Vienna, Austria

Background

It is clear that the City of Vienna is extremely committed to climate protection. Not only are they comprehensive in their strategies, but they are also leaders aiming to be a model smart and climate-friendly city. Viennese city officials credit their success to strong institutions and enthusiastic people. Vienna was able to get to where it is today through a plethora of strategies: they will operate through both public and private partnerships, bottom-up and top-down management, free market and market regulation, a strong welfare state, embracement of technology and digitization, innovation and entrepreneurship, and in-house procurement of open-source data.

Vienna is a great model city for comparison to the City of Toronto. Vienna is less populated than Toronto with a population of around 2 million and closer to 3 million in the metropolitan. Vienna's climate is similar to Toronto's if not milder (Table 2.)

Vienna routinely publishes update reports on their journey towards decarbonization granting thorough and comprehensive research. *Smart City Wien Framework Strategy* (Homeier et al., 2019) is a visioning document outlining Vienna's path to its 2050 goals. *Energy Report of the City of Vienna* (Vogl, 2019) tracks Vienna's progress towards that 2050 vision. And *Energy Framework Strategy* (Buchberger et al., 2017) lays out goals and priorities towards decarbonization by 2030. These strategic documents provide an overview of all successful measures the City of Vienna has taken so far.

In 2018 Vienna required 42,261 GWh of energy, down from 43,280 GWh in 2017. With a population of slightly under 2 million, this converts to about 20,000 kWh of energy required per person per year. Natural gas is Vienna's largest energy source with 43% of the 42,261 GWh followed by "fuels" (petrol and diesel) with 30%. Natural gas is primarily converted into electricity and district heating and fuels are mostly used for transportation. As shown with the grey bars, and at "Energy losses at end users", nearly half of the fossil fuel energy produced is lost (likely as heat).

Vienna's goal is to reduce per capita final energy consumption by 40% from 2005 levels by 2050. In 2005, this was 24,165 kWh per capita, 2017 estimates show a 15.8% drop in consumption to 20,343 kWh per capita. Figure 2. envisions how Vienna intends to change its energy profile to meet its 2050 target.

To arrive at the decarbonized society they envision by 2050, Vienna's electricity, heating, and cooling must come from renewable sources and waste heat. City officials prioritized the order of strategic steps to achieve this feat: improve energy efficiency, use waste heat and waste, and develop renewable energy sources.

Heating & Cooling

13,358 GWh of Vienna's end use energy (36%) is used for space heating. To ensure a sustainable, efficient supply of heat, Vienna built one of the world's most remarkable district heating networks ([*Fernwärme Der Wien Energie*, 2020](#)). Vienna's district heating system supplies over 30% of Vienna's households with space heating and hot water. Using combined heat and power (CHP) technology, the 1,200 km long network collects waste heat from electricity generation at the Simmering and Donaustadt natural gas power plants and the Spittelau waste incineration plant and delivers it to residential and commercial buildings. This low-carbon heating source saves an estimated 1.5 million tonnes of carbon dioxide annually.

Optimizing energy efficiency in private households is an excellent avenue for managing heating and cooling energy demand. Of the 13,358 GWh final energy used for space heating, 7,331 GWh (55%) is for private households, and 2,314 GWh (17%) is lost. Vienna is working to improve the efficiency of this system. New builds are constructed to near-zero-energy standard, existing buildings are fully reinsulated, and heating and energy systems are gradually being converted to non-fossil fuels. Subsidies from the city grant residents the opportunity to undertake whole-of-house refurbishments which both improve the thermal comfort of the home and reduce demand on the grid. Even more, to further encourage home refurbishments, Vienna leads by example and enables curbside appeal by refurbishing their large public housing stock buildings and buildings owned by the City. To ensure the buildings are refurbished, Vienna created spatially targeted regulatory instruments for "Spatial Energy Planning Zones"

Energy Security

A critical first step to ensuring energy security before increasing energy production is to maximize energy efficiency. Through investments in energy efficiency and new technology, Vienna aims to cut its per capita final energy production in half by 2050, as well as have 30% by 2030, and 70% by 2050 of Vienna's final energy consumption originating from renewable sources.

Vienna is systematically evaluating and expanding to meet its objective. Technologies under investigation for large-scale use include: heat pumps, solar thermal and photovoltaic, and conversion of organic waste and biogenic by-products into thermal energy for district heating and bio-methane. Special attention is being given to converting the district heating network to untapped sources of renewable energy and waste heat via large-scale heat pumps. Above all, however, Vienna will have to utilize geothermal technologies to meet their target. Local production of renewable energy will also be supplemented with imports of renewable energy via long-distance cables. For the most effective use of these technologies, the city must use spatial energy planning tools.

Spatial Energy Planning

Spatial energy planning is the combination of energy planning with urban planning for greater integration of low-carbon technologies and waste heat recovery into urban living. Using photovoltaic panels as shading or on the facades or roofs of buildings are examples of spatial energy planning. Because spatial energy planning is a forwardlooking technique, sustainable technologies are more easily integrated rather than forced in less than optimal situations. This increases the efficiency of the technologies and lowers the cost.

Recommendation

- Expand Toronto's use of CHP, solar thermal, photovoltaic, heat pumps, and geothermal.
- Expand Toronto's district heating network.
- Encourage whole-of-house retrofits.
- Combine energy planning with urban planning for greater integration of renewable energy and waste heat recovery into urban living

Figures and Tables

Table 2. Toronto and Vienna climate data averages 1982-2012 *(Climate Data for Cities Worldwide*, 2020).

Metric	Elevation (m)	Annual Temp. (℃)	Summer average	Summer high	Winter average	Winter low	Annual Precip. (mm)	Precip. high	Precip. low
Toronto	105	8.0	21.5	26.6	-5.3	-8.9	785	81, Aug	51, Feb
Vienna	186	9.9	19.9	26.1	-0.6	-3.7	623	75, Jun	35, Jan

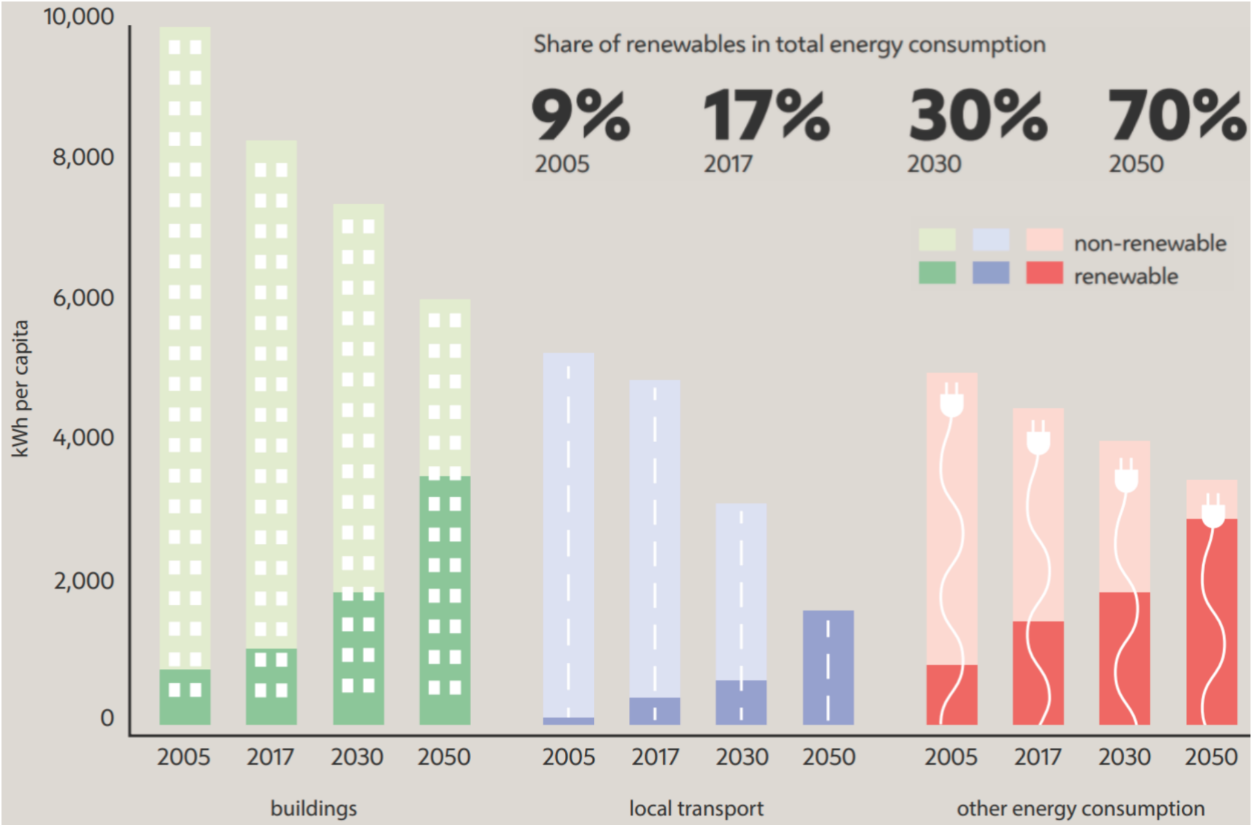

Figure 2. Energy reduction targets for Vienna [(Homeier et al., 2019)](#).

Sources

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