Executive Summary of the ICCA Report: Innovations for Greenhouse Gas Reductions

A life cycle quantification of carbon abatement solutions enabled by the chemical industry

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INTERNATIONAL COUNCIL OF CHEMICAL ASSOCIATIONS

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Executive summary

Under the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) has reviewed the scientific literature and concluded that a significant reduction of greenhouse gas emissions is necessary to slow the rate of growth in atmospheric concentrations of CO_2. The IPCC analysis highlights that to achieve emissions reductions on the scale necessary, the world economy will need to be rapidly "decarbonized", with action taken on all of the available abatement levers. In most cases, the required shifts in behavior are unlikely to happen on a sufficiently large scale without effective policies and regulations – hence the importance of providing policymakers with reliable facts on the impact of the available options and levers most relevant to the chemical industry.

The study drew on a wide range of published data and independently audited original research to calculate the chemical industry's impact on emissions in 2005. McKinsey then assessed how this impact would change in two scenarios to 2030, a "business-as-usual" (BAU) scenario and an alternative "abatement scenario". Both future projections were based on McKinsey modeling and their global GHG abatement cost curve work.

1. A ROBUST AND TRANSPARENT METHODOLOGY TO EVALUATE THE CHEMICAL INDUSTRY'S CONTRIBUTION TO THE DECARBONIZING OF THE WORLD ECONOMY

The study utilized a full life cycle CO_2e analysis to determine emissions linked to the chemical industry, from extraction of feedstock and fuel, through production, to disposal.

Further, to assess the impact of chemicals in enabling greater carbon efficiency throughout the economy, the study conducted "CO_2e life cycle analyses" (cLCAs)[1] for over 100 individual chemical product applications. These cLCAs span the major sectors of the industry and cover a representative portion of the CO_2e savings linked to chemical products. All the production emissions of the industry are included, whereas only the major portion of the in-use savings have been covered. Further cLCA work could therefore yield a higher level of savings than reported in this study.

The cLCAs compared the CO_2e emissions of a chemical industry product in a specific application with the next best non-chemical industry alternative that preserves current life style, through the extraction, production, in-use and disposal phases. For simplicity, the term chemical product is used to define a product that is produced by the chemical industry.

The report adopts two metrics to reflect the chemical industry's impact on carbon emissions. The first is a **gross savings (or X : 1) ratio**, where the amount of CO_2e saved through the use of a chemical product is measured against the amount of CO_2e emitted

1 Carbon Life Cycle Analysis; assessment that focuses only on the CO_2 equivalent emissions.

during that product's entire life cycle. The second metric is the **net emission abatement**, which represents the difference between the gross CO_2e savings enabled by its use and the CO_2e emitted during its own production including indirect and supply chain emissions and disposal. The term cLCA is used throughout the report to indicate CO_2e life cycle analysis.

Two alternative principles were applied in allocating CO_2e savings. In most cases, where chemical industry products play the enabling role in GHG abatement or provide the GHG saving component, 100 percent of the CO_2e savings were attributed to the chemical industry. In three cases where the use of the chemical industry product only contributed to an improvement in CO_2e emissions, savings based on the chemical's cost share of the overall product costs were attributed to the chemical industry. By adopting this approach the authors acknowledge that other parties with an enabling contribution to the same measure may adopt the same approach, which could then lead to multiple counting. The basis for this is explained in the methodology section. Allocations of abatement volumes differ from CO_2e accounting rules within carbon markets. This report is not intended to make any financial claims linked to these GHG savings.

2. TODAY'S IMPACT – THE CHEMICAL INDUSTRY'S CURRENT EMISSIONS, AND THE SAVINGS IT ENABLES

The chemical industry has improved its energy savings at manufacturing sites and in this regard reduced its GHG emissions over the last decades significantly as illustrated by the examples below:

- Between 1990 and 2005, chemical production in the EU rose by 60 percent, while total energy consumption was stable. This meant that the chemical industry has cut its energy intensity by 3.6 percent annually. Absolute GHG emissions, meanwhile, fell by almost 30 percent;
- The Japanese chemical industry reduced unit energy consumption by 2002 to 90 percent of the 1990 fiscal year level – eight years ahead of target. By 2006, further improvements meant that the performance achieved was 82 percent of the 1990 level;
- Since 1974, the US chemical industry has reduced its fuel and power energy consumed per unit of output by nearly half. Since 1990 the US industry's absolute GHG emissions fell 16 percent, a reduction that exceeds the target of the Kyoto protocol;
- The Brazilian association members reduced specific overall energy consumption between 2001 and 2007 by 25 percent while increasing overall production by almost 30 percent. By 2007, more than 50 percent of energy came from renewable sources. Total CO_2 intensity declined by 16 percent between 2001 and 2007.

In 2005, CO_2e emissions linked to the chemical industry amounted to about 3.3 GtCO_2e +/- 25 percent. The majority of these emissions, 2.1 GtCO_2e, were a result of the production of chemicals from feedstock and fuels delivered to the chemical industry.

An additional 1.2 GtCO_2e of emissions – included in this study in line with life cycle thinking – arose during the extraction phase of the feedstock and fuel material, and during the disposal phase of the end products.

Gross savings vary from 6.9 to 8.5 GtCO_2e depending on the scope and assumptions used[2]. This translates into a gross savings ratio of 2.1: 1 to 2.6 : 1. In other words, **for every GtCO_2e emitted by the chemical industry in 2005, it enabled 2.1 to 2.6 GtCO_2e in savings via the products and technologies it provides to other industries or users.**

Depending on the assumption and scope, the net CO_2e emission abatement enabled by the chemical industry's products across the economy amounted to 3.6 to 5.2 GtCO_2e +/- 30 percent in 2005. Net CO_2e savings refer to the difference in GHG emissions with and without the use of chemical products assuming no substantive changes to current life style. In other words, and compared to total global emissions of 46 GtCO_2e in 2005, **there would have been 3.6 to 5.2 GtCO_2e, or 8 to 11 percent, more emissions in 2005 in a world without the chemical industry.**

Taking account of current societal needs and the impact of a growing global population, these savings highlight the vital role of the chemical industry in decarbonizing the economy. In reality, achieving the equivalent CO_2e savings without the benefits of chemical products and technologies would not be possible.

The biggest levers evaluated for emissions savings enabled by the chemical industry were:

- **Insulation** materials for the construction industry, which reduce the heat lost by buildings and thus the use of heating fuel. Insulation alone accounted for 40 percent of the total identified CO_2e savings. This report did not address cooling applications where additional emission reductions in the building industry would be anticipated;
- The use of **chemical fertilizer and crop protection** in agriculture, which increases agricultural yields – so avoiding emissions from land-use change. Due to the uncertainties in land-use changes, yields, soil quality effects and modes of CO_2-binding and assimilation in different conventional and organic agricultural processes, this study adopts two scopes, one with and one without this case;
- Advanced **lighting solutions**: compact fluorescent lamps (CFLs), with longer lifetimes and greater luminous efficacy than incandescent bulbs, save significant energy;
- The seven next most important levers in 2005 were **plastic packaging, marine antifouling coatings, synthetic textiles, automotive plastics, low-temperature detergents, engine efficiency, and plastics used in piping.**

2 The lower end of the range is due to an alternative study scope that excludes the fertilizer case as explained.

3. TOMORROW'S OPPORTUNITY – TWO MCKINSEY SCENARIOS TO 2030, AND CHEMICALS' POTENTIAL DECARBONIZING ROLE

The business-as-usual (BAU) scenario developed by McKinsey and shown in this study was characterized mainly by volume growth, assumptions for efficiency gains and regional production shifts. No additional regulatory push for low-carbon development is assumed in this case. The abatement scenario, which was derived from McKinsey's global GHG cost curve scenario, assumes aggressive implementation of measures leading to a low-carbon economy.

The **BAU scenario** model shows life cycle emissions linked to the chemical industry almost doubling. The number is essentially derived from doubling current emissions to 6.6 $GtCO_2e$, an additional 1.5 Gt due to increased production in countries which are relatively coal dependent for their energy partly offset by assumed BAU efficiency improvements of ~1.6 Gt. The net result from this modeling is global chemical industry linked emissions of 6.5 $GtCO_2e$ +/- 35 percent in 2030.

Depending on the assumptions and scope, the industry's gross savings ratio improves to approximately 2.7 : 1 to 3.1 : 1 in the BAU scenario. The net emission abatement enabled by use of the chemical industry's products will more than double to 11.3 to 13.8 $GtCO_2e$ +/- 40 percent under the BAU scenario.

In the **abatement scenario**, the McKinsey model assesses the full abatement potential across all sectors. This means that industries further reduce both their direct and indirect production emissions, and includes also a reduction of the carbon intensity of the utilized power. Under this scenario, the chemical industry's CO_2 intensity would fall by about 25 percent. Its emissions would be 5 $GtCO_2e$ +/- 35 percent. This equates to only a 50 percent increase on current emissions despite a greater than doubling of the production. However, this comes at significant cost at typical industry discount rates and payback periods. The CO_2 abatement costs for the final increments rise from about 50 to 150 €/t CO_2e. Thus a broadly accepted and global carbon price in the upper range would be one of the essential components to realize this scenario.

On the savings side, this scenario foresees a gross savings ratio of 4.2: 1 to 4.7 : 1 and a net emission abatement of approximately 16 to 18.5 $GtCO_2e$ +/- 40 percent. This scenario is thus also reliant on a greater use of insulation, high-efficiency lighting, lignocellulosic (LC) ethanol, solar and wind energy components, and carbon capture and storage (CCS).

The chemical industry's incremental abatement (composed of both own emissions and product savings) between the above two scenarios is 4.7 $GtCO_2e$. This corresponds to 12 percent of the 38 $GtCO_2e$ abatement opportunity identified in the GHG abatement cost curve published by McKinsey & Company in February 2009. This number assumes, of course, that all opportunities for abatement within the sector are met, and that all opportunities for abatement across the other sectors described in this report are realized. But within the context of these two conditions, the study underlines the important role of the chemical industry in global GHG reductions.

Beyond the savings projected for the abatement scenario, numerous industry innovations currently under development could further increase the chemical industry's net abatement potential. In addition to the technological abatement measures provided by the chemical industry, other measures including changes in consumption pattern will be needed to achieve the longer term aim of absolute global GHG reductions. Such behavioral changes linked to different consumption patterns are beyond the scope of this study.

4. POLICY IMPLICATIONS : OPTIMIZING THE CHEMICAL INDUSTRY'S ABATEMENT POTENTIAL

The emissions saving potential identified in this study will not materialize without effective policy and regulation. ICCA suggests the following guiding principles for consideration when devising policies directed towards a low-carbon economy:

- Develop a **global carbon framework** to accelerate GHG reductions, avoid market distortions and minimize carbon leakage[3];
- Focus first on the **largest, most effective, and lowest cost abatement opportunitiess**;
- Push for **energy efficiency,** as this is one of the largest and most cost efficient sources of CO_2e abatement, by providing incentives for the use of energy savings products and materials such as insulation;
- Support the development of **new technologies** that reduce energy consumption and abate CO_2e including new catalysts, new syntheses, process intensification & integration, use of Combined Heat and Power (CHP), and Carbon Capture and Storage (CCS). A portfolio of technology development initiatives will need to be accelerated, which will require public support and financing. This is most important during the research and demonstration phases. As technologies are commercialized, financial support should be reduced and finally removed to allow the market to work effectively;
- Support the development of the most efficient and **sustainable use of available feedstocks and energy** for the production of chemicals in conjunction with the development of the above mentioned process emission abatement technologies;
- Allow markets to incentivize fast action by **rewarding early movers** that proactively reduce their CO_2e footprint;
- Support the development of new technologies and practices that ensure the **most efficient and sustainable disposal, recovery and recycling** options are implemented;

2 Carbon leakage is the migration of production into non-regulated regions with higher production footprints, or substitution by less stringently regulated products with higher CO_2e footprints.

- Support a **technology cooperation mechanism** for the transfer, sharing and funding of abatement technology between developed and developing countries;
- Design the implementation of the above mentioned measures to complement a future carbon framework. The goal must be to produce GHG intensive products – taking the whole production value chain into account – as carbon efficiently as possible irrespective of the location. This future carbon framework should be designed to ensure this happens as cost effectively as possible;
- As the global framework is being developed, local policy should ensure that carbon burdens do not apply unilaterally within their regions thus avoiding market distortions and unintended consequences such as carbon leakage.