



CLIMATE ACTION PROGRAMME FOR THE CHEMICAL INDUSTRY (CAPCI):

Lessons Learnt and Experiences from Cooperation with Developing Countries and Emerging Economies

1. The Climate Action Programme for the Chemical Industry

The Climate Action Programme for the Chemical Industry (CAPCI) is funded by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) in the framework of the International Climate Initiative (IKI). CAPCI's objective is the development of capacities of key stakeholders in developing countries and emerging economies for implementing effective climate protection measures in the production and use of chemicals. The implementation of CAPCI from 1st March 2021 to 29 February 2024 has yielded broad and valuable learning experiences that are summarized in the following. Some of the learning experiences are more general in nature while others refer to the intense cooperation with CAPCI partner countries, Argentina, Ghana, Peru, Thailand and Vietnam.

CONCEPTUAL APPROACH AND MAIN ACTIVITIES

The main focus of CAPCI is capacity development for climate action in the production and use of chemicals, in the broader context of sustainable development and sustainable chemistry. The project concept comprises three areas of work that are inter-connected and build on each other:

- (1) Information, stakeholder dialogues and knowledge sharing constitute the basis for the further activities and creating awareness for the topic chemistry and climate change,
- (2) Development and implementation of comprehensive training programmes, including a training of trainers and country-specific trainings,
- (3) Action-oriented capacity building, advice and knowledge transfer, e. g. for climate action plans and first steps in companies as well as roadmaps for the chemical sector in selected developing countries and emerging economies.

(1) Information and knowledge were in the focus in the first phase of CAPCI. Inter alia 10 stakeholder dialogues with up to almost 900 participants were realized in 5 partner countries. Activities in the second phase could build on these public-private dialogue events that were continued

for instance to discuss potential roadmaps for the chemical industry. In addition, in three years around 15 international webinars and side events were organized with more than 1.000 participants. Information materials such as publications and factsheets as well as an interactive knowledge base¹ were developed.

(2) At the beginning, CAPCI realized an in-depth training-of-trainers course with more than 30 participants and elaborated a broad set of training materials. On that basis country-specific trainings were developed and designed according to the specific needs of the sector – and particularly the companies – in the partner countries.

(3) Based on the capacity building measures, and in close inter-connection with them, climate protection measures and action plans were developed on company level as well as for the chemical sector in general in form of roadmaps in the three focus countries, Argentina, Ghana and Thailand.

2. Assumptions and Challenges to be Addressed

Some important underlying assumptions of the CAPCI project concept that are explained below could essentially be verified during project implementation.

➡ **The chemical industry matters for successfully fighting climate change, on global level as well as in developing countries and emerging economies.**

The chemical and petrochemical industries account for 7.4% of global greenhouse gas (GHG) emissions, according to the latest Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2023)². Indirect emissions in the value chain (Scope 3, upstream and downstream) are not even included, although they are very relevant in the chemical sector which is characterized by a high resource-intensity, including big amounts of oil and gas

that usually have a high carbon footprint. On the other hand, the big variety of products provided by the chemical industry also includes substances with high global warming potentials, such as fluorinated gases (F-gases), used e.g. as cooling, refrigeration and foam-blowing agents. F-gases are also an important field for GHG mitigation, often considered in national climate policies and Nationally Determined Contributions (NDCs) that countries define according to the Paris Agreement. The chemical industry's high GHG emissions are primarily caused by its enormous energy consumption of around 10% of the global energy demand and predominantly relies on fossil hydrocarbons. At the same time, the chemical industry and its products form the base of almost all industrial value chains, including clean and climate-friendly technologies. The sector's enormous innovation potential can therefore significantly contribute to climate protection and efficiency increase in most other industrial sectors.

➡ **The Nexus Chemistry – Climate Change is not yet adequately reflected on the climate protection agenda of developing countries and emerging economies. The demand for knowledge, information and awareness creation is high.**

Despite its high climate relevance, the chemical sector has not played a major role so far in most NDC's or long-term mitigation strategies. This is also true for International Cooperation with developing countries and emerging economies³ though there are a few exceptions, such as the areas of phasing out F-gases⁴ and reducing laughing gas emissions⁵. While these 2 examples refer to specific types of GHG emissions, the conceptual approach of CAPCI focuses on the entire lifecycle of chemicals and refers to the whole spectrum of GHG emission sources of chemicals production and use. This approach was discussed with stakeholders in the partner countries and found much interest. In some cases, it was welcomed as an important new area of work, for instance by a national association of the chemical industry, expressing that they had not

1: www.isc3.org/page/capci

2: <https://www.ipcc.ch/report/sixth-assessment-report-cycle> NOTE: This figure includes direct emissions (scope 1) and indirect emissions under scope 2.

3: This statement could also be made to some extent for the manufacturing industry as a GHG emission sector in general, though this might change in future. According to the latest IPCC figures (2023), industry accounts for the biggest share of GHG emissions as compared to other emission sectors, at least when scope 1 and scope 2 emissions are considered. Chemical production together with steel and cement production constitutes one of the three most important emission subsectors within the manufacturing industry.

4: See e.g.: Proklima – Klima- und umweltfreundliche Kühltechnologien weltweit fördern - giz.de

5: See e.g.: The Nitric Acid Climate Action Group (nitricacidaction.org)

addressed climate protection sufficiently in the past and recognizing that it needed more attention in the future. In this sense, awareness creation, information and dialogue proved to be indispensable initial steps for positioning the nexus chemistry - climate change on the agenda of important stakeholders from public and private sector and creating a solid foundation for more in-depth, action-oriented cooperation activities on capacity building and strategy development.

➡ **Developing countries and emerging economies generally lack human and institutional capacities for tapping potentials of the chemical sector for successfully tackling climate change.**

Baseline studies carried out in CAPCI's initial partner countries revealed that the awareness regarding greenhouse gas (GHG) mitigation options in the chemical industry was notably limited and that there was an absence of comprehensive training programs addressing the the nexus chemistry – climate change. Against this background but also due to the work on information and awareness creation it is comprehensible that relevant partner institutions and stakeholders showed much interest for the project's capacity building offers. A training of trainers (ToT) on Sustainable Chemistry and Climate Change with participants from 5 partner countries served as a basis for country-specific trainings that were carried out in cooperation with selected partner organizations that demonstrated a high degree of ownership. In the focus countries, Argentina, Ghana and Thailand, the trainings were anchored in partner organizations and supported by CAPCI technically. Even in Peru, that had participated in the ToT phase but could not be further supported⁶ by the project, a series of CAPCI-based trainings was implemented under the lead of the industrial federation (SNI – Sociedad Nacional de Industria) in cooperation with the Ministries of Industry and Environment with around 100 participants mainly from chemical companies in each of the online sessions.

In agreement with the demand perceived by the responsible persons from the partner sides, CAPCI put a special focus on specific training offers for small and medium enterprises (SMEs). Whereas bigger – on the chemical sector often international – companies usually have their procedures and institutional arrangements for assessing GHG emissions and mitigation options, many SMEs in developing countries and emerging economies are not yet prepared: Climate protection is a relatively new topic for them, and they do not have adequate expertise for identifying options and defining strategies as well as concrete measures or action plans on their own. This seems to be even more pronounced for climate protection in the production and use of chemicals whereas there are at least some trainings opportunities on chemicals management and safety (an often very urgent issue!), for example the “Responsible Care”⁷ programme of the chemical industry. CAPCI's training philosophy is designed to create synergies and avoid trade-offs between sustainable chemicals management and climate protection. Regarding mitigation options in companies, it seeks to enhance climate-related skills and knowledge that allows to find economically feasible or even beneficial solutions, e. g. in combination with loss reduction, addressing weaknesses in production processes, as well as circular economy, energy and resource efficiency approaches.

3. Learning Experiences from CAPCI Implementation

➡ **Due to the Covid-19 Pandemic, the modalities of cooperation and project implementation had to be completely re-designed. But remote management worked out!**

The project start of CAPCI in March 2020 was overshadowed by the Covid-19 pandemic. Though the project objectives and indicators could be maintained unchanged, the strategies to achieve them and the corresponding activities and modalities of cooperation had to be changed

6: Peru and Vietnam participated actively in the starting phase inter alia in baseline studies and stakeholder dialogues. But they didn't belong to the focus countries that received further support in the framework of CAPCI. Nevertheless, they continued to take part in networking and knowledge sharing, and the industrial association of Peru (SNI) organized training courses for chemical companies, based on the CAPCI trainings, on its own.

7: Responsible Care® - cefic.org

completely. The CAPCI team based in Germany could not travel to the partner countries for the planification of the project activities and establishing cooperation arrangements. Instead, online meetings played an essential role, while CAPCI could also rely on the GIZ structures and projects in the 5 initial partner countries, where GIZ colleagues from relevant projects acted as focal points, also for coordination with the responsible government institutions. These arrangements proved to be effective for implementing the modified workplan of CAPCI.

➡ The active participation of the chemical industry was a crucial success factor

A crucial support for CAPCI came from the International Council of Chemical Associations (ICCA) that helped to establish contacts with the industrial or chemical associations in the partner countries. ICCA acted as a door-opener and helped to identify contact persons for CAPCI on the industry side, usually representatives responsible for the Responsible Care programme or at least involved in its implementation in the partner countries. These contacts and the support from ICCA and national associations were not only important for establishing functioning cooperation structures and public-private dialogues. It was also a decisive factor for having interested companies on board from the beginning, particularly for CAPCI's information, knowledge sharing and dialogue events, but also finding experienced and knowledgeable representatives of the chemical industry as speakers in the events.

➡ Double Message: The chemical industry is not only part of the problem – it is also part of the solution!

In the communication with chemical companies and associations a double message proved to be helpful: On the one hand, the chemical industry is certainly part of the problem – due to its high share of global GHG emissions⁸ but also in relation with the enormous amount of chemical products, many of which are critical for the environment or human health. On the other hand, the chemical industry is

an indispensable part of the solution, not only for reducing its own emissions but also for a climate-friendly transformation of other sectors. It has a huge innovation potential, and the energy turnaround or sustainable mobility are not possible without products from the chemical sector.

The fact that CAPCI has not only clearly identified the problems as negative aspects, but also the positive role and potential of the sector, is seen as decisive for the acceptance and interest that CAPCI has found in the chemical industry.

➡ Partner organizations took over clear ownership.

As laid out above, CAPCI and the nexus between chemistry and climate change have generated significant interest in partner countries. The establishment of effective cooperation structures with involvement of public and private stakeholders is crucial. Partner organizations took over clear ownership; in the case of Argentina and Peru, the industrial or chemical association were more in the lead, while government organizations were in the lead in Ghana and Thailand. In all cases, CAPCI could rely on the crucial support of both, public and private sector stakeholders, in each of the partner countries – a fact that should be underlined as a critical success factor for driving forward the topic of chemistry and climate change.

➡ The importance of the chemical sector for climate protection in developing countries and emerging economies has largely been ignored.

The marked interest of partner countries for the nexus chemistry - climate change might be explained on the one hand by the necessity of governments to look deeper into the sources of greenhouse gas emissions, when it comes to define effective mitigation strategies. On the other, CAPCI had also put a special focus on facts and figures, showing the high climate relevance of the production and use of chemicals – a fact that turned out to be rather new for many partners. Apparently, the under-estimated importance

8: According to the IPCC (Sixth Assessment Report – IPCC), chemical and petrochemical production account for 7.4% of global greenhouse gas emissions, considering direct emissions (scope1) and indirect emissions under scope 2, e.g. purchased electricity, heat etc. While process-related emissions such as N₂O from nitric acid production inter alia also play a significant role, most of the GHG emissions of chemical production are caused by the enormous amounts of fossil hydrocarbons, for both, as energy carrier and feedstock. It should also be noted that the chemical sector accounts for around 10% of worldwide energy consumption; and the overwhelming part of it stems from fossil sources.

of the chemical sector has to do with the systematics and main categories of national GHG inventories. The lion's share of emissions that are related with chemical production are caused by the use of fossil fuels. A smaller, but still significant part is due to the processes, such as laughing gas (N₂O) which has a high global warming potential (GWP) and is emitted during the production of nitric acid. In national inventories, only the process-related emissions are reported under chemical production in the overall sector of "Industrial Processes and Product Use (IPPU)", while the combustion-related emissions are included in the figures of the energy sector.

In activities of CAPCI, such as stakeholder dialogues on mitigation pathways, it became clear that only this smaller part of process-related emissions was usually perceived as the chemical sector's emissions. In consequence, many decision-makers did not see the chemical sector as a case for climate action; and it was often not considered in national mitigation strategies. At least in CAPCI focus countries this situation changed, and the chemical sector is receiving more attention.

➡ **Ambitious climate objectives require differentiated strategies, considering all relevant sectors; production and use of chemicals get increasing attention.**

Already in an early phase of CAPCI implementation it could be noted, particularly in Thailand and Vietnam, that their commitments to climate neutrality, announced 2021 at CoP 26 in Glasgow, led to increased efforts in these countries for shaping corresponding climate strategies. In consequence, this also implied that emissions and their sources had to be assessed more carefully and that the chemical sector, which had been overlooked for a long time, received more attention. For CAPCI this meant an increased interest and the chance to contribute to the framework of strategies needed for the achievement of the ambitious NDCs.

➡ **Multi-Stakeholder cooperation and dialogue are crucial success factors.**

Establishing such a complex topic as the transformation towards a sustainable and climate-friendly chemical industry on the political and societal agenda, requires the participation of key stakeholders from the public and from the private sector as well as academia and civil society. CAPCI was able to set such processes in motion through a range of activities oriented at information, awareness creation and stakeholder dialogue which are crucial for discussing possible mitigation or decarbonization pathways and securing the support of relevant political and economic actors. The readiness of the industry for moving towards such a transformation depends on clear political objectives (NDCs), enabling policies and incentives as well as the conviction that there are feasible pathways and solutions with long-term benefits.

➡ **The implementation of concrete sector plans for climate protection remains a big challenge for the chemical sector.**

The path from dialogue and strategy development in the chemical sector to implementation of concrete action plans and measures in the involved companies is long⁹. This experience also applies to CAPCI and its focus on action-oriented capacity building: After three years of intense cooperation with three partner countries, roadmap proposals for the chemical sector are available, and climate actions in companies have been identified or even started; but the effective and broad-scale implementation would require further support, ideally with involvement of international cooperation.

➡ **Roadmaps are helpful for shaping the pathway towards a sustainable and climate-friendly chemical industry.**

The development of roadmaps for decarbonizing the chemical industry in the three focus countries proved to be a very useful approach for identifying and discussing

9: It should be noted that at least bigger multinational companies usually have already more or less detailed climate action plans and often net zero objectives, while smaller and medium-sized companies in developing countries and emerging economies are often very much at the beginning.

feasible and as far as possible beneficial mitigation pathways and acceptable solutions. The development of roadmaps should be driven forward stepwise, and a mechanism for periodic review and adaptation should be adopted. Concrete measurable goals and interim goals for different time horizons are important. Technological ambition might increase with time, starting from low-cost measures and “low-hanging fruit” and moving towards more complex technologies. Along with important technological building blocks, necessary political and economic framework conditions as well as infrastructure requirements should be considered. The focus should not only be laid exclusively on GHG mitigation but also take other effects into account and show potential benefits, for instance through increased resource and process efficiency, sustainable chemical management, competitiveness, opportunities in new technological areas, job creation and so on.

➡ The range of mitigation options is big; the technologies are essentially known; but the need for innovative solutions remains high.

When industries start with measures for reducing GHG emissions, it usually makes sense to explore the potential of low-cost measures for example through loss reduction, minor process changes, energy, and resource efficiency approaches etc. **Energy** is of course a key area where options of increased energy efficiency and switching to renewable sources should be assessed. **Circular economy solutions** such as (re-) use of waste heat and residues often pay off after relatively short periods of time. CAPCI webinars and study visits to Germany also revealed a high interest of partner representatives in the significant synergy potentials of inter-connected industrial parks, particularly chemical parks, organized as “Verbundstandorte”¹⁰ that are characteristic for the German chemical industry. The “Verbund” or inter-connection between companies, plants and infrastructures at these sites allows for important efficiency gains in terms of energy and resource use as well as waste and emission reduction, and finally cost savings.

In many developing countries, the elimination of laughing gas (N₂O) emissions, for instance in nitric acid production, is still relevant and constitutes quite a big potential for GHG emission reduction at relatively low prices¹¹. GHG reduction in value chains of chemical products is also of high relevance, upstream as well as downstream, where the still wide-spread use of fluorinated gases (F-gases) is a major cause of emissions due to their very high global warming potential, though climate-friendly alternatives such as natural gases are generally available. In addition, it should be noted that there was high interest in partner countries regarding alternative business models such as **Chemical Leasing, alternative carbon sources** for replacing fossil fuels as a feedstock (from plastic waste, biomass from agriculture waste or carbon capture / “**CCU – carbon capture and utilization**”) as well as **green hydrogen, Power-to-X (PtX)** and **Power-to-Chemicals (PtC)**.

➡ The interlinkages between climate protection and sustainable chemicals management are an urgent field of action.

Synergies and trade-offs between climate protection in the chemical industry and sustainable management of chemicals were constantly in the focus of CAPCI. They were addressed in webinars, stakeholder dialogues, international side events, and trainings. The global challenge of climate change needs to be considered in its manyfold interrelations with chemicals management and the concept of “Sustainable Chemistry”¹². In CAPCI activities it became clear that climate policies and chemical policies are usually separate policy fields without systematic coordination; this situation was observed on national level as well as internationally. As indicated above, the chemical sector is often ignored in the formulation of climate policies. Even though the responsibility for climate and chemical policies is in many cases (but not always) located in the environmental ministries in partner countries, the respective departments or structures have little to do with each other. In CAPCI activities these actors were usually brought together in fruitful stakeholder dialogues.

10: [isc3.org/cms/wp-content/uploads/2023/01/Factsheet_Verbund_060123.pdf](https://www.isc3.org/cms/wp-content/uploads/2023/01/Factsheet_Verbund_060123.pdf)

11: See above: The Nitric Acid Climate Action Group (nitricacidaction.org)

12: See for instance materials and publications in www.isc3.org

There seems to be a case for action also on the international level, if the various problems are to be tackled in a coherent and synergistic way as suggested by the UN report „Making Peace with Nature“ (2021) for the 3 global crisis („Triple crisis“) – climate change, biodiversity loss and pollution¹³. An important step in the right direction was done in the World Chemical Conference (ICCM5 – 5th Session of the International Conference on Chemicals Management) in September 2023 in Bonn, where the interlinkages between the different crisis were addressed explicitly¹⁴. A publication of the secretariat of the Basel, Stockholm and Rotterdam conventions had already shown that climate change would aggravate ecological pollution drastically¹⁵. It should be emphasized that synergies and trade-offs between climate change and chemicals management require increased attention.

➡ **South-South cooperation and knowledge sharing are success factors for addressing evolving topics such as chemistry and climate change in the framework of global projects.**

As laid out above, climate protection in the production and use of chemicals was not on the agenda of many relevant stakeholders – despite the sector’s high share of global greenhouse gas emissions and in contrast to other carbon-intensive industrial subsectors such as steel and cement. This may explain, why the information and awareness creation activities especially at the beginning of CAPCI resulted in big interest and engagement of partner representatives in the cooperating countries. The cooperation experiences also showed that it takes time to establish such a topic on the agenda until it comes to action. The decision-makers want to have sufficient information and draw conclusions from experiences made in other, comparable countries or on international level. In that sense the thematic cooperation with several countries proved to be of enormous value.

It can be clearly stated that the possibilities for South-South cooperation and knowledge sharing provided by the global

project were especially effective. This started with joint webinars, a training-of-trainers course for all 5 involved partner countries and 2 study visits with in-person exchange and was continued in online networking fora. The possibility to study the situation, the challenges, and the responses in other countries in similar conditions serves for better orientation and eventually inspiration for designing one’s own conceptual approach. This could be observed especially in the, more or less, parallel development of mitigation roadmaps for the chemical industry that CAPCI supported in 3 partner countries. It is highly recommended that global projects should explicitly create room for South-South exchange and cooperation. In the case of CAPCI, the network of trained trainers, multipliers and experts (with representatives from public and private sector) played a crucial role. And the project team itself with local experts in Argentina, Ghana and Thailand and a small core team in Germany was also part of this network and actively promoted exchange and mutual learning.

4. The Way Forward

CAPCI has contributed to shed light on the important interlinkages between chemistry and climate change. It has developed a variety of information and training materials on the topic. After the end of the CAPCI project, the nexus chemistry - climate change will constitute a special focus also in the work of the International Sustainable Chemistry Collaborative Centre (ISC3)¹⁶.

In addition to more generic activities for addressing the interlinkages between sustainable chemicals management and climate change, CAPCI’s main work consisted in the support of selected developing countries and emerging economies. In cooperation with partner organizations, trainings and roadmaps for a climate-friendly and sustainable chemical industry were developed. These measures laid a foundation for further work in the partner countries:

13: Recent publications and conferences of the UN clearly call for a synergistic and coherent approach to tackle the three global crisis of climate change, biodiversity loss and pollution; see: Making Peace With Nature | UNEP-UN Environment Programme

14: Fifth Meeting of the International Conference on Chemicals Management (ICCM5) | SAICM Knowledge

15: BRS Secretariat at the Climate COP28 (brsmeas.org)

16: www.isc3.org

Argentina:

Under the new president that took over on 10 December 2023, the government was completely reorganized. It is not yet 100% clear to what extent the efforts initiated by CAPCI can further build on the fluid cooperation structures that were established with the former Ministry of Production and the former Ministry of Environment and Sustainable Development. On the other hand, the good cooperation with the chemical association CIQyP (Cámara de la Industria Química y Petroquímica) continues. CIQyP shows much ownership and still supports actively the implementation of CAPCI trainings and roadmap development. In addition, potential synergies with a new bilateral cooperation programme on climate change and resource efficiency have also been identified. In total, there seem to be good chances that CAPCI results will also be used in future in Argentina.



Ghana:

The initiatives promoted by CAPCI together with its partners in Ghana are still very present at the level of key partner organization such as the Environmental Protection Agency (EPA) and the Association of Ghanaian Industries (AGI). It will be crucial to find support for a follow-up of action plans for climate protection, energy and resource efficiency measures in chemical companies. Issues addressed in CAPCI trainings such as Sustainable Industrial Areas and Green Hydrogen / Power-to-X are also topics of existing bilateral cooperation projects. The EPA has the main responsibility for a possible follow-up of the roadmap proposal for the chemical industry that was developed with CAPCI support.



Thailand:

Thai government organizations such as the political partner DIW (Department of Industrial Works) show great ownership for using further products of CAPCI like the roadmap proposal for the chemical industry in the framework of the different strategies needed for achieving the national climate neutrality objective. It remains to be explored, if new bilateral cooperation projects in the area of energy, mobility and climate change could eventually also provide certain support for the follow-up of the roadmap proposal. The Industrial Association FTI (Federation of Thai Industries) will probably also continue building on CAPCI activities such as the trainings on chemistry and climate that form a good complement of the existing trainings on chemical safety in the context of the Responsible Care programme.



Peru:

CAPCI activities in Peru were actively supported by the national industrial association SNI (Sociedad Nacional de Industria), while government institutions generally joined in. Peru belonged to the partner countries of CAPCI in the starting phase but could not be supported substantially in the second phase. Nevertheless, it is encouraging to note, that under the lead of the SNI, Peru continued to organize online trainings on chemistry and climate change that were based on CAPCI's training of trainers and corresponding materials. The country also has remained active in the CAPCI network.




Vietnam:

Vietnam is the other country that could only be supported in the 1st phase. Vietnam partners regretted that the country was not chosen as a focus country for the 2nd phase of CAPCI. Representatives from partner organizations continued to take part sporadically in the networking activities and international events of CAPCI. On the other hand, it should be noted that Vietnam had committed in 2021 to achieve climate neutrality by the mid of the century. The required efforts and strategies will certainly also affect the chemical sector.



Conclusion

In summary, CAPCI had the opportunity to work in an area that had not been systematically addressed in developing countries and emerging economies or international cooperation until now. CAPCI was able to show that this so far neglected topic, the nexus between chemistry and climate change, is of high relevance for the achievement of national climate goals. The materials and outcomes generated by CAPCI hold promising potential for utilization in international cooperation initiatives and within the partner countries in order to include the chemical sector explicitly into climate change mitigation strategies, to develop capacities and to address the interlinkages between climate protection and sustainable chemicals management.



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