



Technology Executive Committee

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Draft TEC Brief on industrial energy efficiency and material substitution in carbon-intensive sectors

Cover note

I. Background

1. In response to decision 1/CP.21 paragraph 109(c) and as per activity 6 of its workplan for 2016–2018, the TEC is to take forward the outcomes of the technical examination process, taking into account the policy options, and identify gaps and replicable best practices or enabling policy conditions. At TEC 13, the TEC agreed to continue its work in the areas of identified gaps, namely industrial energy efficiency and material substitution in carbon-intensive sectors.

2. As part of TEC 14, the TEC held a thematic dialogue on industrial energy efficiency and material substitution in carbon-intensive sectors.¹ The TEC considered key findings from the thematic dialogue and requested its task force on mitigation to produce a TEC Brief on the basis of those finding.

II. Scope of the note

3. The annex to this note contains the draft TEC Brief on industrial energy efficiency and material substitution in carbon-intensive sectors prepared by the TEC task force on mitigation.

III. Expected action by the Technology Executive Committee

4. The TEC will be invited to provide comments on the draft TEC Brief, with a view to finalizing them after TEC 15.

¹ http://unfccc.int/ttclear/events/2017_event1.

Annex

Draft TEC Brief on industrial energy efficiency and material substitution in carbon-intensive sectors



Why this TEC Brief?

With 37% of global final energy consumption in 2014, the industrial sector consumes more energy than any other end-use sector, with highest shares in China and India. Energy is needed for a number of technologies and industrial processes. Nevertheless, greenhouse gas emissions can be reduced through the application of different energy and material efficiency measures, thereby offering a great energy and cost saving potential.

Despite the high potential of industrial energy efficiency, there are a number of barriers that often impede investments in energy efficiency measures. According to IEA (2016), by 2020, annual investments in energy-intensive industries of USD 35 billion would be needed to reach international climate goals. This corresponds to an 84% increase compared to investments in 2015. A TEC analysis of mitigation-related policy options found that even though experience with implemented policy options is still low, there is high interest for industrial energy efficiency as expressed in the technology action plans (TEC 2016).

We, the Technology Executive Committee (TEC) of the UNFCCC, acknowledge the key role that energy efficiency in industry plays in combating climate change. The objective of this TEC Brief is therefore to outline the challenges and needs in the context of energy and material efficiency improvements in industry, especially focusing on financing, capacity building, awareness-raising, and innovative policies. We also provide a revision of best practices and lessons learned, and highlight success factors as well as the roles of different stakeholders in the process of enhancing industrial energy efficiency.

The TEC Brief targets international as well as local actors, including policy makers in industrialized countries, emerging economies and developing countries, international organizations, financial institutions, and industry actors, providing recommendations for further action.

Highlights

- In addition to cost savings and climate change mitigation, implementing energy efficiency measures in industry entails many additional economic and social benefits, such as increased energy supply security, improved working conditions and health benefits, better reputation, and employment creation.
- In order to achieve carbon emission reductions in the industrial sector, beyond energy and material efficiency measures, digitization gains more and more in importance to optimize the efficiency of industrial processes.
- Despite the high potential of industrial energy efficiency, a number of challenges and unaddressed needs remain, among which the lack of awareness of energy efficiency potential, limited access to financing, and the need for capacity building are the prime ones.
- Although most countries have already established basic structures, such as energy efficiency plans and the institutional framework, in some regions implementation-oriented approaches are largely ignored, including sector-specific policies, financing support, and performance standards, and commitment is rather low.
- Developing long-term strategies, including the definition of targets, choosing adequate policies to overcome barriers, and implementing a package of aligned policies that target different aspects of energy efficiency potential, are among the success factors to effectively address energy efficiency in industry.

1

Benefits of Industrial Energy Efficiency

CO-BENEFITS

Economic benefits and climate change mitigation are put forward as the key decision factors when it comes to implementing energy efficiency measures in industry. Nevertheless, there are also other significant impacts beyond cost savings and climate protection that gain increasing importance in the selection, design and acceptability of policies. Investing in energy efficiency has multiple benefits for both, companies and their employees.

POTENTIAL FOR ENTERPRISES

By investing in energy efficiency, companies can benefit from an increased energy supply security and reduced risks related to volatile fuel prices by being more independent from non-renewable fossil fuels. Other benefits of energy efficiency include a more cost-efficient production, an increased productivity, fewer material losses and a higher product quality. More eco-friendly operation and production processes also lead to better environmental compliance and a better reputation of companies. Furthermore, adapting and developing future technologies for energy and thereby strengthening their competitiveness can be a great motivation for enterprises. Small and medium-sized enterprises (SMEs) account for a high share of industry worldwide and, especially in developing countries, they play an important role in the context of energy-intensive industries. Although individual energy consumption is rather

low, their collective use is considerable. Simple measures could reduce their consumption significantly. Especially for SMEs, the benefits of energy efficiency play an important role since they can contribute to a higher competitiveness and better technological innovation capabilities.

SOCIAL BENEFITS

Also employees can benefit from the positive effects of increased energy efficiency, such as better working conditions due to air quality improvements and resulting health benefits. Besides achieving improved working conditions, energy efficiency can also play a crucial role for creating new employment. It can contribute to the generation of direct jobs, for example for manufacturing, installation, maintenance and related services, such as energy audits, energy management and certification services, as well as of indirect jobs due to effects in the supply chain.

2

Ways to Increase Energy and Material Efficiency

The industry sector offers great potential for reducing greenhouse gas emissions. This refers especially to energy-intensive sectors, such as chemicals, iron & steel, cement, pulp & paper, non-ferrous metals, and food.

ENERGY EFFICIENCY MEASURES

Some energy efficiency measures can be implemented for cross-cutting technologies, such as steam, motor drives, pumping systems, compressed air systems, heating, and cooling. Although technological improvements for cross-

cutting technologies are rather small, they have a high impact on the overall energy usage due to the broad range of implementation possibilities in many sectors. Other energy efficiency measures, however, can only be applied in single sectors due to individual and sector-specific processes and technologies. In addition, companies can improve their energy performance through implementing an Energy Management System (EnMS), e.g. according to the ISO 50001 standard. Generally, isolated energy efficiency analysis and measures deliver limited savings that are lost over time. Alternatively, energy management as a holistic continual improvement approach establishes a business framework for deeper and sustained savings. To date, investments have focused on the implementation of industrial energy management and on improving the efficiency of cross-cutting technologies. More sector- and process-specific investments as well as investments in SMEs in general would be needed in order to further exploit the efficiency potentials of the industry sector.

DIGITIZATION

The emergence of digitization in industry yields vast additional energy efficiency opportunities. In order to realise this potential, the collection of large volumes of data must be followed by timely processing and analysis, enabling companies to take appropriate actions. This way computerization can help to further optimize highly complex processes resulting in high energy savings. While this area has great potential for energy efficiency, there is concern about job losses due to increasing rates of automatization.

MATERIAL EFFICIENCY MEASURES

Material production and processing requires a lot of energy and is thus a main driver of carbon emissions in industry. Steel and cement rank among the most carbon-intensive materials. Related emissions can for example be reduced by changing the type and amount of fuel used for their production and processing. Moreover, material efficiency can be achieved by substituting production materials, reducing material losses, and re-designing products. Material recovery through reuse and recycling, especially of aluminum parts, has additional effects. Depending on the material, between 25% and 97% of overall GHG emissions can be avoided through recycling compared to primary production.

3

Needs and Challenges

Despite the high potential and broad range of possibilities to increase industrial energy efficiency, the identification and implementation of adequate measures often fails because of a number of unaddressed needs and challenges. Among the most severe are the lack of awareness of energy efficiency potentials, the limited access to finance, and the need for capacity building for different target groups.

LACK OF AWARENESS

As a result of industry actors lacking awareness about energy efficiency potentials and the economic viability of corresponding measures, they can miss out on profitable efficiency opportunities. This also concerns the internal lack of awareness, such as that of the top management regarding the importance to train and enable energy managers and production staff. Likewise, many banks and financiers lack awareness and experience in energy efficiency financing and are hesitant to enter this market, which is often seen by them as a niche business. The typically smaller size of energy efficiency projects compared to larger conventional energy projects is associated with higher transaction costs, especially when experience is missing in evaluating a project's eligibility. In addition, revenue streams in the form of energy cost savings are less common in asset-based markets. Nevertheless, banks and financiers could benefit from financial products targeted at industrial energy efficiency in several ways. Through the creation of new loan products, financial institutions can diversify their portfolios gaining new clients. Moreover, energy efficiency investments bear low risk and can even increase the clients' collateral. Financial institutions can thus benefit from increasing revenues and the creation of a positive brand. If multilateral agencies step in, local banks can further benefit from the provision of additional grants, loans or technical assistance. All in all, an exploitation of the industrial energy efficiency potential will be very challenging as long as the investment gap exists and important stakeholders lack awareness.

LIMITED ACCESS TO FINANCING

Particularly for SMEs in the energy-intensive industry high up-front investments are one of the main challenges with regard to implementing energy and carbon saving measures due to limited financial resources. In addition to that, SMEs are often not able to meet the requirements of financial institutions for certain loan products. Unfavorable lending terms such as high interest rates, short repayment periods, and collateral requirements, as well as perceived risks related to a higher vulnerability of SMEs to market changes, makes them less likely to obtain a loan. This is even more challenging in developing countries, where the energy efficiency financing landscape is less developed.

NEED FOR CAPACITY BUILDING

Measures can only be effectively implemented when a qualified workforce is available. Therefore, on the one hand technical personnel (engineers, auditors, certifiers, energy managers) need to be trained to be able to identify, implement, maintain and monitor energy-saving measures. Additionally, they need to be empowered and provided resources by the top management for the application of their knowledge. On the other hand, capacity building is needed for enablers, such as financial institutions and policy makers. They can help to adapt the regulatory and policy framework, to eliminate false incentives (such as energy price subsidies), and to provide support to enterprises, e.g.

in the form of project financing. Further support measures include improving the training landscape by building training centers and offering trainings-of-trainers.

4

Policy Options

There are different policy options to promote energy efficiency in industry and to address specific barriers. These options include:

- **Economic instruments:** direct investment, fiscal and financial incentives, market-based instruments (e.g. Carbon Trading)
- **Information and education:** advice and assistance in implementation, information provision, performance labels, professional trainings and qualification
- **Policy support:** institutional creation, strategic planning
- **Regulatory instruments:** auditing, codes and standards (such as minimum energy performance standards), monitoring, obligation schemes, other mandatory requirements
- **Research, development and deployment:** demonstration projects, research programs
- **Voluntary approaches:** negotiated agreements (public-private), public voluntary schemes, unilateral commitments (private sector).

Whereas regulatory instruments played a more important role in the past to initiate action on energy efficiency, the current trend is moving towards financial and voluntary approaches and certification schemes. This is especially the case for Africa and the Middle East (World Energy Council 2016). In European countries the National Energy Efficiency Action Plans (NEEAPs) from 2015 show that most of the targeted measures are of financial nature.

5

Lessons Learned

INTERNATIONAL ORGANIZATIONS

Many international organizations that are active in the field of energy have highlighted the importance of industrial energy efficiency. Specific networks and initiatives were established in recent years which target increasing energy efficiency in this sector. The focus so far is mainly on supporting the designing and implementation of energy efficiency policies for industry, including the definition of common targets and strategies, regulatory standards, certification schemes, etc. Moreover, many organizations also foster the introduction of energy management systems and the provision of accompanying capacity building options to drive technology innovations and competitiveness of companies. Technology transfer and the development or provision of financing instruments plays a rather minor role in the activities of international organizations so far.

SE4ALL

Under the Sustainable Energy for All initiative, two networks have been established to exclusively work on energy efficiency topics: the *Global Energy Efficiency Accelerator Platform* and the *SE4ALL Energy Efficiency Hub*. According to an SE4ALL analysis of policies and regulations in place, energy efficiency in general plays a minor role in national policy agendas compared to renewable energy. For those countries that have policies in place, these have often rather a superficial character because enforcement is missing. Approaches that are largely ignored include sector-specific policies, the development of financing mechanisms, and the adoption of minimum energy performance standards. This is especially the case for East Asia and Pacific, Latin America and the Caribbean, South Asia, and Sub-Saharan Africa (EBRD & World Bank 2017).

ENERGY MANAGEMENT WORKING GROUP

The Energy Management Working Group under the Clean Energy Ministerial aims to promote a broad application of EnMS worldwide. With the help of its *ISO 50001 Impact Estimator Tool*, governments can assess the potential impact of implementing ISO 50001 on energy and carbon emission savings in a country or in a region. The complementary *Energy Performance Database* helps to better understand barriers to and benefits of EnMS.

G20 ENERGY EFFICIENCY INVESTMENT PRINCIPLES

G20 Energy Ministers agreed on five voluntary investment principles for G20 countries in 2015. They include the consideration of energy efficiency in all relevant decision making processes, encouraging investments and stimulating their demand, unlocking barriers, and raising awareness in public and private financing institutions. With regard to the progress in implementation of the principles, in the framework of the G20 Energy Efficiency Investment Toolkit 2017, the Finance Task Group identified a need for improvement in all areas.

Box 1: Japan – Steel Industry

With the world's second largest steel industry, Japan has managed to achieve the lowest energy intensity among the main steel-producing countries. The sector started implementing energy efficiency measures early on in the 1970s in response to higher energy prices that followed the first oil crisis. The 1979 enforced Japanese Energy Conservation Act laid the foundation for Japan's energy efficiency and conservation policy. It comprises mandatory measures related to efficient production processes and products, the development of innovative technologies, and the transfer of efficiency solutions to other countries. But the low energy intensity is also attributed to self-commitment targets and voluntary approaches of the steel industry that even exceed the mandatory measures. Since 1971 the sector invested about USD 40 billion in energy-saving technologies. Technology developments including process improvements, usage of by-product gas, exhaust heat recovery, usage of waste material and others led to energy savings between 30-40% in the last 50 years. Additionally, by transferring six major energy-saving technologies from the Japanese steel industry to other countries, around 50 Mt CO₂ could be saved per year (TEC 2017b, Tezuka 2017).

Box 2: Mexico – Eco-Credits for the industry

The Mexican Federal Government started the Eco-Credit program (Programa Eco-Crédito Empresarial) in 2012 to support the implementation of energy efficiency measures in industry. The target groups of the program are SMEs, which have high energy saving potentials of 10-20%, but were not able to exploit them due to lack of awareness, technical know-how and access to credits. In the framework of the program companies can apply for eco-credits with attractive conditions. Measures eligible for financing are, for example, the replacement of non-efficient electrical equipment and the performance of energy audits. From 2012 to 2015, an amount of around 25 million USD was invested within the Eco-Credit program and 21.000 units of equipment were replaced. The program can serve as an example to achieve energy efficiency improvements especially in countries with cheap energy prices that do not have an economic incentive for saving energy (IEA and IPEEC 2017).

GENERAL OBSERVATIONS

Many countries are already active in promoting energy efficiency in the industrial sector. The broad range of approaches and instruments used world-wide shows the manifold opportunities of how potentials can be exploited. Usually programs are composed of different policies and measures and most programs are embedded in the national policy strategy. In achieving energy efficiency improvements, the most successful countries are those that

have set specific targets and have designed policies adequately. When designing policies, it is important to take into account which barriers should be addressed. The table below shows which instruments and approaches are effective in overcoming specific barriers and challenges. Voluntary approaches like information and education programs to promote ISO 50001 EnMS can effectively complement regulatory policy instruments and help to overcome many of these barriers.

Table: Policies to adequately and effectively address barriers

Barriers	Suitable Policies	
Lack of Financial Resources/ Capital Access, Transaction Costs	Economic Instruments	Financial Incentives
		Direct Investment
		Market-based Instruments (e.g. carbon trading)
Lack of Awareness/ Understanding	Information	Information Campaigns (on potential, cost, and benefits of implementing energy efficiency measures) Performance Label
	Deployment	Demonstration Projects
Lack of Technical Know-How	Education	Professional Training Aid in Implementation
	Lack of Motivation, Low Priority	Information
Economic Instruments		Market-based Instruments (e.g. carbon trading)
Regulatory Instruments		Auditing Codes & Standards Monitoring Obligation Schemes
Deployment		Demonstration Projects
Energy Price Subsidies	Economic Instruments	Fiscal Instruments (fading out of subsidies/ carbon pricing)
Structural Barriers	Policy Support	Institutional Creation Strategic Planning
		Limited Access to Technology
Research & Development	Research Programs	
Equipment Downtimes, Technology Lock-In	Economic Instruments	Financial Incentives
	Regulatory Instruments	Codes & Standards

SUCCESS FACTORS

Long-term Planning: Only if the overall strategy, targets and framework remain reliable in the long term, companies are encouraged to invest in EE measures.

Addressing Barriers: Based on the identification of barriers that are actually impeding energy-saving measures, the most effective policies can be chosen and designed.

Package of Aligned Policies: In order to cover different aspects and to achieve higher impact, it is recommended to implement a package of policies that are aligned and build on each other.

Focus on Co-Benefits: When designing policies, co-benefits should be considered, e.g. if employment creation is targeted, capacity building should be part of the policy.

Proven Policies: Policy makers should continue to follow proven approaches like the promotion of EnMS, financial and fiscal incentives, or training programs.

Locally Available Resources: Policies should address the use of locally available (waste) energy and material as far as possible to reduce transaction costs and carbon emissions.

Technology Transfer and Development: Fostering technology transfer and development through policies can benefit developing countries additionally through know-how gains, higher competitiveness and value addition.

Coordination of National and Regional Policies: A policy should be designed in line with other national and regional policies in order to achieve highest possible impacts.

Recommendations for Actions by Key Stakeholders

DOMESTIC POLICY MAKERS

Policymakers have a critical role in setting the legal, regulatory and policy framework for energy efficiency in industry and incentivizing different actors:

- Anchor industrial energy efficiency in national energy policy and consider energy efficiency in relevant decision making.
- Establish an adequate policy framework adapted to the respective national/ regional conditions
- Initiate awareness campaigns targeted at industry actors and financial institutions.
- Setting clear and long-term investment signals to ensure energy efficiency investments.
- Simplify public support programs to achieve the maximum benefit of funding in energy efficiency.
- Provide tailored support programs to start-ups that develop energy-saving technologies, to contribute to knowledge-based employment creation.
- Ensure compliance to policies through incentives, information provision and capacity building offers, and if necessary enforcement mechanisms.
- Contribute to increasing the accessibility of data and knowledge as well as their systematic preparation through databases or platforms.
- Establish industrial energy efficiency networks to exchange experiences and provide specific training and education.
- Incentivize broad application of ISO 50001 EnMS.

INTERNATIONAL ORGANIZATIONS

International organizations play a crucial role as they work across borders and can contribute to worldwide knowledge exchange and international collaboration:

- Develop transnational cooperation and strengthen cooperative action on technology transfer and development.
- Provide capacity building in the form of study tours, workshops, or technology demonstration projects.
- Contribute to awareness-raising, e.g. through the establishment of platforms to share best practices, and the creation of policy databases.
- Encourage uptake of ISO 50001 as an international best practice in energy management.
- Engage in R&D projects, supporting pilot projects and the testing of new business models.
- Provide policy support.

FINANCIAL INSTITUTIONS

Financial institutions (FIs) are of great importance to overcome investment constraints for industrial energy efficiency:

International financial institutions and donor community:

- Provide international support for financing instruments (grant schemes, loans, guarantees, performance-based instruments, risk capital etc.).
- Provide funding for pilot projects and technology demonstration projects.
- Increase availability and accessibility and of technical assistance to ensure successful implementation of energy efficiency investment programs.
- Expand distribution activities via partner banks and other channels to increase industrial energy efficiency investment.
- Adapt financing measures to the context and conditions of the respective country.

National public and private financial institutions:

- Consider energy efficiency when making investment decisions.
- Increase investments in projects that aim for energy efficiency improvements in industry.
- Develop and test new and appropriate financing instruments, insurance and risk mitigation products.
- Participate in structured knowledge exchange with other financial institutions.
- Improve measurement and reporting of energy efficiency financing measures, guiding clients towards energy-efficient financing decisions.
- Provide tailored financing programs for SMEs and start-ups that are active in the development of new EE technologies.

INDUSTRY ACTORS

- Engage in networks, clusters, and cooperation projects to share experiences and acquire knowledge about good practices.
- Take part in capacity building (e.g. trainings for energy managers and auditors) to be able to identify opportunities and use implemented measures sustainably.
- Take up energy improvement as an additional business field (e.g. providing energy efficiency services).
- Additionally adopt voluntary measures to further exploit the economic benefits of energy efficiency.



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