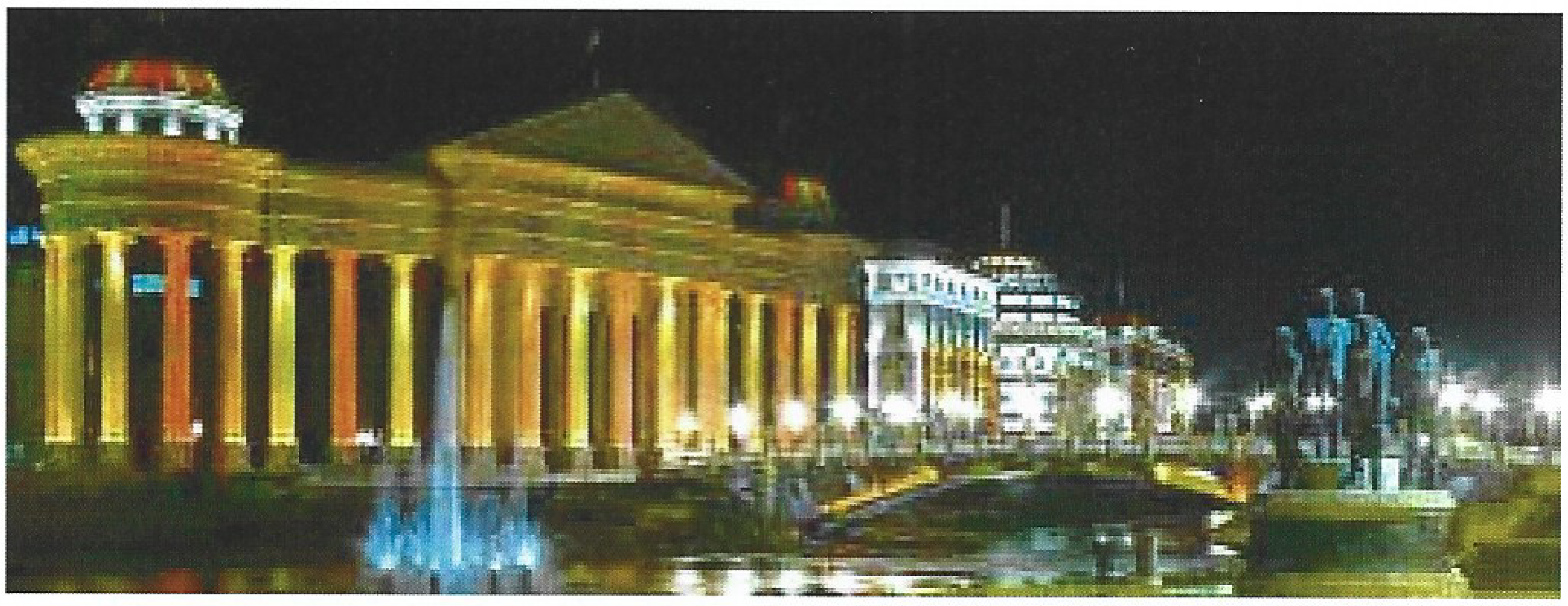
ICON BEST 2024 International Congress for Business, Economy, Sport and Tourism

The 9th International Scientific Congress

Shaping the Future: Trends and Insights for Tomorrow



Hybrid event

- *In-Person at the University of Skopje*
- *"Virtual" on Google Meet Platform*

Skopje, (18th November 2024)

Presentations "The Challenges of future Session" & Presentations "Politics and Legal aspects of Education Session" LINK: https://meet.google.com/dhh-qmte-vqs?authuser=0		
Presenter(s)	**School(s)**	**Topic**
Lidija Gorachinova-Ilieva	University of Skopje	MODEL FOR AWARDING ACADEMIC TITLES IN THE HIGHER EDUCATION INSTITUTIONS OF THE REPUBLIC OF MACEDONIA
Besime Ziberi	Faculty of Economics, AAB College, Pristina, Kosova	LABOR LAW OPPORTUNITIES: RAISING STANDARDS AND SUPPORT FOR WORKERS
Blagoj Conev	University of Skopje	CHINA AND THE BALKANS: INTRODUCTION TO THE BELT AND ROAD INITIATIVE (BRI)
Blagoj Conev Jana Ilieva	University of Skopje	BALKAN STABILITY IN QUESTION: THE UKRAINIAN WAR'S
Jana Ilieva Aleksandar Dashtevski	University of Skopje	NAVIGATING THE BOUNDARIES OF EXPRESSION: THE REALITIES OF ARTICLE 10 AND THE CONTEMPORARY LANDSCAPE OF FREE SPEECH
Vlatko Chingoski	Faculty of Electrical Engineering, University "Goce Delcev"	TOWARDS POLLUTION REDUCTIONS AND DECARBONIZATION OF DISTRICT HEATING SYSTEMS

***Presentations "Information technologies Session"* LINK: https://meet.google.com/iid-psrk-fgf?authuser=0**		
Presenter(s)	**School(s)**	**Topic**
Ana Sekulovska Jovkovska Andrijana Bogdanovska Djurovic Irena Bacanovic Karakasev	University of Skopje Knowledge Centre – Skopje	ASSESSING THE QUALITY OF E-SERVICES FOR CITIZENS IN MACEDONIA: LONG-TERM SOCIETAL IMPACTS AND FUTURE PROSPECTS
Ana Sekulovska Jovkovska Andrijana Bogdanovska Djurovic Irena Bacanovic Karakasev	University of Skopje Knowledge Centre – Skopje	ENHANCING DIGITAL TRANSFORMATION: BRIDGING GAPS IN E-SERVICES FOR BUSINESS GROWTH IN NORTH MACEDONIA
Beti Lameva Sime Arsenovski	University of Skopje	THE IMPACT OF THE USE OF DIGITAL DEVICES ON THE RESULTS OF PISA TESTING
Djejlan Mehmed Ana Sekulovska – Jovkovska	University of Skopje	EXPLORING THE ROLE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION
Kiril Djolev Leonid Djinevski Sime Arsenovski	University of Skopje	CHALLENGES OF AGILE METHODOLOGIES IN ADDRESSING HIGH-SEVERITY ISSUES IN INFORMATION SYSTEMS DEVELOPMENT
Qendresa Kukaj Medain Hashani	Hungarian University of Agriculture and Life Sciences AAB College, Faculty of Economics	EMERGING TRENDS IN POST-SECONDARY EDUCATION: THE IMPACT OF DIGITAL TECHNOLOGIES ON ACCESS, DELIVERY, AND CREDENTIALING

The 9th International Scientific Congress
Shaping the Future: Trends and Insights for Tomorrow

Towards Pollution Reductions and Decarbonization of District Heating Systems

Vlatko Chingoski
Faculty of Electrical Engineering, University “Goce Delcev”- Stip

18.11.2024

Introduction

Global climate changes

- Large influence on energy generation and energy utilization
- Research mainly concentrates on
  - New electricity generation technologies
  - Decrease usage of fossil fuels (coal, heavy oil & gas)
  - Decrease emission of air and water pollutants, such as CO_2, SO_2, NOX, $PM_{2,5}$ & PM_{10} particles, etc.

Energy transition

- Introducing renewables as preferred energy sources
- Increasing energy efficiency on both sides of the process: generation side and consummation.
- Utilization of advanced technologies and materials (nanotechnology, storage facilities, hydrogen utilization, hybrid systems, etc.)

What about the generation of heat energy and district heating systems (DHS)?

About District Heating Systems

- The way we produce and distribute heat is crucial for social sustainability and welfare
- District Heating Systems (DHS) are resilient, dating back over 100 years, and are built on robust technology
- DHS offers many advantages over other heating methods, and there is significant pressure to force this technology considering current climate changes.

The situation with our DHS

- The district heating system is outdated and underdeveloped, relying exclusively on imported natural gas, and with an obsolete infrastructure *(piping, information systems, SCADA, and remote control)*
- Customer coverage is below 30% *(several, mostly high urban zones in Skopje)*, limiting its economic viability
- It contributes to CO_2 and particle emissions and lacks the integration of renewable energy sources

Previous research

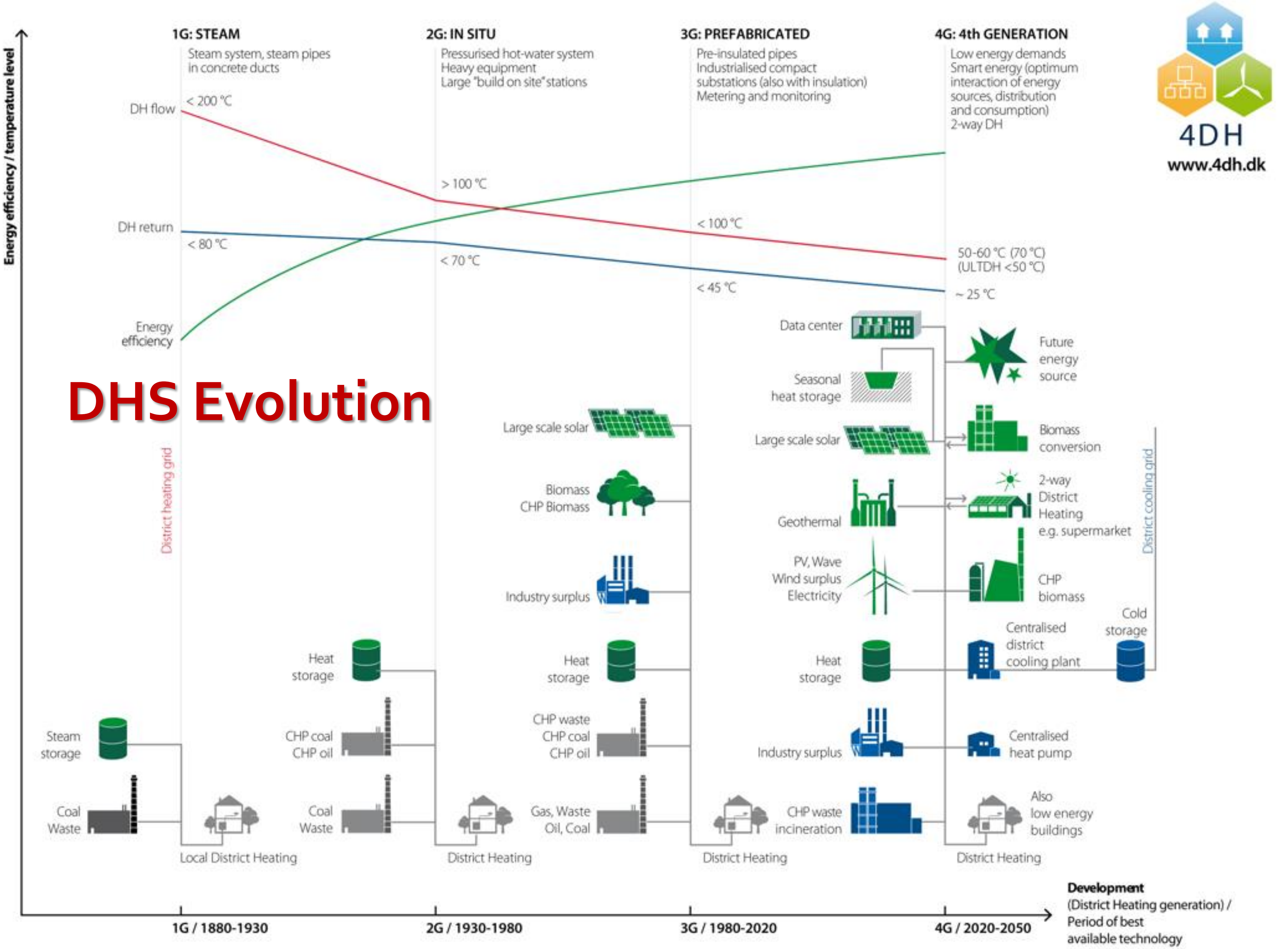
- Many countries are under significant pressure to reduce emissions of pollutants such as CO_2, SO_2, NOX, PM2.5, and PM10, as mandated by international agreements including the UN Framework Convention on Climate Change *(UNFCCC)*, the Kyoto, Copenhagen, and the Paris Agreements.
- The main goal is to limit the rise in global temperatures to 2°C above pre-industrial levels, with an aspiration to keep it within 1.5°C.
- This goal is not feasible if energy generation continues in its current form.
- We need a new energy plan that is both feasible and financially sustainable.
- Recent research and improvements in DH technology have primarily been observed in countries that have historically relied heavily on DHS, such as those in Scandinavia, certain EU states, the USA, and Russia.
- Due to global climate change, other EU countries, even Mediterranean ones are now placing significant emphasis on developing both district heating and cooling systems as part of their new energy transition plan.

Back to DHSs

DHS could be classified into several development stages:

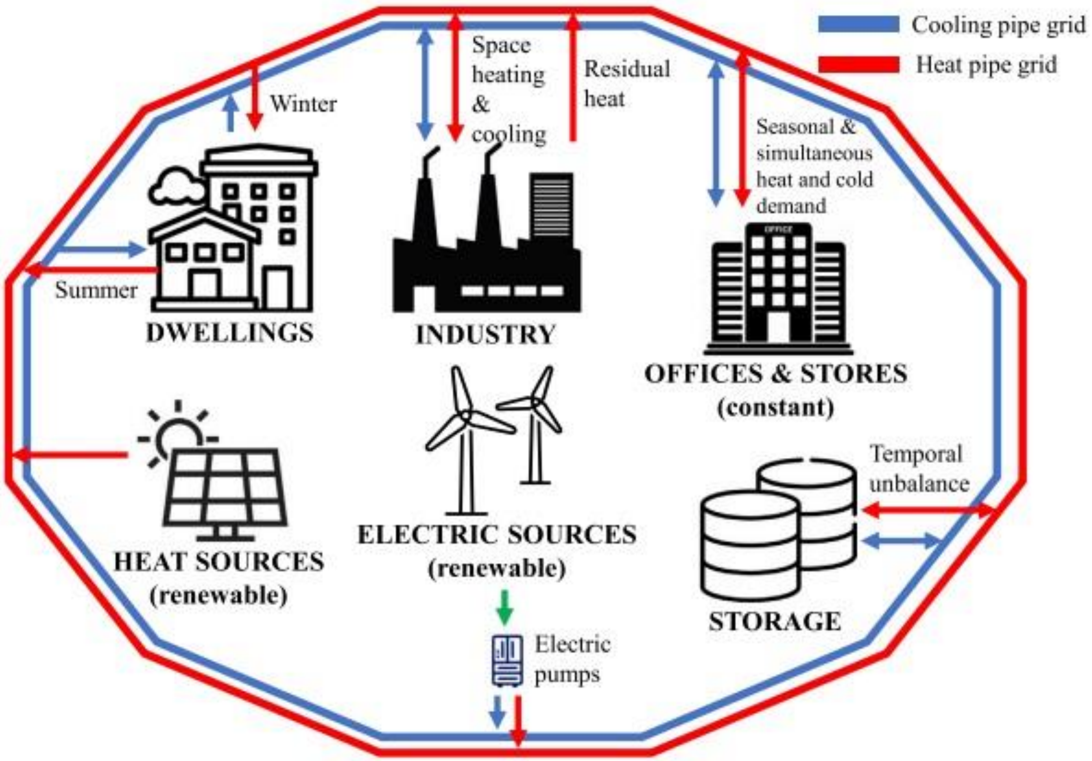
- **1st generation (1920 – 1950)** – A heating system based on hot steam distribution – temperatures > 100°C
- **2nd generation (up to 1980)** – Heating based on a pressurized hot-water system – lower temperatures < 100°C
- **3rd generation (1980 – 2010)** – Result of the strong increase in the fuel prices (mainly heavy oil) – a further decrease of the hot water temperature and using modernized piping system (pre-isolated)
- **4th generation (2010 – ...)** – Transforming the energy system towards a sustainable system, higher share of renewable sources for heating and cooling, heat storages, and reduced specific building energy consumption by reducing supply and return temperatures, including intelligent system control, etc.
- **5th generation (still under research)** – Bidirectional energy flow – heating & cooling, distributed heat generation, new grid topologies, introducing of heat prosumers, etc.

DHS Evolution

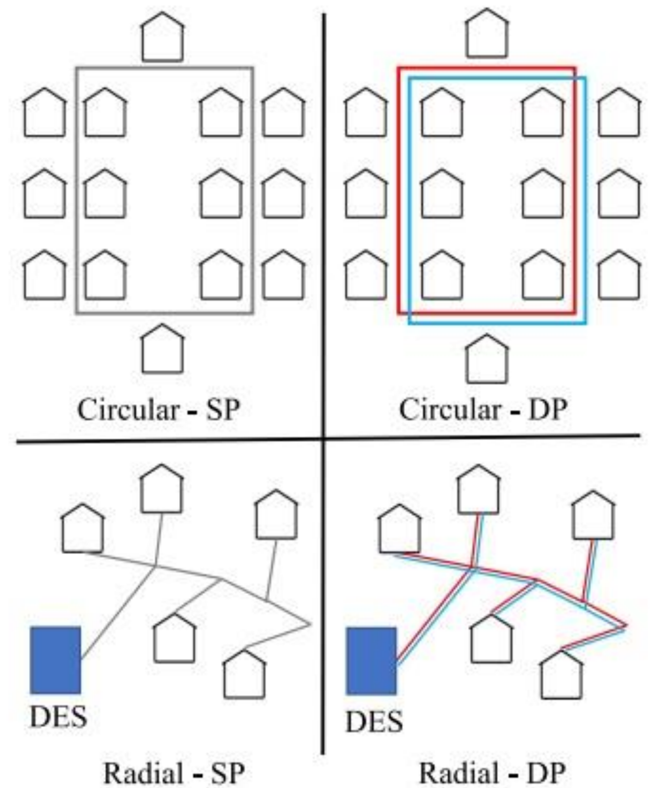


5th Generation of DHS*

Integration of Heating and Cooling Systems



Updated Piping Strategies



DES – District energy system
SP – single pipe system
DP – double pipe system

** According to L. Minh Dang, et al.*

4th and 5th generation of DHS* comparison

The winner in the comparison of the key parameters: **4GDH**

Parameter	Description	4GDH	5GDH
Cost	The 4GDH is the most cost-effective solution for both high and low energy buildings, independent of the temperature level of the heat source.		
Flexibility	The 4GDH can take maximum advantage of periods with low-cost energy. This can realize great savings for utilities and end consumers in 4GDH systems that operate centralized heat pumps and thermal storage facilities. It further enables cost and energy efficient integration with industry waste heat sources, for example from supermarkets and datacenters. 4GDH has the ability to connect various local industry waste heat sources with maximum energy efficiency.		
Robustness	During period of cold weather, 5GDH may fall short due to flow capacity limitations in the distribution network. 4GDH systems would on the other hand be able to ramp up the system supply temperature and flow rates to effectively increase the capacity of the distribution network.		
Reliability	If a critical component like the heat pump fails, professionally operated systems like 4GDH have a built-in redundancy via multiple central heat generation units, such as peak and emergency boilers, which offer exceptionally high reliability. End-users using individual heat supply systems, like 5GDH, are solely reliant on their own heat generation unit.		
Resilience	The centralized 4GDH systems can tap into emergency supplies in case of mayor events, like power grid collapse. The 5GDH systems that rely on building-level power supplies, however, would not be able to operate the heat pump and the system would be non-operational.		

*** Danfoss** – *Comparison study between 4th and 5th generation of DHS*

Where are we now?

- The DHS in the country exists only in the city of Skopje.
- There are five heating facilities: East, West, TE-TO, Energetika, and North. All facilities operate on natural gas.
- The total installed thermal capacity of the system is 794 MW, supported by a distribution network of nearly 250 km, serving ~ 60,000 customers. This represents < 30% of the total thermal heat demand for the entire city.
- The distribution network is limited to the city areas Center, Karpos 1 – 4, Aerodrom, and partially, Kisela Voda, Novo Licise, and Avtokomanda.
- The system comprises a mix of 2nd and 3rd-generation DHS technologies, which do not fully meet current standards for sustainable district heating, according to best global practices.

Major Problems in our DHS

- The existing DHS is relatively outdated and does not meet current standards, necessitating investments and upgrades.
- DHS relies entirely on imported natural gas as basic fuel; therefore, it is vulnerable to fluctuating gas market prices and possibilities for having long-term security of fuel supply.
- Expansion of the distribution system and attracting new customers is crucial for improving the business's economics.
- Heating prices are still too high relative to the economic standards of the community, which has resulted in a significant number of customers seeking disconnection from the system.
- Incorporating renewable energy sources is not existing, with a focus on solar thermal, geothermal, and biomass options.
- There is a potential for utilizing industrial heat and establishing heat recovery facilities compatible with those currently within the DHS, including heat storage.

Conclusions

- **A modern DHS** is vital for social sustainability, welfare, and environmental protection *(sustainable energy plan).*
- **Utilizing all available renewable resources** is essential for a stable and economically viable DHS *(decarbonization).*
- **Better legislation** is needed to address the challenges of increasing energy demands and the energy transition.

e.g., Denmark supplies district heating to 68% of its homes, with 75% sourced from renewables, often at lower costs than alternative heating methods.

- **Upgrading** to the 4th generation of DHS should be prioritized, with **appropriate investment schemes** explored.
- In summary:
  - Reduce fossil fuel use,
  - Maximize renewable energy sources,
  - Enhance distribution networks,
  - Improve energy efficiency.

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