Effects of digitalization on energy demand and climate in Austria

Results report

FINAL REPORT	
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Client:	Climate and Energy Fund (Klima- und Energiefonds)
Date:	Vienna, June 2022

IMPRINT

Published and produced by: Österreichische Energieagentur – Austrian Energy Agency
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Produced and published in Vienna

1 Project description

In the third call of the "Energy Transition 2050" program, a research and development (R&D) service on "The effects of digitalization on energy consumption and climate in Austria" was financed by the Austrian Federal Government's Climate and Energy Fund (KLIEN), see FFG (2020). A joint project application by the Austrian Energy Agency (AEA) and the Association of the Electrical and Electronics Industry (FEEI) was awarded the contract for this tender. This project ended on June 30, 2022.

The aim of this project was to quantify possible effects of progressive digitalization on energy consumption and greenhouse gas emissions in Austria by 2040 in five sectors: industry, transport, households, services and agriculture. For this purpose, the reduction potentials of final energy consumption and greenhouse gas emissions in connection with various digitalization technologies and applications were analyzed and the associated rebound effects were taken into account. This analysis was based on qualitative scenarios that describe the holistic and cross-sectoral effects of different digitalization approaches.

Another project goal was the development of recommendations for RTI policy measures (research, technology and innovation) that will support the technologies and applications associated with digitalization "made in Austria". Both the development of scenarios and the development of recommendations for RTI policy measures took place in close exchange with stakeholders from the areas of research, technology and industry as well as with backgrounds in information and communication technology (ICT) application in the commercial and private sectors.

In this result report, the main findings of the work packages are presented.

2 Digitalization in Austria

In Work Package 2, among other things, an estimate of the current energy consumption of information and communication technologies (ICT) and the resulting greenhouse gas emissions (GHG emissions) was carried out on the basis of national and international market and technology studies, the energy balance and the useful energy analysis of Statistics Austria as well as using Fermi problem estimates.

The estimated energy consumption of ICT in Austria in 2019/2020 is 4.7 TWh. Households accounted for the largest share with 1.4 TWh and data centers with 1.2 TWh, followed by workplace IT (1.0 TWh) and telecommunications (0.8 TWh). Public use with 0.1 TWh and building supply with 0.2 TWh had smaller shares (see also Figure 1). In 2020, the total Austrian final energy consumption was 293 TWh, of which 61 TWh was electrical energy. The ICT electricity consumption estimated here thus accounts for approx. 1.6% of the total final energy consumption in Austria, and approx. 7.7% of the final energy consumption for electrical energy. The direct GHG emissions resulting from this ICT power consumption amounted to between 0.36 and 1.06 million t of CO_2 equivalent (t: metric ton), depending on the method and approach used. In 2018, the total greenhouse gas emissions in Austria were 79.0 million t of CO_2 equivalent (UBA 2020). The GHG emissions of ICT, calculated according to the national accounting method, amounted to 0.56 million t of CO_2 equivalent in 2019/2020 and thus corresponded to approx. 0.7% of the total GHG emissions in Austria in 2018. Detailed analyses of the individual applications were included in report D2.1 "ICT electricity consumption in Austria in 2019/2020".

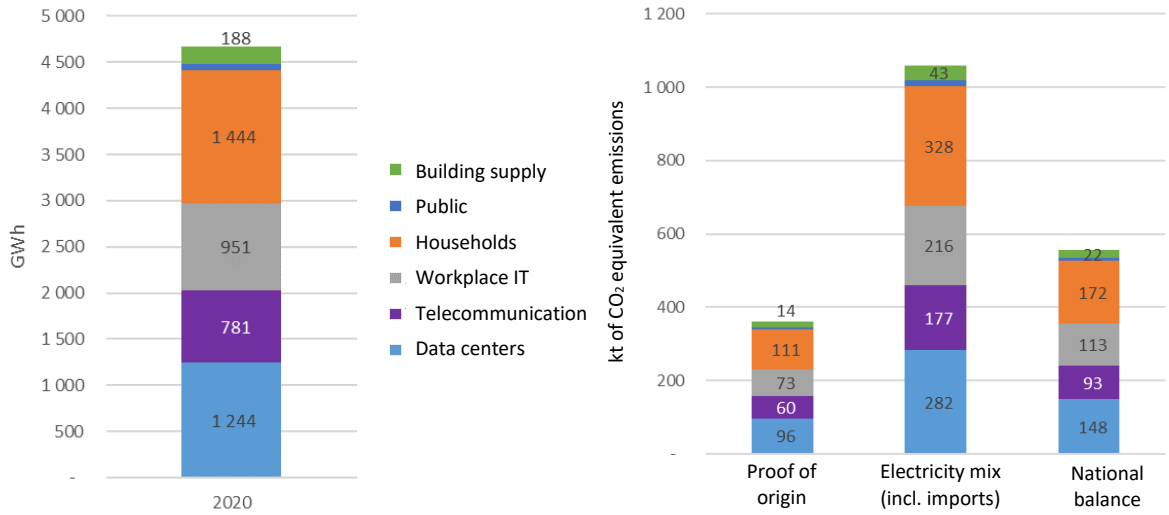

Figure 1: ICT electricity consumption and greenhouse gas emissions in Austria 2020; source: AEA calculations

In addition, industry-relevant digitalization technologies were identified in this work package. These technologies were determined with support of experts from the defined industries, in the form of structured (mostly individual) interviews and so-called screening talks, where several experts from the same industry came together, as well as desk-based research by the project team. In this process, possible existing and future applications of the technology, the technology readiness level (TRL) in the year 2021 (on a scale of 1 to 9), market introduction or diffusion barriers, and the potential for energy consumption and greenhouse gas emissions were assessed. The results of this process were an important basis for scenario creation and quantification (see next chapter). More information can be found in D2.2. "Representation of the technology landscape".

3 Energy and GHG emissions

In the analysis, which was carried out as part of Work Packages 3 and 4, the potential for reducing energy consumption and greenhouse gas emissions (GHG emissions) through digitalization applications in Austria in 2040 was examined. In a first step, digitalization applications were identified and scenarios for low, medium and high market penetration were formed (min, mid, max scenario). In the estimates of market penetration in 2040, assumptions regarding barriers to market entry were taken into account. As far as possible, relevant literature was used for these estimates. For use cases for which no corresponding literature is available, this was supplemented by estimates of experts and Fermi derivations. Most estimates were validated with stakeholders or experts, in stakeholder interviews or in a workshop.

In the max scenario, up to 28.4 TWh of energy can be saved compared to the reference scenario. In the mid scenario, the potential savings are 19.4 TWh, and in the min scenario 11.1 TWh. This means that digitalization applications can save around 4% to 10% in energy consumption in 2040. However, increased use of the information and communication technology infrastructure (ICT infrastructure), data centers and telecommunications infrastructure can cause up to 2.3 TWh of additional energy consumption (this is not included in the possible savings). In the reference scenario, which serves as the basis for calculating the effects of digitalization, extensive independence from oil, coal and natural gas (decarbonization) by 2040 was already taken into account.

The savings opportunities for greenhouse gas emissions until 2040 are also significant. The maximum net savings are 2.3 million t of CO_2 equivalent. In the mid scenario, the possible savings are 1.2 million t of CO_2 equivalent and in the min scenario 0.4 million t of CO_2 equivalent (excluding breeding optimization in cattle farming). The GHG emissions in the reference scenario amount to approx. 23.3 million t of CO_2 equivalent in 2040. Thus, from 2% to 10% of GHG emissions can be saved in 2040 by digitalization applications compared to the reference scenario.

Eight applications account for approximately 80% of the net effects of digitalization applications on energy savings and 70% on GHG emission reductions. A focus of research, technology and innovation (RTI) policy measures on these applications appears to be a good recommendation on the basis of this quantitative analysis. An overview of the individual effects was given in Figure 2 and Figure 3. Detailed analyses of the individual applications are included in report D3.1 "Short paper scenarios".

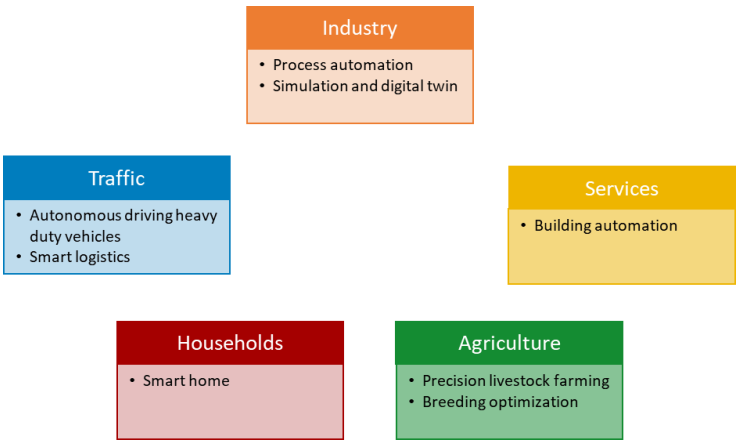

Figure 2: Recommended digitalization applications to prioritize

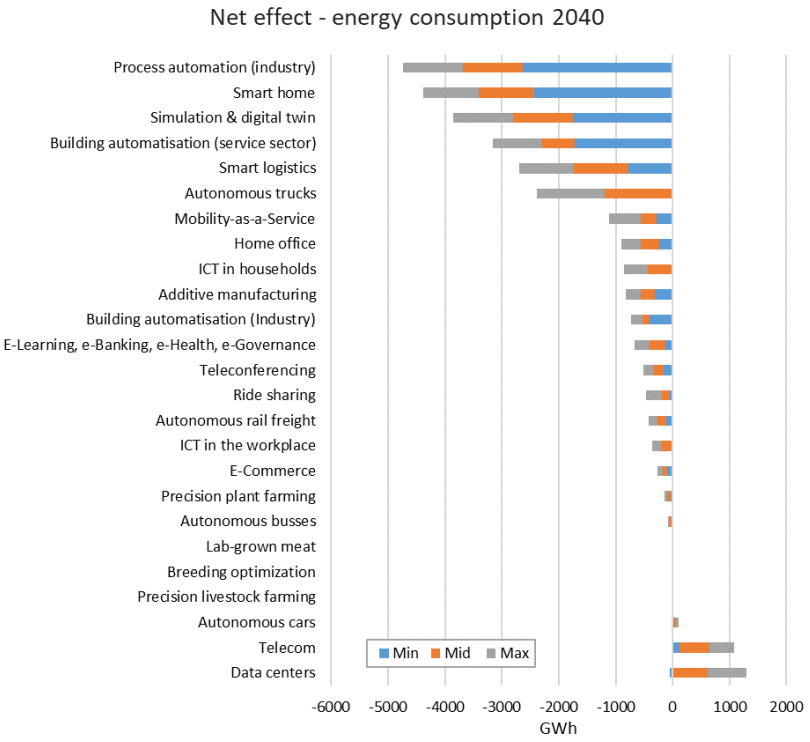

Figure 3: Net effects of digitalization applications – energy consumption 2040; source: AEA calculations

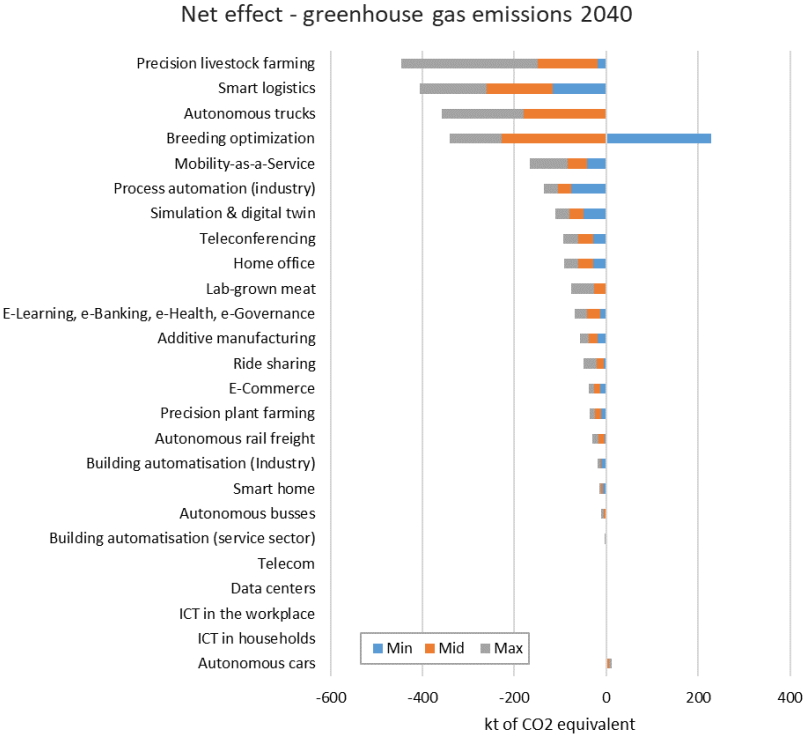

Figure 4: Net effects of digitalization applications – GHG emissions 2040; source: AEA calculations

4 RTI policy measures

In Work Package 5, existing RTI policy measures from Austria (both at the federal level and at the level of the federal states), the European Union and also from the innovation leaders Sweden and Denmark were presented and examined, see D5.1 " Survey of existing RTI policy measures". The focus was on measures that are relevant for the digitalization technologies identified in Work Package 4 as well as for the Austrian players (research, companies ...). The analysis showed that two dimensions of categorization are helpful and that for almost every category, the question of the addressed technology readiness levels (TRLs) must also be considered. Other insights from this study are:

- The analysis of the existing measures showed a significantly large number, diversity and complexity of the RTI funding landscape at all levels. Consolidation and simplification of this funding landscape is recommended, as previous analyses have suggested.

- In general, it should be possible to develop existing programs more towards the identified topics instead of initiating new, specific programs.

- Similar to the approach of the EIC (European Innovation Council), it is useful to look for measures to support this scalability and proliferation of solutions to cross the "valley of death" of innovation.

- For many, especially small and medium-sized companies, it is important that within the framework of innovation measures, already robust and tested technologies are also promoted and that scientific support plays a lesser role in the funding approval process.

- An interdisciplinary, holistic approach is required to exploit the energy saving and GHG reduction potential of digitalization technologies, which has so far only been reflected to a limited extent in funding programs. The inclusion of energy and GHG criteria in the evaluation can help in many funding channels for digitalization programs.

- The demographic development and the strong increase in demand for qualified personnel in the areas of digitalization and energy give reason to expect that human resources will continue to be a bottleneck. In order not to generate any further competitive disadvantages in Austria as a result, qualification and training programs can be strengthened.

Finally, specific recommendations for RTI policy measures for digitalization applications in the examined sectors were made, see D5.2 "Recommendations for RTI policy measures". For these recommendations, inputs were developed, among others, in a workshop with stakeholders.

5 Literaturverzeichnis

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6 Abbreviations

AEA	Austrian Energy Agency
CO_2	Carbon dioxid
D	Deliverable
EIC	European Innovation Council
FEEI	Association of the Electrical and Electronics Industry (Fachverband der Elektro- und Elektronikindustrie)
FFG	Austrian Research Promotion Agency (Österreichische Forschungsförderungsgesellschaft)
GWh	Gigawatthours
R&D	Research and Development
RTI	Research, technology and innovation
ICT	Information and communication technology
IT	Information technology
KLIEN	Climate and Energy Fund (Klima- und Energiefonds)
kt	1000 metric tons
OECD	Organization for Economic Co-operation and Development
t	Metric ton
GHG	Greenhouse gas emissions
TRL	Technology readiness level

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ABOUT THE AUSTRIAN ENERGY AGENCY (AEA)

The Austrian Energy Agency offers answers for a climate-neutral future. The aim is to organise our lives and economic activities in such a way as to no longer affect our climate. New technologies, efficiency and the use of natural resources, such as sun, water, wind and forests, lie at the heart of the solutions. This ensures that we and our children can live in an intact environment and that ecological diversity is preserved without being dependent on coal, oil, natural gas or nuclear power. This is the missionzero of the Austrian Energy Agency.

More than 85 employees from a wide range of disciplines advise decision-makers in politics, business, administration and international organisations on a scientific basis and provide support in reconstructing the energy system and implementing measures to tackle the climate crisis.

On behalf of the federal government, the Austrian Energy Agency manages and coordinates the climate protection initiative klima**aktiv**. The federal government, all federal states, leading companies in the energy and transport sectors, interest groups and scientific organisations are members of this Agency.

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