act!on heat

Appendix - Strategic H&C planning success factors

From heating and cooling strategies to action: how public authorities can strategically plan the decarbonisation of the heating and cooling sector and initiate impactful projects

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Table of contents

1 Appendix I: Summary of the Factsheets

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
A Coruña	Spain	Completed	244850	A Coruña city council GIGA Sl			x		
Ansfelden	Austria	Completed	16035	Research Institutes Mayor/vice-mayor and chief of local administration Regional energy commission/agency Local Utility				x	
Barcelona	Spain	Completed	1600000	Barcelona's city council Barcelona energy agency Barcelona regional. Urban planning department in Barcelona			x		
Bistrita	Romania	In Progress	75076	City of Bistriţa Consulting: E-think Scientific Partner: TU Wien				x	
Brasov	Romania	Completed	275514	Research Institute Deputy-mayor and chief of local administration				x	

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				Local energy agency Local Utility					
Bristol	UK	Completed	467000	Bristol City Council Element Energy Ltd (authors of the plan) UK Government					
Bruges	Belgium	Completed	118536	Municipality; Gemeente Brugge (Bruges Municipality) Waste treatment plant; IVOO Consulting firm; VITO Consulting firm; Futureproofed Consulting firm; Tri.zone	x				
Budapest	Hungary	Completed	1756000	Municipality of Budapest Budapest District Heating Service (FŐTÁV) Government of Hungary		x			
Bursa	Turkey	In Progress	3101833	City; Bursa Public Utility; Ministry of Energy and Natural Resources (MENR); İZODER (The Association of Heat,		x			

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				Water, Sound and Fire Insulators) Energy Efficiency Association; Homeowners and tenants Financial institutions					
Dundee	UK	Completed	149320	Dundee City Council Sustainable Dundee				x	
Geneva	Switzerland	Completed	201000	City of Geneva CREM PlanEnergi City of Frankfurt				x	
Helsingör	Denmark	Completed	62686	Gate 21 Technical University of Denmark (DTU) TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology Fraunhofer Institute for Systems and Innovation Research (ISI)				x	
Helsinki	Finland	Completed	1500000	Technical Research Centre of Finland		x			

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				(helped author) Energy for Humanity (publisher) Ecomodernist Society of Finland (publisher) Helen Ltd (Helsinki energy company) Finnish government					
Herten	Germany	Completed	61860					x	
Innsbruck	Austria	In Progress	133200	Consulting: alpS Consulting: Krismer Consulting: Spectrum City of Innsbruck: Umweltreferat			x		
Kerry County	Ireland	Completed	147707	Kerry County Council Hotmaps XDC Consult PlanEnergi				x	
Konstanz	Germany	Completed	84911	Consulting; Tilia GmbH Consulting; Smart Geomatics Energy Agency; Ravensburg City; Konstanz Public Utility; Stadtwerke Konstanz			x		

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
Kremenchuk	Ukraine	In Progress	219022	Consulting; Tilia GmbH Consulting; Ramboll Group A/S City; Kremenchuk Finance; Danida Sustainable Infrastructure Finance (DSIF) Finance; The Nordic Environment Finance Corporation (NEFCO)					x
Litoměřice	Czech Republic	Completed	29980	Research Institutes Deputy-mayor and chief of local administration Local energy agency Local Utility				x	
Lörrach	Germany	In Progress	48160	Consulting: ifok GmbH Consulting: endura kommunal Energy Agency: greenventory GmbH City: Lörrach Public Utility: Stadtwerke Lörrach		x			
Matosinhos	Portugal	Completed	167026	Research Institutes Deputy-mayor and chief of local				x	

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				administration Local energy agency Local Utility					
Pamplona	Spain	In Progress	199066	Covenant of majors Pamplona city council	x				
Rostock	Germany	In Progress	208900	City: Rostock Public Utility: Stadtwerke Rostock Technical Advisory Project Group includes representatives from University of Rostock, housing industry (die Wohnungswirtschaft), Agenda21 Council, Stadtwerke Rostock AG responsible offices of the city administration.		x			
Salaspils	Latvia	In Progress	22758	Local authority Inhabitants of the city via survey and public hearing		x			
San Sebastian	Spain	Completed	186000	Fomento de San Sebastián (FSS) Environmental department				x	

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
Stockholm	Finland	Completed	1000000	City Executive Office Stockholms stad (municipality)	x				
Strovolos	Cyprus	In Progress	70000	Municipality of Strovolos Cyprus Energy Agency	x				
Tartu	Estonia	Completed	95430	Consulting, energy agency – Tartu regional energy agency Municipality - Tartu City Government	x				
Turku	Finland	In Progress	193924	City of Turku Turku Energia		x			
Valencia	Spain	In Progress	810064	Covenant of majors Valencia city council		x			
Vari Voula	Greece	In Progress	48399	National Technical University of Athens	x				
Vienna	Austria	Planning	1900000	Architects, spatial planners Construction companies Building owners City of Vienna, MA20			x		
Copenhagen	Denmark	In Progress	1349537	Heating company; VEKS				x	

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				Heating company; HOFOR Heating company; CTR Municipality; Københavns Kommune (Copenhagen Municipality) Municipality; Høje-Taastrup Kommune (Hoeje-Taastrup Municipality)					
Sopela	Spain	Completed	12947	Municipality of Sopela EZE BARRIZAR KOOP. Consultancy Basque Energy Agency UDALSAREA 21			x		
Antwerp	Belgium	In Progress	510610	City Antwerp Consulting: DNV; Arcadis N.V.; Kahpo consulting; Createlli Consortium: Antea Group; Endeavours; Overmorgen; Kode	x				
Zürich	Switzerland	In Progress	402275	City; Zürich Target network planning gas: Energie 360° AG			x		

City/Region	Country	Current Status	Inhabitants	Stakeholders	Action Plan	Integrated plan	Energy plan	Heat plan	Other
				District heating planning: ERZ Fernwärme Energy networks planning: ewz-EDL Strategy development: SGE					

2 Appendix II: Factsheets

Name		**Energy strategy 2012-2016, Horizon 2020**
City		A Coruña, Spain
Inhabitants of city/district		244.850
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• **A Coruña city council** • **GIGA SI**
General Short Description of Plan or technical Description for Case-Studies		As part of its policy to reduce and rationalize municipal spending, A Coruña City Council has decided to implement various actions aimed at reducing energy consumption and promoting renewable energies in municipal facilities and offices. With this objective in mind, the ENERGY STRATEGY which is summarized in this factsheet, and which sets out the objectives and the main guidelines and actions to be carried out, as well as a methodology for monitoring compliance. It is an Energy Plan especially focused on municipal facilities and dependencies, which are divided into: • Public lighting • Buildings • Traffic lights • Pumping and purification
Analysis of the status quo	**Short Description**	In order to achieve the final objective of drawing up the Strategic Energy Efficiency Plan, a preliminary study of the current energy situation in the municipality is presented.
	Used Tools	Management tools: • Inventory on GIS system: currently being completed

		with the light points. • Lighting map of the municipality
	Used Data	The analysis and description of the current situation is based on the following three pillars: • Inventory of installations. • Annual consumption and billing data. • The energy management systems used in the municipality.
Potential Analysis	**Short Description**	The plan presents basic data obtained from various sources with the aim of estimating the energy saving potential of the facilities under consideration.
	Used Tools	
	Used Data	
Scenarios	**Quantity**	3
	Short Description	The plan sets a minimum target that takes into account the annual rate of 1.5% foreseen in the 2007 European Plan, resulting in a reduction of 12% by 2020. In addition, it considers two other scenarios depending on the resources available. The three scenarios considered are as follows: • Minimum investment scenario: consumption reduction target of 12%. • Intermediate investment scenario: consumption reduction target of 20%. • Maximum investment scenario: consumption reduction target of 30%.
	Used Tools	•

Measures	**Quantity**	22
	Short Description	In order to achieve the objectives, the Strategy proposes a series of actions or measures of different natures that will are grouped into the following strategic lines: • Management and planning • Energy efficiency and reduction of consumption in public lighting installations • Energy efficiency and reduction of electricity consumption in buildings • Energy efficiency and reduction of electricity consumption in traffic lights • Energy efficiency and reduction of fuel consumption in buildings • Optimisation of energy procurement
Funding		
References/Links		
• https://www.coruna.gal/descarga/1453597571300/Plan_Estrategia_Energetica_A_Coruna.pdf		

Name	**Local heating and cooling strategy recommendations for Ansfelden**
City	Ansfelden, Austria
Inhabitants of city/district	16,035
Type (Case-Study or Plan)	**Heating and cooling strategy recommendations**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Fraunhofer Institute for Systems and Innovation Research (ISI)
	  ○ OÖ Energiesparverband
	• Stakeholders involved in the policy group meetings:
	  ○ Mayor/vice-mayor and chief of local administration
	  ○ Regional energy commission/agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ National and regional authorities
	  ○ Local authorities
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers
	  ○ Finance corporations and insurance companies
	  ○ Local professionals (planners / designers / installers / craftsmen / chimney sweeps)
	  ○ Energy agencies and energy advisors

General Short Description of Plan or technical Description for Case-Studies	This local heating and cooling strategy for the city of Ansfelden was developed for the H2020 project progRESsHEAT to support policy makers and public authorities in the development and implementation of integrated strategies and policies to enforce the use of renewable and efficient heating and cooling solutions. The report was developed through an interactive process that included regular policy group meetings with relevant stakeholders. It is based on a comprehensive analysis of existing demands and potential developments, a survey on specific prevailing barriers and a quantitative assessment of policy options in the municipality. Several renewable possibilities for supplying the new development area from a local district heating network have been investigated under different policy scenarios. Tailor-made recommendations for policy makers regarding support to efficient and renewable heating and cooling were developed. In addition, a roadmap for the local heating and cooling strategy, focusing on the development area, is presented. The analysis shows that at least a certain amount of heat savings is the cheapest option for all buildings.	
Analysis of the status quo	**Short Description**	Total heat demand in 2012: 158.9GWh. Local industry: 190 buildings. Residential sector 66% of the total heat demand. Only the total cooling demand in the region is known (4.74 GWh). Heat densities are lower than 20 GWh/km2. 148 buildings are connected to the district heating system. Other heating options in the region: individual gas, oil and biomass boilers, electrical heating (also heat pumps) and solar thermal. No district cooling or any other centralized cooling system. Cooling demands covered by individual air conditioning units. District heat is delivered by a wood chip fuelled biomass heating plant. The plant has two biomass boilers and a total installed thermal capacity of 14 MW. Around 22 GWh (80 TJ) of heat are generated each year from approx.11 000 t of wood chips. A natural gas boiler serves as back-up system.
	Used Tools	• Invert/EE-Lab model • Least Cost Tool developed within the project • EnergyPro • QGIS
	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and

		synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	3
	Short Description	1. Reference Scenario: 2. Least cost combination of heat savings and heat supply 3. Integration of excess heat into district heating system Plus, model-based assessment of policy intervention in scenarios up to 2050
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html
Measures	**Quantity**	Only 7 pre-existing
	Short Description	• Austria and Upper Austria measures applying to Ansfelden: Umweltförderung im Inland & KLIEN-support-programme, Law for expansion of district heating/cooling networks & Law for CHP-points, Building regulation (OIB standard), Direct subsidies for solar thermal, biomass and heat pumps, Landesumweltförderung, Support programme for biomass heating plants, Energy contracting programme (ECP), OÖ Energiesparverband & Energy advice services, Dual training systems for heating and cooling installers & Energy Academy
Funding		H2020 funding for the assessment and strategy development

References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html

http://www.progressheat.eu/Reports-publications-69.html

Name	**The energy, climate change and air quality plan of Barcelona (PECQ 2011-2020)**
City	Barcelona, Spain.
Inhabitants of city/district	1.600.000
Type (Case-Study or Plan)	Energy plan
Current Status (Planning, in progress, completed)	Completed
Stakeholders involved	• **Barcelona's city council** • **Barcelona energy agency** • **Barcelona regional. Urban planning department in Barcelona**
General Short Description of Plan or technical Description for Case-Studies	This energy Plan, also known as PECQ, is presented as an update of the PMEB which provided the frame of reference for the city's energy policy between 2002 and 2010. The PECQ includes actions that are more crosscutting and more ambitious, that aim to outline Barcelona's energy commitment in the framework of the European Union's Covenant of Mayors: to reduce the emissions of greenhouse gases associated with municipal activity by 20% by 2020. The plan also analyses what has been done to date – the extent to which PMEB projects have been carried out, the obstacles that have hampered progress, the keys to the successes achieved – and puts forward objectives and strategies for the future. The PECQ can be seen as two complementary programs - one city and one municipal – each of which goes into the data in more detail, separating city consumption from municipal activities. This is one of the main new features of the Plan. A number of sectoral studies performed by experts in their respective fields provided the basis for preparing the PECQ. The City Program (PC), along with some of the studies, was coordinated and written by Barcelona Regional, whilst the Municipal Program (PM) was coordinated and written by the Barcelona Energy Agency – part of Barcelona City Council's Department of the Environment - which also coordinated the PECQ itself.

Analysis of the status quo	**Short Description**	The Plan includes a section titled “Diagnosis” in which it gives an exhaustive overview of the current situation regarding both the city program and the municipal program.
	Used Tools	•
	Used Data	The Plan displays and analyses data regarding the following key points: • Energy consumption • Energy generation • Greenhouse gas emissions
Potential Analysis	**Short Description**	The Plan studies the potential energy saving that could be achieved in the different sectors considered in order to design and choose the actions to be implemented. The analysis has also foreseen a qualitative assessment of some PECQ projects as well as the potential impact they have on the production structure of the city and its surrounding areas of influence For the final scenario, the plan presents an analysis of the energy, environmental, economic and social impact of the measures to be implemented.
	Used Tools	
	Used Data	• Consumption and emission ratios • Costs data for the economic evaluation, including the prices of pollutants emissions
Scenarios	**Quantity**	2
	Short Description	When analyzing the future evolution of energy consumption of and emissions associated with Barcelona, two scenarios are proposed: • Starting scenario – a study showing how the situation in Barcelona would be if no corrective measures to reduce

		energy demand were applied. One single trend scenario (Business as usual) is proposed. Overall, the applied methodology is based on examining the evolution of the main historical ratios of energy consumption and emission, and on predicting their most likely evolution in the coming years. Regarding socio-economic indicators they have been analyzed according to forecasts and expectations in terms of macroeconomic variables. • Finishing scenario - PECQ 2020: where this evolution is analyzed taking into account the results achieved with the implementation of projects and measures proposed in the PECQ strategic action.
	Used Tools	•
Measures	**Quantity**	108 projects
	Short Description	To bring about the finishing scenario, the strategy for action includes a set of projects aligned with the PECQ's objectives. The Plan is structured in two blocks: • The city programme: 85 projects including the following sectors: domestic, commercial, industrial, road mobility (excluding, here, municipal vehicles), etc. • The municipal programme: 23 projects related to matters that are the exclusive competence of the Council: municipal buildings, public lighting, traffic lights, water fountains and municipal vehicles
Funding	Not specified	
References/Links		
• https://mycovenant.eumayors.eu/docs/seap/381_1331047596.pdf		

Name		**Heating and cooling strategies for pilot cities – Bistriţa**
City		Bistriţa
Inhabitants of city/district		75.076
Type (Case-Study or Plan)		Plan
Responsable Partner		Corina Simon, Primaria Municipiului Bistriţa
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• **City of Bistriţa** • **Consulting: E-think** • **Scientific Partner: TU Wien**
General Short Description of Plan or technical Description for Case-Studies		**In order to reach the political targets of greenhouse gas emission reduction and energy efficiency at local as well as national and EU level, heating and cooling systems in Bistriţa have to be changed. A strategic analysis has been conducted to find technically, economically and resource-efficient solutions fulfilling these targets. In the course of the Hotmaps project, a strategy development process for decarbonising the heating system in Bistriţa has been performed, according to the following steps:** • **Description of the city and stakeholder analysis** • **Mapping of demand, resource potentials and existing plants** • **First stakeholder meeting** • **Setting up scenarios** • **Second stakeholder meeting** • **Strategy formulation**
Analysis of the status quo	**Short Description**	The basis for the bottom-up estimation of heat demand and the development of a heat demand density map for the municipality is a database of the buildings in the area. The database of the building stock is hosted by the Cadastre service and Real Estate Claims Department of Bistriţa Municipality and was provided for the work within this project. Hereby an extraction of the database from March 2019 has been used.

	Used Tools	• Hotmaps Toolbox • Invert/EE-Lab model (bottom-up simulation model of the energy demand for heating and cooling in buildings)
	Used Data	• Database of the building stock hosted by the Cadastre service and Real Estate Claims Department of Bistriţa Municipality. • Invert/EE-Lab database (effective useful energy demand)
Potential Analysis	**Short Description**	The economic calculations for this heating strategy reflect socio-economic criteria: the depreciation time was set to the lifetime of the technologies and an interest rate of 3% was used. This interest rate includes inflation on the one hand and also a supplement for the risk of losing the investment on the other hand.
	Used Tools	• Hotmaps-Tool “CM – District heating potential: economic assessment” has been used for estimating the costs of district heating network • Costs of renovation measures in buildings were estimated by the Invert/EE-Lab model
	Used Data	• Invert/EE-Lab database for Romania • own calculations based on experiences in various projects • price data from the Horizon 2020 SET-Nav • prices for fossil energy carriers were taken from the IEA World Energy Outlook 2016
Scenarios	**Quantity**	3
	Short Description	In order to identify technically and economically sound solutions for future heating systems in Bistriţa, three scenarios are calculated and assessed regarding costs and CO2 emissions. The scenarios differ in their assumption of saving 19%, 36% and 50% heat demand in the city.
	Used Tools	Invert/EE-Lab

Measures	**Quantity**	
	Short Description	The heating and cooling strategy of Bistriţa does not define specific measures, but sets several staps on a road to a low carbon district heating system: • Developing a renovation roadmap for the buildings • A detailed analysis of the potentials for renewable energy and excess heat • And a (pre)feasibility study of a potential district heating system
Funding	Funded by the Horizon 2020 programme of the European Union	
References/Links		
•		

Name	**Local heating and cooling strategy recommendations for Ansfelden**
City	Brașov, Romania
Inhabitants of city/district	275,514
Type (Case-Study or Plan)	**Heating and cooling strategy recommendations**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Fraunhofer Institute for Systems and Innovation Research (ISI)
	  ○ Agentia Pentru Management ul Energiei si Protectia Mediului Brasov
	• Stakeholders involved in the policy group meetings:
	  ○ Deputy-mayor and chief of local administration
	  ○ Local energy agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ National and regional authorities
	  ○ Local authorities
	  ○ Households
	  ○ Energy Suppliers
	  ○ Energy agencies and energy advisors

General Short Description of Plan or technical Description for Case-Studies	This local heating and cooling strategy for the city of Brașov was developed for the H2020 project progRESsHEAT to provide a pathway towards a viable heating solution for the city, decarbonisation, and introducing renewable energy sources in the local energy mix. The strategy aligns with the objectives of the SEAP 2010 -2020: -32% CO2 emissions and + 4% energy from RES. The document tackles how to transform an oversized district heating system with substantial losses, bad public image, and few connected users into a reliable, trustworthy system with increasing users, decarbonising the city, and introducing renewable heat sources. After analysing the heat demand, the buildings stock renovation potential and the available local energy sources, technical solutions were developed, and a policy package identified. All analysis followed an integrated approach by respecting the European, national, and local legislation framework and strategies, software tools and price evolution of fuels and technologies, as well as environment requirements. The policy package was developed in multiple stages engaging stakeholders in policy group meetings at local and national level.	
Analysis of the status quo	**Short Description**	Total heating demand of 937 GWh. More than 90 % of the buildings are residential private buildings. Three industrial parks and one business center. The total heating demand of buildings is 67 % of the total final energy demand of the city. Main district heat producer: Bepco SR, private company, 3 high-efficiency cogeneration natural gas plants. Tetkron (93% shares owned by the municipality), 11 natural gas fired district thermal plants, transport and distribution network. In 2016, the Local Council decided to reorganize the DH system in order to ensure an efficient system and to have control over the production, transport, distribution and supplying the heat to the consumers, so the District Heating Public Local Service was founded. The district heating system was oversized, with substantial losses, bad public image, and few connected users. The heating and cooling strategy of Brașov was developed in a period of very important changes (the trading company operating the DH system was transformed to local public service) and high distress for the consumers (the supply was interrupted for more than half a year). Therefore, the heating strategy is a very important support document for the policy makers in order to make the right decisions during the transition to a sustainable community with low CO2 emissions.

	Used Tools	• Invert/EE-Lab model • Least Cost Tool developed within the project • EnergyPro • QGIS • Policy package and technical solutions analysed in a matrix approach with calculation tools.
	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	2
	Short Description	4. Reference Scenario, with private or with public investor 5. Alternative Scenario, with private or with public investor, with or without RES subsidied
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html
Measures	**Quantity**	8 pre-existing and 34 defined and assumed during the prject

	Short Description	• Pre-existing: Contribution to high efficiency cogeneration, National Energy Efficiency Action Plan (NEEAP), Building regulations (Law no. 372, Law no. 153/2011, neZEB solution, GD no. 462/2006, GEO 18/2009), Energy audit obligation, Law no. 121/2014 on energy efficiency, PIEE 2014-2020 (Energy efficiency program), SEAP 2010-2020 • Defined and assumed during the project: 34, organized in: Energy efficiency in buildings, Energy efficiency and optimization of district heating networks, Energy efficiency and optimization of district heating system, Renewable Energy Sources in District Heating, District heating support policies, Others
Funding	H2020 funding for the assessment and strategy development	
References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html http://www.progressheat.eu/Reports-publications-69.html		

Name		**An evidence based strategy for delivering zero carbon heat in Bristol**
City		Bristol, UK
Inhabitants of city/district		467,000
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		Plan completed
Stakeholders involved		• Bristol City Council • Element Energy Ltd (authors of the plan) • UK Government
General Short Description of Plan or technical Description for Case-Studies		The plan considers several possible scenarios for the decarbonisation of Bristol's heat sector by 2050. Below is an outline of the approach of the plan: • Developed model of building stock and current heat demand in Bristol then developed heat demand projection to 2050 • Determined energy efficiency saving potential • Determined potential low-carbon heating options in view of constraints specific to Bristol's building stock • Constructed heat decarbonisation scenarios deploying various low-carbon heating options and energy efficiency measures to 2050 and estimated the carbon emissions saving • Identified low-regrets options and key decision points to inform Bristol's zero carbon heat strategy
Analysis of the status quo	**Short Description**	• Use number of buildings of each type in Bristol and heating fuel type for each building to get annual heat demand for space heating and hot water for each typical building type in Bristol • Current CO2 emissions associated with space heating and hot water (659 ktCO2) • Heat demand projection to 2050 based on construction rates, demolition rates, and energy efficiency uptake scenarios

		• Assessment of local and national policy on heat decarbonisation relevant to Bristol
	Used Tools	• Two building stock models: domestic and non-domestic • National Heat Map, Bristol region, 2011
	Used Data	• Private Sector Housing Stock Condition survey, ORS for BCC, 2011 • National Energy Efficiency Database (NEED), 2016 • Social housing data from BCC, 2017 • Energy Consumption in the UK (ECUK) tables, 2016 • Valuation Office Agency (VOA), 2017 • Building Energy Efficiency Survey (BEES), 2016
Potential Analysis	**Short Description**	• Analysis of the reduction in heat demand to 2050 with varying levels of energy efficiency applied • Sources of heat with potential to supply heat networks in Bristol: Energy-from-Waste (EfW), industrial waste heat, water source heat pump • Previous studies commissioned by Bristol City and South Gloucestershire Local Councils identify several potential low carbon Energy-from-Waste (EfW) facilities that could supply heat to heat networks. • Water sources for heat network: River Avon (including tributaries), floating harbor, and estuary. Significant challenges to using the river Avon as a heat source (including the tidal range, silting etc.). The benefit of using heat from the River Avon over the estuary is its proximity to the most heat dense areas in Bristol. However, if the challenges are insurmountable, the capacity of the estuary and floating harbour together would still likely be sufficient to serve the baseload heat demand. • Identified a list of large individual heat users in the vicinity of existing and planned heat networks, including large public and commercial buildings (such as Bristol Arena, Bristol University Hospital, Croydon House, Fremantle House etc.)

	Used Tools	• National Heat Map
	Used Data	• Previous energy master-planning studies for Bristol • WSP Parsons Brinkerhoff, Avonmouth & Severnside Heat Network Study – Heat Mapping Report, December 2015l • Sustainable Energy Limited, Avonmouth and Severnside Heat Network Development Study, A report for South Gloucestershire and Bristol City Councils (pending publication) • Defra, Energy recovery for residual waste: A carbon based modelling approach, February 2014
Scenarios	**Quantity**	6
	Short Description	In each scenario (apart from Baseline), there is a high rollout of energy efficiency measures. • **Baseline** – reflects current policy ambition regarding the uptake of heating technologies • **High heat networks** – extensive development of heat networks with a partially decarbonized gas grid using biomethane and bio-synthetic natural gas • **High heat pumps** – heating dominated by heat pumps, including hybrid gas-electric heating in the medium term • **Decarbonised gas** - gas grid repurposed to deliver hydrogen from 2040, medium heat pump and heat network deployment • **High heat networks and high heat pumps** – aiming to achieve the deepest decarbonisation possible through the deployment of proven technologies • **Mixed pathway** – heat pumps and heat networks deployed widely into 2030s. Following this, gas grid converted to hydrogen to serve remaining gas customers
	Used Tools	• National Grid Future Energy Scenarios
Measures	**Quantity**	4 themes
	Short	Several scenarios have commonalities in the short term. The

	Description	plan identifies these as *low regret* actions, which should be acted on urgently. These low regret actions would result in a 48% reduction in CO2 emissions by 2030 • Retrofit Bristol's building stock to EPC C by 2030. Further retrofits completed by 2040. • Strong planning policy and financial support for the rollout of heat networks in new and existing buildings. *Strategic Heat Main* suppliying low carbon waste heat from Avonmouth to city centre. • Wherever possible, all new buildings are served either by low carbon heat networks or heat pumps • 18,000 heat pumps by 2030 directed initially at the off-gas grid dwellings The recommendation at this stage is for Bristol to implement low regrets actions and to learn from this experience, building a stronger evidence base on the cost and other implications of deployment of each technology option. Full decarbonisation by 2050 pathway can then be chosen in 2030.
Funding	Not specified	
References/Links		
• https://www.bristol.gov.uk/documents/20182/3368102/An+evidence+based+strategy+for+delivering+zero+carbon+heat+in+Bristol.pdf/39cb877b-6de0-c2d0-9865-d8cc4c8d599c		

Name		**Sustainable Energy Action Plan 2020**
City		Bruges, Belgium
Inhabitants of city/district		118,536
Type (Case-Study or Plan)		Energy plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Municipality; Gemeente Brugge (Bruges Municipality) • Waste treatment plant; IVOO • Consulting firm; VITO • Consulting firm; Futureproofed • Consulting firm; Tri.zone
General Short Description of Plan or technical Description for Case-Studies	Bruges signed the international mayoral covenant in 2014, which bound the city to reaching a 20% reduction in carbon emissions by 2020. One of the sectors included in the plan is heating and cooling (H&C), which would achieve the goals through a combination of expanding the district heating network, installing heat pumps and making housing and other buildings more energy efficient through insulations renovations. Through a carbon emission assessment, the progress would be tracked.	
Analysis of the status quo	**Short Description**	The carbon emission levels for 2011 were chosen for the reference point to which the city would measure its carbon emission reductions. This reference point constituted a total of 682,172 tons CO2.
	Used Tools	• 'KMI-tool' (Climate Measure Instrument); an excel sheet that allows for the processing of carbon emissions data.

	Used Data	• Carbon emissions for various sectors (including H&C) from the so-called 'LNE-tool' (Department Environment, Nature and Energy of the Flemish Authority dataset for carbon emissions) • Carbon emission by fuel and electricity • Municipal spatial plan
Potential Analysis	**Short Description**	The city of Bruges proposed to reach its goals for the SEAP 2020 in the H&C sector by reducing the energy requirements of buildings through insulation.
	Used Tools	'KMI-tool' (Climate Measure Instrument); an excel sheet that allows for the processing of carbon emissions data. This tool would measure the economic impact of the carbon reducing measures (the cost of the reduction in carbon emissions based on investment costs, and other profits).
	Used Data	• Carbon emissions for various sectors (including H&C) from the so-called 'LNE-tool' (Department Environment, Nature and Energy of the Flemish Authority dataset for carbon emissions) • Carbon emission by fuel and electricity
Scenarios	**Quantity**	1
	Short Description	The SEAP preceded the more ambitious plans for 2030 and 2050 scenarios for the Energy Action Plan Bruges. For the SEAP the City of Bruges anticipated a total carbon emission reduction of 26%, meaning 180,000 tons reduced in carbon emissions.
	Used Tools	• None specified.
Measures	**Quantity**	9
	Short Description	• Roof insulation for households and industry buildings • Wall insulation for 25% of households • Replacement of single-pane windows to insulated windows in 20% of households • Solar boilers for 2000 households • Building heat-pumps in 20% of new construction

		• “Renovation scans” for 400 households per year • Attention to ‘optimal orientation’ for new constructions regarding optimal exposure to the sun • Expansion of the district heating network “IVBO”
Funding	N/A	
References/Links		
• https://www.eumayors.eu/plans-and-actions/action-plans.html • https://klimaat.brugge.be/eindrapport-seap-2020-		

Name		**Climate Strategy**
City		Budapest
Inhabitants of city/district		1.756 million
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Municipality of Budapest • Budapest District Heating Service (FŐTÁV) • Government of Hungary
General Short Description of Plan or technical Description for Case-Studies	The Strategy envisions the development of district heating by connecting district heating "islands" and improving the efficiency of the system. Plans also include the expansion of the consumer base and exploring how renewables can be integrated into the system. Establishing a market for district heating is also sought, since it is heavily monopolized, which could lead to market inefficiencies. A further goal is the more thorough integration of the heat produced by thermal baths.	
Analysis of the status quo	**Short Description**	District heating constitutes 11% of Budapest's energy needs and 95% of this energy produced was based on fossil fuels in 2015 (the year the report's data was based on). This led to 767,754 metric tonnes of CO2 eq or 9.7% of the total. A number of entire districts (e.g. V, VI, VII) are not included in the grid and the district heating system is clustered around a few islands. Developments are ongoing with major projects executed in recent years.
	Used Tools	• Descriptive statistics • Interviews, stakeholder dialogue • SWOT analysis

	Used Data	• Data provided by the Budapest District Heating Service (FŐTÁV) • Data provided by the Hungarian Energy and Public Utility Regulatory Agency
Potential Analysis	**Short Description**	The district heating system is analysed by including it in overall actions identified in the Strategy. Goals of the development are also superficially indicated.
	Used Tools	District heating is included in the SWOT Analysis (strengths, weaknesses, opportunities, and threats) of the city's climate ability to take action against climate change.
	Used Data	• This is based on the analysis of the status quo and is developed in-line with other pre-existing, older city strategies that all underscore the need to develop district heating.
Scenarios	**Quantity**	N/A
	Short Description	No comprehensive scenarios are developed, but the Strategy articulates three targets: • Efficiency of own heat production facilities: 91.3% (2019) to 92% (2024) • New consumers added (five-year moving avg.): 22 MW/year (2019) to 20 MW/year (2024) (The figures refer to new additions, which the strategy expects will slow down, given the saturation of easily convertible buildings) • Heat losses based on base year: 98% (2019) to 96% (2024)
	Used Tools	• N/A
Measures	**Quantity**	N/A

	Short Description	• N/A
Funding	Estimated to require HUF 43.9 billion (approx. EUR 125 million), which would be covered from national funds, the municipality's budget, and additional support from public and private actors.	
References/Links		
• https://budapest.hu/Documents/klimastrategia/Bp_Klimastrategi%C3%A1ja_vegleges_KGY%20elfogadott.pdf		

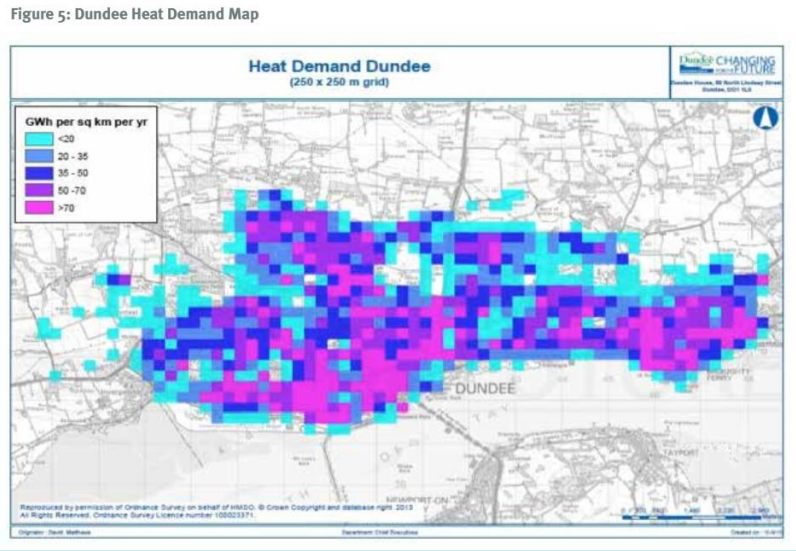
Name		**Bursa Sustainable Energy and Climate Change Adaptation Plan 2017**
City		Bursa, Turkey
Inhabitants of city/district		3,101,833
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• City; Bursa • Public Utility; Ministry of Energy and Natural Resources (MENR); İZODER (The Association of Heat, Water, Sound and Fire Insulators) Energy Efficiency Association; • Homeowners and tenants • **F**inancial institutions
General Short Description of Plan or technical Description for Case-Studies		The plan has evaluated urban heat island, urban water areas, green areas, green corridors and biodiversity, public health, administrative organization and planning against the adverse effects of climate change. Climate change adaptation strategies have been developed to make Bursa city more resilient to natural disasters such as hot weather fluctuations, drought, floods, and landslides due to climate change. In this framework, Bursa has been the first city to develop climate change adaptation strategies at a national scale. With the greenhouse gas inventory of Bursa province, mitigation targets and strategies for adaptation to climate change will serve as a guide for other cities to create climate- friendly cities.
Analysis of the status quo	**Short Description**	An inventory analysis with sectoral energy consumption and greenhouse gas emission, current heating situation was carried out.
	Used Tools	

	Used Data	• Energy consumption data - issued by TurkStat and EMRA • Greenhouse gas emission - Urban Carbon Footprint Inventory Calculations for Bursa Metropolitan Municipality
Potential Analysis	**Short Description**	Potentials for energy saving in building and industry sector, utilization of waste from power plants, as well as renewable energy (including wind, solar, geothermal and biogas), renewable energy installation were analyzed.
	Used Tools	No named, but the methodology is described
	Used Data	• Renewable energy potentials - BIDEP 2015
Scenarios	**Quantity**	2
	Short Description	A business-as-usual and a mitigation scenario were developed. The mitigation scenario is based on the emission reduction measures proposed by Sustainable Energy Action Plan.
	Used Tools	
Measures	**Quantity**	4
	Short Description	• Heat insolation in existing housing • Renewable energy application in existing housing • Heating of about 100,000 residences with localized heating (including waste heat and biomass fuels utilization) • Energy efficient renewals in existing municipal buildings

Funding		
References/Links		
• https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/8/q3AIPvado5fRrB_0x9FWYDtOLjo11sks.pdf		

Name	**Dundee City District Heating Strategy**
City	Dundee, UK
Inhabitants of city/district	149,320
Type (Case-Study or Plan)	Plan
Current Status (Planning, in progress, completed)	Completed
Stakeholders involved	• Dundee City Council • Sustainable Dundee

General Short Description of Plan or technical Description for Case-Studies	2018-2028 The strategy/plan outlines the current district heating in Dundee, opportunities for heat supply, energy centres and energy from waste. The objectives aim to tackle fuel poverty, reduce carbon emissions and decentralise energy. The District Heating Strategy follows the Scottish Government's Heat hierarchy of: 1. Reducing the need for heat 2. Supply heat efficiently and at least cost to consumers 3. Use renewable and low carbon heat resources The Strategy aims to achieve the following objectives: • Deliver sustainable and affordable energy to reduce fuel poverty and energy costs. • Achieve reductions in the Council's CO2 emissions and contribute to the city's emissions reduction target of 40% by 2030. • Develop the city's heat network at a pace which is financially and practically viable and which improves economic efficiencies from assets. • Develop the knowledge and skills base to facilitate heat network delivery. • Foster collaborative partnerships and agreements for heat network delivery The opportunities for district heating networks in Dundee are characterised by their role in delivering: • Reduced energy costs and customer protection – addressing fuel poverty. • Carbon savings – from a mix of technology solutions. • Energy security – multiple technology options supplying into the network. • Revenue generation – through owning and operating district heating networks. • Economic development - Dundee as an attractive place for businesses to locate and invest	
Analysis of the status quo	**Short Description**	The city has a small high temperature steam network connecting low rise housing estates. The University of Dundee has its own district heating system which may be expanding to include the University of Abertay and further buildings. There are also a number of domestic district heating installations within ten multi-storey developments at

		Dallfield, Lansdowne, Lochee and Whorterbank. These schemes are currently gas-fired.
	Used Tools	• GIS – heat demand map Figure 5: Dundee Heat Demand Map 
	Used Data	• Dundee City Council has been working with the Scottish Government's Heat Mapping programme to support the development of a local GIS based heat map. The local system means local data and priorities, such as fuel poverty, planning, economic opportunity or public sector estate, can be considered at the same time • Building data, type, tenure and heat demand estimated from the Scotland Heat Map. This was then enhanced with local data. • New developments data, proposed floor areas, number of dwellings, planned energy supply plant • Fuel poverty indices, proposed infrastructure works, utilities.
Potential Analysis	**Short Description**	Opportunities for district heating were identified through workshops in 2017, combining the interests of Planning, Property, Housing and Energy Management. Participants reviewed the Heat Map and in particular the layers showing the heat demand data, proportion of social rented properties (as a proxy for fuel poverty), and future development proposals and constraints maps from the Local Development Plan.

	Used Tools	• Heat map • Matching supply and demand map
	Used Data	• Similar to status quo – used data to find and understand where heat need is (demand) and opportunities to generate and provide heat (supply).
Scenarios	**Quantity**	Mixture of different technology scenarios and an action plan with short, medium and longer term actions.
	Short Description	Short term (2018-2020), medium (2020-2024) and longer term (2024-2028)
	Used Tools	• No stated tools but ideas for development of business cases and some stakeholder engagement
Measures	**Quantity**	Action plan with 13 actions
	Short Description	• Councils first non-domestic district heating scheme at the Regional Performance Centre for Sport • Develop feasibility studies for district heating projects and networks within the Lochee Corridor and Dighty Corridor • Expansion of the district heating network in the city centre • Explore district heating opportunitiies in the Menzieshill and Coldside • Explore alternative methods of heat generation to decarbonise district heating networks in line with emerging technologies
Funding		Not stated – However there is an example in the appendix, the low carbon district energy hub at the Regional Performance Centre for Sport. The council applied for funding from the Scottish Government's Low Carbon Infrastructure Transition Programme (LCITP), which subjected the proposals to further rigorous testing of the financial and technical viability of the scheme. The Council successfully secured £2.9 million funding from the LCITP in March 2017, together with an allowance of £100,000 towards enabling works.
References/Links		
• https://www.dundeecity.gov.uk/sites/default/files/publications/districtheating.pdf		

Name	Local heating and cooling strategy recommendations for Ansfelden
City	Geneva, Switzerland
Inhabitants of city/district	201,000
Type (Case-Study or Plan)	**Heating and cooling strategy**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ City of Geneva
	  ○ CREM
	  ○ PlanEnergi
	  ○ City of Frankfurt
	• Stakeholders considered in the stakeholders' analysis:
	  ○ Local authorities (Canton de Genéve, Association des communes genevoises - ACG)
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers (Services industriels de Genève - SIG)
	  ○ Real Estat Agencies (Régies)
	  ○ Action groups (citizens, NGOs, Lobbies, Politics)

General Short Description of Plan or technical Description for Case-Studies	This report was developed in the framework of the H2020 project Hotmaps. The City of Geneva has 3 specific targets for 2020: reducing consumption of energy (-17% in 2020), growing part of renewable energy (20% in 2020) and reducing carbon emission (-20% in 2020, already done), and the 2050 target of 100% renewable energy. The city started transitioning from oil heating to natural gas and renewable energies. Multiple local authorities and the energy supplier work together to implement the current policy objectives and must set new targets for 2030 and 2050. The city adopted Hotmaps as decision-making tool to compare different scenarios and to define the socio-economically appropriate energy supply strategy for the Master Plan 2020-2030. The main result of this work was that the administration learned how to segment the territory (zoning), adopt scenarios, identify the best technological solutions for different areas and determine their economic and climatic impacts. After defining 3 scenarios (BAU, current policies, current policies with increased support to DH and RES), a detailed analysis was carried out on the BAU scenario, whose results confirmed that in a BAU set-up the energy policies objectives of the city of Geneva would not be met.	
Analysis of the status quo	**Short Description**	Currently, Geneva has the largest heat demand in the canton, but very few energy networks on its territory. The City of Geneva represents half of the canton's heat consumption, with very high urban and energy densities. The development of the master plan for energy networks must consider socio-economic conditions, heating and cooling needs, the use of renewable resources and excess heat, the extension of existing networks and the possibilities for creating new ones.
	Used Tools	• Hotmaps • QGIS ? • Invert/EE-Lab model ?
	Used Data	• GIS data of building stock (Gross floor area, Construction year, Refurbished year, Building type / use, Heat demand, Existing heat supply: natural gas, district heating, individual oil boiler etc.) • Statistical data on buildings, projections, population, energy price scenarios, current policies • Hotmaps database

Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	• Hotmaps (CM - District heating potential: economic assessment, CM - District heating potential areas: user-defined thresholds) • Overlay of results with SITG maps
	Used Data	• Hotmaps database and integration of OCEN data • Invert/EE-Lab database for Switzerland ? • Own calculations based on experiences in various projects • DH Price data (Ceiling cost for the construction of the DH network [EUR/MWh], Average construction cost [EUR/m], Construction cost index [EUR/m2], Interest rate (%)) • Prices for fossil energy carriers
Scenarios	**Quantity**	3
	Short Description	6. BAU 7. PDE + PDER projects 8. Intervention +
	Used Tools	• Hotmaps • Invert/EE-Lab model
Measures	**Quantity**	13 pre-existing regulations

	Short Description	• Pre-existing:
		  ○ National level: Swiss energy strategy 2050, Energy laws and strategies (Confederation and Canton of Geneva), Climate strategy with national CO2 law
		  ○ Cantonal level: Climate plan, General energy concept, Energy Master Plan, Networks energies master plan (district heating and cooling, electricity, gas and water)
		  ○ Municipal level: European Energy Award Gold, Municipal energy and climate policy with Action Plan 2011-2014 and 2014-2018,

		Strategy "100% renewable in 2050 for heating municipal buildings" (2006), Municipal electricity strategy: "Consuming less and producing better" (2011)
Funding	H2020 funding for the assessment and strategy development	
References/Links https://www.hotmaps-project.eu/geneva/ https://www.hotmaps-project.eu/wp-content/uploads/2020/10/Hotmaps_D.6.3_Geneva-HC-Strategies_FINAL_reduced.pdf		

Name	**Local heating and cooling strategy recommendations for Ansfelden**
City	Helsingør, Denmark
Inhabitants of city/district	62,686
Type (Case-Study or Plan)	**Heating and cooling strategy recommendations**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ Gate 21
	  ○ Technical University of Denmark (DTU)
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Fraunhofer Institute for Systems and Innovation Research (ISI)
	• Stakeholders involved in the policy group meetings:
	  ○ Deputy-mayor and chief of local administration
	  ○ Local energy agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ National and regional authorities
	  ○ Local authorities
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers
	  ○ Local professional (planners / designers / installers / craftsmen / chimney sweepers)
	  ○ Energy agencies and energy advisors
	  ○ Action groups (citizens, NGOs)

<table>
<tr><td>General Short Description of Plan or technical Description for Case-Studies</td><td colspan="2">This local heating and cooling strategy for the city of Helsingør was developed for the H2020 project progRESsHEAT to ensure a quick and efficient deployment of renewables in heating and cooling systems. The municipality makes a determined effort to limiting carbon emissions, subscribing to the Capital Region of Denmark’s climate strategyand to the Global Covenant of Mayors for Climate & Energy. Target: total CO2 emissions per capita below 1 tons before 2030 and minimum of 30% renewable energies in their energy supply. Barriers for further decarbonization of the heating and cooling sector in Helsingør have been identified, contrasted by a series of national and local conditions, as well as drivers in favor of enhancing renewable energy solutions.

After further analysis on five technical scenarios, as well as the impact of different shifts in policies, the report reaches a conclusion on five central recommendations:
○ Promote heat savings in buildings
○ Promote shift from individual fossil heat supply - especially oil boilers
○ Information campaigns on the advantages and disadvantages of individual biomass boilers in densely populated areas
○ Ensure cheap, CO2 neutral DH from Forsyning Helsingør
○ Advocate a shift to fossil free district heating - if continued import from Norfors</td></tr>
<tr><td rowspan="2">Analysis of the status quo</td><td>Short Description</td><td>A rather densely populated municipality compared to the Danish average. Total heating demand 571 GWh in 2013. Thereof 70% are space heating and domestic hot water in residential buildings. Cooling demand is negligible. Natural gas has the highest share in heating supply with 44%. District heating constitutes only 35% of the heat supply when compared to the national average of 45%. In Denmark, zoning ensures limited overlap of areas supplied by district heating and by natural gas. The district heating company intends to expand their networks into natural gas areas, which they are allowed to do if they can substantiate that district heating is more feasible from a socio-economic viewpoint than individual gas fired boilers. District heating is supplied from municipality-owned companies Forsyning Helsingør (88% of total sales) and Hornbæk Fjernvarme (12% of total sales). The main energy plants supplying Helsingør are a decentral CHP plant and heat-only boilers situated in the municipality, and a waste incineration plant located outside Helsingør.</td></tr>
<tr><td>Used Tools</td><td>• Invert/EE-Lab model
• Least Cost Tool developed within the project</td></tr>
</table>

		• EnergyPro • QGIS • Policy package and technical solutions analysed in a matrix approach with calculation tools.
	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	5
	Short Description	9. BAU (Reference Scenario) 10. RES 2030 11. HP 2030 12. BAU 2050 (Reference Scenario) 13. Combi 2050
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html
Measures	**Quantity**	5 pre-existing measures
	Short Description	• Pre-existing: Energy Agreement 2012, ESCO + renovation project expanded, ECO-city project (demonstration activities), Climate education and training of craftsmen, Helsingør Energy Center

Funding	H2020 funding for the assessment and strategy development
References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html http://www.progressheat.eu/Reports-publications-69.html	

Name		**The Carbon-neutral Helsinki 2035 Action Plan**
City		Helsinki
Inhabitants of city/district		656 250
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• **Consulting: Gaia Consulting Ltd** • **Consulting: WSP Finland Ltd** • **Helsinki Region Environmental Services** • **City of Helsinki** • **Smart & Clean Foundation**
General Short Description of Plan or technical Description for Case-Studies		The objective of the Helsinki City Strategy 2017-2021 is to make Helsinki carbon-neutral by 2035. This goal will be achieved by reducing the greenhouse gas emission by 80 percent, compared to 1990. The remaining 20% will be compensated, by implementing emission reduction outside the city. The action plan concludes an already ongoing decline of emission of greenhouse gases, but to reach carbon-neutrality in 2035, the emissions still need to be reduced more rapidly in the future. Stakeholders set up the Action Plan and made it online available for reading and commenting for anyone interested. The plan included suggestions for emissions reduction actions. In its final form, the plan consists of 147 actions which are related to actions in e. g. traffic and transport, construction consumption, procurements, sharing and reduction of resident's carbon footprint.
Analysis of the status quo	**Short Description**	The Helsinki Region Environmental Services (HSY) calculates the emissions annually and compares them to the emission level in 1990. Emission sectors are district heating, oil heating, electric heating, consumption electricity, traffic, industry and machinery, waste management and agriculture.
	Used Tools	Not specified in the action plan
	Used Data	Not specified in the action plan

Potential Analysis	**Short Description**	The two consulting firms conducted surveys, which provides an additional proof that Helsinki could become carbon-neutral by 2035. These surveys are mentioned in the action plan, but are not further described and refered.
	Used Tools	Not specified in the action plan.
	Used Data	Not specified in the action plan.
Scenarios	**Quantity**	
	Short Description	To estimate the required emission reduction, scenarios for the development of emissions until 2035 were devised. The Business as usual (BAU) scenario shows how the emissions will progress, if the development of last years continues. The BAU scenario concludes an emission reduction of 52%, therefore additional actions are needed.
	Used Tools	Not specified in the plan
Measures	**Quantity**	
	Short Description	Many measures in different sectors will help to reach the action target of carbon neutrality in 2035. The specific measures in construction and use of buildings are: Recovering unused waste heat, reducing the total consumption of heating with energy efficiency actions, increasing the proportion of locally produced renewable heating in properties, decreasing the proportion of oil in separate heating, increasing the demand response of heating, etc.
Funding		The city will inform residents about funding options.
References/Links		
•		

Name	**Local heating and cooling strategy recommendations for Ansfelden**
City	Herten, Germany
Inhabitants of city/district	61,163
Type (Case-Study or Plan)	**Heating and cooling strategy recommendations**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Fraunhofer Institute for Systems and Innovation Research (ISI)
	  ○ EE Energy Engineers GmbH
	• Stakeholders involved in the policy group meetings:
	  ○ Deputy-mayor and chief of local administration
	  ○ Local energy agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ Local authorities
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers
	  ○ Finance corporations and insurance companies
	  ○ Energy agencies and energy advisors
	  ○ Media
	  ○ Research and development institutes

General Short Description of Plan or technical Description for Case-Studies	This report was developed in the framework of the H2020 project progRESsHEAT and provides a heating and cooling roadmap for Herten focussed on district heating (DH). A policy analysis assessed the role of DH regarding the municipality's climate goals. The analysis concludes that if the stock of de-central heating technologies develops in the future as forecasted for Germany, even with a very ambitious renovation plan, GHG reduction goals can only be achieved if the DH supply includes much more RES. Large-scale solar thermal collector fields and heat pumps seem the most promising solutions for long-term supply security. However, for large-scale heat pumps business conditions are not favourable and policy measures seem necessary, especially reduced electricity tariffs. Additionally, an increased consumer-base is necessary to keep DH generation cost competitive, especially with ambitious renovation rates. A building stock model showed that by far enough multi-family houses are not or only partly connected to the DH network. Therefore, active planning of the DH network (by zoning) and grants for connecting new consumers to the DH network seem the most promising measures. Both electricity tariffs and grants for the connection to the DH network are usually set on the national or at least regional level. Municipalities in Germany, especially in this region, are facing severe financial problems in the last decades. However, what they can do with existing capabilities is an active planning of new connections (zoning) and attracting new customers, i.e. with information campaigns, cooperation with housing associations.	
Analysis of the status quo	**Short Description**	Herten is a city of 60 000 inhabitants, now shrinking, previously grown around a coal mine, now closed, whose economy shifted to the services sector, especially logistics. The heat demand in Herten is mostly due to the building sector (space heat & hot water), with over 80 % is consumed in households. The main energy carrier for heating is natural gas, followed by DH and fuel oil. Notable is that there is still a significant use of coal. The building stock has mainly multi-family buildings of 1960s to 1980s in the city centre and single-family houses in the outskirts. About 95 % of DH is produced by coal fired CHP plants which belong to the supra-regional utility company (E.ON), and delivered via an interconnection pipe (trunk line). Compared to average for Germany indicates that • the share of RES is substantially lower, • the share of mineral oil products is substantially lower, • the share of DH is a lot higher.

	Used Tools	• Invert/EE-Lab model • Least Cost Tool developed within the project • EnergyPro • QGIS
	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	7
	Short Description	14. No Renovation 15. Renovation Scenario 16. Renovation + Soar DH 17. Renovation + Het pump DH 18. Renovation + DH expansion with RES 19. Renovation + waste incineration DH 20. Roadmap Scenario
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html
Measures	**Quantity**	6 pre-existing and 6 analysed measures

	Short Description	• Pre-existing: Market Incentive Programme (MAP), Renewable Heat Act (EEWärmeG) & Energy Saving Ordinance (EnEV) with KfW programme, CHP Act & Renewable Energy Sources Act, Energy tax law (EnergieStG), Climate protection plan North Rhine-Westphalia, Climate protection plan 2020plus Herten • Analysed, but not set, potential additional measures: District hot spots, Zoning and free connection, Urban solar planning, Electricity price reduction, Grants and soft loans, Carbon price
Funding	H2020 funding for the assessment and strategy development	
References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html http://www.progressheat.eu/Reports-publications-69.html		

Name		**Innsbrucker Energieentwicklungsplan**
City		Innsbruck
Inhabitants of city/district		133.200
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• **Consulting: alpS** • **Consulting: Krismer** • **Consulting: Spectrum** • **City of Innsbruck: Umweltreferat**
General Short Description of Plan or technical Description for Case-Studies	**The energy development plan of Innsbruck (Innsbrucker Energieentwicklungsplan; IEP) initiated a detailed analysis of the heating demand and electricity consumption of the. Based on this analysis four different scenarios were elaborated, which represent the possible development of Innsbruck in terms of energy consumption and energy supply under certain assumptions. Based on this scenarios, the medium-term target projections (until 2025) were derived and a bundle of measures were defined.**	
Analysis of the status quo	**Short Description**	To create the possible future scenarios, a detailed analysis of current energy situation in Innsbruck was conducted. All buildings were categorized in two sectors, the residential and non-residential sector. Through multiple surveys a database was built consisting details about the building stock, energy consumption and energy carriers in Innsbruck.
	Used Tools	For GIS-data, the software ESRI ArcGIS® and for the data base the system Microsoft Accesses® was used.

	Used Data	The data are based on the building and housing register (Gebäude- und Wohnungsregister) of statistic Austria, a GIS-database consisting the building polygons, and a survey of building owners about their heating system and energy carriers.
Potential Analysis	**Short Description**	The energy plan does not mention a specific potential analysis, but it defines three sectors to raise the energy efficiency: • Comprehensive renovation of the building sector. • Individual optimization in the commercial and industrial sector. • Increased efficiency in electricity.
	Used Tools	Not mentioned in the plan.
	Used Data	Not mentioned in the plan.
Scenarios	**Quantity**	4
	Short Description	The consortium developed 4 possible future scenarios: • The business-as-usual scenario (BAU). • The scenario with minimum change. • The scenario with achievement of the ambitious targets. • The energy self-sufficient scenario.
	Used Tools	Not mentioned in the action plan.
Measures	**Quantity**	

	Short Description	In a start forum three so-called action teams were established. Each team took the responsibility over a sector (housing, commercial/industrial/etc, public buildings) and defined several measures. In the housing team defined measures were: • A renovation rate of 1.3% per year • Exchange rate of the heating system of 3% • No fossil energy carriers in renovated and new buildings in 2021.
Funding	City of Innsbruck	
References/Links		
• https://energie.innsbruck.gv.at/page.cfm?vpath=microsites/energie/energieplan • https://energie.innsbruck.gv.at/data.cfm?vpath=subsites/energie1/innsbrucker-energieentwicklungsplan-endbericht-phase-i		

Name		**County Kerry Heating strategy - Hotmaps**
City		Kerry – County
Inhabitants of city/district		147,707 (County Kerry population) Killarney - 14,219 and Dingle – 2,000
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Kerry County Council • Hotmaps • XDC Consult • PlanEnergi
General Short Description of Plan	The outcome of the Hotmaps study is a heating strategy, evaluating two key areas for potential district heating grids in Kerry County. Killarney is a built-up town area with 14,219 population and 28,000 hotel beds (typically occupied from May to September during the summer season). Dingle is a smaller settlement with 2,000 population. This population also increases in summer due to the tourism industry. The strategy outlines how the Hotmaps tool can be applied to an area, alongside stakeholder involvement and tailored to the local area. Heat demand and supply options were analysed, followed by scenario analysis with a set of different heating supplies and % expansion of district heating.	
Analysis of the status quo	**Short Description**	The heat demand in County Kerry has been analysed under SmartReFlex project. This is in the form of a 250m x 250m resolution heat demand map divided into residential and non-residential. There is currently a 1 MW biomass (woodchip) district heating system in Tralee town. Also as part of the SmartReflex EU project, Kerry County Council has analysed the possibilities to expand the district heating grid in Tralee.
	Used Tools	• Hotmaps tool – a heat demand was calibrated to match the bottom-up heat demand model, prepared by XDC Consult.

	Used Data	Hotmaps use open source, publicly available data. There is no detailed local data and the plan includes input from local stakeholders at different stages. • Customised heat and floor area density maps (estimate demand) • Scale heat and cool density maps • Heat load profiles
Potential Analysis	**Short Description**	Identification of stakeholders, business cases and resource potentials.
	Used Tools	• Hotmaps tool - The calculation modules in the Hotmaps tool were used in the subsequent calculation steps to identify possible potentials for district heating and the resulting cost, carbon emission effects and distribution of energy supply via DH and centralised heat supply Economic assessment is calculated using the Hotmaps CM DH user-defined threshold which identifies the maximum district heating coverage in the area, based on two boundary conditions: 1) Minimum heat demand in hectare and; 2) Minimum heat demand in a DH area. The first factor determines the scattering of the consumers considered for connection to DH, while the other condition decides on the size of the network.
	Used Data	• Demand projection – current heat demand plus future projections (can be adjusted by user) • Heat load profiles – when energy will be used is likely to be a flatter profile due to tourism • District heating potential, economic assessment with estimated prices of heat • Renewable energy resource potentials, excess heat potentials such as an anaerobic digestion plant
Scenarios	**Quantity**	Many scenarios – at least 7 for Dingle and 10 for Killarney Different heat supply costs, CO2 intensity per kWh, share of renewable energy resources, share of fuel/combustion free-heating etc. Different minimum heat demand in a hectare and minimum

<table>
<tr><td></td><td></td><td>heat demand in a DH area</td></tr>
<tr><td></td><td>Short Description</td><td>Dingle:
1.Biogas (from a possibly coming anaerobic digestion plant) sized according to the available biogas production potential and a backup boiler (wood pellets)
2.Wood pellet boiler
3.Electric Heat Pump:
a. Air-to-Water
b. Brine-to-water, close to the surface
4.Woodchip boiler
5.Solar thermal + woodchip boiler
<table><tr><th>scenario0</th><th>scenario1</th><th>scenario2</th><th>scenario3</th><th>scenario4</th><th>scenario5</th><th>scenario6</th></tr><tr><td>S0 Reference 2050 + No DH expansion + Only decentral supply</td><td>S1 Reference 2050 + High DH expansion 34% high DH budget + Biogas CHP (available potential) + wood pellet boiler</td><td>S2 Reference 2050 + High DH expansion 34% high DH budget + Wood pellet boiler</td><td>S3 Reference 2050 + High DH expansion 34% high DH budget + ASHP (air to water)</td><td>S4 Reference 2050 + High DH expansion 34% high DH budget + GSHP (brine to water)</td><td>S5 Reference 2050 + High DH expansion 34% high DH budget + Wood chip boiler</td><td>S6 Reference 2050 + High DH expansion 34% high DH budget + Solar thermal + Wood chip boiler</td></tr></table>
Killarney
1.Large Energy-from-Waste CHP supplying the most of the energy demand and a backup wood pellet boiler
2.Medium Energy-from-Waste CHP and a backup wood pellet boiler
3.Small Energy-from-Waste CHP supplying baseload and a large wood pellet boiler</td></tr>
</table>

		<table><tr><th>scenario0</th><th>scenario1</th><th>scenario2</th><th>scenario3</th><th>scenario4</th></tr><tr><td>S0 Reference 2050 + No DH expansion + Only decentral supply</td><td>S1 Reference 2050 + Limited DH 6% DH expansion medium budget + EfW large + peak pellet boiler</td><td>S2 Reference 2050 + Limited DH 6% DH expansion medium budget + EfW medium + pellet boiler</td><td>S3 Reference 2050 + Limited DH 6% DH expansion medium budget + EfW small + large pellet boiler</td><td>S4 Reference 2050 + Semi-Ambitious 30% DH expansion medium budget + EfW large + peak pellet boiler</td></tr></table> <table><tr><th>scenario5</th><th>scenario6</th><th>scenario7</th><th>scenario8</th><th>scenario9</th></tr><tr><td>S5 Reference 2050 + Semi-Ambitious 30% DH expansion medium budget + EfW medium + pellet boiler</td><td>S6 Reference 2050 + Semi-Ambitious 30% DH expansion medium budget + EfW small + large pellet boiler</td><td>S7 Reference 2050 + Ambitious 38% DH expansion medium budget + EfW large + peak pellet boiler</td><td>S8 Reference 2050 + Ambitious 38% DH expansion medium budget + EfW medium + pellet boiler</td><td>S9 Reference 2050 + Ambitious 38% DH expansion medium budget + EfW small + large pellet boiler</td></tr></table> 1.CM Decentral Heating Supply: The results from this CM are used to evaluate the energy carriers and costs and emissions related to these, in individual heating systems. 2.CM DH Economic Assessment: The results from this CM are used to evaluate a variety of different district heating shares. 3.CM DH Supply Dispatch: The results from this CM are used to evaluate the energy carriers and costs and emissions related to these, in individual heating systems.
	Used Tools	• Hotmaps tool
Measures	**Quantity**	2 – recommendations based on scenario outputs with an economic view
	Short Description	For Dingle, it can be concluded that district heating is unlikely to result in significant cost reductions of the total costs for heat supply in the area. There certainly are ways to reach significant carbon reductions at cost neutrality or minor cost reductions. However, these are only obtained in small parts of the total heat demand. For Killarney, it can be concluded that significant reductions of heat-related CO2 emissions (up to 5,000 tonnes/year) can be reached by establishing a district heating grid, primarily supplied by a waste-to-energy plant. These

		reductions would result in a minor increase in heating costs for those affected and are hence unlikely to be feasible to carry out, without economic incentives.
Funding	EU funded	
References/Links		
• https://www.hotmaps-project.eu/wp-content/uploads/2020/10/Hotmaps_D.6.3_Kerry-HC-Strategies_FINAL_reduced.pdf		

Name		**Energienutzungsplan Konstanz**
City		Konstanz, Germany
Inhabitants of city/district		84,911
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Consulting; Tilia GmbH • Consulting; Smart Geomatics • Energy Agency; Ravensburg • City; Konstanz • Public Utility; Stadtwerke Konstanz
General Short Description of Plan or technical Description for Case-Studies		The energy plan focuses primarily on the building sector. More than 7900 apartments are planned to be built by 2035. During the analyses, individual focus areas were defined which have high energy or greenhouse gas savings potential. Both the city and the municipal public utility were involved in the process. There were regular steering group meetings. A lot of public outreach was done, but only after the plan was published. Many innovative technologies not yet ready for the market are described for possible future use. Detailed actions are proposed, but with no implementation date. The collected data was inserted into BICO2BW. A controlling was implemented, in which the current data is to be collected every 2 years within the scope of an audit.
Analysis of the status quo	**Short Description**	An inventory analysis with an energy balance, CO2 balance and a presentation of the existing energy infrastructures was carried out.
	Used Tools	• "Short Procedure Energy Profile"; IWU • BICO2BW; ifeu

	Used Data	• existing data of the city; "Liegenschaftsdaten" • Census data (building age classes) • Electricity and gas consumption data from the public utility company • By intersecting the data, the consumption of the buildings was additionally assigned the function • Through the municipal public utilities and the chimney sweeps, the energy producer inventory was recorded
Potential Analysis	**Short Description**	Potentials for wastewater heat, solar energy, environmental heat, shallow and deep geothermal energy, wind energy, hydropower and biomass were analyzed.
	Used Tools	No named, but the methodology is described
	Used Data	• Wastewater heat - "Entsorgungsbetriebe" Konstanz • Solar potential - consulting Smart Geomatics • Near-surface geothermal energy - State Office • Deep geothermal energy - study by GeoEnergyConsulting • Wind and water power - Energy Atlas Baden-Württemberg • Biomass - Lake Constance Foundation
Scenarios	**Quantity**	2
	Short Description	A business-as-usual and a climate protection scenario were developed. The climate protection scenario is based on the climate protection targets. Rising electricity demand was taken into account in this scenario.
	Used Tools	• TA-BULA (EU-Project)
Measures	**Quantity**	8

	Short Description	• Successive conversion of decentralized heat supply to renewable sources • Use of air-source heat pumps • Use of biomass • Comprehensive building renovation • Use of geothermal energy • Expansion of heat networks (incl. wastewater and seawater heat utilization) • Integrated district concepts • Utilization of solar potential
Funding	50% national funding Additional 20% state funding	
References/Links		
• https://www.konstanz.de/leben+in+konstanz/umwelt/klima+_+energie/energienutzungsplan • https://konstanz.maps.arcgis.com/apps/webappviewer/index.html?id=a4f2ae54e37c4a90beb7952efc4fa9da • https://www.konstanz.de/site/Konstanz/get/params_E-1549619840_Dattachment/75731/Energienutzungsplan%202018.pdf		

Name		**Kremenchuk district heating renovation project**
City		Kremenchuk, Ukraine
Inhabitants of city/district		219,022
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• Consulting; Tilia GmbH • Consulting; Ramboll Group A/S • City; Kremenchuk • Finance; Danida Sustainable Infrastructure Finance (DSIF) • Finance; The Nordic Environment Finance Corporation (NEFCO)
General Short Description of Plan or technical Description for Case-Studies		The project provides a bridge to renewable energy based systems with biomass technology, which holds a significant potential in Ukraine. The overall project objective is to maintain the life, health and environment in the Rakovka district of the city of Kremenchuk by securing reliable and affordable heating and hot-tap water.
Analysis of the status quo	**Short Description**	An inventory analysis about socio-economic situation, energy sectors (including energy authorities and policies, district heating, biomass market) was carried out.
	Used Tools	
	Used Data	• Socio-economic situation – International Monetary Fund • Ukraine energy mix • District heating capacity, heating age, average

		system losses
Potential Analysis	**Short Description**	Potentials for biomass, cost saving, CO_2 emission saving, synergy, were analyzed.
	Used Tools	• Euros saved annually from increased energy efficiency and partial use of biomass instead of natural gas as outcome indicator • Tons of CO2 emissions avoided annually through higher energy efficiency and use of biomass as outcome indicator
	Used Data	
Scenarios	**Quantity**	0
	Short Description	
	Used Tools	
Measures	**Quantity**	5
	Short Description	• systemic improvements (roof repairment, installation of separate heating points, etc.) • installation of a 4 MW biomass boiler • construction of new gas boilers • replacement of the distribution and transmission pipes • installation of a new central remote control system and 122 new individual heat substations.

Funding	33.1 million DKK grant from DSIF; 44.7 million DKK loan from NEFCO; 16.8 million DKK funding from city Kremenchuk
References/Links	
• **Kremenchuk district heating renovation project** • https://ramboll.com/media/rgr/towards-a-more-modern-district-heating-network-in-ukraines-city-of-kremenchuk	

Name	**Local heating and cooling strategy recommendations for Ansfelden**
City	Litoměřice, Czech Republic
Inhabitants of city/district	29,980
Type (Case-Study or Plan)	Heating and cooling strategy recommendations
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Technical University Denmark (DTU)
	  ○ City of Litoměřice
	• Stakeholders involved in the policy group meetings:
	  ○ Deputy-mayor and chief of local administration
	  ○ Local energy agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ National and regional authorities
	  ○ Local authorities
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers
	  ○ Finance corporations and insurance companies
	  ○ Energy agencies and energy advisors
	  ○ Action groups (citizens, NGOs)
	  ○ Media
	  ○ Research and development institutes

General Short Description of Plan or technical Description for Case-Studies	The city of Litoměřice developed a broad Energy Concept in 2009, adopted a Municipal Energy Plan in 2014 and was preparing a Sustainable Energy and Climate Action Plan (SECAP), when this report was developed in the framework of the H2020 project progRESsHEAT. The main goal of Litoměřice is to reduce energy consumption in municipal property by 20% by 2030 (reference year 2012) through the local programme Municipal Energy Saving Fund for public institutions, but no CO2, energy savings, nor RES targets were defined at local level. Barriers and drivers for RES penetration in Litoměřice were collected and analysed via interviews and surveys. Main barriers: lack of awareness, lack of information, need for best practice examples, high investment costs. Main drivers: energy independency, local funding campaign, local awareness campaign (ENGAGE), financial incentives. The existing heating and cooling system of the city was simulated, then 4 technical and policy scenarios for possible future conditions of heating and cooling in the city were analysed. The scenario with the highest profitability both for 2030 and 2050 for all analysed policy settings is the expansion of DH mainly through geothermal. This accounts also for individual heating supplied by natural gas, biomass and solar thermal energy, and retrofit actions leading to heat savings of 1.5% per year. This scenario shows the lowest operating costs, despite highest initial investments, and the lowest CO2 emissions of the heating and cooling sector.	
Analysis of the status quo	**Short Description**	Total heat consumption 258,3 GWh in 2013, half from households, a third from the industry (healthcare, water treatment, education, bakery, furniture production and metallization) and the rest from municipal buildings and services. DH constitutes 36% of heat supply, little below national average. DH is supplied by Energie Holding (98%) and Helia Pro (2%). The main plant supplying heat to the DH system is a coal plant. Individual natural gas boilers are the most common heat supply option in the city (gas distributed by RWE GasNet).
	Used Tools	• Invert/EE-Lab model • Least Cost Tool developed within the project • EnergyPro • QGIS

	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	4 x 3
	Short Description	21. BAU 22. DH expansion 23. DH expansion mainly from gothermal 24. DH expansion replaced by individual gas boilers Each scenario tested for: • no policy • a municipal subsidy for performing heat savings • a municipal subsidy for installing solar collectors.
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html
Measures	**Quantity**	7 Pre-existing measures, 3 identified action items, 4 agreed priorities

	Short Description	• Pre-existing: Operational Programme Environment (OP E) Priority axis 5, Operational Programme Enterprise and Innovations for Competitiveness (OP EIC) Priority axis 3, Integrated Regional Operational Programme (IROP) Priority axis 2, Green Investment Scheme, Municipal fund for the solar systems, Municipal Energy Saving Fund, Communication Strategy Geothermal Plant • Action items identified: Propose new projects to finance of the geothermal project; start a deeper cooperation with current district heating operator; present results of modelling to relevant stakeholders • Priorities and timelines agreed on: prepare a feasibility study and a cost benefit analysis (CBA); ensure financial means for the geothermal energy project; communicate with main stakeholders to ensure public acceptance; review of the Energy saving Fund (ESF) and other support schemes.
Funding	H2020 funding for the assessment and strategy development	
References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html http://www.progressheat.eu/Reports-publications-69.html		

Name		**Wärmeplanung Landkreis Lörrach**
City		Lörrach, Germany
Inhabitants of city/district		48,160
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• Consulting: ifok GmbH • Consulting: endura kommunal • Energy Agency: greenventory GmbH • City: Lörrach • Public Utility: Stadtwerke Lörrach
General Short Description of Plan or technical Description for Case-Studies		The project started on January 1, 2021 and will run for 20 months. First, the relevant data from municipalities, energy suppliers, commercial companies and other players in the heat supply are collected. This is followed by an inventory analysis of the heat demand and the supply infrastructure. Based on this, the stakeholders will develop a joint potential analysis for energy and waste heat in specialist discussions. Finally, the project partners will generate a target image for a climate-neutral heat supply in 2050. After the heat planning project, the district of Lörrach will develop a heat transition strategy as a blueprint for similar available projects.
Analysis of the status quo	**Short Description**	Inventory analyses with demographic development, social structure, settlement structure, transport structure, floor area information (Flächenangaben), energy- and greenhouse gas balance were carried out.
	Used Tools	• BICO2BW;

	Used Data	• existing data of the city from "Statistischen Landesamt (StaLa) Baden- Württemberg" • energy consumption data from the municipalities in the district as well as companies and energy providers.
Potential Analysis	**Short Description**	Potentials for reducing GHG emissions, climate-neutral supply in the district, such as commercial and industrial waste heat, geothermal energy, solar thermal energy or biomass, increased efficiency in the building sector, and to link them with existing heat requirements elsewhere.
	Used Tools	„Potential tool“ from energy agency Ravensburg
	Used Data	Data about ● heat consumption, ● heat supply facilities, ● waste heat potential ● heating age ● heating and gas networks ● other information about chimney sweeps, municipalities, companies, network operators and energy suppliers from: ● Data base of potential and energy atlas from LUBW, ● State Statistical Office (StaLa) ● Climate Protection and Energy Agency Baden-Württemberg GmbH (KEA) ● energy suppliers in the district
Scenarios	**Quantity**	3
	Short Description	Scenarios about • maximum scenarios for power supply in the district until 2050 (including one with increasing electricity demand due to heat pumps, digitization, smart

		homes, etc.) • maximum scenario for the heating sector up to the year 2050 • Climate protection scenarios for fuel consumption and its generation
	Used Tools	
Measures	**Quantity**	23
	Short Description	• Energy supply and renewable energies Expansion program for solar power generation in the private sector - 365 roofs / a; Active application of the Baden-Württemberg Energy Atlas; Expansion program for solar power generation in the corporate sector; Transparent communication of the results of identified expansion potential for renewable energies; Roof areas PV - all own properties, as far as suitable, equipped with PV; Solar energy - architecture and planning; Promote energy storage; Build biogas plants in the district; Support of cooperative models for the implementation of renewable energy projects / energy efficiency projects; Project continued: Promotion of efficient heating networks; CitizenGIS; Adaptation of heating systems to EWärmeG • Energy saving and efficiency Ambitious renovation of district-owned buildings; Use of efficient technologies in municipal properties; beacon projects in the private sector: Efficient Houses - Open House; Project "partner company climate protection"; Awards for beacon projects in the corporate sector; Competition / award for real estate companies (e.g.

		Wohnbau Lörrach / Baugenossenschaft); Climate protection in schools; Training of public administration employees; Annual campaign for climate protection; Competition: climate-friendly ideas; Introduce energy controlling for municipal properties;
Funding	State support	
References/Links		
• https://www.loerrach-landkreis.de/Klimaschutz/Waermewende • Integriertes Energie- und Klimaschutzkonzept für den Landkreis Lörrach		

Name	**Local heating and cooling strategy recommendations for Matosinhos**
City	Matosinhos, Portugal
Inhabitants of city/district	167,026
Type (Case-Study or Plan)	**Heating and cooling strategy recommendations**
Current Status (Planning, in progress, completed)	Completed, year of implementation: 2017

Stakeholders involved	• Authors:
	  ○ TU Wien, Energy Economics Group, Institute of Energy Systems and Electrical Drives, Vienna University of Technology
	  ○ Fraunhofer Society for the advancement of applied research (ISI)
	  ○ Instituto de Engenharia Mecânica e Gestão Industrial (INEGI)
	• Stakeholders involved in the policy group meetings:
	  ○ Deputy-mayor and chief of local administration
	  ○ Local energy agency
	  ○ Local Utility
	• Stakeholders considered in the stakeholders' analysis:
	  ○ National and regional authorities
	  ○ Local authorities
	  ○ Businesses
	  ○ Households
	  ○ Energy Suppliers
	  ○ Local professionals (planners, designers, installers, craftsmen)
	  ○ Energy agencies and energy advisors
	  ○ Action groups (citizens, NGOs)
	  ○ Research and development institutes

General Short Description of Plan or technical Description for Case-Studies	This report, developed in the framework of the H2020 project progRESsHEAT, and it summarizes the study, the modelling, the local case-study of Matosinhos, the strategic recommendations and a roadmap for increasing the use of RES in heating and cooling. The limited authority of the municipality the heating and cooling sector, due to the centralized energy management in Portugal, is the main obstacle, limiting most of the intervention potential to the reduction of energy demand. Another significant barrier towards local climate action in Portugal is due to little involvement of stakeholders by local authorities and scarce financing conditions and instruments. Transitioning from a heavily industrialized region towards a more service oriented, Matosinhos shows proximity between large industrial facilities that could be a source of excess heat (e.g. a refinery) and large service buildings. A modelling exercise shows that relying on the excess heat of the refinery would be cost-effective when compared to other standard decentralized solutions. This could be further incentivized by a range of policies (CO2 taxes, low interest rates for sponsored financing, subsidizing investment at 30%, or even public ownership of the investment). Heat pump systems fed through solar photovoltaic showed similar prices to more conventional solutions.	
Analysis of the status quo	**Short Description**	33 665 residential buildings, about 2.5 housing units per building, over 80% detached or semi-detached. 80% of buildings built before 1990. 3180 GWh/year of final energy used in residential buildings. Residential buildings present low energy demand for heating and even lower for cooling, and low density of thermal energy demand. Energy demand in new commercial buildings (e.g. shopping malls) is driven by cooling demands (mostly decentralized compression cooling equipment). Several large services buildings and industrial facilities located in the municipality, in particular, a refinery, close to a number of potentially relevant large buildings demanding heating and cooling (all within 1 km radius): a prime opportunity for a DHC system. The energy supply of the municipality is covered mainly by fossil fuels, (transports). Residential buildings in Portugal tend to have only modest use of heating and negligible use of cooling. Heating systems are almost exclusively individual and tend to be either fireplaces (typical in older buildings) or natural gas/LPG/diesel boilers/furnaces. The few heat-pumps that exist, which enable also cooling in summer, are essentially of the air-air type. Services buildings tend to be heated or cooled continuously, relying on an assortment of individual HVAC units. There are no district heating and cooling facilities in Matosinhos. Generally, district heating is not used in Portugal, with the

		exception of one network in Lisbon. The promotion of solar thermal panels and solar PV for self-consumption are already in place at the national level (min. levels of RES for new buildings, efficiency standards, etc.).
	Used Tools	• Invert/EE-Lab model • Least Cost Tool developed within the project • EnergyPro • QGIS
	Used Data	• GIS data of building stock (type of building and age) • Heat deamand, statistical data on buildings, projections, population, energy price scenarios • Least cost combination of renovation vs supply • Different policies All data and analyses are summarized in the Strategy and synthetized in the progRESsHEAT case study http://www.progressheat.eu/Reports-publications-69.html
Potential Analysis	**Short Description**	Based on existing estimations and other studies, potential for renewables and efficient energy use were mentioned and used, but not developed within the project.
	Used Tools	N.A.
	Used Data	N.A.
Scenarios	**Quantity**	5
	Short Description	25. Status quo (excl. capital costs) 26. Status quo (incl. capital costs) 27. Heat pump 28. Heat pump with photovoltaic (PV) 29. Refinery excess heatBAU
	Used Tools	• Invert/EE-Lab model • EnergyPro • http://www.progressheat.eu/Reports-publications-69.html

Measures	**Quantity**	7 pre-existing measures, 7 propsed action items, and 3 priorities
	Short Description	• Pre-existing: National Action Plan for Renewable Energy (PNAER); National Climate Change Programme (PNAC) with RNBC, FPC and ENAAC; Program E4 (Energy Endogenous and Energy Efficiency); National climate change adaptation strategy (ENAAC); National Building Energy Certification and Internal Air Quality System (SCE); Solar Thermal 2009 & 2010 programme: and Efficient Building 2012 programme; Action Plan for Sustainable Energy of Matosinhos • Action items proposed: Mapping the excess heat sources in the municipality and the main heat uses; assess with the refinery the possibility of getting its excess heat at very low cost; foster a dialogue between the building owners of the Amorosa/Avessada area, to identify a preferred business model for a DHC network; adopt urban management ensuring DHC options for new large urban areas; formally adopt the plan of energy transition that was proposed by the Porto Energy Agency; regularly update the energy matrix for the area and/or adopt the online monitoring platform; keep following the best practices of other European municipalities. • Priorities and timelines: adopt an Energy and GHG monitoring instrument in the municipality; adopt an Energy transition plan (by 2018) and to start discussion on implementation (by 2020); discuss with the refinery owners how to use their excess heat (by 2018).
Funding		H2020 funding for the assessment and strategy development
References/Links http://www.progressheat.eu/Local-strategy-development-process-96.html http://www.progressheat.eu/Reports-publications-69.html		

Name		**Action plan - Energy transition analysis and planning**
City		Pamplona. Spain
Inhabitants of city/district		199.066
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• **Covenant of majors** • **Pamplona city council**
General Short Description of Plan or technical Description for Case-Studies	This plan aims to support Pamplona-Iruña City Council in the development of an Energy Transition strategy, with a medium and long-term vision, as well as specifying a short-term strategy. With this objective in mind, the Plan presents a diagnosis of the situation of the municipality's energy policy and will define an energy action plan through a roadmap with the measures to be developed to achieve results in the short term and begin to carry out and plan more far-reaching actions. In other words, the Plan is defined to implement the energy transition and some of the measures defined in the 2015 Municipal Decree in the field of energy in the city of Pamplona over the next two years.	
Analysis of the status quo	**Short Description**	The Plan presents an analysis in order to characterize the city's energy demand, both at municipal and private level, in order to make decisions from a clear starting point.
	Used Tools	•
	Used Data	• Agenda 21 Emissions Inventory. Period 2004 - 2008. • Agenda 21 Sustainability Audit. Years 1998, 2004 - 2006. Total data • Agenda 21. Iberdrola Distribución Eléctrica and Gas Natural energy plan data.

		• Distribution, Navarra Energy Plan data. Years 2013 - 2016 • Sustainability Indicators of the Agenda 212 Service
Potential Analysis	**Short Description**	
	Used Tools	
	Used Data	•
Scenarios	**Quantity**	
	Short Description	
	Used Tools	•
Measures	**Quantity**	22
	Short Description	All the measures proposed are based on this four action lines: • Municipal development supported by the energy transition: social innovation, technology, employment, renewable energies, sustainability, empowerment of users (citizens) and local administration. • Reduction of energy demand as a priority • Remunicipalisation of energy services and assets. • Social involvement

Funding	Funds or aid at regional and state level
References/Links	
• https://www.pamplona.es/sites/default/files/2019-01/Plan%20de%20Acci%C3%B3n%20Energ%C3%A9tica_0.pdf	

Name		**Wärmeplanung Landkreis Rostock**
City		Rostock, Germany
Inhabitants of city/district		208,900
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• City: Rostock • Public Utility: Stadtwerke Rostock • Technical Advisory Project Group includes representatives from University of Rostock, housing industry (die Wohnungswirtschaft), Agenda21 Council, Stadtwerke Rostock AG responsible offices of the city administration.
General Short Description of Plan or technical Description for Case-Studies		Accompanied by public participation and the involvement of important actors from the city as well as external experts, the climate protection control center is developing a strategy for the future supply of climate-neutral district heating and decentralized heating. The starting point for the strategy will be the development of heat demand in Rostock and local potential for renewable energies. This plan aims to work out coordinated scenarios for the heating transition, a concrete action plan as well as a time and financing plan with the actors involved. Furthermore, area for the energy supply is to be ensured in the land use plan. The heating plan is expected to be completed in autumn 2021 and then submitted to the mayor and the city council for a resolution.
Analysis of the status quo	**Short Description**	An inventory analysis with settlement structure; population structure; economic structure; energy generation, supply and consumption; an energy balance, CO2 balance and a presentation of the existing energy infrastructures was carried out.

	Used Tools	SWOT-Analysis
	Used Data	• existing data of the city; "Liegenschaftsdaten"; • Energy data from Stadtwerke Rostock AG; • database for transport goods statistics of the Federal Statistical Office (Verkehrsgüterstatistik des Statistischen Bundesamtes);
Potential Analysis	**Short Description**	Potentials of renewable energy sources like biomass (including the district), solar, geothermal, environmental heat and waste heat were studied. Possibilities for seasonal heat storage and integrating these new space requirements into urban planning were also analysed.
	Used Tools	studies with territorial reference
	Used Data	• biogenic solid fuels - Diplomarbeit H. Großkopf; • relevant biogas substrates- Diplomarbeit H. Großkopf; • Solar thermal for heating support + hot water supply- Solarpotenzialanalyse Rostock, M. Busch; • Photovoltaics (ST heating and hot water) in Rostock- Solarpotenzialanalyse Rostock, M. Busch; • Geothermiepotenzialanalyse Rostock, H.S.W.
Scenarios	**Quantity**	2
	Short Description	A business-as-usual and an ambitious scenario were developed.
	Used Tools	
Measures	**Quantity**	6

	Short Description	• Implementation of the ambitious scenario for energy efficiency • Development of renewable energy sources in the surrounding area + geothermal energy • Low-emission or zero-emission energy for motor vehicles • Reduce energy consumption (e.g. through energy-efficient development, energy-efficient renovation rate). • private house owners have to invest in more climate-friendly energy sources (away from natural gas). • areas for renewable energies should have priority in the new land use plan (FNP).
Funding	Funded by the state of Mecklenburg-Vorpommern and the federal government with funds from the European Structural Fund ERDF.	
References/Links		
• https://rathaus.rostock.de/de/service/aemter/amt_fuer_umwelt_und_klimaschutz/immissions_und_klimaschutz_umweltplanung/klimaschutzleitstelle/waermeplan/312421 • Ergebnisbericht zum Arbeitspaket Nr.1 „Analyse des Ist-Zustandes“ https://rathaus.rostock.de/media/rostock_01.a.4984.de/datei/Ergebnisbericht_AP1_20130823.pdf • https://rathaus.rostock.de/sixcms/media.php/4984/Masterplan_2013-09-19_HHI_Teil3.pdf • https://rathaus.rostock.de/media/4984/2021-02-03%20Protokoll%20Agenda%2021-Ratssitzung.pdf		

Name	**Sustainable development strategy of Salaspils region for 2014-2030**
City	Salaspils, Latvia
Inhabitants of city/district	22,758 (in 2020)
Type (Case-Study or Plan)	Plan
Current Status (Planning, in progress, completed)	In progress

<table>
<tr><td colspan="2">Stakeholders involved</td><td>Local authority
Inhabitants of the city via survey and public hearing</td></tr>
<tr><td rowspan="1">General Short Description of Plan or technical Description for Case-Studies</td><td colspan="2">Salaspils local authority has published three documents on its webpage that are available to the public:
- Sustainable development strategy for 2014-2030
- Development program for 2019-2025 Strategic Part
- Spatial plan
At the request of the local authority, all plans were developed by the business consultancy SIA KONSORTS.
Sustainable development strategy for 2014-2030 is a more general document, without any specific tasks and identified projects. However, Development program for 2019-2025 Strategic Part includes not only the description of the current situation, long-term and medium-term strategic goals and their coherence with other planning and development documents at both national and regional level, but also includes action plan and investment plan.
A supporting document for the above mentioned plans is the Investment plan which is updated once a year. Investment plan includes investment projects, which are necessary to implement the medium-term objectives set out in the Development Program for 2019-2025 Strategic Part, and planned actions included in the action plan. The Investment plan gives a more detailed information about the specific projects, namely responsible executors, needed investments and source of funding and a project implementations timeline.</td></tr>
<tr><td rowspan="3">Analysis of the status quo</td><td>Short Description</td><td>The description of the current situation includes general information about the city, its inhabitants and their employment, information about the city’s business environment and the development of the sectors of the city, traffic infrastructure and transport, public utilities, the situation in the real estate sector, social services and the healthcare, culture and sports, public security.</td></tr>
<tr><td>Used Tools</td><td>N/A</td></tr>
<tr><td>Used Data</td><td>Existing data of the city
Data from the public utilities
Data from the
Central Statistical Bureau of Latvia
State Revenue Service</td></tr>
</table>

		○ State Regional Development Agency of Latvia ○ Office of Citizenship and Migration Affairs of Latvia
Potential Analysis	**Short Description**	The *Development program for 2019-2025 Strategic Part* includes long-term and medium-term strategic goals that are broken down into specific projects.
	Used Tools	N/A
	Used Data	N/A
Scenarios	**Quantity**	N/A
	Short Description	N/A
	Used Tools	N/A
Measures	**Quantity**	5
	Short Description	The *Development Program for 2019-2025 Strategic Part* includes the following tasks related to the decarbonization: Task 1. Informing the public about objective facts about energy efficiency and the importance of renovation. (Responsible *SIA Salaspils Siltums*) Task 2. Partial reimbursement of project expenses of improving the energy efficiency of multi- apartment buildings (Responsible Local authority) Task 3. Reconstruction of public buildings owned by the municipality and improvement of energy efficiency, including integration of renewable energy equipment (Responsible Local authority)

		Task 4. Reduction of energy consumption in municipal buildings and infrastructure (construction of LED lighting in municipal streets) (Responsible Local authority) Task 5.
Funding	Mostly from the budget of Salapsils municipality and financing from EU funds: Task 2. 300,000 EUR (municipal budget) Task 3. 1.2 mill. EUR (municipal budget 180,000 EUR, EU funds 1.02 mill. EUR) Task 4. 500,000 EUR (municipal budget 75,000 EUR, EU funds 425,000 EUR) Task 5. 117,348 EUR (public utility *PSIA Valgums S*)	
References/Links		
• https://www.varam.gov.lv/sites/varam/files/content/files/ATR%20reforma/Info%20par%20novadiem/salaspils_novads_2020.pdf • https://salaspils.lv/lv/attistibas-planosanas-dokumenti • http://investinsalaspils.lv/attistibas-planosana • Sustainable development strategy for 2014-2030: https://salaspils.lv/sites/default/files/Att%C4%ABst%C4%ABba/2020/IAS_2014-2030_1.pdf • Development program for 2019-2025: https://salaspils.lv/sites/default/files/Att%C4%ABst%C4%ABba/2020/Strat%C4%93%C4%A3isk%C4%81_da%C4%BCa_II_s%C4%93jums.pdf		

Name		• **Hotmaps – Heating and Cooling Open Source Tool for Mapping and Planning of Energy Systems**
City		San Sebastián
Inhabitants of city/district		186,000
Type (Case-Study or Plan)		Case study
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Fomento de San Sebastián (FSS) • Environmental department
General Short Description of Plan or technical Description for Case-Studies		This strategic plan for the city of San Sebastián was developed in the frame of the Hotmaps European project following a commonly defined strategy process and using the Hotmaps toolbox for quantitative scenario analysis. The strategy process included the following steps: an analysis of barriers and drivers, a stakeholder analysis, the mapping of the existing heat demand and available resource potentials, the development of scenarios for heating demand and supply in the city in the year 2050 and the discussion of these steps and their outcomes with relevant persons in the city. The plan presents and evaluates various scenarios for future heat demand and supply for the city which, at that moment, was nearly entirely supplied with natural gas. With this aim, the plan studies the costs and potentials for heat savings in buildings, for decentral heat supply and for the supply of district heating. To conclude with, the plan presents a quantitative scenario analysis which shows that district heating should be considered as a potential future option for supplying remarkable parts of the buildings' heat demand in the city and renovation strategies would be interesting to reach certain saving objectives.
Analysis of the status quo	**Short Description**	The plant concludes presenting a quantitative analysis of the different scenarios presented and states that further studies will be needed and the identification of two main lines of action on the road to a low carbon heating system in San Sebastián: • Feasibility study of the integration of the heat from the

		waste incineration plant into a potential district heating system • More detailed analysis of the heat savings in the buildings of the city.
	Used Tools	• Hotmaps toolbox
	Used Data	• Database of the building stock hosted by the Urban Development Department of San Sebastián • Data on the building stock and energy demand values per gross floor area taken from the Invert/EE-Lab database • Several data for economic calculation extracted from different sources (European projects, IEA…) • Temperature and hourly solar irradiation data for the location of San Sebastian
Potential Analysis	**Short Description**	The plan presents and analysis of the potential for heat savings in buildings, for decentral heat supply and for the supply of district heating with the aim of evaluating various heat demand and supply scenarios for the city. All potential scenarios are evaluated for 2050. The results of the analysis presented by the plan show that high shares of heat supply via district heating could be cost-effective in the city of San Sebastián but lays out that further studies will be needed
	Used Tools	• Hotmaps toolbox
	Used Data	For the potential analysis the plan presents and studies the following parameters with their related data: • Heat demand density maps considering different saving scenarios • Costs of decentral supply • Sensitivity of economic disrict heating expansion • District heating portfolios and related costs
Scenarios	**Quantity**	8

	Short Description	The plan presents different scenarios varying the characteristics regarding the following parameters: • Decentral supply, district heating network and district heating supply • Savings of heat demand • DH market share • DH portfolio • High electricity and CO_2 price
	Used Tools	• Hotmaps toolbox
Measures	**Quantity**	4 single renovation measures combining to form different packages
	Short Description	Renovation measures: For each typical building currently existing in the city a set of 9 renovation packages is developed. Each renovation package hereby leads to different relative savings and consists of a combination of the following single measures: insulation of roofs, insulation of exterior walls, insulation of basements and change of windows.
Funding		
References/Links		
• https://www.hotmaps-project.eu/category/areas/ • https://www.hotmaps-project.eu/wp-content/uploads/2020/10/Hotmaps_D.6.3_SanSebastian-HC-Strategies_FINAL_reduced.pdf		

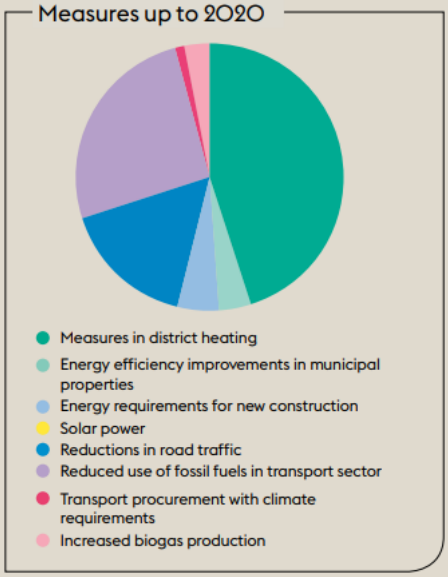
Name	**Strategy for a fossil-fuel free Stockholm by 2040**
City	Stockholm, Finland
Inhabitants of city/district	1m (Stockholm population)
Type (Case-Study or Plan)	Plan
Current Status (Planning, in progress, completed)	Plan completed

Stakeholders involved		• City Executive Office • Stockholms stad (municipality)
General Short Description of Plan or technical Description for Case-Studies	Published in 2016, the report sets out a strategy for Stockholm to be fossil-fuel free by 2040. The strategy is very high level and doesn't go into detail about the analysis or different scenarios. Stockholm already has a large district heating network and one of the strategies to be fossil-fuel free by 2040 is to increase the connection to the Open District Heating network. This network enables customers to deliver their excess heat into the district heat network at the same time as turning a cooling cost into a revenue. Customers act as small-scale heat production units and the network as the energy carrier where heat can be moved from places with surplus to places with demand.	
Analysis of the status quo	**Short Description**	Main fossil-fuel energy users: • Coal in the Vartan CHP plant that produces district heating and electricity • Oil for boilers in buildings and district heating • Natural gas for boilers in buildings • Fossil-based plastics for waste incineration Between 1990 and 2014, progress in reducing carbon emissions has been greatest in heating buildings (fallen by 50%). The heating and cooling sector still accounts for approximately 56% of total emissions in Stockholm. In 2014, a total of 7600 GWh of energy was used to heat properties in Stockholm (700 GWh for cooling). 4 main sources (by GWh supplied) of this energy are energy-from-waste, biofuel, process water/sea water, and electricity. 80% of buildings in Stockholm are heated by district heating. Primarily CHPs using the energy sources mentioned above and supplemented, to some degree, with heat recovered from industrial/commercial operations (Open District Heating).

	Used Tools	None
	Used Data	Data sourced from Stockholm Environment and Health Administration
Potential Analysis	**Short Description**	Decarbonising the city's district heating network is crucial to meeting the city's climate goal. The report recommends increasing the connections to the Open District Heating network. This "heat market" was launched in 2014. This network enables customers to deliver their excess heat into the district heat network at the same time as turning a cooling cost into a revenue. Customers act as small-scale heat production units and the network as the energy carrier where heat can be moved from places with surplus (e.g. data centres) to places with demand. During 2017, 1% of heat delivered on the heat network was from recovered heat. Estimated to increase to 10% by 2035. Electricity consumption can be reduced by replacing electrically generated cooling solutions with district cooling. The cooling systems make use of "free cooling", either in the form of naturally cool sea water or cooler outdoor air.
	Used Tools	None
	Used Data	Not specified
Scenarios	**Quantity**	None
	Short Description	Different scenarios were not discussed in this strategy.
	Used Tools	None
Measures	**Quantity**	
	Short Description	Listed here are the measures/steps in the strategy that relate to heat

Measures to meet the 2020 milestone

- The City effectuates a district heating system that reduces overall emissions by at least 240,000 tonnes of CO2e by 2020
- The City takes action to improve energy efficiency in its municipal operations by 10% compared with the reference year 2015. This will reduce emissions by at least 20,000 tonnes of CO2e by 2020
- The City acts to impose an energy consumption ceiling of 55 kWh/m2 in new-builds on municipally allocated land, with the ambition of achieving a level of 45 kWh/m2. This will reduce emissions by at least 25,000 tonnes.



Steps towards fossil-fuel freedom by 2040

- The City supports Fortum Värme's work to increase connections to the Open District Heating network and to investigate the potential for even more users.

Funding	Not specified

References/Links

- https://international.stockholm.se/globalassets/rapporter/strategy-for-a-fossil-fuel-free-stockholm-by-2040.pdf
- https://www.thermos-project.eu/fileadmin/user_upload/THERMOSInspire1__Martin_Brolin.pdf
- https://www.opendistrictheating.com/

Name		**Sustainable Energy and Climate Action Plan of Strovolos Municipality**
City		Strovolos
Inhabitants of city/district		Around 70,000
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• Municipality of Strovolos • Cyprus Energy Agency
General Short Description of Plan or technical Description for Case-Studies		Within the framework of the LIFE+ Project Urbanproof, the Sustainable Energy and Climate Action Plan 2020 - 2030 was prepared for the Municipality of Strovolos. The action plan includes measures at the local level, which are planned in addition to the national measures. The envisaged measures are expected to contribute to the achievement of the national CO_2 emission reduction target of 40% (reference year 2009) and even help to exceed it. The total energy savings from the implementation of the action plan amounts to 107,343 MWh/ year and the production from RES to 1,970 MWh/ year. The reduction in CO_2 emissions amounts to 58,595 tCO_2/ year and corresponds to a reduction of 42% compared to the reference year level.
Analysis of the status quo	**Short Description**	Various sources were used in order to estimate the final energy consumption for 2009 in the following sectors: • Primary sector • Secondary sector • Tertiary sector • Residential sector • Public Lighting • Transport
	Used Tools	• A bottom-up estimation approach was adopted, using the available modelling tools to capture the energy profile of the Strovolos Municipality.

<table>
<tr><td rowspan="2"></td><td></td><td></td></tr>
<tr><td>Used Data</td><td>Two categories of input data were extensively used:
direct energy amount (i.e. final energy demand of the sectors in the respective Municipality, etc.) or
indirect statistical data and general information provided to modelling tools (i.e. energy demand profiles of different consumer categories, energy efficiency factors of different technologies used, etc.).
Final energy consumption in Strovolos Municipality in 2009:<table><tr><th>Sector</th><th>Final Energy Consumption in MWh (2009)</th></tr><tr><td>Residential</td><td>283,050</td></tr><tr><td>Primary</td><td>1,582</td></tr><tr><td>Secondary</td><td>30,919</td></tr><tr><td>Tertiary</td><td>265,677</td></tr></table></td></tr>
<tr><td rowspan="2">Potential Analysis</td><td>Short Description</td><td>Based on the same approaches as for the analysis of the status quo , an estimation of the energy consumption in different sectors was carried out for 2016-2018.</td></tr>
<tr><td>Used Tools</td><td>A bottom-up estimation approach was adopted, using the available modelling tools to calculate the estimated energy consumption of the Municipality of Strovolos for 2016-2018.</td></tr>
</table>

<table>
<tr><td></td><td>Used Data</td><td>For the potential analysis two categories of input data were extensively employed:
direct energy amount (i.e. final energy demand of the sectors in the respective Municipality, etc.) or
indirect statistical data and general information provided to modelling tools (i.e. energy demand profiles of different consumer categories, energy efficiency factors of different technologies used, etc.).
Estimated final energy consumption in 2018:<table><tr><th>Sector</th><th>Final Energy Demand in MWh (2018)</th></tr><tr><td>Residential</td><td>249,754</td></tr><tr><td>Primary</td><td>897</td></tr><tr><td>Secondary</td><td>19,886</td></tr><tr><td>Tertiary</td><td>241,740</td></tr></table></td></tr>
<tr><td rowspan="3">Scenarios</td><td>Quantity</td><td>2</td></tr>
<tr><td>Short Description</td><td>Two basic scenarios for projecting CO_2 emissions were analysed. The calculation of the CO_2 emission trajectories is based on the estimated final energy consumption in the Municipality of Strovolos for 2016-2018:
Business as usual (BAU)
Sustainable Energy and Climate Action Plan (SECAP)
BAU forecasts CO_2 emissions in the Municipality of Strovolos without the policies and measures mentioned in the Strovolos action plan.
The SECAP scenario foresees the successful completion and implementation of all policies and measures mentioned in the Strovolos action plan.</td></tr>
<tr><td>Used Tools</td><td>The calculation of CO2 emission trajectories was based on the estimated final energy consumption in the Municipality of Strovolos for 2016-2018. More specifically, two categories of input data were extensively used:
direct energy amount (i.e. final energy demand of the sectors in the respective Municipality, etc.) or
indirect statistical data and general information provided to modelling tools (i.e. energy demand profiles of different consumer categories, energy efficiency factors of different</td></tr>
</table>

<table>
<tr><td></td><td></td><td>technologies used, etc.).</td></tr>
<tr><td rowspan="2">Measures</td><td>Quantity</td><td>7</td></tr>
<tr><td>Short Description</td><td>The following policy measures are mentioned in the action plan:
<table>
<tr><th>Sector</th><th>Measure</th><th>Implementation year</th><th>Cost (in €)</th><th>Energy Saving (in MWh/y)</th></tr>
<tr><td>Public Buildings</td><td>Energy Upgrading of the Town Hall</td><td>2021-2028</td><td>248,300</td><td>195</td></tr>
<tr><td>Public Buildings</td><td>Energy Upgrading of the Public Buildings</td><td>2022-2028</td><td>17.,500</td><td>12</td></tr>
<tr><td>Tertiary Sector</td><td>Energy Upgrading of Schools</td><td>2023-2025</td><td>300,000</td><td>27</td></tr>
<tr><td>Residential</td><td>Green roofs</td><td>2024-2029</td><td>300,000</td><td>421</td></tr>
<tr><td>Local Energy Production</td><td>PV on Town Hall</td><td>2020</td><td>14,000</td><td>15</td></tr>
<tr><td>Local Energy Production</td><td>PV on Acropolis Park</td><td>2022-2023</td><td>4,500</td><td>4.5</td></tr>
<tr><td>Local Energy Production</td><td>PV parks</td><td>2024-2028</td><td>450,000</td><td>450</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>Funding</td><td>The measures in the action plan are expected to be funded by the following financial sources:
<table><tr><th>Source</th><th>Percentage</th></tr><tr><td>Municipal budget</td><td>41%</td></tr><tr><td>National funds</td><td>37%</td></tr><tr><td>European funds</td><td>3%</td></tr><tr><td>ESCO</td><td>13%</td></tr><tr><td>Citizens’ participation</td><td>4%</td></tr><tr><td>Green taxes</td><td>2%</td></tr></table></td></tr>
<tr><td colspan="2">References/Links</td></tr>
<tr><td colspan="2">• https://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/8/fynAAtHozmUtddwZFOO5SWNw5Jg0yCOQ.pdf</td></tr>
</table>

Name		**Tartu energia 2030. Tartu linna energia- ja kliimakava (Tartu Energy 2030. Tartu City Energy and Climate Plan)**
City		Tartu, Estonia
Inhabitants of city/district		95,430
Type (Case-Study or Plan)		Energy plan
Current Status (Planning, in progress, completed)		Completed
Stakeholders involved		• Consulting, energy agency – Tartu regional energy agency • Municipality - Tartu City Government
General Short Description of Plan or technical Description for Case-Studies		The energy and climate plan focuses on the overall energy and climate goals for the city of Tartu up until 2030, with separate sections dedicated to (district) heating and cooling, as well as residential sector. During the process of compiling the plan, two multi-stakeholder workshops took place, both involving over 60 representatives of the topic. As a result of the workshops, a vision was agreed upon. Mostly, with regards to heating and cooling, the plan focuses on decarbonising the district heating and cooling sector. The latest by 2030, it is planned to fully move away from using fossil fuels for district heating. With regards to biomass, only low-value (and certified accordingly) wood is to be used in district heating in Tartu. There are also plans for district cooling. In addition, all citizens, organizations having activities or located in Tartu and apartment associations are encouraged to join so-called societal agreement about achieving the goals set out in the plan.
Analysis of the status quo	**Short Description**	Baseline emissions inventory was prepared for the base year 2010, later an interim emissions inventory was collected in 2017. Furthermore, Tartu has pledged to do a monitoring emissions inventory at least once every 4 years. Emissions are based on energy consumption data.
	Used Tools	• Two stakeholder workshops for agreeing on a vision • Setting targets based on baseline emissions inventory

	Used Data	• Existing data of the city • Data about sold heating and cooling in MWh • Absolute heating losses in MWh, relative heating losses in MWh • Data about clients connected to district heating • Data about energy sources in district heating • CO2 emissions data for the municipal sector; private and public sector • Living space of apartment buildings in m^2, energy consumption data for those
Potential Analysis	**Short Description**	The plan does not specify or conduct potential analyses connected to heating or cooling. Instead, for instance, for renovation potential, a country-wide study has been used (and then intersected according to the data about living space and buildings in Tartu).
	Used Tools	Tools not specified. Methodology is specified only sporadically.
	Used Data	• Potential for CO2 reduction in buildings – SEI Tallinn and Finantsakadeemia OÜ study „Analysis about the opportunity to raise Estonian climate ambition“.
Scenarios	**Quantity**	1
	Short Description	No separate scenarios specified. The plan sets out the goal of -40% emissions reduction by 2030 (in comparison to 2010) and in the long term, achieving climate neutrality by 2050. More specifically for the heating and cooling sector, three main aims are foreseen by the scenario: (1) fossil fuel free district heating and cooling the latest by 2030; (2) from 2024, buildings in the Tartu municipal sector will not consume energy from fossil fuels (except for district heating/cooling, where the target is 2030); (3) expansion of the district heating network.
	Used Tools	• Not specified

Measures	**Quantity**	19
	Short Description	• Municipal sector switching to RES (societal agreement) • Cooperation agreement between Tartu and energy producer to achieve carbon neutrality in district heating • Ending usage of fossil fuels in district heating and cooling • Increasing usage of residual heat in district heating • Expansion of district heating area • Introduction of energy storage in district heating energy production and distribution • Reduction of network losses in district heating • Low temperature district heating and the use of waste and residual heat in the district heating network • Gradually adding buildings in Supilinna and Karlova buildings to the district heating network • Analysis of the possibilities of separating residual heat from wastewater • Adding district cooling to the City planning documents • Investigating the extension of the district cooling network in the Ropka industrial area • Development of an integrated district cooling network in the Turu, Aardla and Tulbi regions together with energy storage • Reduction of network losses in district cooling • Development of financing options and schemes for housing renovation • Renovation of apartment buildings • Renovation of small houses • Establishment of Renovation Support Center • Renewable energy production opportunities and constraints map application (if necessary, specification of data and performance of additional surveys, incl. analysis of the

		possibilities of using ground source heat pumps)
Funding	Co-funding from Horizon 2020 SmartEnCity	
References/Links		
• https://tartu.ee/sites/default/files/uploads/Linnavarad/SECAP/Tartukliimakava2030.pdf		

Name		**City Climate Plan 2029 (sub-chapter on carbon neutral energy system 3.2.); Turku Energy road map**
City		Turku
Inhabitants of city/district		193 924
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• **City of Turku** • **Turku Energia**
General Short Description of Plan or technical Description for Case-Studies		In the city of Turku, the share of RES in district heating production will reach 65% by the end of 2021, and the overall share of RES out of all electricity and heat sold by Turku Energia will be at least 80% by the end of 2025. Smart solutions, multi-way systems and energy storage will be used in the work of Turku Energia. Waste heat will be used to improve energy efficiency in the area of the city. Certain areas, such as Skanssi and Turku Science Park will be dedicated to areas of interest for energy investment and experimental technologies in between years 2019 and 2025. The city's binding energy efficiency agreement mandates that Turku will have to reach an energy efficiency improvement of 7,5% by 2025.
Analysis of the status quo	**Short Description**	In the baseline year 2015, district heating formed a 39% share of the city's total greenhouse gas emissions.
	Used Tools	• SECAP method of CO2 emissions calculation.
	Used Data	• Data on buildings: by the city of Turku • Data on emissions and fuels used for heating: CO2 report (Finnish emissions portal https://www.co2-raportti.fi/)
Potential Analysis	**Short Description**	The plan does not determine the potential of each individual action, but all the planned district heating measures combined would account for a 45% reduction of the city's total emissions by 2029.

	Used Tools	SECAP method of emissions calculation
	Used Data	• SECAP analysis of the planned actions • National Energy and Climate Strategy 2030 and its annexes • expert interviews • Finnish Government Programme 2020-2023
Scenarios	**Quantity**	1
	Short Description	The scenario of reaching carbon-neutrality (80% emissions reduction + compensating the remaining emissions) was calculated for years 2021, 2025 and 2029. The necessary reductions were determined for each individual sector. Reaching the planned emissions reductions in the district heating sector are crucial for the carbon-neutrality scenario as their share accounts for 45% of the total emissions reductions necessary.
	Used Tools	• SECAP method of emissions calculation
Measures	**Quantity**	5 district-heating specific measures
	Short Description	• 80% share of district heating carbon-neutral by 2025 • Two-way heating system in Skanssi • All-renewable fuel in the TSE Naantali plant • Increasing energy storage • Increasing the efficiency of energy use in order to reduce wasting heat in the district heating network
Funding		Not publicly available (Turku Energia is a private company)
References/Links		
• https://www.turku.fi/sites/default/files/atoms/files/ilmastosuunnitelma_2029.pdf • https://www.turkuenergia.fi/valopilkku/artikkeli/olet-matkalla-kohti-hiilineutraalia-lammitysta/		

Name	**Plan de Acción para el Clima y la Energía Sostenible de la ciudad de Valencia**
City	Valencia. Spain
Inhabitants of city/district	277198
Type (Case-Study or Plan)	Energy Plan
Current Status (Planning, in progress, completed)	In progress
Stakeholders involved	• **Covenant of majors** • **Valencia city council**
General Short Description of Plan or technical Description for Case-Studies	Valencia wants to get to be a reference as a model city with a culture of energy conservation through public awareness and the creation and strengthening of instruments to reinforce existing actions addressing climate change. The Sustainable Energy Action Plan of Valencia aims to establish the strategies, actions and tools needed to achieve sustained development of the use, consumption and energy production. Therefore, the objectives of THE SEAP are: • Reduce CO2 emissions in the city by at least 40% by 2030 • Increase resilience by adapting to the impact of climate change • Achieve or improve the EU climate and energy targets of at least 27% energy consumption from renewable sources; and energy savings of at least 27% by 2030 • Reduce social inequalities, addressing actions to curb energy poverty • Providing the city with alternative and sustainable energy sources • Sharing the vision, results, experience and know-how with local and regional administrations • Comply with current environmental and energy legislation and prepare for future restrictive scenarios

Analysis of the status quo	**Short Description**	A comprehensive analysis of the status of the energy planning strategy has been carried out from the global to the local level, passing through the European, national and regional levels. Within this framework, the continuity of energy planning for the city of Valencia has been defined. To design the necessary measures to achieve the proposed objectives, the plan presents a detailed analysis of the following aspects: • Geographical aspects • Socio-economic aspects • Climatic aspects • Organizational aspects • Financial aspects In addition, the plan includes a very detailed Baseline Emission Inventory and a section including all actions and measures planned until 2030.
	Used Tools	•
	Used Data	• Previous plans, strategies and initiatives affecting the city • Available geographical, socio-economic, organizational and financial data about the city • Emissions data
Potential Analysis	**Short Description**	Once the situation at different levels has been presented, as well as the reference inventory of CO2 emissions and the analysis of risks and vulnerabilities derived from climate change, the Plan presents the measures to be implemented in order to achieve its objectives by 2030. The presentation of each of the measures to be adopted includes their required investment and their potential impact on key points regarding environmental and efficiency matters
	Used Tools	

	Used Data	• Investment • Reduction of CO2 emissions • Energy savings • Impact on total emissions • Impact on total consumption
Scenarios	**Quantity**	1
	Short Description	An ambitus scenario for 2030 is presented. The key goals to achieve before 2030 are: • at least 40% reduction in greenhouse gas emissions (relative to 1990 levels). • at least 27% share of renewable energy. • at least 27% improvement in energy efficiency. • increase resilience to climate change.
	Used Tools	•
Measures	**Quantity**	209
	Short Description	Following the strategic objectives set, the Plan proposes a total of 209 specific actions, divided into 123 measures within the mitigation line and 86 within the adaptation line, to achieve the objectives in energy efficiency, renewable energies, sustainable mobility, awareness, resilience, etc.
Funding		Total budget: 216.179.719 € Municipal own funds and aid to municipalities from regional, state and European bodies
References/Links		
• https://www.pactodelosalcaldes.eu/sobre-nosotros/la-comunidad-del-pacto/firmantes/plan-de-acci%C3%B3n.html?scity_id=11935		

Name	**Long-Term Planning for Energy and Climate towards Climate Neutrality**
City	Vari Voula Vouliagmeni Municipality
Inhabitants of city/district	48,399
Type (Case-Study or Plan)	Plan
Responsible Partner	eclareon
Current Status (Planning, in progress, completed)	In progress
Stakeholders involved	• National Technical University of Athens

General Short Description of Plan or technical Description for Case-Studies	Long-Term Planning for Energy and Climate towards Climate Neutrality was drafted within the Framework of the Horizon 2020 Project C-Track 50 “Putting regions on track for carbon neutrality by 2050”. The Plan describes the existing situation at the Vari Voula Vouliagmeni (VVV) Municipality, the priorities and the proposed measures that could lead to climate neutrality until 2050. The plan focuses not only on energy production but also on climate mitigation and adaptation. General remark for Greece: There are no comprehensive strategic plans for H&C in Greece. Generally, Greek municipalities participate in the Covenant of Mayors for Climate and Energy and are obliged to draft and submit a Sustainable Energy and Climate Plan (SECP). The Plan includes general policies and measures that might need further elaboration in strategic plans.	

Analysis of the status quo	**Short Description**	The energy consumption sectors studied fall into the following categories:
		• Farming sector
		• Buildings, equipment / facilities and Industry
		  ○ Municipal buildings, equipment / facilities
		  ○ Municipal-public lighting
		  ○ Houses
		• Tertiary buildings, equipment and facilities (non-municipal)
		  ○ Industry

<table>
<tr><td></td><td></td><td>

Transportation

Municipal fleet
Public transport
Private and commercial transport

Local energy production
Renewable energy sources (RES)

</td></tr>
<tr><td></td><td>Used Tools</td><td>

Reference year is 2011 (the administrative reform “Kallikratis” merged three municipalities into one).
Energy consumption calculation was based on:

The guidebook “How to develop a Sustainable Energy Action Plan Part 2”: https://www.covenantofmayors.eu/IMG/pdf/SEAP_guidebook_Part_II.pdf
International Plant Protection Convention: https://www.ippc.int/en/ (used in order to translate energy consumption into emissions)

</td></tr>
<tr><td></td><td>Used Data</td><td>
<table>
<tr><th></th><th colspan="8">Final Energy Consumption [MWh]</th></tr>
<tr><th rowspan="2"></th><th rowspan="2">Electricity</th><th colspan="5">Fossil Fuels</th><th>RES</th><th rowspan="2">Total</th></tr>
<tr><th>Natural Gas</th><th>Liquid Gas</th><th>Heating Oil</th><th>Diesel Oil</th><th>Unleaded</th><th>Solar Thermal</th></tr>
<tr><td colspan="9">Buildings</td></tr>
<tr><td>Municipal Buildings</td><td>2,216</td><td>0</td><td>0</td><td>1,041</td><td>0</td><td>0</td><td>0</td><td>3,257</td></tr>
<tr><td>Tertiary Sector</td><td>111,059</td><td>1,796</td><td>0</td><td>32,801</td><td>0</td><td>0</td><td>509</td><td>146,165</td></tr>
</table>
</td></tr>
</table>

		Domestic Sector	150,280	6,004	0	331,862	0	0	80,775	568,921
		Public Lighting	5,568	0	0	0	0	0	0	5,568
		Industry	2,551	20	0	4,062	0	0	0	6,633
		Sub total	271,674	7,820	0	369,766	0	0	81,284	730,544
		Transport								
		Sub total	0	114	22,271	0	58,426	262,890	0	343,701
		Primary Sector								
		Sub total	190	0	0	0	748	0	0	938
		Total	**271,864**	**7,934**	**22,271**	**369,766**	**59,174**	**262,990**	**81,284**	**1,075,183**
Potential Analysis	**Short Description**	The plan included a Climate Change Risk Assessment and Vulnerability Analysis. Additionally, a chapter was dedicated to energy poverty.								
	Used Tools	• Adaptation Assessment of the VVV Municipality ○ Urban Adaptation Support Tool (UAST) • Risk Assessment and Vulnerability Analysis								
	Used Data	• Weather Data • Data based on Regulation on Energy Performance of Buildings								
Scenarios	**Quantity**	None								

<table>
<tr><td rowspan="2"></td><td>Short Description</td><td>No specific scenarios are described. The plan only contains the description of policies and measures.</td></tr>
<tr><td>Used Tools</td><td>• N/A</td></tr>
<tr><td rowspan="2">Measures</td><td>Quantity</td><td>With regard to H&C sector the proposed measures include the replacement of fossil fuel- based heating systems with heat pumps, the installation of rooftop PV and solar thermal systems. Further, energy efficiency measures such as roof insulation and frame replacement are also foreseen. Additionally, awareness raising campaigns and dissemination activities are expected to be introduced.</td></tr>
<tr><td>Short Description</td><td>An indicative presentation of the cost of renewable H&C measures in the buildings sector is presented below (the costs are cumulative, i.e. the cost in 2050 includes the aggregate cost for the period 2030-2050):
<table>
<tr><th>Measure</th><th>2030</th><th>2040</th><th>2050</th></tr>
<tr><td>Heat pumps in public buildings</td><td>39,500 €</td><td>79,000 €</td><td>158,000 €</td></tr>
<tr><td>Rooftop PV in public buildings</td><td>109,000 €</td><td>163,600 €</td><td>218,200 €</td></tr>
<tr><td>Solar thermal (hot water) in public buildings</td><td>21,000 €</td><td>42,000 €</td><td>56,000 €</td></tr>
<tr><td>Heat pumps in the domestic sector</td><td>6,469,500 €</td><td>12,130,500 €</td><td>20,217,000 €</td></tr>
<tr><td>Rooftop PV in the domestic sector</td><td>21,026,000 €</td><td>28,035,000 €</td><td>49,060,000 €</td></tr>
<tr><td>Solar thermal (hot water) in the domestic sector</td><td>5,750,700 €</td><td>7,188,400 €</td><td>7,907,200 €</td></tr>
<tr><td>Rooftop PV in tertiary sector</td><td>16,286,400 €</td><td>21,715,200 €</td><td>27,144,000 €</td></tr>
<tr><td>Solar thermal (hot water) in hotels</td><td>94,500 €</td><td>189,000 €</td><td>264,600</td></tr>
</table></td></tr>
</table>

Funding	Funding is planned to be secured from Operational Programs (EU co-funded), the Electra Fund for the renovation of public buildings (funded by the Consignment Deposits and Loans Fund) and own funds.
References/Links	
http://mycovenant.eumayors.eu/storage/web/mc_covenant/documents/31/o5zymxkcIItu51pXttYqXQZJLYntNo0m.docx	

Name		**Energy Zoning Planing**
City		Vienna
Inhabitants of city/district		1.9 Mio.
Type (Case-Study or Plan)		Plan
Current Status (Planning, in progress, completed)		Planning
Stakeholders involved		• **Architects, spatial planners** • **Construction companies** • **Building owners** • **City of Vienna, MA20**
General Short Description of Plan or technical Description for Case-Studies		**The objectives for energy zone planning under STEP 2025 and the Energy Framework Strategy 2030 for Vienna have a focus on energy efficiency by reducing energy demand in the context of infrastructures, mobility and in the construction and refurbishment of buildings. The reduction is archived by covering the energy demand by renewable resources and waste heat where it is possible. The legal basis for energy zoning planning sets the Vienna Building code, which considers climate-friendly use of energy resources, green infrastructure that serves the microclimate, resource-saving forms of mobility and reduction of energy consumptio. Guidelines and checklists help planners and constructors to archive the goals in the framework of STEP 2025.**
Analysis of the status quo	**Short Description**	The urban structures in Vienna have been evaluated by a classification of the different building blocks. The paper does not mention a specific methodology, but refers to the area screening from the EU HORIZON 2020 project SMARTER TOGETHER and its method. This method will be further developed and the gained data will be published in an open-source database.
	Used Tools	Not mentioned in the action plan.

	Used Data	The action plan refers to an own evaluation of the building stock, but does not mention the methodology.
Potential Analysis	**Short Description**	The action plan does not mention a specific potential analysis, but mention to proceed an analysis as soon as sufficient spatial data are available.
	Used Tools	
	Used Data	
Scenarios	**Quantity**	
	Short Description	Future representation of an area in maps with suitable spatial resolution will translate the data into clear demand models. On this basis, demand scenarios will be created and heat supply scenarios can be drawn up.
	Used Tools	Not mentioned in the action plan.
Measures	**Quantity**	
	Short Description	• The amendment of the Vienna Building Code 2018 forms a legal basis of energy zoning planning instruments. For new buildings it takes into account a climate-friendly use of energy resources • Green infrastructure that serves the microclimate • Resources-saving forms of mobility and reduction of energy consumption • Efficient use of waste heat and renewables potentials
Funding		
References/Links		

Name	**Varmeplan Hovedstaden 3 (VPH 3)**
City	Copenhagen
Inhabitants of city/district	1,349,537 (Greater Copenhagen)
Type (Case-Study or Plan)	Energy Plan
Current Status (Planning, in progress, completed)	In progress
Stakeholders involved	• Heating company; VEKS • Heating company; HOFOR • Heating company; CTR • Municipality; Københavns Kommune (Copenhagen Municipality) • Municipality; Høje-Taastrup Kommune (Hoeje-Taastrup Municipality)

General Short Description of Plan or technical Description for Case-Studies		• The plan is part of an overarching project by three (and now four) district heating companies in the Greater Copenhagen area to expand the district heating network in Copenhagen. VPH3 succeeded VPH1 and VPH2, whose final reports were concluded in 2009 and 2011 and precedes “Fremtidens Fjernvarme Hovedstaden 2050” (Future District Heating the Capital 2050) (FFH50) that is currently in early planning stages. • The three heating companies have agreed on the common goal to deliver carbon-neutral heat by 2025 that is also price competitive vis-à-vis other (decentralised) technologies. • In doing so, the companies produced common reports on the current and future energy needs for the Greater Copenhagen area for heating as well as an inventory of the current and (proposed) future fuels. The reports and the project in whole are supported by the municipalities of Copenhagen and Høje-Taastrup as well as external consulting companies invited ad-hoc. • A final report called “Varmeplan Hovedstaden 3 – Omstilling to bæredygtig fjernwarme” (Heating Plan the Capital 3 – Conversion to Sustainable District Heating) was compiled by the stakeholders, which included data on the status-quo as well as the future scenarios calculated for 2035 and 2050 and laid forth the road map to a 100% renewable-based district heating system for the Greater Copenhagen area considering the existing economic and legal framework.
Analysis of the status quo	**Short Description**	The plan included carrying out an inventory of the area that is covered by the municipal district heating network as well as what fuels were used to generate the heat. Additionally, the project analysed the legal framework on the national and European level as well as the economic situation mainly in relation to energy pricing.
	Used Tools	• ”Varmeplan Hovedstaden 3 – Omstilling to bæredygtig fjernwarme”; final report by Varmeplan Hovedstaden • Various Danish legislation regarding energy supply • EU climate targets for 2020 and 2030.
	Used Data	• Map of the district heating network of each district heating company • Analysis of the fuels used in the heating plants and peak heating plants as well as the energy consumption in the years 2011-2013. • Legal and economic framework for energy consumption and heating supply

Potential Analysis	**Short Description**	The plan focused on the expansion of the district heating network as well as the conversion of the network to a fully renewable-based heating system. This included looking at converting the existing heating plants to renewable fuels like biomass. Those plants that cannot be converted to biomass due to their inner-city locations will be replaced by to-be-constructed plants outside of the city. Additionally, due to the Government goal to reduce waste production, the network will have to shift from burning waste to another fuel or using a third technology.
	Used Tools	None mentioned.
	Used Data	• Various academic reports on biomass quotas • National and EU legal frameworks for the use of biomass • 'Ressourcestrategien "Danmark uden affald"' from the Danish Environmental Agency (Miljøstyrelsen)
Scenarios	**Quantity**	3 for 2035 and 4 for 2050
	Short Description	The plan has developed three scenarios for the situation in 2035, whereas it has developed four "perspective scenarios" for the state in 2050. The 2035 plans consist of a 'reference' scenario that focuses on the (continued) use of biomass as well as two alternative plans that envision greater shift towards heat pumps, geothermal and solar heating. All three scenarios assume that the district heating network will be carbon neutral by 2025. The 2050 scenarios consider the possible development in the EU as a whole for electricity production. The four scenarios are divided, on one hand, along an 'EU-Denmark' axis and a 'wind-biomass' axis, one the other hand.
	Used Tools	• "Varmemarkedets udvikling – Baggrundsrapport til Varmeplan Hovedstaden 3"; background report by Varmeplan Hovedstaden • "Varmeplan Hovedstaden 3 – Omstilling til bæredygtig fjernvarme"; final report by Varmeplan Hovedstaden • Data on heat energy needs per housing type and by city district; SBi and RISØ DTU

Measures	**Quantity**	7
	Short Description	• Regular review of district heating planning. • Pilot and demonstration projects for further developing technologies for a more cost-effective operation; in particular, geothermal and heat pumps. • Review the scenarios leading to 2035 and the future operation of the Copenhagen district heating network. • Proposing new legal frameworks for sustainable biomass fuels for heating. • Investing in heat storage solutions. • Investing in solar heating. • Converting the peak load to a carbon-neutral alternative.
Funding		N/A
References/Links		
• https://varmeplanhovedstaden.dk/ • https://varmeplanhovedstaden.dk/wp-content/uploads/2020/04/VPH3_Varmemarkedets-udvikling_maj2014.pdf • https://varmeplanhovedstaden.dk/wp-content/uploads/2020/04/VPH3_Hovedrapport_okt2014.pdf • https://varmeplanhovedstaden.dk/wp-content/uploads/2020/04/VPH3-Baggrundsrapport_Teknologier-produktion-af-varme_oktober_2014.pdf		
Name		PLAN ENERGÉTICO MUNICIPAL DE SOPELA 2019-2030
City		Sopela (Spain)
Inhabitants of city/district		12.947
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		
Stakeholders involved		• **Municipality of Sopela** • **EZE BARRIZAR KOOP. Consultancy** • **Basque Energy Agency**

		• **UDALSAREA 21**
General Short Description of Plan or technical Description for Case-Studies	**The Energy Plan has a special focus on action in the public sector, in order to make the municipal administration lead with the example. The objectives of the Plan are the following:** • **To carry out an updated energy diagnosis of the City Council, giving greater importance to the public sphere.** • **Define an action plan in response to citizens' needs.** • **Pursue the path towards energy sovereignty, responding to current challenges and improving the resilience of the territory.** • **Define fixed targets to address climate change in at least: the service sector, the public sector and the residential sector.**	
Analysis of the status quo	**Short Description**	An analysis of local resources including biomass, solar energy and wind was carried out. An inventory of energy consumption with different categorizations and an emissions inventory are included.
	Used Tools	• WeatherSpark • Municipal data
	Used Data	• Characteristics and volume of different tree species in the area • Percentage of cloud covered sky by month • Solar irradiation • Wind speed
Potential Analysis	**Short Description**	Energy saving potential, increase the share of renewables in thermal energy
	Used Tools	• WeatherSpark • Municipal data

	Used Data	• Characteristics and volume of different tree species in the area • Percentage of cloud covered sky by month • Solar irradiation • Wind speed
Scenarios	**Quantity**	2
	Short Description	Emissions with and without the Energy Plan.
	Used Tools	•
Measures	**Quantity**	8 thermal energy measures
	Short Description	• Improve thermal insulation in town hall • Regulation and control in thermal systems in municipal buildings • Improve thermal insulation in private sector buildings • Thermal and photovoltaic solar installation on the roof of the sports centre • Biomass boiler installation in town hall • Replace natural gas boilers with heat pump systems in the private sector • Implementation of solar thermal energy systems on available roofs • Develop a district heating network in an appropriate area of the municipality
Funding		
References/Links		
• http://sopelaudala.org/images/areas_departamentales/sostenibilidad/pdf/informe_pem_sopela_cas.pdf • http://sopelaudala.org/index.php/es/areas-municipales-sostenibilidad/3573-plan-energetico-sopela		

Name		**Antwerp's Climate 2030 Plan**
City		Antwerp, Belgium
Inhabitants of city/district		510,610
Type (Case-Study or Plan)		plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• City Antwerp • Consulting: DNV; Arcadis N.V.; Kahpo consulting; Createlli • Consortium: Antea Group; Endeavours; Overmorgen; Kode
General Short Description of Plan or technical Description for Case-Studies	The case study maps H&C supply potential recoverable from waste heat coming from ports. Antwerp, as one of the frontrunners for district heating in Belgium, establishes a building code stipulating that every new apartment building with at least nine living units should have a room in the basement where a centralised heating system or a heat exchanger can be installed. Also, room should be given for heat transport lines from this room to the living units. Antwerp is now in need of a sophisticated heat strategy, which can better assess the neighbourhoods for their potential to develop DH grids, like the favourable conditions in function of the already existing gas infrastructure and its age, the share of DHC technology, and so on.	
Analysis of the status quo	**Short Description**	90% of the City of Antwerp's heating requirements are currently met by fossil fuels such as oil and gas. Almost 80% of the current residential consumption for heating and cooling is being covered by natural gas boilers.

	Used Tools	
	Used Data	• Euroheat • Arcadis
Potential Analysis	**Short Description**	Potentials of reducing energy demand (through renovation) and availability of renewable and waste energy source (hear and electric) and renovation potential are to be assessed. Energy sources potential for heating and cooling (wind, solar, geothermal, waste water, waste heat, biomass) is already available.
	Used Tools	Not listed
	Used Data	• Solar power - Antwerp port authority • Biomass – Antwerp port authority • Geothermal – HITA, Engie
Scenarios	**Quantity**	1
	Short Description	An ambitious but realistic scenario was defined that is supported by all major stakeholders. This scenario will lead to a GHG reduction between 50% and 57% in 2030. The target for the city services in this scenario is set at a GHG reduction of 85% by 2030. If we extrapolate this ambitious level, the city services would become carbon neutral by 2035.
	Used Tools	• Co-creative and participative approach combining a top-down and bottom-up process

Measures	**Quantity**	9
	Short Description	• Reduce usage of natural gas and eliminating usage of heating oil for heating of houses and buildings • Connect houses to industrial waste heat • Renovate houses and buildings • Increase usage of solar energy • Increase energy efficiency • Increase share of wind energy • Use renewable gas • Reduce carbon intensity of imported electricity • Fight energy poverty
Funding		
References/Links		
• http://planheat.eu/antwerp • https://www.arcadis.com/en-au/projects/europe/belgium/warmtenetprogramma-antwerpen • https://www.dnv.com/news/dnv-gl-outlines-antwerp-s-low-carbon-2030-roadmap-130820 • https://www.thinkgeoenergy.com/engie-and-hita-partner-on-geothermal-development-in-belgium/		

Name		**Energieplanung 2020 Zürich**
City		Zürich, Switzerland
Inhabitants of city/district		402.275
Type (Case-Study or Plan)		Energy Plan
Current Status (Planning, in progress, completed)		In progress
Stakeholders involved		• City; Zürich • Target network planning gas: Energie 360° AG • District heating planning: ERZ Fernwärme • Energy networks planning: ewz-EDL • Strategy development: SGE
General Short Description of Plan or technical Description for Case-Studies		Energy supply planning is an instrument for implementing urban energy and climate policy in the field of thermal energy supply. Based on the goal of the 2000 watt society in the municipal code and the principles in the energy master plan, it defines measures to decarbonise the energy supply with analysis of the locally available energy sources and a spatially differentiated assessment of the future heat demand, efficiency potentials as well as assessment of situation of power supply for building sector. The planning is based on a long-term perspective up to 2050. The area specifications for grid-based energy supply are valid for at least 15 years, which ensures planning security. Realistic periods are planned for the expansion of the wired energy supply. This creates the prerequisite for implementation wherever possible and meaningful within the framework of coordinated construction. In addition, it takes into account the long life and depreciation cycles of systems and lines for district heating and gas supply as well as all other subsurface trades affected by the expansion.
Analysis of the status quo	**Short Description**	The situation of energy provision of ERZ district heating networks including waste incineration plant and sewage treatment plant and ground water flows is described. And analyses with heat supply, useful energy requirement (cooling demand, heating demand), final energy

		consumption, power supply, energy balance, electricity mix, primary energy consumption, greenhouse gas emissions, electricity production in urban areas and power grid capacity was carried out.
	Used Tools	•
	Used Data	• annual statistics of the ewz and the UGZ • annual statistics of the UGZ on energy consumption and greenhouse gas emissions • model calculations within the framework of EK 2050 • measurement data for the years 2010–2014 and the model values for 2015 as reference • comparisons with the future development as presented by the EK 2050 scenarios
Potential Analysis	**Short Description**	Potentials for line-bound energy supply, gas supply, energy use of river and lake (Gewässer), groundwater and shallow geothermal, geothermal probes, ambient air (Außenluft), solar thermal energy and cross-site energy supply were analyzed.
	Used Tools	
	Used Data	• cantonal data from Zürich city, Department der industriellen Betriebe
Scenarios	**Quantity**	2

	Short Description	Two scenarios for the change in heat demand and heat supply are developed: a “reference scenario”, which essentially continues the previous development, and an “efficiency scenario”, which is based on tightened energy policy measures for the federal government, the canton and the city of Zurich, and thus a higher energy efficiency and an accelerated change of energy source.
	Used Tools	
Measures	**Quantity**	9
	Short Description	• Monitoring and scenario building • Improvement of the energy standard and system efficiency • Stimulation of energy carrier change • Use of location-based energy sources (Waste heat from thermal power stations, waste water and sewage sludge incineration; energy from lake water, river water and groundwater) • Conception of the line-bound energy supply • Initialization of energy connections • Coordination between settlement and energy supply planning • Gas supply • Decentralized energy supply
Funding	From municipal and some energy provider	
References/Links		
• Planungsbericht Energieversorgung (STRB vom 2.Dezember 2020) • https://www.stadt-zuerich.ch/energie/de/index/energiepolitik/energieplanung/dokumente.html#themenkarten_energieplanung		

3 Appendix III: Summaries of the interviews

Partner	Country	Region	Municipality	Position of interviewee
e-think	Austria	-	-	Researcher in a non profit research organisation

The interviewee works at AEE INTEC, a non for profit research and consulting organisation in the field of renewable and efficient energy technologies and systems located in Austria. His work concentrates on strategic heating and cooling planning and the use and processing of geographically explicit data. Amongst other projects, he is involved in the GEL-SEP projects I and II, two large national research projects to advance spatial energy planning at local and regional levels (https://waermeplanung.at/). The interview focused on the factors deemed important for making a heating and cooling plan effective and successful.

Of great importance for the transition towards carbon neutrality in heating and cooling is the commitment from the local level administration. Regulation at regional and / or national level is important, but the drive towards the implementation of the transition needs to come from the local level, since the single decisions on relevant projects and action is taken in the cities and municipalities.

In a first step a joint vision and mission for the short, medium and the long term should be derived. Secondly, the necessary organisational and communication structures at local level should be established. This mainly concerns the data management and the interdisciplinary decision-making structures at local level. As strategic (heat / energy) planning is a highly interdisciplinary cross-cutting issue, relevant decision making processes within cities or communities need to be adapted accordingly and cross-cutting information flow need to be ensured. All committees established in a city or municipality, like e.g. the climate saving committee or the regional development committee, need to include the topic of carbon neutral energy systems on each meeting agenda. The topic must become daily business. When discussing and deciding upon relevant projects in the (city or municipality) council the climate and energy impact of energy projects above a certain project size (e.g. monetary threshold) should be taken into account and measures in line with the vision and mission should be evaluated and further processed. At the same time, it is always important to estimate the impact on regional job creation and salaries as these are important factors for political decisions.

In which way it is most efficient to include stakeholders and the broad public into the strategy development is not straight forward. On the one hand it increases the public acceptance if interested people are involved in the process, on the other hand it becomes more difficult to find decisions the more people are involved, especially in case that non-specialists are involved.

In addition to the vision and mission and an interdisciplinary organizational and decision-making structure, a regulatory framework that enables and enforces the energy transition at the local level (city, municipality) is essential for a successful energy transition.

Last but not least, information is crucial to any planning process. With regard to strategic energy/heat infrastructure planning, spatially explicit information about the building stock (use, age, refurbishment status, heating/cooling/electricity demand), about existing energy infrastructures such as district heating or natural gas networks, and about locally available (renewable) energy resources such as

solar, (shallow) geothermal or surplus heat from industry is needed, on the one hand, to better understand current deficiencies and bottlenecks and, on the other hand, to enable concise master planning and detailed planning based on it.

Partner	Country	Region	Municipality	Position of interviewee
ISI	Belgium	Flandern	-	Energy/Climate protection manager

The interview was conducted with a sustainable heat transition manager in Flanders, who works for the Association of Flemish Cities and Municipalities (VVSG). Their role is to support the local government and also to act as a network to bring together the relevant stakeholders. Since 2019, there is an update of the official heat demand map in Flanders based on real data. However, the data set is not yet sufficient as far as the heat suppliers are concerned. Currently, a tool is being developed to support local heat planning and will be supplemented with a heat guide. In it, definitions are to be developed, a workflow for heat planning is to be provided and the heat demand map is to be used in practice. The workflow will include the following five steps: Political engagement, gather all stakeholders, heat inventory, zoning, implementation. 5 pilot cities are selected to be supported by VVSG in their development of local heating/cooling plans (strategies). The goal is to develop ideal paths towards local heating and cooling planning in many cities. In Flanders, it is generally a challenge to do heat planning, as spatial planning policies only started to focus on higher building densities in city centers. Resulting in a historically originated highly scattered urban landscape, in which city centers are often linearly stretched deep into e.g. agricultural areas and non urban areas.

In terms of stakeholders, it is brought up that the issue of heat planning is a very local issue. Often there is a lack of appropriate staff capacity in the cities. This is often a challenge, especially in smaller cities. Cities are seen as the main drivers for successful heat planning, but in general it is important to involve all stakeholders (sustainability officer, urban planning department, politicians) in the process.

In Flanders, there is generally no obligation to carry out heating and cooling planning. In Flanders, the system is generally very decentralized, so decisions in terms of heat planning and zoning should be made at the local level. Intermediaries, e.g. local agencies or organizations, are also seen as drivers. It is seen as a challenge that heat planning often requires other plans to be rewritten or vice versa. This means that, if possible, integrated planning with all actors should take place. If this is not the case, there is a high probability that the plan will not be implemented.

In conclusion, political engagement and stakeholder engagement are the most important drivers for successful heating and cooling planning. It is a very complex story and therefore it is important that all stakeholders are involved in the process. Likewise, heat planning should be seen as an iterative process and updated at specific times. It is seen as a challenge that there is a lack of a long-term regional policy and strategy and the corresponding the necessary supporting measures (tax shift from electricity to gas, spatially differentiated policies, an efficient financial incentive system for innovative collective heating and cooling projects,…)

Partner	Country	Region	Municipality	Position of interviewee
e-think	Bulgaria	-	Varna	Manager/Expert in energy consulting company

Plejades Bulgaria ODD is a strategic consulting company located in Sofia acting at the interface of technical and management consulting. The focus lies on economic and legal consulting for the sectors environment, mining, energy, water and waste. Rumyana Mirtcheva is the general manager of the company and Plamen Kirovski is the expert for energy efficiency and renewable energy.

In 2020 Plejades Bulgaria ODD was contracted by the Bulgarian Ministry of Energy to perform the "Comprehensive assessment of the potential for efficient heating and cooling" under Article 14 of Directive 2012/27/EU for Bulgaria. Plejades Bulgaria ODD used the Hotmaps toolbox and database for several parts of the analyses and for the public provision of the mapping data generated in the study. A user account was set up with all layers uploaded and the credentials are provided in the final document[1].

In Bulgaria energy planning and monitoring is organised at the national level by the ministry of energy. At national level goals for energy efficiency increase and the use of RES are defined and monitored. At local level this is not obligatory and energy planning and monitoring is only occasionally performed. To receive a tax reduction for investments in energy efficiency or RES projects, e.g. for thermal renovation or change of heat supply systems in a building or for the installation of a CHP plant, an energy audit of the investment project must be performed by a licenced company. Plejades Bulgaria ODD has such a licence and regularly performs such audits. These audits are reviewed and approved by the agency for sustainable energy development. Data regarding the building stock in the country are generally hosted by the municipalities and the National Statistic institute on an irregular basis. The municipalities provide data on yearly basis derived from the energy efficiency audits performed during each year to the ministry of energy and the ministry then monitored the development against national targets.

Plejades Bulgaria ODD is currently working on two strategic documents for the city of Varna, the Green city action plan (GCAP) and the sustainable energy strategy (SES). The GCAP is organised within the EBRD Green Cities programme and involves the mayor and all departments of the city, the SES is an initiative of the energy efficiency department of the city. Both documents should be agreed on in the city government upon their finalisation. The time horizon of the GCAP is 15 years and it includes overall environmental performance of the city. The SES covers sustainable energy supply and focuses on important demand and supply options to be implemented in the coming years like a new CHP plant, the potential integration of heat pumps into the existing district heating network currently supplying two big living areas, and the potential expansion of the existing district heating network to several administrative and multi-family buildings.

When developing strategic energy plans for cities or regions or at national level, Plejades Bulgaria ODD find most of the time being consumed for compiling adequate input data for the analyses. Often the data from different data sources is not compatible and must be adjusted. The development and discussion of different scenarios then is deemed less effort. For the analyses performed by Plejades Bulgaria ODD so far in none of the cases data for all buildings in the area (e.g. a shape file of the buildings containing several attributes) has been available. Thus, statistical data from different sources is usually used to calculate the status of energy demand and supply of the buildings.

Plejades Bulgaria ODD identify the following success factors for effective heating and cooling plans: the local authorities must be committed to the implementation of the plan. This is often difficult due to the long-term horizon of such plans and at the same time often frequent changes in the composition of the local governments. It often increases the chance for a plan to be implemented if the number of

[1] https://www.me.government.bg/uploads/manager/source/video_upload/Final_BG_CHP_Bulgaria_1.pdf

projects is limited, the investment volume of the projects are in line with available funds at the local level and if they are socially accepted.

Partner	Country	Region	Municipality	Position of interviewee
eclareon	Czech Rep.	-	Prague	Energy and/or Climate protection manager

Dr. Klusák is responsible for the energy system management, energy savings, use of renewable energy sources, including heating. He is not a heating engineer, but there is a Heating Commission, which concentrates solely on the topic of heating in the City of Prague.

The City of Prague faces a very specific situation because it has sold its heating plant, incl. related heating system network, which led to the establishment of a company called Pražská teplárenská being, however, a private company with a limited liability, with a heat supply contract with the city by 2038. Currently, the contract is deemed unfavourable from the City of Prague's perspective. Other local energy sources are operated by further private firms, but these are considered of lesser importance. Future heating deployment is therefore based primarily on the plans of those private companies. The topic of heating planning is currently not addressed by strategic development plans of the city.

The Climate Plan of the City of Prague by 2030, which was approved on 10 May 2021, was developed mainly by the Department of Environmental Protection and the Commission on Sustainable Energy and Climate Protection.[2] Diverse entities (incl. the general public, city districts, etc.) could comment on only a working version of the Climate Plan, as there have been no public consultations held before.

The City of Prague aims to address a national climate commitment of Czechia through its Climate Plan draft since the city itself accounts for around 10% out of this national commitment. The plan is considered a green plan, deemed therefore as an economic opportunity for the city and its sustainable transformation by 2030. The plan was developed as a municipal umbrella energy and climate document and also includes the heating sector.

In the heating sector, there is a goal to achieve 30% of heat generated by RES in the City of Prague by 2030. This should be realised heavily relying on a project on the use of waste heat of a water treatment plant with stable water temperatures over the year. Best practices on this topic were (also) collected during a business trip in the City of Helsinki 3 weeks ago. In the past, Dr. Klusák, but also his other colleagues have participated in a few Horizon 2020 projects, and they are also attending the COP26 Glasgow Climate Change Conference in coming days.

The City of Prague foresees the possibility that the plan must be updated in the meantime. If it is the case, it will be known how demanding it is.

In general, macro data collection and data quality are not regarded as an issue, it is sufficient, incl. its quality. However, the Energy Manager Division has been attempting to create a unified system that would aggregate all (i.e., more granular) energy-related data from around 8,000 objects, but due to the challenging nature of this task it is not possible to estimate now whether such endeavour will be

[2] The 2021 Climate Plan of the City of Prague is the main municipal document for its heating decarbonisation at the moment. There is no plan drafted solely for the heating sector developed by the City of Prague yet, but there are some plans of private companies active in the heating sector.

successful or not.

Speaking of the Climate Plan, there has been probably some scenarios, but he has not been responsible for this part of the document. This question cannot be therefore fully answered.

Regarding an action or implementing plan, the Climate Plan includes several indicators (incl. energy savings, PV installations, etc., totalling around 25 ones), but there are also so-called project cards elaborated with responsible authorities, financial demands, partial indicators, etc. by 2030. When the plan was developed, it was taken into account that the plan should be evaluated based on specific performance indicators anytime so that a progress could be (easily) assessable. If a progress made in the heating sector is to be evaluated, it will be realised by both the Department of Environmental Protection and the (independent) Heating Commission. However, the Heating Commission comprises of a several private companies with diverse interests, incl. the profit-seeking ones as preferred to sustainable goals.

The drafting of the Climate Plan was primarily funded by the municipal budget, but also partly through a funding instrument of the State Environmental Fund. The Plan has been developed internally, but there have been a few external inputs. Also, in the plan itself, there are total implementing costs provided amounting to around 230 billion CZK (approx. 9.1 billion EUR[3]). These costs should be covered by the budget of the City of Prague (approx. 10% share), external sources, third subjects, etc.

Dr. Klusák thinks that effective municipal heating plans are based on independent expert teams that are able to think and plan green deployment. A broad consensus on future decarbonisation targets should be achieved. Moreover, a plan implementation should be assessed regularly (e.g., every 6 months) per each responsible party, being in line with general principles of successful project management. Finally, remuneration of responsible employees (serving as motivation) should be proportionate to the plan fulfilment.

Partner	Country	Region	Municipality	Position of interviewee
ISI	France	-	-	Project manager in a Network of cities

The interview was conducted with a project manager from a city network in France, involved in the following EU project: https://energy-cities.eu/project/decarb-city-pipes-2050/. Transition roadmaps are being developed for selected pilot areas. In France, there is generally no obligation for municipal heat planning and there is generally no overall approach. However, if a municipality wants to create a voluntary energy master plan, it can get support from the national energy agency. However, a new law is to be introduced where they can zone different areas for district heating. A special feature in France is that there are virtually no local utilities. Most of heating networks are operated by 3 or 4 big companies. This means that planning currently lies primarily with these large companies, and regional players contribute little to heat network planning. Another result of this constellation is that almost no open source tools are used for planning, because the companies use their own tools. Moreover, the large companies focus mainly on the largest cities in France.

Stakeholder engagement, however, is also seen as an important driver for heat planning. The big companies also need to work with local stakeholders to develop the networks. They need public

[3] Based on the exchange rate as of 8 November 2021.

money and support. Currently, a big challenge is also that the awareness that a shift away from natural gas is necessary has not yet reached all stakeholders. Local stakeholders can play an important role in this. In France, there are currently many electric heating appliances. This is a major barrier to the development of heat networks. In addition, the costs for a transfer station are higher than for a gas connection.

Partner	Country	Region	Municipality	Position of interviewee
ISI	Germany 1	Baden-Württemberg	-	Energy and/or Climate protection manager

The interview was conducted with a city in Germany that had started the preparation of the heat plan before the obligation to prepare heat plans came into force. At the time of the interview, the heat planning was largely completed. There was a call for tenders from the city for the preparation of the heat plan. The contract was then awarded to an engineering company, which involved the local public utilities in a subcontract.

With regard to data collection, it was mentioned that it was important that the municipal utilities were involved in the preparation of the heat plan. Much of the data could only be collected by the municipal utilities. The data basis for the buildings is the energy atlas of the ifeu institute, which created an energy atlas for the whole of Germany. The city also has a building cadastre with information on height, area, etc. of the buildings, but this may not be used for heat planning, as this data was not collected for this purpose. However, the building age classes from this building cadastre were used. Overall, data collection is very laborious and has to be gathered from many different sources. In the future, much hope is placed on data collection by chimney sweeps, who are expected to collect detailed data on heat generators.

For the creation of the scenarios, the city is guided by the existing climate protection concept from 2018. The scenario thus represents a target scenario that is to be achieved through the measures mentioned in the heating plan. However, the difficulty of breaking down the national scenarios and targets to the regional level was described.

Concrete implementation measures were pre-formulated in the heat plan. A municipal support programme for the replacement of modern heat generators was created. In the field of urban planning in the new building there are many instruments, but for the field of existing buildings it is very difficult. It is pointed out that also on a national level measures for the building stock could be helpful. For example, a ban on oil boilers. Regarding the decarbonisation of district heating, it is mentioned that this is very difficult in this city, that there are altogether about 30 networks with 6 operators, which all have to be addressed individually.

In general, it was described that there was a conflict of interest between the actors involved. The municipal utilities see great potential in synthetic gases. The engineering office rather assumes that the role of gas will decline in the next few years and that the heat supply will therefore have to be covered by other energy sources It is considered positive that the municipal utilities were involved in the process, as they were able to provide good data on the one hand and are responsible for the implementation of many measures on the other hand. the discussions with the remaining energy suppliers should be maintained. It was mentioned that the planning part has to be decentralized, but the framework and laws should be created centrally. It was said, for example, that a higher CO2 price would solve many problems, as homeowners would then be more likely to take action themselves.

Finally, it was mentioned that a big problem is that the actors can decide differently than it is foreseen in the heat plans. If the municipal utilities want to expand the gas network, they can do so, even if it is not foreseen in the heat plan. The heat planning is seen by the city only as a first step. The implementation itself is the most important. With better framework conditions (clearer reduction path and prices) the instrument could work even better. In the national context, for example, the role of synthetic gases and hydrogen is discussed, but the municipalities themselves do not know how to react to these developments. It is also mentioned that a common database with technologies, prices and CO2 factors should be created for the different actors.

Partner	Country	Region	Municipality	Position of interviewee
ISI	Germany 2	Baden-Württemberg	-	Energy/Climate protection manager

The interview was conducted with a German city that has been engaged in energy master planning for 7 years. Many years ago, a target vision and the associated potential for renewable energy was identified. However, the potential is limited due to the specific geographical location of the city. In 2016, the city adopted an energy concept with targets and its own carbon budget was calculated. This involves an annual review of whether the city is on target. In total, there is a team of 45 people in this city that deals with the energy management of the city's properties and the further development and implementation of the city's energy and climate protection concept. In the past, a lot of work has been done on the topic of data acquisition. The city is obliged to create a heat plan and the responsibility for the creation lies with the city itself. There is no external contracting. Smaller sub-aspects such as the investigation of geothermal potential or wastewater heat are contracted out to other companies, but for the most part the plan is to be developed by the city itself. There is a gas network in about 95% of the city area. There is a heat network in about 30% of the city area, which is parallel to the gas network. In recent years, the focus has also been on the expansion and installation of local heating networks. In the energy planning, a total of 56 focus areas were identified, which are processed according to different prioritization in order to be able to identify individual solutions for the individual areas. However, it is not always necessary to investigate only one heating network. Depending on the circumstances, climate-neutral individual solutions can also be prioritized if the requirements for a heating network are not met. The municipal properties are to be climate-neutral by 2030 and all new municipal buildings are planned as plus-energy houses. Renovations will always be carried out with the goal of climate neutrality. State subsidies are used for energy master planning.

A lot of detailed data is available in the city. An energy cadaster has been created for the entire city. This contains the energy requirements of the buildings, which were determined on the basis of property data and models. In addition, the aggregated data was compared with top-down information from the grid operators. From a housing market survey, the renovation rate of the buildings could be determined and included in the modeling. It was noted here, however, that the sample for the survey for individual neighborhoods was very small in places and therefore detailed data was not available. However, data protection poses special hurdles for the city, as it is not allowed to publish the existing data in detail. Reference is made to the chimney sweep data that may be available in the future, which should capture detailed data on heat generators. Finally, it was noted that good data availability is essential for the creation of a good heat plan.

Regarding the concrete implementation of measures, it is mentioned that especially consulting programs and subsidy programs are highly effective. It is said that federal subsidies are not sufficient

to achieve a climate neutral building stock. For this reason, there are various municipal subsidies that cover the difference to a better level of the minimum standard in case of a renovation. It is said that in the area of new building it is possible to control via development plans, but especially in existing buildings there are bigger problems. For new quarters, the use of district heating is not blanket, it is also always checked to what extent local renewable potential can be used. However, it is also mentioned that the general German electricity mix has a major impact on the city's greenhouse balance, as the final energy demand, especially in the electricity sector, will remain at a similar level in the future or will probably even increase.

Overall, it is said that the existence of guidelines is considered very useful. In addition, the exchange with other cities is of great importance to see what is implemented and planned in the other cities. Due to the obligation to prepare the heat plan, discussions are stimulated and thus the heat plan is also used to a large extent as a communication tool. However, it is also mentioned that it is very important to define a caretaker. It is noted that the cities can only steer the activities in the city to a limited extent. For many measures they depend on the support of other actors. All measures in the field of public relations and information campaigns are very difficult to back with savings. Overall, it was said that the municipal council is the decisive body. However, it was also mentioned that climate protection is an important topic across all parties.

Finally, it was noted that the connection to a district heating network is a very emotional topic. Many people do not want to be in a dependency relationship, which is why in this city, even in new buildings, connection to the heating network is only made in individual cases. It is also noted that it is utopian that the city does not need to be additionally supplied from outside, because there is not enough renewable potential in the city area. For successful heat planning, it is very crucial who makes the plans, as different people have different interests. The utilities have mainly an economic interest. Furthermore, data acquisition is seen as a big obstacle and a good data basis is seen as essential for a good heat plan. It is also mentioned that it is important that the plan is not only understood as a plan, but that implementation measures are actually derived from it. For this purpose, it is of great importance to appoint a manager.

Partner	Country	Region	Municipality	Position of interviewee
ISI	Germany	Baden-Württemberg	Göppingen	Manager/Expert in Public utility

The interview was conducted with a German city, which is obliged to carry out heat planning. The city is currently preparing to carry out heat planning. For this purpose, a contract is awarded to the municipal utility. The public utility is a municipal enterprise, so it is an in-house contract. However, it has not yet been finally decided who will be involved in the preparation of the heat plan in addition to the public utility. It is assumed that the work packages will be distributed to different contractors. The work packages are to be created using the KEA BW guidelines. The award of contracts will be reviewed by the municipal procurement office. The publicly provided funds will be used for the preparation of the heat plan, however, these alone are not sufficient.

The city informs that the collection and use of the data is possible by the public utility as a municipal enterprise. It is noted that it is difficult for detached network operators to pass on the data without a declaration of consent from the customers due to data protection. However, even in the case of the city, the data protection issue has not yet been conclusively clarified. As a result, data on energy consumption is available, but data on the buildings is currently still missing. Here, one hopes for data

from the city and from the chimney sweeps, which collect detailed data on the energy consumers. With regard to the chimney sweeps, however, it remains unclear whether they will also collect data on the buildings. Estimating the potential of industrial waste heat is very difficult. There are a large number of automotive suppliers in the region, and it is not clear how they will develop in the future. There is also a waste incineration plant. However, this is operated privately, which is why an exchange regarding possible waste heat utilization has been very difficult so far.

The city says that references and existing best-case projects would help a lot in the preparation of the heat plans. In addition, the categorization and the individual work steps should be specified for a uniform preparation. It was said that the heat planning should be done by actors who are also responsible for the implementation afterwards. The planning should therefore be carried out by municipal utilities or supply companies rather than by engineering offices or scientific institutes. The actors should then plan directly how they can achieve CO2 neutrality in a way that is open to all technologies. For this, however, it is also important to harmonize small-scale regional planning with higher-level planning. Here, the example is given that the transport network operators are pursuing long-term expansion plans, which must be coordinated with the distribution network level. Overall, the common vision and projection into the future is missing at this point. It is also mentioned that currently no district heating is being expanded in new construction. Overall, the compulsory connection to district heating is not wanted and politically very difficult to implement. Finally, it is emphasized that both the political will of the city and the will and involvement of the utilities must be present in order to carry out successful heat planning.

Partner	Country	Region	Municipality	Position of interviewee
ISI	Germany	Baden-Württemberg	Karlsruhe	Energy and/or Climate protection manager

The interview was conducted with a German city, which is currently in preparation for an energy master plan. The creation of an energy master plan was decided by the city council. For the creation of the plan, subsidies from the state were used and the plan will probably cost about 150k€ and should be created in 10 months. This energy master plan is to cover other energy issues in addition to heat planning. The technical supervision of the energy master plan is the responsibility of an employee of the city administration as one task among many. No additional staff will be hired for the preparation of the energy master plan. The city itself is responsible for the preparation, but would like to award a contract to an external service provider. For the tender, a model service specification will be used, which was created by KEA BW. The municipal utilities should also be involved in the process, but are not to lead the energy master planning.

Regarding the data, the city states that there is generally a good data stock. It is known where the data should come from and which persons and institutions must be approached in order to be allowed to use this data. In the future, much hope is placed on the data collection by the chimney sweeps, who are to collect detailed data on the heat generators. In addition, it is assumed that the municipal utilities can also provide good data on energy consumption. In the city itself, data is available from the public cadastres, which will also be used for planning. The Office for Urban Development and the Real Estate Office are responsible for this. The company that is to carry out the planning will be allowed to request the data from the responsible offices.

The creation of a target scenario is planned. The city's climate protection concept currently formulates a target for 2030. This is to be expanded in the energy master plan to include a target for

2040.

With regard to the implementation of the measures, it is said that the energy master plan is initially only a plan and the implementation of the measures must be examined separately. The economic viability of the measures will play a decisive role in their implementation. Citizen participation may also play a role, although this is not yet certain. The tension between new construction and existing buildings is mentioned. High standards exist for new construction, and the city can prescribe further standards for certain areas through urban development resolutions. For private areas and the existing building stock, there are no possibilities for exerting influence, or only information tools can be offered here.

Overall, the instrument of local heat planning is considered positive. The creation of target systems and target scenarios is seen as a useful aspect. In addition, the transparent presentation of the planning of heat network areas and redevelopment areas is evaluated positively and that these areas can be shown in maps. This allows interested citizens to find out where which things are planned. In addition, it is positively emphasized that an area-wide potential survey is carried out. An exchange of best-practice experiences with other municipalities is considered very important. An imponderability in the implementation is seen in the fact that in the construction and operation of electricity and heat networks, the city is dependent on network operators, since the city itself does not operate any electricity and heat networks. These operators are only found if a measure is economically feasible. Political will is also seen as an important aspect. In larger cities, the resources can be built up to deal with the issues of climate protection and heat planning. Smaller municipalities, however, have to deal with other problems and have less capacity for climate protection and heat planning.

After the energy master plan has been prepared, it is presented to the municipal council for approval. Part of the energy master plan is a catalog of measures with concrete actions already for the next 5-10 years. The energy master plan is both a planning tool that shows the city's options for a climate-neutral energy supply and, at the same time, a catalog of measures with concrete implementation options.

Partner	Country	Region	Municipality	Position of interviewee
eclareon	Greece	-	Vari Voula	Researcher in a university, H&C related

The laboratory coordinates the C-Track 50 project (https://www.c-track50.eu/). Within the framework of the project, the laboratory is responsible for drafting and preparing “Long- Term Climate and Energy Action Plans”. The Municipality of Vari-Voula-Vouliagmeni (VVV) was one the 11 supported municipalities in Greece and a “Long- Term Climate and Energy Action Plan towards carbon neutrality” was composed. VVV collaborated with the laboratory by providing feedback to the plan (Technical Services Unit and European Programmes Unit) as they will be in charge of implementing the plan. A public consultation was carried out, while the final plan was approved by the municipal council and submitted to the European Commission. VVV has already implemented a Sustainable Energy Action Plan (SEAP) until 2020 and the main success factor for the implementation of the plan is the engagement of the VVV municipality and its public servants in order to adopt a climate and action plan that will enhance and improve the quality of life of city inhabitants. Apart from that, the laboratory has ample experience in composing SEAPs/Sustainable Energy and Climate Action Plans (SECAPs) during the last 12 years. Nevertheless, VVV’s plan was the first of its kind to be completed. H&C is part of the plan. However, it follows a more holistic approach.

VVV's "Long- Term Climate and Energy Action Plan towards carbon neutrality" will be implemented during the period 2021-2050. Data availability has always been one of the issues the researchers are confronted with. For those reasons, a number of assumptions were initially made, in order to reflect the current situation in VVV. A realistic approach was followed by adopting fairly ambitious targets (especially in the residential and tertiary sector). Different scenarios were developed internally in order to find the most suitable pathway towards decarbonisation. More specifically, the researchers looked into the different policy scenarios and after taking into consideration some important local parameters, the most feasible option was singled out. Finally, only the most suitable scenario was put into the plan. It should be underlined that a similar approach has also been followed for the other municipalities. For example, in VVV, wind energy has been excluded as there is limited potential for its exploitation. The same can be argued for heat pumps, where an ambitious but a feasible target is proposed. These parameters change if the profile of the municipality is different e.g. it is located in a rural environment.

VVV's "Long- Term Climate and Energy Action Plan towards carbon neutrality" includes a number of measures. Nevertheless, the measures are general and should be further broken down. As it was mentioned above, VVV and the laboratory have an extensive experience in such plans and realise the necessity of proposing measures that can be implemented. In any case, the plan is monitored by the Covenant of Mayors with specific criteria. Additionally, an update of the plan every five years is proposed.

VVV's "Long- Term Climate and Energy Action Plan towards carbon neutrality" policies and measures in the public sector are expected to be financed mainly by the National Reference Strategic Framework, while collaboration with private investors through ESCOs will be sought where possible. Especially for the public buildings, the Electra Fund is expected to finance energy efficiency measures in municipalities, but the launch of its operation has been substantially delayed. Financing energy efficiency and renovation in the domestic sector posed the greatest challenge, especially for Greece. Based on pure economic terms, cost intensive renovation measures (wall insulation, double glazing, etc) in southern Greece pay off over a long period of time (>15 years). Only if the citizens consider the indirect benefits of those measures, i.e. increased well-being, better indoor environment and quality of life, they will be willing to invest in such measures.

Critical success factors of plan are the commitment of the municipality as well as the stakeholders' engagement. In the example of VVV, the Mayor himself is continuously showing an interest in promoting such activities and disseminates the results of these activities in conferences and other events. Apart from that, public servants in VVV are tightly engaged in the implementation process, thus contributing to the plans' success. Stakeholders' involvement and engagement is a further success factor. In VVV, hotel sector is a pivotal part of the municipality's economy. Due to the sector profile, e.g. increased electricity, water consumption, their active engagement is of primary importance. A similar argument can be articulated for the citizens' involvement and active participation. They should be adequately informed and convinced that related measures are of great value and they should invest e.g. in heat pumps and rooftop PV. In addition, citizens' behavioural change towards climate friendly options is also crucial for the successful implementation of the plan.

Barriers regarding the successful implementation concern the lack of communication and coordination across different levels of administration (national, regional and local), technical difficulties in obtaining reliable data and structural difficulties in public administration. First, almost all municipalities lack a specific climate and energy unit. Consequently, the plan implementation is dispersed in different units and they lack coordination. On a municipal level, the authority is obliged to draft specific action plans, e.g. in the field of civil protection, land-use, waste management,

sustainable mobility. In many cases, these plans are drafted by different consulting companies. As a consequence, those diverse plans lack coherence, even though they should be interrelated. On a regional level, the administrative regional unit is in charge of climate adaptation plans. Nevertheless, these plans do not take into consideration the traits of each municipality and a detailed description of specific policies and measures is lacking. In any case, both examples clearly demonstrate that the lack of coordination between different hierarchical instances and units at the same level can be regarded as important barriers. Technical difficulties have mainly to do with problems in gathering data necessary for the plan. For that reason, VVV aspires to establish a specific unit for that purpose.

Partner	Country	Region	Municipality	Position of interviewee
eclareon	Hungary	-	Budapest	Project manager/Expert in Public utility

Főtáv provides district heating services to nearly 240,000 households in Budapest, which represents approximately 30% of the heating sector in the nation's capital[4]. It is the largest district heating provider in the country and has recently been incorporated into a single corporate entity based on the *stadtwerke* model, to streamline the upkeep and maintenance of Budapest[5]. This has changed its ownership structure, but has had little impact on the way the firm operates.

The company develops and implements its strategies in a web of interrelated strategies, which the company itself is able to influence and which, recursively, shape its priorities as well. These are the following:

- EU policy
- Hungary's National Energy and Climate Plan; National Energy Strategy
- Budapest's Climate Strategy; Integrated Urban Development Strategy of Budapest
- Főtáv Strategy

At the highest level, EU directives, regulations, and policy shape how Főtáv plans its future. The 'Fit for 55 Package' has been the most recent policy that provides long-term guidance. On the national level, the National Energy Strategy, which has an outlook until 2040, is what has the largest influence on Főtáv's activities. Although, the closely related National Energy and Climate Plan is also indicative of goals and priorities. Nested in this, is Budapest's Climate Strategy and the Integrated Urban Development Strategy, which have a more direct effect on the projects Főtáv undertakes. Within this web of strategies is Főtáv's own strategy. This indicates the objectives that it plans to pursue, while also providing guidance and input for the broader strategies developed at the municipal or national level.

Főtáv's current strategy (2021–2023) is its third, following the 2013–2016 and the 2016–2019 strategies, the latter of which had an outlook for the 2020–2024 interval as well[6]. In principle, previous strategies have been deemed quite successful, since the company could realise approximately 70% of the objectives it stated. Projects that it could not realise were largely due to changes in the external financial support. This may have been a government decision to withdraw support for a large projects or prices of source fuels increasing to levels that make certain investments unprofitable.

[4] https://www.fotav.hu/tortenet/
[5] https://www.napi.hu/magyar-vallalatok/budapest-kormany-szigor.720843.html
[6] http://fotav.hu/letoltes/2281/8004.pdf

The strategy is based on the assessment of the *status quo*, which the company's in-house Strategy and Environmental Protection Department conducts based on the input from experts working in various departments of the company. The Strategy Department then executes PEST (political, economic, social and technological) and SWOT (strengths, weaknesses, opportunities, and threats) analyses, based on which it identifies the company's mission and vision. These steps not only allow experts to articulate a company strategy, but they can also identify essential projects.

Főtáv develops its strategies in-house. It does not rely on external experts, since it has the expertise and experience, both technical and economic, for this task. The proposals the Strategy Department makes are, however, adapted based on the input of executive management and the owners of the company. Once accepted, the company takes to implementing these strategic objectives. The Strategy Department is responsible for monitoring and evaluating implementation. It undertakes an in-house assessment on a quarterly basis. It also shares these results twice a year with owners. This allows the company to stay on track and meet its goals, or adapt them according to a changing environment.

Főtáv's central role in Budapest's district heating system makes it influential in shaping Budapest's strategies and, by extension, it has some influence in the national objectives as well. It influences these through the Association of Hungarian District Heating Enterprises[7]. The Association provides expert input for municipal and national strategies, while lobbying for the sector. Municipal strategy development is typically initiated by the bureau of the municipality, in this case, Budapest's Mayor's Office. This has a Department for Climate and Environmental Affairs[8], which typically takes the lead in developing municipal strategy. The Association and companies are then involved in a stakeholder discussion. Companies are generally invited to provide comments and input on the material that the municipality is developing, this form of gathering input is occasionally complemented by working groups.

Főtáv, as the district heating provider of a large urban area, has substantial difficulties in introducing and meeting renewable targets. The core element of its strategy is based on developing another waste management facility, which would reduce its emissions, since EU accounting suggests that waste-based heat is 50% renewable. The efficiency of the system could also be increased by adding additional combined heat and power systems to the heat grid, which would also reduce emissions.

Given the high population density of the city and the relatively low economic competitiveness of biomass, its options to introduce renewables are quite limited. It is exploring geothermal with two pilot projects (a 20 MW and a 5 MW plant)[9] and has articulated high ambitions, but the technology has its limitations. This begins with the geology of the town, but continues with the large number of thermal baths, which are considered a part of the Budapest and Hungarian national heritage; thus, disrupting their operations is not an option. Moreover, the districts of Budapest have very different natural endowments, which, when coupled with a high population density, make it difficult, costly, and risky to undertake large drilling projects – sufficient government support for these has been lacking.

On the demand side the popularity of district heating is increasing both from households, but, even more so, from commercial buildings, ranging from offices to shopping centres. These not only expand the number of users the firm has, but also ensures its financial viability, because, unlike households, their prices are not regulated by government decree. To reach a growing number of consumers,

[7] http://tavho.org/

[8] https://einfoszab.budapest.hu/form/belso-szervezeti-egyseg-view;id=1801046

[9] https://www.fotav.hu/tajekoztatas/hireink/kozlemenyek-hirek/kozlemenyek/geotermikus-tavhotermelo-projekt-indulhat-budapesten

expanding the company's reach by constructing infrastructure and connecting formerly isolated "district heating islands" has been a core element of Főtáv's strategy.

Projects, both supply-side developments and the expansion of its pipeline infrastructure, are heavily reliant on external funding. EU funds distributed through vehicles, such as the Environmental and Energy Efficiency OP (KEHOP+)[10], have been instrumental in financing endeavours. Főtáv expects that the Modernisation Fund and the Next Generation EU to also offer substantial support to support its endeavour to decarbonise operations and increase efficiencies. These have been complemented with some investment loans provided by the Hungarian state. While these loans' conditions have offered relatively favourable conditions, the EU subsidies allow for the company to take more ambitious action.

Főtáv plays a central in greening the Hungarian energy system through its ability to provide energy in an efficient manner to a large number of consumers. While it faces a number of challenges in reducing the emissions of its operations, it is still one of Budapest's best options to substitute natural gas-based heating systems that are widely popular throughout the city. Developing and executing its strategy has been essential for the company, given the structure of the industry and the scale of investment. In-turn, its weight in the sector has led it to become an influential force in the municipality's strategy development as well.

Partner	Country	Region	Municipality	Position of interviewee
CSE	Ireland	-	Dublin	Energy Systems Analyst

Ireland ranks as one of the lowest countries in Europe for generating renewable heat (around 6.3%[11]) and proportion of district heat (DH) networks supplying thermal demand (under 1%[12]). This means they are in a unique and exciting position in the early stages of their district heating journey. The energy agency is creating heat plans and strategies for local authorities (LA's) surrounding the Dublin area. These heat network plans are starting to become a reality such as the Tallaght network, which will supply waste heat from a data centre, and the Poolbeg Waste-to-Energy networks. The main motivation to create heating and cooling plans was to decarbonise heat, which is one of the hardest sectors to decarbonise.

The energy agency is involved in European projects such as leading the Heat Net (Interreg North-West Europe)[13] project and being involved in Decarb City Pipes[14] (creating transition roadmaps for cities to decarbonise the heating sector). These improve the understanding of best practise in the sector. They believe that successful heating and cooling plans are created by having good spatial data available (data can be more accessible in map form showing areas suitable for district heating and other areas suitable for individual heat pumps). The lack of data availability can be seen as a barrier, as well as the knowledge on how to find, access (NDA's/license contracts), and apply it.

They use tools to carry out spatial energy demand analysis, such as QGIS for mapping and Tableau and GeoPandas. Maps ideally need to be open source and publicly available. There is a need for tools to be relatable for stakeholders who may not be trained in the subject matter. For example,

[10] https://ec.europa.eu/regional_policy/EN/atlas/programmes/2014-2020/hungary/2014hu16m1op001
[11] https://assets.gov.ie/181002/9be835fa-eea8-40b5-831b-c79d399d5e86.pdf
[12] https://www.seai.ie/publications/2016_RDD_79._Guide_District_Heating_Irl_-_CODEMA.pdf
[13] https://www.nweurope.eu/projects/project-search/heatnet-transition-strategies-for-delivering-low-carbon-district-heat/
[14] https://energy-cities.eu/project/decarb-city-pipes-2050/

engaging business owners and citizens. Their analysis uses a database of Building Energy Ratings (BERs), which are equivalent to EPCs in the UK, for residential dwellings. Commercial estimates are based on floor areas provided by the evaluation office and applied benchmarks (e.g. CIBSE TM46 and Guide F). Using benchmarks on the commercial side is not ideal; however, improved monitoring and recording of data will improve this. Low carbon heat sources were also identified and mapped, such as water treatment works, waste energy (e.g. from data centres), geothermal and surface water.

Scenarios are created up to 2030 and 2050, which is in line with their national targets. For each small area (80-120 buildings), it is evaluated whether there should be either district heating or heat pumps (whichever is the most cost-effective approach for decarbonising i.e. lowest €/tCO2 abated but also considering level of fabric upgrades required for HPs, fugitive emissions, etc.). It needs to be considered that the electricity grid infrastructure will need significant improvements to meet the demand of heat pumps. The scenarios also include decarbonising the electricity grid and gas grid (using biomethane), aiming to be in line with the 51% reduction in emissions by 2030 (government target).

One of the main triggers for a plan to come into action is the evidence base. According to a study by Heat Roadmaps Europe, up to 57% of Ireland's heat demand could be covered by district heat networks. The evidence base has led to an increase in political interest in district heating in Ireland. Translating the plan into projects, you also need to make it accessible and relevant to targets (for politicians and local councillors) through stakeholder engagement.

The Tallaght project is happening as a direct result of the heat planning work and policy recommendations. For example, in planning applications for new or expanding large industrial they recommended to require waste heat reports, which allows the council to know the amount of waste heat available. This could be seen as the catalyst for the whole project. With the Poolbeg Waste-to-Energy plant, the planning permission was subject to providing heat to a heat network.

The LA leads the implementation of heat network plans, as they are best placed to do so, but they need to be engaged in the relatively new issue. Sometimes this means requiring a district heating champion within the LA. The Dublin LA's generally have good engagement. However, some projects in less-engaged areas will likely be more private-led, although the LA will still have a key role in planning. The LA's may also have a lack of resources and will require help (e.g. from the energy agency for a technical lead).

The heat plans are part funded by LA's as well as European funding streams, such as Interreg (NW Europe) and Horizon 2020. The regional energy masterplan was funded by Sustainable Energy Authority of Ireland (SEAI) in the research development and demonstration programme. Poolbeg and Tallaght projects received around £25 million in grant funding, which predominantly came from the Irish government's climate action fund but also Interreg, the LA, with the remainder coming from the ESCO (energy service company).

Partner	Country	Region	Municipality	Position of interviewee
eclareon	Latvia	-	-	Member in District Heating Association

In Latvia, district heating is commonly used and has been for the last 50–60 years. Most heating plans cover the change of energy source from fossil to RES or modernisation of the existing boiler houses. The heating networks are already very extensive and therefore their expansion is rarely planned only their reconstruction.

Development and implementation of the heat plan is the responsibility of a district heating company. Depending on the planned works, a municipality's acceptance may be needed. The main planning that includes determination of requested capacity, choice of fuel, etc. is done using in-house expertise. In the later stage, when the main idea and tasks are defined and accepted, engineering companies or consultants get involved.

Public consultation is held in cases when required by law or normative acts of the Cabinet of Ministers. According to the regulatory framework, public consultation may be required for construction works or for obtaining a pollution permit, or for environmental impact assessment, but this depends on the nature of each project.

According to the Latvian NECP[15] , in the period from 2012 to 2018, the use of RES in the district and local heating has increased almost 3 times. In 2018, district and local heating produced 8,247 GWh of heat energy in Latvia, of which 46.7% was produced using RES, where solid biomass (fuelwood) dominates - 93.5% in 2018. The use of heat produced in natural gas combined heat and power plants CHPP-1 and CHPP-2 in Riga are the reason why the share of RES is not higher. CHPP-1 and CHPP-2 are the most important sources of generation of electricity in Latvia with a total installed electric capacity of 976 MW in 2018.

In most cases, available funding is the driving factor for new project development and implementation. Rarely the reason is the expansion of urban residential areas.

Funds (their funding conditions) determine the eligible technologies. In the last years, the switch from fossil fuels to biomass has always been eligible for funding. Funding for the use of solar collectors is available less often. If the funding conditions envisage funding for various technologies, then several scenarios are analysed.

Specific project plans are detailed including investment plan, action plan, time-frame etc.

Specific tools are used only for heating network expansion. In that case, it is done by engineering or consultant companies.

Natural gas combined heat and power plants CHPP-1 and CHPP-2 in Riga is the biggest obstacle to raising the share of RES in district heating as described above. As long as electricity is produced in these plants, the share of RES in the heating sector will not change significantly.

Partner	Country	Region	Municipality	Position of interviewee
eclareon	Slovakia	-	Bratislava	Energy and/or Climate protection manager

Mr Kovačovič is responsible for the municipal energy sector, which includes, among others, energy purchases, maintenance and repairs of existing facilities. The main accountable body is the Department of Lightning, Networks and Energy. It was highlighted by the interviewee that he has been working at the department only for the period of about two months.

The major challenge the City of Bratislava faces is that it does not own any energy sources, which

[15] National Energy and Climate Plan for 2021-2030 Available at: https://www.em.gov.lv/lv/nacionalais-energetikas-un-klimata-plans

results in a policy where primarily connection of new buildings to the system of centralised heating stays in the centre. In places where it is not possible another energy solutions are preferred, e.g., condensing boilers with high efficiency. The city defines conditions for project developers so that energy needs of new buildings are in line with such principles.

The Concept of Thermal Energy Development of the Capital of the Slovak Republic Bratislava, which was approved in late January 2020, is the core municipal document for its heating decarbonisation at the moment. It has been externally developed by a private consulting company.

Regarding its public consultations, Mr Kovačovič was not at the office at that time so he has no information about this process. As the document was processed externally, questions with regards to its methodology should by rather answered by the company itself. The Concept of Thermal Energy Development is to some extent interconnected with the Plan of Municipal Development, but there are no links to other documents, e.g., decarbonisation plans, because they do not exist at the local/regional level yet.

When it comes to data collection, the data is easily accessible, also up-to-date and of sufficient quality. Currently, it is not perceived as a problem at all.

There has not been any analysis on opportunities of future heating system decarbonisation conducted. There are only a few small initiatives in this direction, such as the one relevant only for five buildings owned by the Magistrate of the City of Bratislava. In this case, the city participates in a scheme supported by the Norwegian Funding Mechanism with the aim of decarbonisation (CO2 cuts) of these five buildings.

The document was funded by the city itself, i.e., thought the municipal budget.

Partner	Country	Region	Municipality	Position of interviewee
CSE	UK	London	Islington	Energy Sustainability and Consultancy Manager

Islington is one of the 33 boroughs of Greater London, located in the northern part of inner London. The borough is run by a London Borough Council, the third layer of government below the national UK government and the Greater London Authority (GLA). The borough is largely residential, although it has some commercial areas in the south near the border with the City of London. Its population is around 230,000, making it the most densely populated district in the UK.

Islington Council is the major social landlord in the borough and operates 48 communal heating systems on its estates, serving over 4,000 dwellings. The council also operates one of the borough's two heat networks, the council-owned Bunhill network, which supplies residential buildings, two leisure centres and a small number of offices, and the Citigen network operated by E.On, which is largely based in the City of London, but serves some buildings in Islington.

The Energy Services team at the council is responsible for the on-going development of a decentralised energy programme, with activities largely guided by a Decentralised Energy Masterplan issued in 2014 which set out the vision of how thermal energy systems can be developed in the borough. The Masterplan is largely based on a district-wide heat mapping exercise which identified 11 new priority areas thought to have the most potential for heat networks. It is mainly focused on residential heat supplies but also identifies clusters of different types of buildings which offer high spatial heat demand densities, including council-owned or operated properties. Although

the Masterplan has not been updated since its issue and has no specific time-bound delivery targets, it serves to provide a basis on which to select projects once specific opportunities arise. This typically depends on funding availability or, for example, when works around heat supply can be combined with other refurbishment activities.

No wider stakeholder consultation was undertaken during the development of the Masterplan, although it was published on the council website once finalised. Consultation is undertaken on a project-by-project basis, mainly involving engagement with residents and how they may be impacted by specific proposals. There is an intention to update the Masterplan once resources are available to do so – this is likely to involve external consultancy support.

The Energy Services team undertakes a significant amount of project planning and development work in-house and has used the THERMOS tool for pre-feasibility work on heat networks. External consultants are also employed to work in three main areas: feasibility studies, client engineer role for capital projects (which includes early-stage design work and ongoing project support), and project design & build. The council also enters into partnerships on certain projects, for example, GreenSCIES (Green Smart Community Integrated Energy Systems), which concerns the development of a 5th generation heat network, working in conjunction with London South Bank University. Islington also liaises closely with other London boroughs and is currently looking into future potential to connect to other heat networks in adjacent parts of the city.

The approach taken in developing and delivering the council's decentralised energy programme and related sustainable heat supply initiatives has been influenced by the changing political control of the council, which has resulted in different approaches being adopted. In 2019 the council declared a Climate Emergency and since adopted a net-zero target by 2030. This is supported by the Vision 2030 publication which cites communal and district heat networks as making an important contribution to net-zero. The council also places due importance on the social benefits that are likely to result from heat networks and decentralised energy initiatives, in particular the potential to reduce fuel poverty and increase security of energy supply through sourcing heat from multiple networked local heat sources.

The Energy Services team suggests that the key success factors of heat planning are around facilitating implementation i.e. acknowledging and, as far as possible, preparing for the reality that subsequent actions can only be implemented once early senior-level buy-in is obtained from decision-makers and suitable funding has been identified. Such funding needs to be largely sourced externally and has been a major barrier to project implementation in Islington. One specific funding barrier encountered by the council has arisen as a result of the criteria for project acceptability, which invariably focuses on commercial viability and may not align with the council's views on other criteria, such as the weighting given to the wider social benefits of projects. Commercial viability however is often helped by the council's existing policy which obligates new developments to connect to heat networks where possible. This helps in commercial negotiations with potential clients and encourages transparency.

Another strategic planning challenge relates to the decreasing carbon saving benefit offered by existing heat networks where gas CHP is used. Carbon savings from electricity generation are gradually reducing due to on-going decarbonisation of the national electricity grid and will continue to do so. This is likely to make connecting to these networks less attractive unless it can be demonstrated that very low or zero carbon heat supplies will displace gas CHP within a timescale which is acceptable to the customer.

act!on heat

About Act!onHeat

Heating and cooling (H&C) accounts for about half of Europe's total energy needs with 75% still dependent on fossil fuels. Thus, rapid and significant change is needed to reach the EU 2050 goals. Due to the local nature of H&C systems, action has to be taken at local level involving a variety of stakeholders. This has been recognised in recent years and activities have been started like developing best practice policies and open source analysis tools. However, (efficient) H&C planning and project development are still not commonplace in most European municipalities.

Act!onHeat will enable and accelerate local Heating & Cooling transitions by:

- identifying success factors of effective energy plans, turning them into practical workflows;
- developing individual and group support activities to guide municipalities, local planners and stakeholder in applying these workflows;
- facilitating finance and the design of effective heat & cooling projects and policy frameworks

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