
  - DH potential
- The impact of evolving market share and heat demand on DH areas
- Study of the distribution grid & service pipe costs
- Approx. trench length

#### Advantages:

- No knowledge of programming nor GIS
- Starting data is provided
- Get new metrics out of existing data
- Use own or default country specific construction costs.
- Suitable for calculation on large areas: NUTS 3 and higher



## **ASSUMPTIONS**



- Market share (MS) & heat demand evolves uniformly in all areas.
- Calculation is done from socioeconomic perspective. Therefore, the location of the existing grids are not considered.
- From the end of investment period till the end of depreciation time, the market share and covered demand remain the same.
- 30mm pipe diameter for service pipes.
- Even though MS gradually changes, we consider pipes covering highest demand in the investment period.
- Base year: 2015.





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# **METHODOLOGY**

- Find coherent areas in which:
- $\overline{LCOH}_{distribution} \leq c_{dist_max}$
- Area\_demand ≥ min\_demand

- LCOH<sub>distribution</sub>:
- c\_dist\_max :

average distribution grid cost distribution grid cost ceiling

$$LCOH_{distribution} = \frac{a}{\sum_{t=0}^{m} q_{s,t} \cdot (1+r)^{-t} + \sum_{t=m}^{n} q_{s,m} \cdot (1+r)^{-t}} \cdot \left(\frac{C_1 + C_2 \cdot d_{a,DistributionPipe}}{w_{DistributionPipe}} + \frac{C_1 + C_2 \cdot d_{a,ServicePipe}}{w_{ServicePipe}}\right)$$

W C <sub>1,T</sub>	Effective width [m] Construction costs constant [€/m]	LCOE =	$\frac{\text{sum of costs over lifetime}}{\text{sum of energy produced over lifetime}} =$	$\frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$
C <sub>2,T</sub> d <sub>a</sub>	Construction costs coefficient [€/m²] Average pipe diameter [m]	I <sub>t</sub> :	investment expenditures in the year <i>t</i>	
т	Investment period	<i>F</i> <sub>t</sub> :	fuel expenditures in the year $t$	
n	Depreciation period	<b>E</b> t :	energy generated in the year t	
<b>q</b> <sub>s,t</sub>	Heat supplied by DH in year "t" [GJ]	<b>r</b> :	discount rate	
		<b>n</b> :	expected lifetime of system or power station	

# **METHODOLOGY**

- Default construction cost constant  $(c_1)$  & coefficient  $(c_2)$  adapted for each Member State
- Effective width as a function of plot ratio & market share

 $W_{DistributionPipe} = A_L/L =$ 

AdjFactor =

 $e^2/(AdjFactor \cdot pr)$ 

 $4258\ln(MS) + 0.9607$ ,

0.019785,

[m]

 $MS \ge 10\%$ 



1%

10%

19%

28%

64%

Market Share (%)

73%

91%

100%

# **INPUTS**

#### **Default inputs**

- Parameters
  - Construction cost coefficients if not provided by user

- Raster Layers with the same raster origin
  - Heat demand density [MWh/ha]: EPSG:3035, 100x100m
  - Gross floor area density [m<sup>2</sup>/ha]: EPSG:3035, 100x100m

### **User inputs**

- Parameters
  - Market share [%]: start & target years
  - Expected accumulated heat saving in the target year [%]
  - Investment period [year]: period in which MS increases/decreases
  - Depreciation time [year]
  - Interest rate [%]
  - Grid cost ceiling in DH areas [EUR/MWh]
  - Construction cost coefficients





# **OUTPUTS**



#### Indicators

- Total [MWh] & average demand [MWh/ha] in
  - the selected region, and
  - Potential DH areas
- Size and extent of the Potential DH area
- Maximum potential of DH system through the investment period [MWh]
- Energetic specific DH distribution & service pipes costs [€/MWh]
- Specific DH distribution grid costs per meter [€/m]
- Total distribution grid costs annuity [€/yr]
- Total distribution grid trench length [km]
- Layers:
  - A Shapefile showing the potential DH areas
- Figures
  - For sensitivity analyses



## **CASE STUDY: AUSTRIA**



	Connection Rate - Start Year:		45						90		
		Connection Rate - End Year:	45		90			90			
	Total heat demand										
Country	in 2050 in GWh	grid_cost_ceiling [EUR/MWh]:	40	50	60	40	50	60	40	50	60
AT	62,032.4	DH heat coverage [GWh]	9,096.5	10,524.1	11,246.3	22,684.6	26,032.8	28,209.1	27,407.7	28,710.5	28,726.0
		Average grid costs in all DH areas [€/MWh]	30.2	33.5	35.2	29.1	32.5	34.8	24.6	25.6	25.6
		share from total heat	15%	17%	18%	37%	42%	45%	44%	46%	46%







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## ENERMAPS CONCEPT

#### Make energy data FAIR(er)



EnerMaps has two entrypoints for data management functioning as a coherent tool.

- > DHexpPOT IS PART OF ENERMAPS DMT
- > ENERMAPS: H2020 PROJECT
- ➢ 03/2020 02/2022





## **PRODUCTS**

ER PS	https://ene	rmaps.open	aire.eu	DEPOSIT LINK	SEARCH
Energy Res	search				
	Research outcomes 🔹 Search b	Ac	SEARCH Ivanced Search		
SUMMARY	Publications RESEARCH DATA	SOFTWARE OTHER RESEARCH			
The Energy Re Gateway to pu Curated by: • Created: 08-ju Projects: 1.751 Linked to 50	408,935 2,297   search community gateway is supported by the blication and data related to the field of energy Dlane von Gunten, ● Jakob Rager n-2020 Members: 16   Content Providers: 114 ③   Zenodo Communities ④	43 2,469 E EC H2020 ENERMAPS project (884161). It alms <i>y</i> planning and research.	to provide a Subjects Energy Manage Deal, Nuclear users, Highforo turbine, Photo thermal, Distri Building energy Energy Policy	ment, Power2gas, European Green nergy, Wind energy, Power2X, Energy voltage, Sustainable building, Wind roltaics, PV system, PVGIS, Solar t heading network, Excess heat, needs, Solar panel, Thermal energy. View all	



#### **Research Community Gateway**

Outputs from the research graph focused on energy

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#### Data Management Tool

Visualization & manipulation of data

