via their national budgets and ‘conditional targets’ where additional sources of financing will be needed for example through private sector investment and/or international support.

Against this background, the process of developing a national resource efficiency agenda should therefore consider from the beginnings prerequisites necessary for later NDC integration. This requires, amongst others, conducting detailed appraisals of priority actions for key sectors and developing a resource use related greenhouse gas inventory, together with a specific system for measurement, reporting and verification (MRV). Defining GHG abatement effects together with a specific system for measurement, reporting and verification (MRV). Defining GHG abatement effects of resource efficiency measures along the value chain is a relatively new discipline requiring still more investigation. International exchange of experience gained in this field can therefore help to shorten the learning curve.

Sources
1) Statistisches Bundesamt 2017. G20 in Figures. available at: https://www.destatis.de/G20/figuren
3) UNFCCC. 2016. Paris Agreement - Status of Ratification. available at: https://unfccc.int

Project
Initiative Resource Efficiency and Climate Action

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of the Federal Republic of Germany

Improving resource efficiency is a key contribution to climate protection. The efficient and sustainable use of natural resources bears many potentials for climate protection. These opportunities could be used more effectively. According to the International Resource Panel, resource efficiency is indispensable to meet the targets of the Paris Agreement cost effectively.

Population and economic growth driving resource use and global climate change

Since the beginnings of industrialization, anthropogenic greenhouse gas emissions have led to a 40% higher CO₂ concentration in the atmosphere. As a result, the global mean temperature is today 1.2°C higher than in pre-industrial times.

In 2015, the G20 countries had a share of 80% of global economic output, accounting for more than 86% of global greenhouse gas (GHG) emissions. In spite of the progress made to reduce energy and carbon intensity of their economies, this has not been sufficient to compensate for economic and population growth.

Considering direct and indirect emissions, the industrial sector is worldwide the largest emitter, accounting for more than thirty percent of global GHG emissions. About a third of these emissions can be attributed to the extraction and processing of metals and minerals. If current trends concerning population growth, urbanization, carbon intensive production and consumption persist until 2050, demand for metal ores will increase by 90% and for non-metallic minerals even by 169%, going hand in hand with a plus of 41% in GHG emissions. This would lead to a 3°C increase in global mean temperature by the end of the century.

Figure 1: Total anthropogenic GHG emissions (Gt CO₂eq per year) by economic sector: energy, industry, transport, buildings, and agriculture, forestry and other land use (AFOLU). Source: IPCC (2014)
These interactions illustrate the close nexus between resource use and GHG emissions. They underpin at the same time the huge potential of more efficient and effective use of natural resources that can have not only for mitigating negative climate impacts but also for increasing competitiveness of industry and employment opportunities.

**Box 1**

Paris Agreement

| Mitigation goals | To keep a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. |
| Signature | 176 out of 197 Parties to the Convention have ratified so far (May 2018) the Paris Agreement and confirmed to the UNFCCC their Nationally Determined Contributions (NDCs). |
| Main mitigation actions | Nearly all countries address in their NDCs mitigation actions in energy sector, followed by energy supply, transport and waste. |
| Emission gap | If all NDCs were implemented, only 45% of the necessary emission reductions would be reached in 2030 for a two degrees pathway. Global warming would therefore still increase between 2.9°C and 3.4°C by the end of this century, relative to pre-industrial levels. |
| Update of NDCs | Countries need to identify further options for closing the gap, raising the level of ambition of the updated NDCs to be submitted to the UNFCCC by 2020. Resource efficiency provides an opportunity to raise the ambition of NDCs. |

**Box 2**

**Carbon intensity of metals and secondary raw materials**

Turning metals into products requires large amounts of energy in the upstream value chain to extract, refine, process and transport the initially mined ores and concentrates. In 2012, iron and steel alone accounted for 6.2% of global GHG emissions. The carbon-footprint of primary and secondary raw materials differ considerably, illustrating the relevance of the use of secondary raw materials in industry and infrastructure for climate action.

**Example 1: Closing the loop for aluminium chips**

Companies producing aluminium profiles generally have to deal with metal waste. In one case, a company was generating about 50 tons of aluminium chips per year. Due to the mixture with cooling lubricants, these aluminium chips could not be easily smelted and thus not be used as secondary raw material. As costs for collection and removal of the waste material exceeded its value, the company purchased a briquetting press to turn the aluminium chips into briquettes. This not only reduced significantly the bulk volume but also allowed pressing out the cooling lubricants almost completely. Such briquettes are suitable for smelting, allowing the company to close the loop, saving in logistics and material purchasing. The investment paid for itself after about two years, reducing substantially the GHG footprint of the company: The sourcing and processing of 50 tons of aluminium from primary sources corresponds to about 640 tons of CO₂ equivalents, using recycled aluminium for the quantity has a carbon-footprint of about 90 tons.

**Example 2: Metallic additive manufacturing of lightweight components**

Taking a small series of 12 wheel carriers suitable for lightweight vehicles as example, Fraunhofer Institute for High-Speed Dynamics at the Ernst Mach Institute (EMI) in Germany analysed the relevance of 3D printing of metal components for resource efficiency and climate protection. The design of a wheel carrier offering maximum performance for the defined load scenarios turned out to be a challenge for conventional production processes such as turning or milling. Therefore, additive manufacturing was chosen as alternative. Thanks to the lightweight design, 28% less material was used per component. The additive production of the lightweight model required 10 kilowatt hours per piece, compared to 12 kilowatt hours required for the traditional design. CO₂ emissions were 19% lower. In addition, the lightweight construction also reduced production time by 14%.

**Recommendations**

While renewable energies and energy efficiency are widely recognized as relevant for mitigating climate change, the potentials of resource efficiency appear to be still under-estimated. Yet, resource efficiency becomes more and more relevant as a key contribution to climate protection. Against this background, initiating national processes – ideally multi-stakeholder – for raising awareness of these potentials and existing gaps and to link resource efficiency and climate policy, as well as sharing good practice from national and international level is an important step. It can help to identify priority fields of action, paving the way towards a roadmap on resource efficiency with common goals, indicators, activities for implementation and strategies for communication.

Following the Paris Agreement Ambition Mechanism, by 2020 countries will have to take stock of progress and - informed by this stocktake - submit a climate action plan that is progressively more ambitious than the last. Given the existing emission gap, countries could use this process for linking their Nationally Determined Contributions with their resource efficiency agenda. The NDCs differentiate between ‘unconditional targets’ countries can meet...