



ELECTRIC BUSES IN MAASTRICHT

STI, POLICY AND SDG RELEVANCE

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13 CLIMATE ACTION



- **TARGET 13.1**

STRENGTHEN RESILIENCE AND ADAPTIVE CAPACITY TO CLIMATE-RELATED HAZARDS AND NATURAL DISASTERS IN ALL COUNTRIES

- **TARGET 13.2**

INTEGRATE CLIMATE CHANGE MEASURES INTO NATIONAL POLICIES, STRATEGIES AND PLANNING

INTRODUCTION: THE WIDER PERSPECTIVE

Since 2007, Maastricht has committed itself to becoming a climate-neutral city. The city's electric buses, which have been in operation for not even half a decade, are a fundamental part of achieving this goal. The main motivation for this vision are the reduction of greenhouse gas (GHG) emissions of fossil fuel-based public transportation, which therefore contributes to climate change.

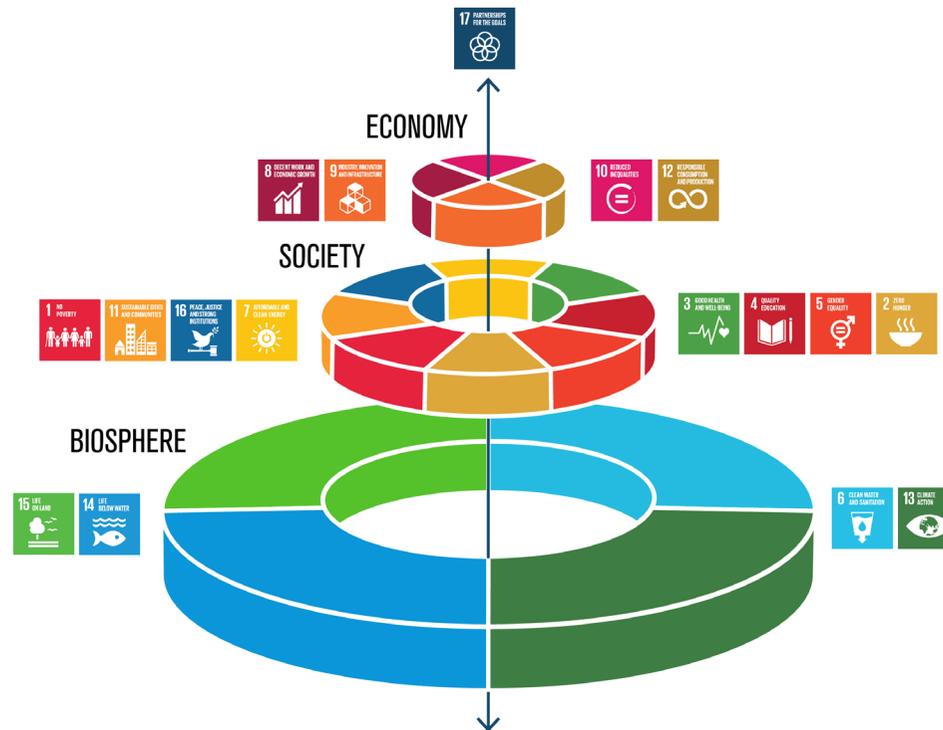
The Sustainable Development Goals (SDGs) provide specific targets to reach a sustainable network of transportation. Below, we assessed the innovation of Maastricht's public buses through the themes of four SDGs, including the technological and institutional breakthroughs required to make this innovation feasible. Due to the city's motivation, our main focus in this paper is on SDG13, as this initiative is a clear demonstration of climate action.

In the final section, we discuss the relevance of these measures for the citizens of Maastricht. We conclude with a short outlook.



THE SUSTAINABLE DEVELOPMENT GOALS: HOW ARE THEY RELATED?

The SDGs that we assessed as relevant to implementing electric buses in Maastricht are SDGs 7, 9, 12 and 13. This broad range of SDGs needs structuring to reveal our main line of argumentation, accompanying the entire journey from idea to implementation. Useful for this structuring is the graphic below that was produced to illustrate how food connects all SDGs (Stockholm Resilience Center, 2016). We argue that the same structuring can be used for the case at hand. SDG 13 on climate action is at the basis of our report – it aims to preserve the biosphere that we need to live in Maastricht. Due to the negative influence of GHG emissions of buses running on fossil fuels, that biosphere is negatively affected by a transportation system. The next layer is about society, where SDG 7 comes in, about renewable resources and sustainable cities to ensure that future generations will be able to live with improved standards of living than the current generation. Finally, SDGs 9 and 12 are considered in the final layer. This initiative is about sustainable production and use of electricity which also requires the proper transportation infrastructure, such as charging docks for the buses to charge their batteries. The SDGs and the relevant targets will be further integrated in the sections below.



7 AFFORDABLE AND CLEAN ENERGY



- **TARGET 7.2**

BY 2030, INCREASE SUBSTANTIALLY THE SHARE OF RENEWABLE ENERGY IN THE GLOBAL ENERGY MIX

- **TARGET 7.A**

BY 2030, ENHANCE INTERNATIONAL COOPERATION TO FACILITATE ACCESS TO CLEAN ENERGY RESEARCH AND TECHNOLOGY, INCLUDING RENEWABLE ENERGY, ENERGY EFFICIENCY AND ADVANCED AND CLEANER FOSSIL-FUEL TECHNOLOGY, AND PROMOTE INVESTMENT IN ENERGY INFRASTRUCTURE AND CLEAN ENERGY TECHNOLOGY

THE IDEA: AFFORDABLE AND CLEAN ENERGY AS FUEL

To support the considerable effort that countries needed to go to in order to comply with SDG13, whole infrastructures would need to be reconsidered and effectively planned for. In 2012, the municipality of Maastricht set out guidelines for sustainability policy in its duurzaamheidskompas (Gemeente Maastricht, 2012). The guidelines states fossil fuel use needs to be reduced due to the negative impact on the climate and their depletion and non-renewability. It is therefore encouraged to use renewable resources and energy. Another challenge addressed is increased mobility that requires good accessibility across the city. Within that framework, the municipality of Maastricht devised the program #missionzeromaastricht, which should lead to a climate-neutral city by 2030. In April 2016, the Dutch government signed an agreement with all public transport providers that stipulates that all new buses in local public transport must be emissions-free after 2025 (Government of The Netherlands, 2016). Furthermore, all electricity that is used by the buses must be sustainably generated by 2025. The province of Limburg, of which Maastricht is the capital, was instrumental in facilitating this agreement. This clearly showed the commitment of the city to working toward SDG13.

The scientific and technological context of these modifications therefore play a fundamental part in correctly assessing what projects would contribute to this target. The science behind the concept of clean energy appears rather intuitive: zero emissions buses indicates no CO₂ produced, and no contributing GHG to the biosphere. However, there are other elements of electric buses that also contribute to the argument for the conversion to clean energy as fuel. A report comparing energy consumption between standard diesel buses and electric buses found that battery powered engines consumed 1.80 kWh/km, whereas diesel engines consumed considerably higher at 5.52 kWh/km (Gao et al, 2017). This hints towards long term cost efficiency in terms of investment, with electric-

7 AFFORDABLE AND CLEAN ENERGY



ity prices competing with potentially rising gasoline prices due to depletion of natural resources.

Key stakeholders needed to be organized in order to transform this idea into an affordable reality. This was successfully attained through public private partnerships (PPPs) and inter-province communication. Instrumental to these efforts was the Zero Emissions Bus Foundation (ZEBF) which pioneered the idea of implementing zero-emission public buses by 2025 (European Investment Bank, 2017). It successfully aligned interests of the public and private sector with these goals, and its tasks were integrated into the different parties involved. The ZEBF was funded by the European Local Energy Assistance (ELENA) program that the European Commission and the European Investment Bank (EIB) provide for initiatives that aim at implementing energy efficiency, distributed renewable energy and urban transport projects and programs (European Investment Bank, 2018). The ELENA grant helped hire external experts, conduct feasibility and market studies and structuring the ZEBF's work. In order to make this grant worthwhile as a societal investment, it must lead to an investment at least 10 times the amount of the grant, otherwise the grant must be paid back (European Investment Bank, 2017).

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



- **TARGET 7.2**

DEVELOP QUALITY, RELIABLE, SUSTAINABLE AND RESILIENT INFRASTRUCTURE, INCLUDING REGIONAL AND TRANSBORDER INFRASTRUCTURE, TO SUPPORT ECONOMIC DEVELOPMENT AND HUMAN WELL-BEING, WITH A FOCUS ON AFFORDABLE AND EQUITABLE ACCESS FOR ALL

- **TARGET 7.A**

BY 2030, UPGRADE INFRASTRUCTURE AND RETROFIT INDUSTRIES TO MAKE THEM SUSTAINABLE, WITH INCREASED RESOURCE-USE EFFICIENCY AND GREATER ADOPTION OF CLEAN AND ENVIRONMENTALLY SOUND TECHNOLOGIES AND INDUSTRIAL PROCESSES, WITH ALL COUNTRIES TAKING ACTION IN ACCORDANCE WITH THEIR RESPECTIVE CAPABILITIES

INNOVATION OF THE SERVICE

Drawing on Schumpeter's categories of innovation, electric buses in Maastricht can be defined as both a product innovation and organizational innovation, as the former consequently induced the latter. Product innovation is defined as 'launch of a new product or a new species of already known product' (Śledzik, 2013). Diesel buses had already been used for many years in Maastricht. Therefore, conversion to electric buses can be seen as a 'new species' of the original.

For the concept of process innovation, we have to refer to the definition 'new industry structure such as the creation or destruction of a monopoly position.' (Śledzik, 2013). In order for electric buses to run efficiently, the placing charging points that are accessible in terms of bus routes required sufficient changes in the infrastructure.

The public sector plays a special role in achieving the monopoly position regarding this innovation in the Netherlands. The province of Limburg sets out a concession with certain conditions. This includes the area in which the transport provider may operate in, but also which locations need to be serviced and which environmental requirements need to be fulfilled (Broos, Ockers, & Van Rookhuizen, 2017). In 2016, the province of Limburg negotiated a concession of 15 years with Arriva, which included the requirement of zero emissions public transport by 2025. In return for winning a monopoly on the market of the province, Arriva bears the burden of cost of acquiring new buses, trains and charging infrastructure (Bouthoorn, Teeuwisse, & Van de Poll, 2016). Due to this agreement, Maastricht is very likely to reach its goals of zero emissions public transport in the set out timeframe.

This agreement is in line with both targets 7.2 and 7.A. However, improvements can still be made, which will be discussed below.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



- **TARGET 12.2**

BY 2030, ACHIEVE THE SUSTAINABLE MANAGEMENT AND EFFICIENT USE OF NATURAL RESOURCES

- **TARGET 12.6**

ENCOURAGE COMPANIES, ESPECIALLY LARGE AND TRANSNATIONAL COMPANIES, TO ADOPT SUSTAINABLE PRACTICES AND TO INTEGRATE SUSTAINABILITY INFORMATION INTO THEIR REPORTING CYCLE

- **TARGET 12.7**

PROMOTE PUBLIC PROCUREMENT PRACTICES THAT ARE SUSTAINABLE, IN ACCORDANCE WITH NATIONAL POLICIES AND PRIORITIES

SUSTAINABLE BUSES AND USE OF RESOURCES

With a project that aligned itself with responsible climate goals, the government was challenged with finding contractors that shared the same goal as the initial idea and also had the right capacity to deliver the requirements. The desired outcomes also neatly aligned with some of the targets laid out by SDG12.

Due to the nature of the PPP, Arriva is responsible for acquiring electric buses. As it is a company competing with other transport providers, it needs to compete for lowest cost. For Limburg, Arriva procured buses from Dutch electric bus manufacturer VDL (VDL, 2018). As VDL is located in Eindhoven, delivery routes are short. On top of this, VDL is strongly committed to achieving a circular production cycle and sustainable generation of electricity. The company is also focused on innovating its technologies, leading to further efficiency in consumption and production (VDL, 2018). Such practices are in line with the SDG Industry Matrix devised by the Global Compact and KPMG (UN Global Compact, KPMG International, 2015).

As previously mentioned, the consumption from electric buses was considerably lower than diesel buses, indicating a step towards target 12.2 and the 'efficient use of natural resources' from Arriva as a company. Furthermore, as a large company, Arriva's step into producing this type of service promotes sustainability practices within the private sector, as the electricity is also to be sustainability produced.

RELEVANCE TO SOCIETY

Principally, the citizens of Maastricht could benefit in three ways from this innovation. Firstly, fewer emissions of CO₂ are beneficial for health and well-being, as CO₂ is connected with a negative impact on health. Secondly, Maastricht is also affected by climate change, which could negatively impact the city. Thirdly, ticket prices could decrease due to the abundance of sustainable energy sources and the likely depletion of fossil fuels.

To the first point, SDG3 on well-being and health was not considered, as the negative health impact of the CO₂ emitted by the buses in Maastricht is negligible (Bouthoorn, Teeuwisse, & Van de Poll, 2016).

Considering climate change, warming of 2-4°C is expected, with longer winters, heavier rainfall and drier and hotter summers (Gemeente Maastricht, 2012). Apart from the direct impact, the city is dependent on many areas in the world due to international supply chains. These areas are also affected by climate change, and so this impact also counts for Maastricht. As the SDGs herald, worldwide GHG emissions can only be reduced if all areas at all levels are involved. Therefore, even if the contribution of this innovation is small, the reduction of CO₂ emissions chips off the global anthropogenic GHG emissions.

The third point is also a benefit for the long-term, as the exploitation of renewable energy sources is still catching on and oil is still abundant enough to prevent a crisis in fuel prices. Due to the abundance of renewable resources, a reduction in ticket prices would be likely, making public transportation cheaper.



CONCLUSION AND OUTLOOK

With the help of the four discussed SDGs, the policy to implement electric buses in Maastricht is a successful step towards SDG13, climate action. With the contribution of fossil fuels set to zero, this can be seen as a monumental step for the transportation sector. Affordable and renewable clean energy maintains itself as a much more sustainable resource than fossil fuels, promoting the long term sustainability of the innovation within the wider infrastructure. As this is the first step towards this type of technology in the local context of Maastricht, it is assumed future innovations of both the product and the process are likely to further build upon this service. However, by laying the foundations of this in place now, the future of the city is likely to see the benefits on all three levels: in the economy, in society and in the biosphere.

And while these strides are clearly in line with the achievement of the SDGs, which are also set to be reached by 2030, improvements are already possible today. For example, buses can be charged when energy use is at its low points during the day, which is a smaller strain on the electricity network and saves cost. The savings could be up to 15% (Jacobs, 2017). Furthermore, new charging techniques are already explored, and better buses are continuously being developed. The example of Maastricht and the Netherlands as a whole is promising for local transport all over the world, and could help achieve the SDGs worldwide.



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