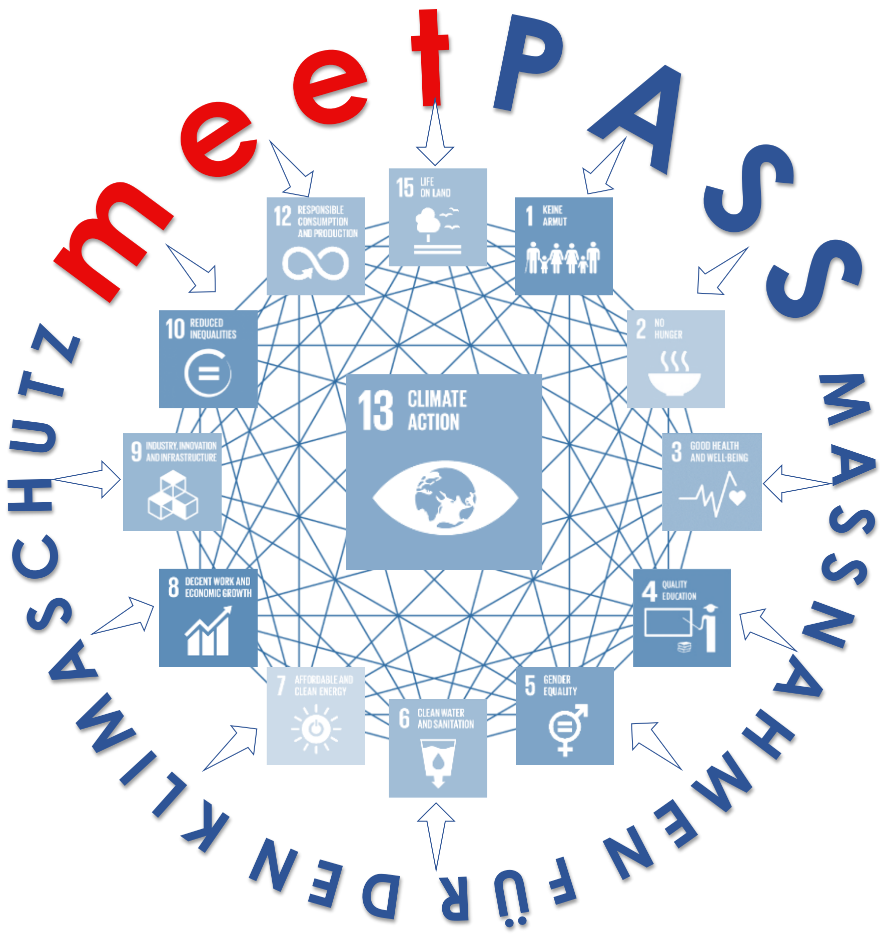
Development of the meetPASS Mitigation Scenario



meetPASS: meeting the Paris Agreement and Supporting Sustainability

Working Paper No. 3

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GWS SPECIALISTS IN EMPIRICAL ECONOMIC RESEARCH

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Content

1 Introduction and Background

The central goal of meetPASS is to explore whether, and to what extent, achieving the goals of the Paris Climate Agreement reinforces or potentially impedes reaching the UN Sustainable Development Goals (SDGs). By conducting an integrated, model-based scenario analysis – involving stakeholders and experts – we analyse the economic, environmental and social impacts of a transition to a low-carbon-society from a global, European and Austrian perspective.

In December 2015, all 196 members of the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Global Agreement on Climate Change (**Paris Agreement**[1]) at the COP21 meeting in Paris. The Paris Agreement aims to keep the increase in the global average temperature well below 2°C compared to pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C.

Each country must determine the way in which it will contribute to meeting the 1.5°C target. While recognising the need for the global community and EU Member States to act together in deciding on binding legislation to fight climate change, resource depletion as well as inequality and poverty, Austria must also prepare its own robust and independent strategies towards a sustainable and low-carbon-society.

In meetPASS, we therefore present and analyse the feasibility of a COP21-compatible future scenario and its global impacts, and then project the impacts onto selected SDGs for Austria. The development and analysis of this scenario facilitates a first assessment of the mutual relationships between deep decarbonisation pathways and (selected areas of) the SDGs. meetPASS investigates the feasibility as well as the impacts of potential measures implemented in Austria. It also examines whether they can encourage progress within other important areas of sustainable development, or where they may be trade-offs.

To map the feasibility of a COP21-compatible future scenario and the implied international impact, we designed a global meetPASS Scenario which we initially quantified using the global GINFORS model. Focusing on social and equality issues, we then evaluated the related impacts on the Austrian society and economy in more detail with the Austrian model e3.at.

The scenario modelling results are useful for a critical discussion of the relationship between the international climate policy and SDG agendas as well as for the identification of strict and socially acceptable mitigation pathways. They show which opportunities exist to meaningfully link these two processes. On the national level, where implementation, monitoring and review will (mainly) take place, the modelling results of meetPASS provide evidence as to whether measures that support the transition to a low-carbon-society may also have positive social and equality implications and lead to economic benefits.

The rest of this working paper is laid out as follows: In chapter 2 we describe the objective behind the meetPASS Scenario and the remaining global and national (Austria) CO_2 budget that can still be emitted in order to fulfil the Paris Agreement. Chapter 3 explains the process of scenario development. Chapter 4 describes the Business as Usual (BAU) scenario (global and for Austria), where no further meaningful policy developments occur. The final chapter describes the main elements of the meetPASS scenario globally and for Austria.

[1] See http://www.un.org/ga/search/view_doc.asp?symbol=FCCC/CP/2015/L.9/Rev.1&Lang=E

2 The challenge: reaching climate and environmental goals

The Paris Agreement (UNFCCC, 2015), adopted on 12 December 2015, provides the framework for the meetPASS Scenario. It is a global milestone for increasing collective action and accelerating the global transformation to a low-carbon and climate-resilient society. The agreement entered into force in October 2016, after having been ratified by 55 countries, which together account for at least 55% of global emissions.

Concerning the reduction of global emissions, the countries agreed on the following key elements:

- To keep the global average temperature well below 2°C above pre-industrial levels;
- To pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, since this would significantly reduce risks and the impacts of climate change;
- The need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries;
- To undertake rapid reductions thereafter, in accordance with the best available science.

The Paris Agreement includes both mitigation and adaptation actions. The meetPASS however, only considers the effects of mitigation policies. The scenario has the primary intention to **limit the rise of global average temperature to no more than 1.5°C above pre-industrial levels**.

The concentration of greenhouse gas (GHG) emissions in the atmosphere largely determine the rate of warming. This raises the question of how many tonnes of GHGs humanity may emit in order to limit warming to the 1.5°C target.

Thanks to the approximately linear relationship between the cumulative total amount of greenhouse gases emitted and the resulting increase in temperature (IPCC, 2014, 5th Assessment Report), it is possible to calculate a **carbon budget** (or CO_2 budget). This is the amount of CO_2 emissions[2] from anthropogenic sources that can still be released (with a 50 to 66% probability) to comply with a defined warming limit, taking into account the amount that already has been released since the beginning of industrialisation.

In a special report on the impacts of global warming of 1.5°C, the IPCC (2018) calculates that, to have a 50% probability of achieving the target, humanity may only emit an additional 580 to 770 Gigatonnes (Gt) of CO_2. This amount reduces to 420 to 570 Gt at a probability of 66%.

The choice of global temperature indicator also affects the estimated remaining carbon budget. Using global mean surface air temperature (GMSAT) gives an estimate of the remaining carbon budget of 580 Gt CO_2 for a 50% probability of limiting warming to 1.5°C, and 420 Gt CO_2 for a 66% probability. Alternatively, using global mean surface temperature (GMST), the budget is 770 Gt and 570 Gt of CO_2, for 50% and 66% probabilities, respectively. Uncertainties in the size of these estimated remaining carbon budgets are considerable.[3]

The following table shows the remaining global carbon budget.

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[2] With respect to the carbon budget IPCC only refers to CO_2 since CO_2 is both the most important greenhouse gas in terms of quantity and the fastest and easiest reducible greenhouse gas. We also use this approach since the models GINFORS and e3.at only contain CO_2 emissions, not all GHG emissions.

[3] IPCC (2018) points out that "irrespective of the measure of global temperature used, updated understanding and further advances in methods have led to an increase in the estimated remaining carbon budget of about 300 $GtCO^2$ compared to the AR5," that is the IPCC 5 Assessment Report from 2014.

Table 1. Remaining global carbon budget for reaching the 1.5°C target

	global CO_2 budget from 2017 onwards
	in Gt
GMSAT, 66% probability	420
GMSAT, 50% probability	580
GMST, 66% probability	570
GMST, 50% probability	770

Source: Own calculation, based on IPCC (2018)

Even for this 1.5°C increase, scientists expect considerable negative consequences, which increase sharply as the temperature rises (IPCC, 2018).

The remaining **global carbon budget** can be broken down for individual countries like Austria or regions like the EU. In meetPASS the budget is **distributed to an equal contingent per capita**, regardless the country he/she lives in, in order to divide the remaining emission budget evenly across the world's population[4].

Based on the figures presented in Table 1 we calculate the share of Austria's and EU27's remaining carbon budget based on the world population in 2017. Assuming a 50:50 chance of reaching the 1.5°C target, the EU has a remaining CO_2 budget of around 40 to 53 Gt, while Austria can emit 0.7 to 0.9 Gt, depending on which global mean temperature measure is used. At a 66% probability, this reduces to 29 to 39 Gt for EU27 and 0.5 to 0.7 Gt for Austria.

The following table shows the carbon budget from 2017 onwards (global, EU27 and Austria) at probabilities of 66 and 50%.

Table 2. Carbon budget available for achieving the 1.5°C target based on different measures for global mean temperature and different probabilities

	Population in 2017	CO_2 budget from 2017 onwards (GMSAT)		CO_2 budget from 2017 onwards (GMST)	
		50% probability	66% probability	50% probability	66% probability
	millions	Gt	Gt	Gt	Gt
World	7.458,78	580,00	420,00	770,00	570,00
EU	508,55	39,55	28,64	52,50	38,86
Austria	8,81	0,68	0,50	0,91	0,67

Source: Own calculation, based on IPCC (2018).

These global and national budgets form the basis of the meetPASS Scenario. In addition to the CO_2 target, meetPASS also applies targets for material consumption and use of cropland (as proxy for land use change).

So far, decarbonisation strategies have focused mainly on improving energy efficiency and on promoting electricity from renewable energy sources. However, in order to reduce the physical

[4] For other approaches to derive the national budget from the global budget see e.g. Meyer und Steininger (2017).

scale of the global economy, climate policy needs to be broadened to promote higher resource productivity, with the aim of **decreasing overall material consumption**.

Behrens (2016) points out that more than two-thirds of annual raw material inputs return to the atmosphere in the form of greenhouse gas (GHG) emissions. The rest represents solid waste and additions to stocks, e.g. in the form of buildings and infrastructure. These figures indicate a direct physical relationship between the quantity of raw materials used in industrial processes, the energy required and, hence, GHG emissions.

We set the limit for global material consumption at 45 billion tonnes TMC[5], in order not to overshoot the earth's safe operating space[6]. Formulating a per-capita target based on the absolute target of 45 billion tonnes TMC would lead to a maximum of 5 tonnes per capita of material use with an expected world population of 9.7 billion people in 2050.

Furthermore, **land-use changes** are crucial for climate policy. Native vegetation and soils store plentiful carbon and their losses due to agricultural expansion – together with emissions from agricultural production – account for 20 to 25% of greenhouse gas emissions (Searchinger et al., 2018; Edenhofer et al., 2014). Furthermore, agriculture is responsible for over 90% of global water stress and biodiversity loss (IRP, 2019).

We use the planetary boundary target to limit cropland expansion to 15% of the global ice-free land surface (Rockström's et al., 2009). With a world population of 9.7 billion people in 2050, this amounts to a cropland footprint of 0.15 ha per capita. In the industrialised regions like the EU, the current cropland footprint surpasses this level. Thus, meeting the target will require changes to agricultural practices as well as diet, such as reducing meat and dairy intake.

These proposed targets are based on the results of the IntRESS project[7] for the German Federal Environment Agency.

In addition to the climate, resources and cropland targets, meetPASS also considers a number of Sustainable Development Goals (SDGs) that may be impacted by climate action.

From a total of 17 SDGs and 169 targets, we considered those that are both **relevant for Austria,** and which may be feasibly **analysed with the E3 (economy-energy-environment) model e3.at**. In total, we identified 13 SDGs and 29 targets (see Working Paper 2), which are of special interest for the purposes of scenario development. It should be noted that the scenario analysis is mainly one-directional: it evaluates the impact of mitigation measures on the SDG targets, but not the effect of the targets on climate protection.

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[5] **Total material consumption (TMC)** measures the total amount of materials required for domestic consumption. It is a measure of all direct and indirect primary material extractions, both at home and abroad, which are associated with economic activity.

[6] The safe operating space ensures the functioning of the Earth system and its subsystems. Rockström et al. (2009) have defined nine planetary boundaries that effectively represent a "safe space" for human habitation, based on the idea that many subsystems of Earth react in a nonlinear way and are particularly sensitive around threshold levels of certain variables. When the variables pass those thresholds, rapid and unpredictable environmental changes might produce dangerous results, compromising the ability of the planet to support human societies in their present form.

[7] see www.intress.info

3 Scenario development

3.1 Approach

In order to address the meetPASS research question we have developed two narratives: the business as usual (BAU) Scenario and the meetPASS Scenario. We specified both scenarios globally (with GINFORS) as well as for Austria (with e3.at). While in the BAU Scenario an increasing ambition to foster decarbonisation fails to materialise, in the meetPASS Scenario we assume that all countries co-operate to purpose decarbonisation through international agreements and harmonised economic and regulatory policy instruments.

The development of both scenarios is based on the preparatory work of the EU project POLFREE[8], which saw the development of three policy scenarios. The most important dimensions and the structure of the POLFREE Scenarios are summarised in the following box.

Box 1: Overview of the POLFREE Scenarios

Business-as-Usual – An increasing focus or ambition to foster decarbonisation fails to materialise. This creates a case against which the outcomes of alternative scenarios may be compared.

Global Cooperation – All countries co-operate to pursue decarbonisation through international agreements and harmonised economic and regulatory policy instruments. Climate policy has four pillars:

- An upstream carbon tax for all industries,
- A regulation of the share of renewables in electricity production,
- A set of regulations and economic instruments favouring e-mobility and
- Subsidies for investment in the energy efficiency of buildings.

EU Goes Ahead – The EU pursues the development of a low-carbon, resource-efficient economy unilaterally, through strong EU-level economic and regulatory policy instruments instituted by Member States. The rest of the world fails to increase existing ambition. The main change to the climate policy mix in the EU compared with Global Cooperation concerns the design of a taxation instrument in a way that avoids problems with international competitiveness. The upstream carbon tax is substituted by an ETS system with a flexible supply for basic industries.

Civil Society Leads – Civil society, NGOs and businesses drive decarbonisation through voluntary changes in preferences and behaviour. Policies are introduced to facilitate such changes. The scenario assumes that intrinsic motivation of consumers, employees and firms induces structural change of the economy to such a degree that the ambitious environmental targets are achieved. Several activities change the structure and volume of consumption, reducing environmentally harmful commodities like consumer durables, high-carbon, material-intensive transport and meat consumption. In addition, employees seek to reduce hours worked in the formal economy, inducing an increased share of part-time employment.

Source: Meyer et al. 2016

[8] POLFREE was completed in 2016 and received funding from the EU's Seventh Programme for research, technological development and demonstration under grant agreement No 308371. It was executed by a renowned international consortium which, i.a., involved also SERI and GWS. As the three considered future scenarios (global cooperation, EU goes ahead, civil society leads) of the POLFREE project had already been finalized in 2014, they could not be aligned to the later COP21 outcomes. See http://polfree.seri.at/ for further details.

For the BAU Scenario, we updated the POLFREE BAU Scenario to capture recent developments (for the years 2013 to 2016), concerning the historic development (between 2013 and 2016) of endogenous variables (e.g. GDP, fossil fuel prices, exchange rates etc.) as well as updated trajectories for future development to 2050; namely, the UN World Population Prospects 2017 and the IEA World energy outlook 2017.

For the meetPASS mitigation scenario, we have combined the measures from the three POLFREE policy scenarios in a way that is capable of meeting the 1.5°C goal. In addition, we consulted stakeholders and experts and screened the literature to learn from other relevant projects, focusing on different policy options and actions (regulations, economic instruments and voluntary changes due to increased awareness as well as on measures addressing values, culture and preferences).

The POLFREE scenarios mainly focused on environmental and economic aspects. **To capture social aspects and also offer a more extensive evaluation of the Austrian market**, we extended our modelling framework using the Austrian model e3.at.

In the following we describe the elements of the BAU and the mitigation scenario, both in their global as well as Austrian forms. In addition to quantitative elements, the storylines also contain qualitative aspects that cannot be implemented in the models.

4 Business as Usual (BAU) Scenario

4.1 The global BAU Scenario

The global Business as Usual (BAU) Scenario shows the expected future development until 2050 under the assumption that governments announce no new policy targets but continue with current policies. This means that the BAU Scenario does not include the necessary emissions reduction policies that would be central to meeting the Paris Agreement.

Comparing the BAU Scenario with the meetPASS Scenario allows us to recognise effects of changes induced by the scenario design. An important caveat is that the BAU Scenario does not include possible costs of inaction (e.g. of adaptation to climate change). This has to be in mind when interpreting the results, as from a macroeconomic point of view, costs of inactions are expected to be higher than costs of action on climate change (IPCC, 2007; Stern, 2015). According to OECD (2017), quick and decisive action on decarbonisation can increase the economic performance of the G20 countries by an average of 2.5-2.8%, while a delay by 2025 would lead to a decline in economic output by an average of 2% by 2035.

In POLFREE the exogenous assumptions on **population dynamics** were based on the Medium Variant of UN World Population Prospects 2010. In meetPASS we derived these from two sources: the Eurostat baseline projection for EU countries, released in June 2017, and the UN World Population Prospects 2017 for the rest of the world (Medium Variant). These population dynamics, differentiated for three age groups (0-14 years, 15-64 years, 65+ years) for the period up to 2050, are the same for BAU and meetPASS Scenarios.

According to these exogenous sources, the world population is expected to grow to 9.7 billion people by 2050. The EU as a whole is only expected to growth slightly, though for Austria, Eurostat baseline projection is for growth of over 11% up by 2050. The following table summarises these findings and additional figures for selected countries.

Table 3. Population dynamics for selected countries and regions

		2017	2025	2030	2040	2050
EU27*	Millions	509	517	520	525	525
USA	Millions	326	345	356	376	391
China	Millions	1,388	1,420	1,426	1,409	1,358
India	Millions	1,296	1,405	1,464	1,554	1,608
World	Millions	7,459	8,093	8,460	9,123	9,687

* EU member states without Croatia

Source: own representation based on Eurostat (2017) and United Nations (2017)

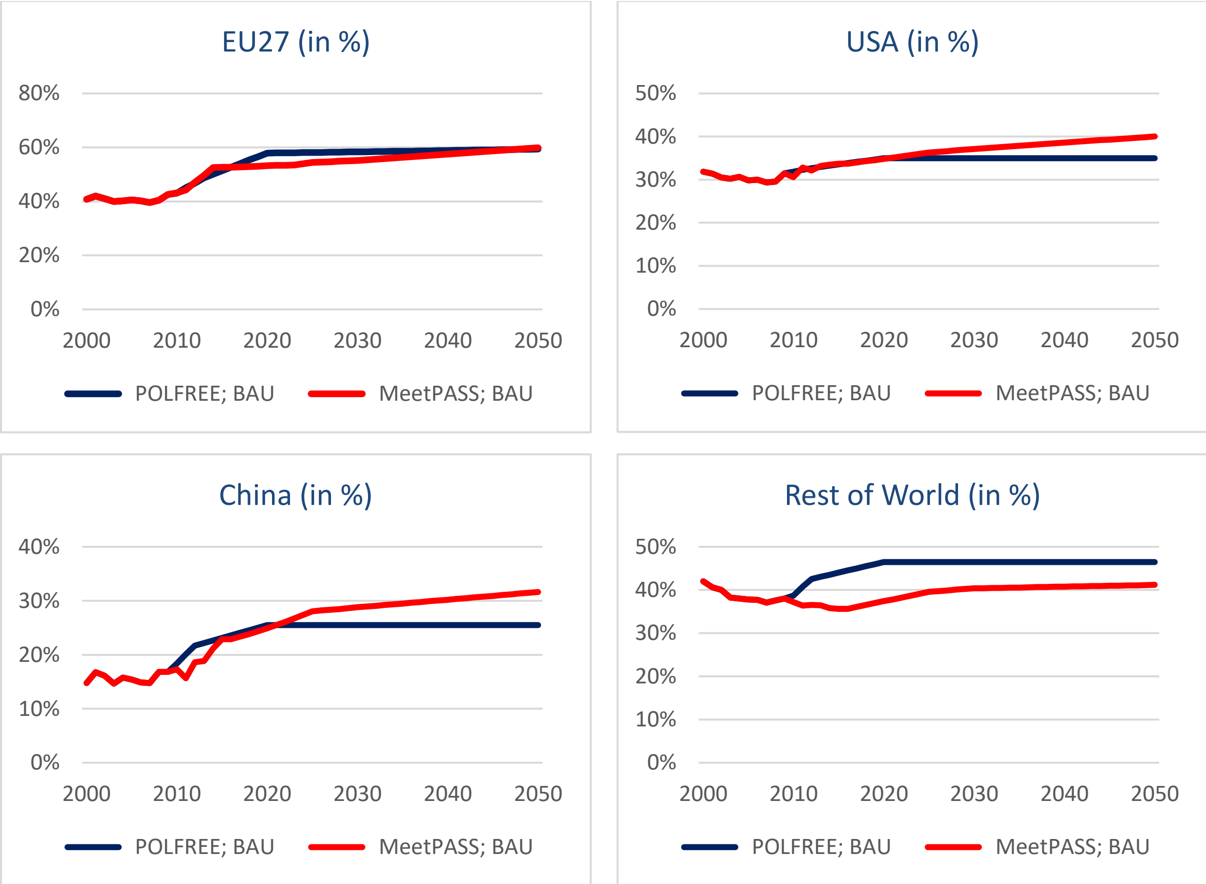
Another key aspect in parametrising the BAU Scenario is the question of dynamics in **technology shifts in electricity generation**. How fast will the different renewable technologies evolve and force out the carbon-based technologies? And what is the future role of nuclear technology in Europe and world-wide, knowing that the construction of new nuclear plants in many parts of the world is becoming more and more expensive in comparison to renewable energy (RE) plants?

The following figure shows results for the evolution of the shares of carbon-free (RE and nuclear) electricity generation in the BAU Scenario of meetPASS compared to the BAU Scenario in POLFREE. These results demonstrate that POLFREE assumed the share of RE would not change past 2020. By contrast, the BAU Scenario in meetPASS builds on latest assumptions by IEA (2017) under the “Current Policies Scenario” of the World Energy Outlook 2017. These assume a slightly stronger increase in RE, even in the absence of stronger policies, especially in the EU and China.

As regards policy interventions, the model implicitly assumes that non-market-based instruments (regulations or voluntary agreements) will continue to develop as they did in the past. For market-based instruments (taxes and subsidies) the general assumption of the meetPASS BAU scenario is that tax rates (on products, income, etc.) will not be adjusted in the forecast period.

The meetPASS BAU Scenario expects the EU carbon price to grow only very moderately (up to 40 USD2017 per ton in 2050). This assumption is more or less in line with the “Current Policies Scenario” of IEA 2017 which forecasts that the carbon price will reach 40 USD by 2040.

Figure 1. Share of carbon-free electricity generation in total electricity generation in the BAU Scenarios in POLFREE versus meetPASS



Source: own representation

4.2 The Austrian BAU Scenario

The BAU Scenario covers all relevant legislation and policies already implemented in Austria but does not include additional measures formulated in the "mission2030", the integrated Climate and Energy Strategy for Austria. A comparison of the BAU Scenario with the meetPASS Scenario thus shows the differences due to the introduction of climate policy measures within Austria.

The assumptions for this scenario were taken from relevant Austrian publications that refer to the Scenario "With extisting measures" (WEM) (see Meyer et al., 2018, Umweltbundesamt 2017, EEG. 2017 IVT/TU 2017).

Main exogenous data include population and household development and energy prices.

Population and household developments follow the assumptions of the main variant of Statistics Austria. The population is growing steadily until 2050, but with decreasing rates at the end (approximately 9.6 million inhabitants by 2050). The number of households is steadily rising to 4.5 million households by 2050. The number of one-person households is growing fastest (+24% compared to 2017).

The **energy price assumptions** are based on IEA World Energy Outlook 2017 (these were also used for the other countries within GINFORS). Accordingly, real crude oil prices are expected to rise continuously, from 41 USD in 2016 to 97 USD in 2025,136 in 2040 and 162 USD in 2050 (in 2016 prices). Owing to supply constraints and political pressures, crude oil prices are expected to rise more than coal and natural gas prices. Such prices influence the price to produce and ship goods, sand as such, consumer demand.

Assumptions for the Austria BAU scenario also include those that already form part of Austrian energy and climate policy. In this respect, developments in energy efficiency and energy substitution, such as in motor vehicles and heating systems, are expected to play a decisive role. The share of electric vehicles is expected to rise to 60% by 2050, while in the heating sector in particular, oil systems are expected to be phased out as households shift to solar and ambient heat. Electricity production will continue on its current path towards photovoltaics and wind power plants.

It should be noted that the Austrian BAU Scenario – as the global one – **does not account for the costs of inaction**. However, if no additional climate policy measures are introduced it can be expected that costs of adaptation to climate change will be unavoidable. Results of the project COIN (Steininger et al., 2015) show that weather-related and climate-related damage in Austria already accounts for an annual average of around 1 billion Euro. This figure only considers major natural disasters and heat-related premature deaths. The total damage already quantifiable up to the middle of the century may be within an average range of 3.8 to 8.8 billion Euro per year.

5 The storylines of the meetPASS Scenario

5.1 The global meetPASS Scenario

meetPASS combines measures from all three POLFREE policy scenarios (Global cooperation, EU goes ahead and Civil society leads) in order to meet the Paris Agreement. The elements of the scenario are based on Jäger et al. 2014 and described in the following. In general, we refer to the global level, but add the European perspective where relevant.

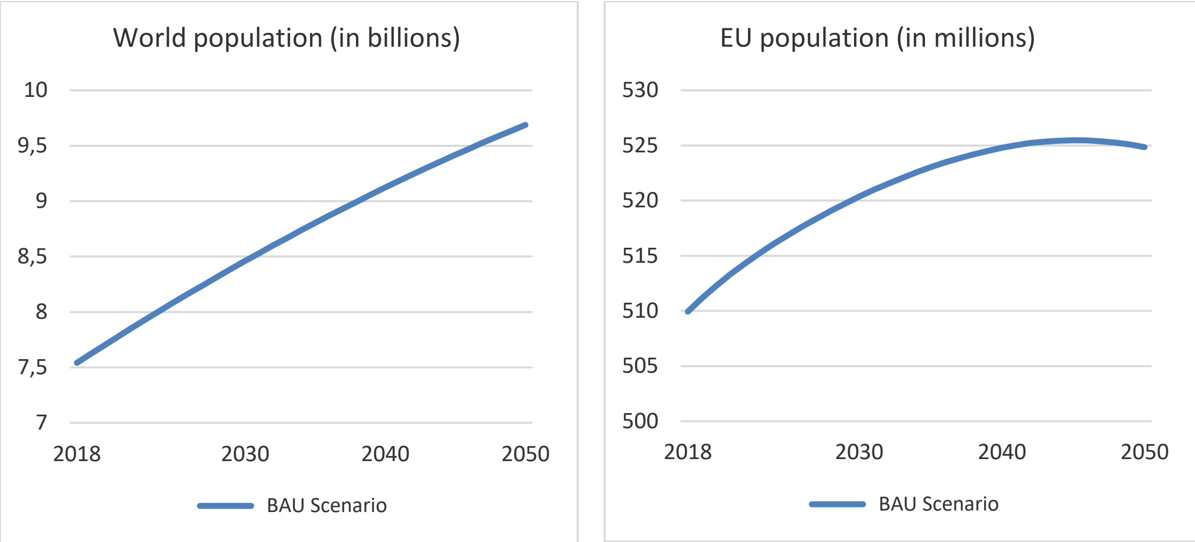
The following explanations quote not only elements of the meetPASS scenario that are directly visible in model variables but try to give an illustration of the broader narrative of a global, COP21-compatible transition pathway.

5.1.1 Population

Figure 2 illustrates the outlook for the global population as well as for the European Union (EU member states without Croatia). These match those of the BAU Scenario.

In 2050 the world population is expected to increase to 9.7 billion people, while in the current member states of the European Union the population should stabilise at around 525 million.

Figure 2. Population outlook (worldwide and EU27)



Source: own representation based on Eurostat (2017) and United Nations (2017)

The scenario also assumes that, by 2050, basic needs (e.g. food, shelter, access to basic education and healthcare, sanitation and water) are met the world over, as well as needs that go beyond the essentials for survival, such as security, identity, social interactions and freedom. Although even in 2050 there will still be a difference between the rich and poor nations, the gap will have been reduced. The risk of poverty will be lower than in the BAU scenario. The same holds for migration owing to poverty or because of extreme weather events.

In Europe in 2050 more than 50% of the population will be over 60 years of age. This will require new forms of health and care systems, pension systems, as well as adapted housing and mobility options.

5.1.2 Governance

Cooperation rather than competition guides the approaches to dealing with energy and resource efficiency. Long-term, iterative and structured participatory processes will lead to increased trust. Democratically legitimated global governance will be strong enough that planetary boundaries, including those for climate change and resources, are respected and there is a framework for regional, national and local participatory approaches towards sustainability. Transparency in governance at all levels would be assured. Long-term, systemic (holistic) goals and targets would guide short-term decision-making. Monitoring and reporting progress towards goals and targets would be carried out at all levels of governance and support adaptive governance, in which learning plays a central role. Minimum environmental performance standards would be set to remove the least resource-efficient and most polluting products from the market. The regional, national and local participatory processes would empower citizens and non-governmental organisations to take responsibility in the transition to a resource-efficient and low-carbon economy. At the national level, states play a pro-active role in designing and implementing strategies for resource efficiency, including, for example, green public procurement.

The deepening and broadening of facilitated processes of stakeholder engagement in governance at all levels would be based on a new “social contract” that recognises the joint responsibility of states, business, science, civil society and even individuals for tackling sustainability challenges. A new form of interaction between politics, society, the economy and science brings creativity, resources, capacity, legitimacy and political would act together to achieve common goals. The precautionary principle would be a fundamental aspect of governance as relates to resource management.

It also envisages that by 2020 the EU Emissions Trading System will be reformed and linked with other systems (an international ETS). Labelling on resource and energy consumption of products would be augmented, supporting the strong focus on raising awareness on sustainable energy and resource use. Market and policy incentives would contribute to business investments in efficiency, and requirements on Green Public Procurement would be strengthened for all products with significant environmental impacts. Educational reforms across the EU would integrate systemic approaches to problem-solving and basic education about all aspects of sustainability. Investments in coordinated Research, Development and Innovation for material and energy efficiency would also stimulate innovation.

5.1.3 Energy

By 2050, the European energy system would be low-carbon, resource-efficient, secure and competitive. Electricity generation would be based 100% on renewable energy. As fossil fuels are replaced by renewable energy, electricity will play an important role in satisfying final energy demand and in particular energy demand for passenger cars and light-duty vehicles.

In developing countries, new power grid infrastructure would enable increased access to electricity, while in developed countries such as Austria more investments in storage capacities would further increase the share of renewable energy.

At the same time, decarbonisation of the economy means that fossil fuel import dependency will have been reduced considerably.

Decentralisation of the power system and heat generation would be higher due to more renewable generation. Centralised large-scale systems and decentralised systems would work together and depend on each other. Access to modern energy technologies would be universal. This means that there would be energy interdependency of small groups, communities and cities as well as multiple benefits for society (energy security, decreased poverty, increased welfare and health) with a more resilient energy infrastructure.

Climate policy would include a substantial increase of the carbon price in the emission trading system, which will be extended to a world-wide system by 2020 in all industries. In addition, government would **regulate the share of renewables in electricity production**, so that 90% of electricity would be produced by renewable sources. This policy would be supported by feed-in tariffs and green certificates. Additionally (and this is new in meetPASS compared to POLFREE), we assume a stepwise phase-out of nuclear energy in the EU up to 2050 and worldwide up to 2060.

5.1.4 Transport and mobility

The transport system of 2050 would be low-carbon, resource-efficient, secure and competitive and uses clean technologies and transformed transport networks. Mobility and transportation would be accessible and affordable for everyone, but in different ways than in the past. There would still be cars, but they would increasingly run on a mix of electricity, hybrid engines and renewable fuels. Society would also come to see mobility from a new perspective: with strong recognition of the importance of being mobile for social inclusion and participation in the social and cultural daily life of poorer, elderly and handicapped individuals. Accordingly, authorities would design new infrastructure measures to, on the one hand, meet the demands of all people; and on the other hand, respect the long-term effects on the environment.

Public transport would support the daily leisure as well as household-related (e.g. shopping) transportation demand in urban areas and cities (which would satisfy not only passenger demands, but also cover the whole urban area through e-mobility buses, tramways and ultralight transport systems), with gaps filled by various sharing services (car & bike sharing schedules and car & van-pooling).

The modal share of biking and walking would be high, greatly improving the health and overall quality of life of all inhabitants. People would become aware of the “real costs” of unsustainable transportation for humans and the environment. Accordingly, aviation transport would decline considerably. Goods and freight transport in cities is now carried out by cargo bikes for small to medium sized goods and by zero-emission lorries and trucks. Railways and ships would be responsible for most international goods and freight transportation.

A set of regulations and economic instruments favouring e-mobility would support sustainable mobility. Governments would introduce binding emission standards for new cars and taxation of fossil fuel burning engines, and subsidies for the use of hybrid and electric cars, offsetting any costs to industries and households. Cities would introduce better parking conditions for the use of electric cars, exemptions from city taxes, etc.

Although we assume a strong increase in e-mobility to reduce CO_2 emissions it has to be mentioned that e-mobility has a high ecological rucksack. Friedrich Schmidt-Bleek (2014) explains that for a small car, nature "pays" today on average - calculated from the cradle to the grave - about 45 kilograms of material per 100 km travel distance, for a mid-range car about 85 kg, and for a comparable electric vehicle about 120 kg per 100 km. These figures also include the infrastructures required for operation. According to this, nature will be burdened with a "special levy" of about 40 kg for saving around 10 kilograms of CO_2 via e-mobility. Researchers have also calculated that today's e-car must be driven over 100,000 km before its total CO_2 emissions undercuts that of the gasoline engine. Because still the current power mix - also for the vehicle production - is very "CO2-intensive" (power generation of oil and coal), which improves however by the increase of wind power and other dematerialized production methods for electricity in favor of the e-vehicle.

Thus, it is also important to dematerialise mobility via car-sharing, reducing transport distances and expand public transport, etc.

All subsidies on air and water transport would be reduced linearly, reaching a 100% reduction in 2030 while taxes on air transport services would increase linearly by 50% within the period up to 2050.

It is up to industry and market competition to create and develop the best solutions.

5.1.5 Resources (material consumption)

Within the same 2050 timeline, the European consumption of global resources would be brought within the planet’s safe operating space, and there would be a fair distribution of resource use across the population. This safe space would be reached by higher resource efficiency on the one hand and less consumption-driven lifestyles on the other. Extraction and production practices on the ground would be more sustainable — for example, with better maintenance of soil fertility in agriculture, preferred exploration of ´low-burden´ mines and better remediation after mining, and widespread implementation of reduced-impact logging in forestry. To this end, certification and transparency would be vital policy instruments.

Overall, **resource efficiency** would be improved across the lifecycle of resource use with a multitude of benefits for nature and for people. In particular, it would contribute to reducing pressure on natural systems related to both the scale of resource demand and the externalities of production and consumption. Furthermore, it would enable greater access to resources for all people to strengthen resource justice across the world.

The EU would continue to be largely dependent on imports of metals, but the scale of imports will have been reduced as a result of closed-loop design and the development of **circular-economy** networks for redefining supply chains. As a net-importer of abiotic resources, the EU would engage in knowledge-sharing and capacity building abroad, in particular to support the integration of mining into development policies in a holistic way at local and regional levels.

Mining is characterised by high levels of transparency and accountability, dedication to worker safety, and reduced environmental impacts. Increased urban mining would offer new and resource-efficient ways to recycle the materials stocked in buildings and infrastructures. These "mines of the future" would comprise metals such as steel and copper, wood, plastics, and in particular concrete. Recycling of concrete (including upcycling) would also contribute to lowering Europe’s demand for minerals like sand.

Materials would be managed so that they do not become waste. Thus, **waste generation and incineration** would be reduced to an absolute minimum. Effective systems of material stewardship and global extended producer responsibility would support the production and use of resource-light products. Product-service-systems would be commonplace. Information and Communication Technology devices and infrastructures would create massive increases in resource-efficiency of consumption patterns – removing reliance on critical raw materials. These technologies would be designed to be **durable, repairable and recyclable**. Illegal shipments of waste will have been eradicated. Energy recovery would be limited to non-recyclable materials, with no landfilling of organic materials and minimal deposition of minerals, while improvements in recycling would enable production of high-quality secondary materials. The eco-efficiency of materials would on average improve by a factor of 10. Advanced materials would enable resource hyper-efficiency in key sectors, such as transport and energy.

Concrete policy measures in this area include **regulation for recycling of ores and non-metallic minerals**, an **upstream tax on ores and non-metallic minerals** and a **public innovation fund for improving material efficiency**.

5.1.6 Agriculture and Food

The global expansion of cropland, pastures, and fast-growing tree plantations into grasslands, savannahs and forests would cease by 2020. This means that "**land take**" in the EU would stop – especially due to improved city planning – and deforestation, in particular in the tropics, would reverse, also as a consequence of reduced demand for agricultural products so that they can be produced within the global safe operating space. The EU would meet both its target initiatives for no net loss of biodiversity and for reducing its level of global cropland use to sustainable levels.

Land production systems would be diverse and, as a whole, able to cope with climate change. Best management practices would integrate scientific and local knowledge on both small and large-scale farms. Widespread application of the principles of agro-ecology would enhance soil fertility, nutrient cycling and water cycling in both conventional and organic farming systems, leading to a reduction in the use of fertilisers, pesticides and water. Major investments in soil restoration worldwide would enable cropland to expand somewhat, into previously abandoned farmland, and food losses from the field to the fork would reduce dramatically.

Livestock production would also be more climate-friendly by 2050, mostly due to a **reduction in the demand for meat**, enabling a combination of grassland-based production systems and sustainable intensification (especially in the tropics). EU policies would take into account their direct and indirect impact on land and water use in the EU and globally. In the EU, demand for food would be oriented toward regional, organic, vegetarian and seasonal foods.

New governance structures would encourage the use of locally-produced foods (especially) in schools, hospitals and canteens, as well as at catered events. Diets would shift toward levels consistent with dietary recommendations, easing pressure on land, lowering the costs of health care systems, and improving human health.

Together with greater awareness and knowledge-sharing, households and retail outlets would eliminate most **food waste**. The EU would also follow the principle of "food first" for using global cropland. While biomass would contribute to energy supply, it would come mainly from residues (after accounting for soil fertility needs) and organic waste. The import of energy crops or derived biofuels would drop to close to zero.

In addition, consumer would shift their preferences in favour of more **durable and long-lasting products** (housing, furniture, etc.). All people in Europe and across the world would have access to clean water and sanitation.

5.1.7 Housing

New ways of living together would also support the decarbonisation process. The proportion of co-housing would grow, while cultures with more conventional housing patterns would also adopt some of its principles. Sharing household chores and responsibilities, jointly organising cooking and other household activities, coming together for meals, keeping an eye on each other's children and on the elderly or infirm would become common practices. Changes in the building and housing sector would also alter mobility patterns, especially in the increasingly urbanised areas: small-scale settlement structures and living close to work and amenities would reduce travel demand with remaining needs met by sustainable alternatives, such as car sharing systems.

Green buildings would also become the norm for all public buildings. The construction industry would contribute to the resource efficient economy through renovation and refurbishment, increasingly sourcing recycled materials from urban mining, and employing ever-increasing resource-light innovations in (re)construction. This would create a steady-stocks society, as the net addition to stocks would approach zero, and the industrial metabolism would no longer be characterised by the linear flow of resource extraction to disposal, but rather on greater resource cycling within the economy.

In addition, **modular construction** would enable easier repair, reconstruction and rearrangement of interior and exterior components, also allowing for the integration of new technologies, especially building-integrated photovoltaics (BIPV). Through a systemic planning approach, construction companies would erect new buildings by combining the high-tech aspects of sustainability – smart grids and efficient heating and cooling – with the natural advantages of earthen walls, rooftop gardens and indoor vegetation. The choice of construction materials; sharing of equipment and spaces – allowing buildings to perform different services during the day and at night – would also help lower the overall resource use.

Subsidies for investment in the **energy efficiency of buildings** would ensure higher renovation rates. All new buildings would be close to or of zero-energy standard and many would produce energy (energy-plus houses). 100% of non-hazardous construction and demolition waste would be recycled.

5.1.8 Lifestyle and economy

Civil society, NGOs and businesses would also contribute to decarbonisation through **voluntary changes** in preferences and behaviour. A comprehensive policy programme would facilitate such changes using the aforementioned economic instruments, information instruments and regulations.

The **intrinsic motivation** of households would lead to a structural change of the economy to such a degree that the ambitious climate and environmental targets could be met. Several activities would change the structure and volume of consumption, reducing environmentally harmful commodities like consumer durables; high-carbon, material-intensive transport; and meat consumption.

As a result, consumers would reduce the share of private consumption that they spend on air transport by up to 25% by 2050 (depending on the current level of air travel). Also, individuals would choose new modes of living, especially in industrialising economies: for example, multi-generation houses. This would result in a reduction in the demand for living space by up to 50%; as a consequence, energy, heating and new buildings demand would also fall.

Furthermore, employees would seek to work fewer hours in the formal economy, inducing an increased share of part-time employment. This **working time reduction** would allow more free time for caring for the elderly or working for the community and also contribute to lowering resource use. The manufacturing industry would respect the limits of non-renewable resources. End products would be more efficient, longer lasting and use less material. Closed-loop production patterns would dominate all economic sectors, reducing the need for primary resource extraction and making the concept of waste obsolete. Industrial symbiosis would also be normal business practice and all European companies would adopt a circular approach to resources.

Europeans in 2050 would also have lifestyles that are less resource-intensive and more fulfilling. There would be diverse options for people to meet their needs, contribute in a meaningful way to their communities and spend their leisure time in a resource-efficient way.

Governance would play a key role in creating the conditions, infrastructure and networks which make more sustainable lifestyle choices possible. With greater coherence between local and regional governments and national and EU policies, cities and communities across Europe would meet the sustainability challenges in different ways. The EU would remain culturally diverse – with local architecture, food culture, and traditions a defining aspect of European identity – and have a common foundation for achieving a resource efficient and sustainable society.

5.2 The Austrian meetPASS Scenario

The global meetPASS Scenario is broken down for Austria and expanded by Austria-specific developments and measures in order to meet the goals of the Paris Agreement.

As per the global meetPASS Scenario, the Austrian meetPASS Scenario combines measures from all three POLFREE scenarios. As Austria is also explicitly modelled within GINFORS, the carbon budget for Austria develops from GINFORS' per capita distribution and amounts to 0.9Gt (910 million tonnes) of CO_2 to reach the 1.5°C target with a probability of 50% and falls to 0.5 Gt (500 million tonnes) with a 66% chance.

GINFORS modelling results indicate that the carbon budget derived for Austria would be depleted far before 2050 if only the measures of the global meetPASS Scenarios are introduced, indicating that Austria emits on cost of other countries producing low CO_2 emissions. The modelling results of GINFORS (see Working Paper 4) show that additional measures are required to fulfil Austria's responsibility for reaching the 1.5°C target. Thus, we have to adapt and supplement the global meetPASS storyline and the derived measures. Important sources in this respect are the WAM, the WAM+ and the Transition Scenario (see Meyer et. Al, 2018, Umweltbundesamt 2017) and the mission 2030, the integrated Austrian climate and energy strategy (BMNT and BMVIT, 2018).

It captures the following targets for 2030:

- Austria's objective to increase the ratio of renewable energy to gross final energy consumption to 45-50% by 2030
- 100% of total electricity consumption from national renewable energy sources by 2030.
- Reduction of greenhouse gas emissions by 36% in 2030 compared to 2005

The following section describes the most important elements of the Austrian meetPASS Scenario, which contains bottom-up as well as top-down changes.

As in the case of the global scenario the following explanations describe a broader narrative of an Austrian transition pathway, that goes beyond the quantifiable elements of the meetPASS scenario.

5.2.1 Population

As in the BAU Scenario, the population is expected to grow by more than 11% to 2050, based on the Statistik Austria baseline projection (see chapter 4.2).

By then, all population groups of both sexes would have the widest possible access to sources of information and have the opportunity to participate in political decision-making processes. Due to increased education and awareness raising, the population is increasingly environmentally friendly and focuses on quality over quantity.

5.2.2 Governance

In 2050, the commitment to global and European cooperation would be strong, but Austria would recognise the high responsibility of national states as main drivers for eco-social change, recovering its former leading position in sustainability policy. Climate and resource policy would form a main pillar of Austrian governance. The country would be characterised by social, economic and environmental reform, and by its ambitious and strong levels of citizen engagement. First class education and improved work-life balance would allow for a strong and critical civil society, which would lead to a reinvented, participatory democracy and high engagement in all areas of policy. The federal and national administrations would cooperate strongly to favour regional development on the one hand, on the other lay the foundation for unified, strong environmental laws and joint approaches in the fields of transportation, land use planning, water and waste management as well as natural resources.

Such developments would see the removal of environmentally harmful subsidies especially in the transportation and energy sector, taxes on CO_2-intensive products and services, as well as direct taxes on resources. Additional tax revenues are used for investment in a low-carbon society.

Sustainable public finances would also create the room for investments and actions needed to achieve climate and energy targets. However, businesses and private households would provide most financing of climate- and energy-related measures.

5.2.3 Energy

By 2050, Austria’s energy would have shifted to almost only renewables: solar and wind would strongly increase, while hydropower and biomass would stay at similar levels as today. The energy supply would also be decentralised: end users would generate electricity to meet their own demand and feed any excess electricity into the grid, while energy companies refocus their business on developing and operating the necessary infrastructure, mirroring the broader European trend.

As such, energy suppliers (utilities) would become energy service providers. A functioning European market would help ensure energy stability, with all the corresponding infrastructure required. Demand-side management would also contribute to stability. Primary energy imports would fall in tandem with a general reduction of energy consumption and an increased production of renewable energy.

Nonetheless, **carbon-free electricity generation** would be vital to offset the increase in electricity consumption, with electricity from renewable sources in Austria being used in the mobility, building and production sectors to replace imported fossil fuels.

In their integrated climate and energy strategy (“mission2030”), the Austrian Federal Government has set a target to meet 100% of total national electricity consumption with national renewable energy sources by 2030 (BMNT and BMVIT 2018). This would be met via development of the necessary storage facilities, transmission and distribution networks; as well as investments in energy efficiency. Wind power and photovoltaics would be the driving force, with biomass-fired electricity production making only a limited contribution. The main potential of biomass lies in decentralised systems with combined heat and power plants and in the heating sector.

In order to mitigate the dependency of the **heat** market on imported fossil fuels, there would be an increase in the use of solar heat and ambient heat. This would succeed in replacing a large part of the use of natural gas. Energy efficiency measures, such as increased renovation rates, would strongly increase energy efficiency. As an example, the switch from oil-fired heating to renewable energy sources has already taken place. In new buildings the switch would be completed in all regions in the early 2020 (e.g. via new building regulations). In existing buildings, phase-out of boilers over 25 years old would begin in 2025.

The increased feed-in of biogas and synthetic methane from power-to-gas plants to the natural gas network would also enable a cost-effective coupling of electricity, heat and mobility with renewable energy. Sludge and agricultural waste would provide the raw materials for the production of biogas.

The quantity of sustainably produced biofuels would develop constantly until 2050, in tandem with a highly efficient district heating system. District heating would play an important role in urban areas in particular, further accelerated by energy regulation. This scenario also assumes that by 2050, industry will have solved the central challenges of the district heating sector, such as integration of renewable energy, the temperature level, the flexibility and the coupling with the electricity sector.

Together renewable energy sources and combined heat and power, waste heat from factories would provide another source of district heating. Spatial energy planning would incentivise the use of waste heat. An efficient spatial energy plan[9] would allow for innovative energy concepts to be implemented that focus on affordable, locally available renewable energy, the use of waste heat and integrated mobility systems.

In 2050, **affordable prices** would guarantee all population groups access to adequate and sustainable energy services. The risk of energy poverty would be minimised.

Price incentives, such as carbon taxes, feed in tariffs and green certificates would form the backbone of energy policy. A stricter implementation of EU emissions trading would lead to an increase in CO_2 prices (from around 20 Euro by 2018 to over 200 Euro in 2050), with the introduction of a CO2 tax in non-ETS sectors from 2025 onwards (in the same amount as the

[9] „Energy spatial planning deals with the spatial dimension of energy consumption and energy supply. Equivalent to the energy efficiency of buildings there are also energy efficient spatial and settlement structures, which can be characterized by a mix of functions, sensible density, short paths and compactness. Spatial dimensions of energy supply lie in identifying and developing sites for energy production systems, power distribution installations and energy storage systems. In addition, areas for the production of renewable resources need to be secured. This should be planned in such a way that conflicts of land use are anticipated and minimized“ (see https://boku.ac.at/en/rali/irub/fachliche-schwerpunkte/raumplanung/energieraumplanung).

carbon price). This substantial increase and the elimination of environmentally harmful subsidies would initially raise consumer prices. However, this effect would diminish over time as less fossil fuel is used.

Lawmakers would adapt the “Green-Electricity-Law“ (Ökostromgesetz) to a secure and stable environment, enabling long-term planning for industry. A modified Energy Efficiency Act would help to achieve higher energy efficiency more efficiently and without unnecessary bureaucracy.

5.2.4 Mobility and transport

Through a balance of external economic incentives and intrinsic motivation, Austrian citizens would fundamentally change their transport behaviour. Among other factors, such as awareness raising and education, this would lead to a drastic shift in transportation: greater take-up of public transport, and reduced travel by car and plane. Through high quality education, citizens would be sufficiently well-informed to develop and use their own climate friendly alternatives: car-sharing and e-mobility would take off, as would a trend towards “slow traveling” via train, bike or on foot.

Public transport would become cheaper and more frequent, making it more attractive. Urban planners would improve infrastructure to encourage pedestrian and bicycle traffic. An improved, easily accessible public transportation system would also replace much individual transport, further supported by a move towards car-free inner cities. Private transport, buses, small trucks and heavy commercial vehicles would be electrified or deploy other efficient technologies. Electric cars would run on electricity from renewable sources, while a reform of housing law would enable charging infrastructure to be installed in apartment blocks.

Since Europe (and Austria) would have developed, extended and modernised the railway network, long distance traveling would no longer rely on aviation. Global, market-based measures and the efficient use of modern communication technologies would lead to a significant reduction of business travel, furthering support a reduction in air traffic.

The expansion of the railway network would also result in a shift of freight transport from road to rail. Changing consumption patterns, favouring products with longer life spans and more regional products, would also reduce the overall volume of freight traffic.

Off-road vehicles, such as those used in farming and construction, would be electrified where technically possible. Any off-road and freight segments that cannot be electrified would switch to alternative energy sources (hydrogen and biofuels).

Nationwide speed limits (30 km/h in urban centres, 80 km/h on national roads and 100 km/h on highways) would increase traffic security and further reduce transport emissions.

Land use regulations would shift towards limiting land utilisation, preventing soil sealing and permitting only compact urban and commercial settlements. **Spatial planning** concepts would include climate and energy targets, promoting a proper mix of functions (like housing, work, leisure, etc.).

The diesel price adjustment to gasoline would be completed by 2020; in addition, both the taxation of diesel and gasoline will be augmented by 10 cents (nominal) in 2023 and further 10 cents (nominal) in 2027. These price increase will be accompanied by a regulatory cap of GHG emissions in fleets.

5.2.5 Resources

The transition to a **circular economy** would play a central role as a means to conserve and preserve energy, materials, land and water – and to prevent pollution. Industries would implement circular economy practices, such as promotion of a sharing economy, greater emphasis on repair and remanufacturing and higher rates of recycling and more efficient (zero-waste) production methods.

By 2050, **sustainable resource management programmes** would provide a harmonised approach for pursing decoupling of wealth and resource consumption (taking into account the resource nexus, i.e. the linkage between different natural resources, materials, energy, water and land) and integrate the aims of security of supply (food, raw materials, etc.) with conservation. These programmes would also provide incentives for actors in the production and consumption sectors to use their purchases so efficiently that the overall consumption level stays within the safe operating space of the planet.

In addition to the policy measures of the global scenario (regulation for recycling of ores and non-metallic minerals, an upstream tax on ores and non-metallic minerals and a public innovation fund for promoting material efficiency), a **construction resource tax** (i.e. a tax on non-metallic minerals) would expand energy-based taxation and form an important step towards a more comprehensive environmental tax reform in Austria.

5.2.6 Housing

In the area of living and housing, uniformed and binding construction standards must be applied to all of Austria. To create real change, this would require **new regulatory standards**, especially for construction of new buildings and renovation, favouring low-energy and heat/cooling efficient buildings, accompanied by a shift towards natural temperature-regulating measures, such as green or white roofs in cities and new designs and innovations to efficiently stabilise temperatures. New laws would also favour the use of mono-materials and natural materials that can be more easily recycled. Buildings refurbishment, the use of natural materials (like straw and clay) and recycled materials, as well as a return to more traditional construction practices – combined with new practices and materials – would create significant energy and emission savings.

Such measures would boost the **renovation rate** from less than 1% in 2018 to an average of 2% between 2020 and 2050. High-quality renovations with corresponding obligations would lead to a very high thermal-energy quality of buildings.

Integrated, Austria-wide land use and spatial planning would help contain urban sprawl, supporting conservation of natural resources and simplifying the provision of energy and sanitation, as well as sharing of consumer goods and cars. Communal living would enable residential units within cities to achieve a “village” culture. Decentralization, strong housing units, peer learning and self-supply in terms of energy and food would be key drivers in the housing and living sector. The public sector would also act as a role model for the conversion from fossil fuels to renewable energy sources in public buildings.

A **heat strategy** would focus on reducing the thermal energy demand of buildings and replacing fossil fuels with renewable energy sources and high-efficiency district heating.

Storage of energy (heat and power) would also be boosted through building regulations and funding schemes. In future, buildings would contribute to the supply and storage of energy for their own use. All available building surfaces would be used optimally for integrated photovoltaics. An increase in private generation of photovoltaics would help to relieve the pressure on the distribution and transmission network.

Further changes in spatial planning and settlement structures (in order to increase the potential for district heating) as well as ban of new oil boilers and mandatory replacement of existing oil boilers are already mentioned in chapter 5.2.3.

5.2.7 Food and Agriculture

A strong civil society, educational reform, and high-quality transparent information and protection of consumers would rise the share of local, seasonal and organic food. Food and agricultural goods would be supplied over shorter distances. Community supported farming, and a return to small scale agriculture would allow for fair employment and direct trade with producers. A focus on organic, mixed and crop rotation farming with agroforestry and permaculture influences would increase efficiency and a sustainable intensification of land-use. There would be less competition for land, which would further decrease competition between protein feed for animals and food production. Moreover, improved nutrient cycling would limit nitrogen and phosphate losses, resulting in improved soil, ground water and stream water quality. Through the favouring and the demand for diversity of varieties and the favouring of hedgerows and cultural practices like orchards, biodiversity on fields and farmlands would improve drastically. Consumers and tourists value traditional, idyllic Austrian farming, further supporting regions and small scale farming, and improving regional development.

By 2050 consumers would know where the food on their plate is coming from and learn about food production and the connection to water and forest cycles in school. To be a farmer would no longer be frowned upon but encouraged. Because of the high degree of education in this field, food would be valued differently. This would also reduce food waste along the food chain and especially by end users.

5.2.8 Lifestyle and Economy

Lifestyles would undergo drastic changes to 2050. A strong civil society together with market prices through CO_2 taxation and the ETS would drive the shift towards low energy products and goods.

Labelling on the resource and energy content of products and payment systems for ecosystem services would go hand in hand with a strong focus on awareness-raising.

Trading, swapping and sharing of goods in communities, households and in neighbourhoods would contribute to the circular economy concept, which favours flow of goods and services, but would no longer depend on the exploitation of natural, financial and human capital. The use of long-lasting, high-quality products alongside a change in values (using instead of owning, sharing economy, etc.) would cause changes in production processes, leading to a highly efficient use of energy and resources.

Trade volumes would reduce in favour of a more regional, eco-social economy, where all forms of growth have limits. Civil society would not fall for the idea of a “green growth economy” but demand an economy based on efficiency and sufficiency. Gross domestic product (GDP) would be supplemented by additional measures of well-being. Economic growth would be based increasingly on intangible goods.

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