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WORKING PAPER 06/2014

Sustainable assessment of chemical industries for policy advice

The case of the Philippines, Thailand, Indonesia and Viet Nam

INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

RESEARCH, STATISTICS AND INDUSTRIAL POLICY BRANCH
WORKING PAPER 06/2014

Sustainable assessment of chemical industries for policy advice

The case of the Philippines, Thailand, Indonesia and Viet Nam

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1. Introduction

Over the past decades, globalization and industrial development have fostered high economic growth in several emerging countries in the ASEAN region. Since 1990, the region's GDP has grown more than 5 percent annually, much faster than the world's average of around 3 percent. Unfortunately, this economic growth was coupled with a rapid rise in energy demand, high natural resources use as well as environmental degradation.

In order to meet energy and material demand for development and to ensure that pollutants and unsustainable resource consumption decrease in total terms, economic growth must be decoupled from environmental impacts. This can be achieved by applying an integrated framework to support the greening of industries, consisting of industry-led initiatives, adoption of best practice technologies, market-based policy instruments and regulations, backed by political support and information flow. However, more often than not, the rule of the game is damage limitation in the pursuit of continued economic growth.

This report presents a new methodology that aims to provide an effective assessment of industries in an effort to provide an adequate analysis to inform policymaking. It hence focuses on the chemical industry in five ASEAN countries, namely Indonesia, Malaysia, the Philippines, Thailand and Viet Nam.

That "manufacturing" is the engine of growth is a commonly heard slogan. The internationally acclaimed Cambridge economist Ha-Joon Chang devotes one full section to the importance of manufacturing for economic growth in his book. He claims: *"History has repeatedly shown that the single most important thing that distinguishes rich countries from poor ones is basically their higher capabilities in manufacturing, where productivity is generally higher, and, most importantly, where productivity tends to (although does not always) grow faster than in agriculture and services" (Chang, 2007:213).* Hence, the case for industrial policy remains strong and is becoming stronger yet with technological change and globalization (Lall, 2003) as a means to attain the full potential of manufacturing sector growth in any country.

Industrial development depends on the international context, which is changing rapidly, and is driven by globalization, liberalization and technological change. Specifically, it is characterized by tighter linkages within global value chains based on close coordination between national and international actors within integrated systems. The success of national industries thus increasingly depends on a countries' ability to be engaged in industries which are dynamic, fast growing and have high returns. On the other hand, the national context also plays a role. On the supply side, the fundamental changes that take place in any economy can, to a large degree, be

associated with the changes in a country's factor endowment, which entails differences between countries in terms of labour and capital stock. At the static level, this notion implies that a country must align its productive capacities and labour with its current endowment structures. At the dynamic level, this notion suggests that countries that excel in the production of goods as services, which are in line with their endowment, can accumulate capital and knowledge and thereby change and improve their endowment structures.

1.1 Industrialization in the context of a prospective AEC

Founded in 1967, the Association of Southeast Asian Nations (ASEAN) promotes economic and political cooperation between member countries in East Asia, thereby facilitating their interaction with the rest of the world. Following the Bali Concord II in 2003, the formation of an ASEAN Economic Community (AEC) was deemed the end goal of regional economic integration. Transforming ASEAN into a single market and production base by 2015, achieving the free movement of goods, services, investment, skilled labour and a freer flow of capital within the region, lies at the heart of the AEC concept.

The formation of AEC opens up a plethora of opportunities and challenges for various industries. We list a few in this section.

The most ostensible opportunity is the enhanced market, which comprises over 600 million people. Over the period of 1998-2012, the ASEAN's average economic growth was 5.9 percent, which exceeds that of most other regional blocks, signifying the ASEAN market's expanding purchasing power. Unfortunately, the desk study and fieldwork revealed insufficient information data availability on air emission control tools, techniques, education programmes or best practices in the chemical industry that are shared across authorities, industry and locals, and it is therefore not possible to make any statements on energy-related education in Viet Nam.

- Cheaper raw materials: most industries can tap into the cheaper raw materials stock available elsewhere in the AEC. ASEAN is rich in natural resources, for instance, ASEAN possesses over 40 percent of the oil and gas resources of the Asia-Pacific. This, too, will enable industries to find cheaper and consistent supplies of resources.

- Reduction in production costs: in addition to cheaper raw materials, industries can further reduce their costs through improved logistics, a reduction in tariffs and formalities. A McKinsey research report (2004) finds that firms in the electronic goods industry have been able to cut up to 20 percent of their costs due to the establishment of AEC. The report also finds similar cost reductions for other industries as well.

- Increased competition: all industries must brace themselves for more competition. Firms not only have to compete with their counterparts in other ASEAN economies, but with foreign counterparts as well, as the formation of AEC makes the region a more lucrative market.

- Increased flow of foreign investments: Charumanee (2012) predicts that the formation of AEC will result in an increased flow of foreign investments to the region. This will definitely have an impact on the region's industrial landscape.

The former Secretary General of ASEAN[1] correctly identified its three strengths "We (ASEAN) have abundant natural resources in our region. We have large supplies of professionals and talented people. And, we have the capability to adopt, adapt and advance technology." Effective industrial policy is necessary to capitalize on these strengths and adapt to the opportunities and challenges the AEC brings. This includes, but is not limited to, improving hard and soft infrastructure to reduce logistic barriers, providing capacity building of domestic firms, channelling skills development to cater to industries and creating opportunities for those rendered unemployed due to increased competition. We provide certain guidelines on such policy measures in this report to ensure the sustainability of the ASEAN industrialization strategy.

1.2 Profile of the chemical industry

The profiling of the chemical industry under ISIC Rev 3.1 covers the manufacture of basic chemicals and chemical products and that of man-made fibres. This division is based on the transformation of organic and inorganic raw materials by a chemical process and the formation of products. It distinguishes the production of basic chemicals, which comprises the first industry group, from the production of intermediate and end products, which requires further processing of basic chemicals and comprises the remaining industries.

[1] Remarks by H.E. Ong Keng Yong, Secretary General of ASEAN, at the ASEAN Gala Dinner, London, 4 December 2006.

Table 1 Chemical industry classification

ISIC Rev.3.1 code 24: Manufacture of chemicals and chemical products

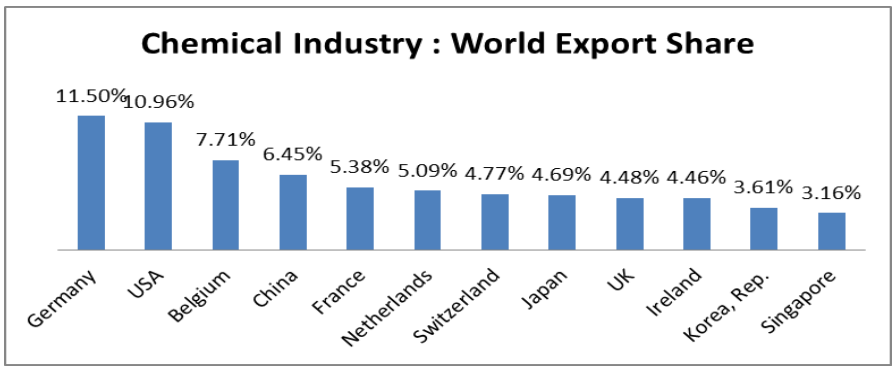
- 241 - Manufacture of basic chemicals
  - 2411 - Manufacture of basic chemicals, except fertilizers and nitrogen compounds
  - 2412 - Manufacture of fertilizers and nitrogen compounds
  - 2413 - Manufacture of plastics in primary forms and of synthetic rubber
- 242 - Manufacture of other chemical products
  - 2421 - Manufacture of pesticides and other agrochemical products
  - 2422 - Manufacture of paints, varnishes and similar coatings, printing ink and mastics
  - 2423 - Manufacture of pharmaceuticals, medicinal chemicals and botanical products
  - 2424 - Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
  - 2429 - Manufacture of other chemical products n.e.c.
- 243 - Manufacture of man-made fibres
  - 2430 - Manufacture of man-made fibres

1.3 An overview of the global chemical industry

The chemical industry has been on a path of continuous expansion, with production spreading to new destinations and products becoming increasingly diverse. Valued at US$ 171 billion in 1970, the industry's gross output grew to US$ 4.12 trillion by 2010[2], with over 10,000 product varieties. Looking at the global export of chemicals, Germany, USA and Belgium emerge as the top exporters with a market share ranging from 7.7 percent to 11.5 percent, but the position of developing countries in the production ladder, such as China, India and Brazil, is continuously climbing, with China already claiming 6.45 percent of international chemical trade. The top exporters in the chemical industry and their market share are presented in Figure 1. The emergence of new producers and new product lines make the chemical industry particularly dynamic.

[2] UNEP (2012).

Figure 1 Chemical industry



Source: Author's calculation using the WITS-COMTRADE dataset for 2011

The Asian region has been the chief driver of growth in the chemical industry in the last 25 years with nearly 50 percent of global sales already taking place in the region[3]. In 2010, 43 percent of the global chemicals market value was produced by Asia and the region is expected to expand this share to 60 percent by 2030, which will coincide with the global chemical industry doubling its turnover[4]. The presence of huge and expanding domestic markets lends distinct locational advantages to most Asian producers. At the same time, many major global players have already established their presence in Asia; this trend is expected to intensify in the near future, making the Asian market highly competitive. The upstream chemical industry is the most important in the value chain as it provides all the synthetic materials needed for further processing. The Asian chemical industry is in a growing stage and is expected to continue to grow in the next decade. Production capacities are expanding due to the high interlinkages in the economy, with chemical products serving as inputs to other industries and the growing domestic market being characterized by increasing spending power. There is thus a strong focus in Asian countries on the growing domestic market.

The chemicals industry is one of the most regulated industries in the world, a natural consequence of its potential adverse impact on the environment throughout its production value chain. In the UNEP report titled 'Priority products and materials: Assessing the environmental impacts of consumption and production', which assesses and ranks different product categories based on their environmental impact, the figures for the chemical industry rank high on the list. To address the challenge complex chemicals and associated chemical waste pose, the Johannesburg Plan of Implementation adopted at the World Summit on Sustainable Development 2002 sets out the target that 'by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the

[3] ATKearney (2012).
[4] Roland Berger Consulting (2011).

environment'[5]. To achieve this objective, there is an urgent need to heighten efforts to minimize the environmental impact of the domestic chemicals industry within national policy frameworks. This is particularly relevant for ASEAN countries whose chemicals industries are ready to commence on an expansive future path.

2 Economic analysis

2.1 Introduction/conceptual framework

To effectively design appropriate industrial policies, governments in developing countries must be aware of their competitive position in comparison to other countries and the rest of the world, given the current domestic and global demand trends. It is equally important for countries to understand the domestic factors and conditions that impact their competitive position. Such analysis not only benefits governments, but also the private sector as it provides the information on which strategic decisions can be based.

Global integration through international trade and capital flows are the cornerstones of modern economics. If an economy is to become competitive and to develop, it will need to actively engage in trade with other economies –economies that can rely on catering to their domestic markets only are few in number. In other words, it is important for a country to identify products and industries that are:

- in line with its current endowment structures;
- growing dynamically at the global level due to current and future consumption trends.

The former represents the supply side of our analysis, i.e. the core competencies of a country, and the latter represents the demand side of our analysis, i.e. whether there is a growing market for the products of specific industries.

Understanding supply side constraints relates to understanding a country's comparative advantage, which is defined by its endowment structures. According to former chief economist of the World Bank, Justin Lin, a country's factor endowment entails differences between countries in terms of labour and capital endowments as well as between countries' ability to create the necessary capabilities based on those endowments (Lin, 2011, 2012). These in turn determine what products countries are able to produce. His theory builds on an integrated approach, which emphasizes the role of markets for resource allocation, on the one side, and the government's role in actively coordinating investments for industrial upgrading and

[5] Johannesburg Plan of Implementation, Chapter III, para. 23.

diversification, on the other, as well as in compensating for externalities generated by first movers in the dynamic growth process.

One cannot look independently at the supply side of the coin and continue to produce goods that are declining in terms of demand. Demand is driven by the international and domestic markets. Some industries, such as food and beverages or construction materials, are inherently more geared towards domestic market demand, while others focus more on the international market. Products are increasingly becoming more complex, dependent on intermediate goods, which in turn rely on further intermediate goods. The production of final goods is increasingly becoming intrinsically linked to their degree of reliance on intermediate goods along their supply chain. Consumption patterns and thus demand, whether domestic or international, affect the growth of industries that produce intermediate as well as final goods. The entire value chain is influenced by consumption and it is therefore important for an economy to identify the growing industries in terms of international and domestic demand both for final as well as for intermediate goods.

Consolidating these two aspects to develop a rigorous approach for industry selection is a challenging task, but may be paramount for a country to successfully undergo structural transformation from poorly performing industries to dynamic ones, which generate high value added and provide sufficient employment opportunities without damaging the environment.[6]

This opens up the following questions:

- **On the demand side:** Which are the dynamically growing industries at the global level? What is a country's weight in globally growing industries and how has its position changed compared to a decade ago? Can these industries also cater to domestic demand?

- **On the supply side:** Are these industries in line with the country's comparative advantage and its endowment structures? Does the development of selected industries guarantee positive spillovers to other industries of an economy through the supply linkages?

These two aspects represent the basis of the analysis framework presented in this report.

[6] In UNIDO, this approach is referred to as the "3 E's" ("economy, employment and environment").

2.2 Economic methodological considerations

Some important economic methodological considerations need to be outlined:

- *Use of quantitative and transparent data.* This report does not rely on business perceptions to assess countries' industrial competitiveness. Notwithstanding their usefulness, perception-based surveys generate partial indicators for inter-country comparisons, as the views of individuals and companies are shaped not only by objective circumstances, but by subjective and context sensitive factors as well. UNIDO's methodology relies on a number of carefully selected, objective, outcome-based indicators published by international organizations. Although quantitative indicators will never be perfect proxies of what they intend to measure, they provide a solid foundation for inter-country analyses.

- *Analysis of levels and trends.* The report assesses countries' industrial performance as well as the overall trends for a specific period. Such an analysis is particularly useful for countries experiencing high levels of growth and which have not yet achieved the rates of development typical of industrialized countries. The analysis covers the period 2000–2009 for all countries.

- *Macro and sectoral analysis.* Macro analysis provides a general overview of a country's industrial competitiveness vis-à-vis other countries. By using UNIDO's methodology, the report combines macro with sectoral analysis, enabling policymakers to establish realistic and applied parameters. The depth of sectoral analysis depends on various factors, including data availability and the objective of the study. The report analyses sectoral performance at the 2-digit level in SITC revision 3 and ISIC revision 3.

- Data

  - *Value added data source.* Value added is defined as the return to factors of production. It is the difference between total output and total operating costs incurred in the production of goods, where total operating costs refers to the sum of total materials and operating costs. This data can be obtained from INDSTAT. The major limitation of INDSTAT is the limited industry, country and year coverage. Data for a given country for a number of years in a specific industry might be missing. Another limitation of the INDSTAT data relates to the fact that some countries report data as a combination of two or more 2-digit ISIC categories – this requires us to aggregate the data, which can result in a loss of relevant information, which we would otherwise obtain at a more disaggregated level. Moreover, the source of valued added data for the 2-digit ISC categories derives from

industrial surveys, which only include a representative subset of all the firms operating within that industry.

- Export data source. Export data was obtained from UN Comtrade. It covers international trade data and is quite extensive in terms of product, industry, country and time coverage. The data provides a detailed overview of trade patterns at a global and country level for selected industries or products. UN Comtrade data has two crucial limitations. First, data are reported in nominal terms: this means that data are not adjusted for inflation and might therefore show a distorted picture in terms of actual trade performance, which could be either underestimated or overestimated, depending on the country in question. Secondly, all trade data are output data: this means that we cannot determine the true value addition of a country's trade performance, as we are also accounting for intermediate input, which covers: (a) the value of materials and supplies for production (including the cost of all fuel and purchased electricity); and (b) the cost of industrial services received (mainly payments for contract and commission work and repair and maintenance work).

- Input-output tables. Input-output tables capture the most important financial transactions between different industries and consumers within an economy. They provide an overview of the whole economy along the production and supply chain to intermediate and final use. Input-output tables can be obtained at the national and international level. In this paper, we use input-output tables at the international level. One of the major limitations of input-output tables are that they are disaggregated at the sectoral level and not at the product level, which can result in omissions of some of the most important interdependencies.

2.3 Economic assessment

2.3.1 Analysis of exports

An industry's competitiveness can be assessed by analysing its world export share, along with the international dynamism and demand for the product (measured by the annual growth of the product in the world market). Our analysis covers a period of 11 years, from 2000 to 2011. To determine the industry's dynamism in the world market, we look at how the industry is growing in relation to the manufacturing average. We calculate the compound annual growth rates (CAGR) of the industry-specific exports and of the total manufacturing exports. Based on these results, we can determine whether an industry's exports of a given country are growing faster or slower than the average manufacturing export rate. Industries that are growing faster than the

average manufacturing export rate are considered to be dynamic, and those industries that grow slower than the average are considered to be static.

The share of manufacturing exports of the given country is then calculated for the period 2000 to 2011 to measure the country's impact on world demand for the products of that particular industry. The share of exports in world exports of a given industry indicates a country's competitive position relative to others in international markets. Gains in world market shares reflect improved competitiveness, while losses signal a deteriorating competitive position. This analysis provides us with a methodology for the classification of industries into four categories based on their export performance.

Champions: a champion export is a highly dynamic product, which grows above the average of world exports, with a world market share gain. Successful exporters tend to have an important number of champion exports, reflecting a country's ability to gain world market share in the most dynamic and demanded products;

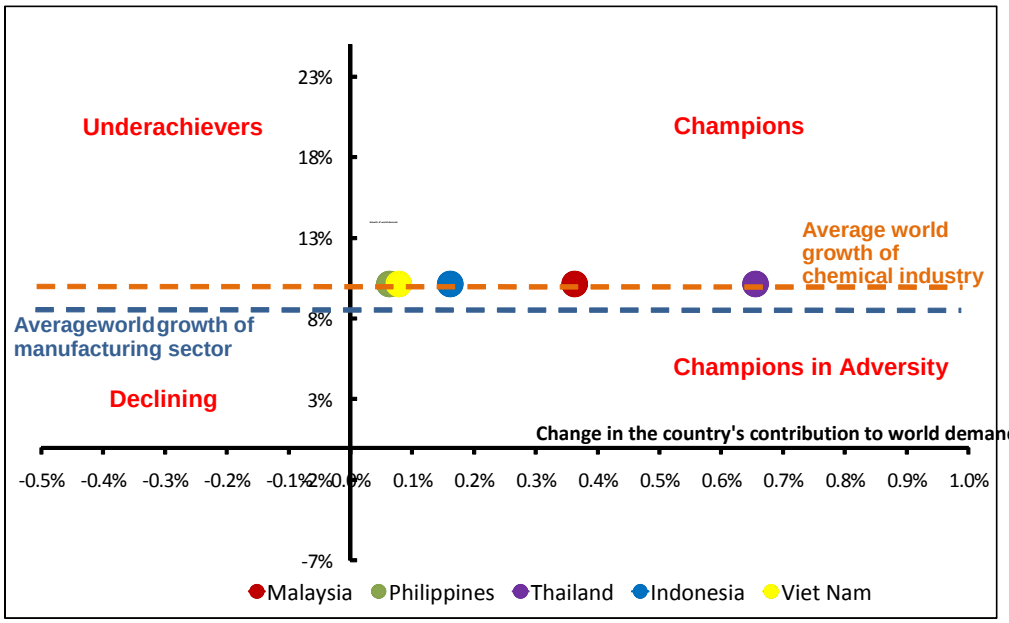
Underachievers: these exports are highly dynamic in world markets, but the country is losing world market share. Such exports are considered 'lost opportunities' as the country is failing to compete in fast growing products;

Champions in Adversity: overachiever exports are not very dynamic products — they grow below the average of world exports — and yet the country is gaining world market share. This tends to be a common feature of many resource-rich developing countries as their major exports see sluggish growth in world demand;

Decline: products from this group are slow growing exports in world markets where the country is losing world market share. It must be noted that it is not necessarily a bad sign for the country to have declining exports if they are balanced out by champion exports. This is indeed a feature of many industrialized countries that lose competitive edge in slow growing, labour-intensive exports while strengthening the position of high value added and technology-intensive exports.

Figure 2 classifies the chemicals industry into the four respective categories in the five ASEAN economies based on their export performance.

Figure 2 Analysis of export performance of the chemical industry



Manufacturing accounts for the bulk of world exports (78 percent in 2010), and is less exposed to external shocks, price fluctuations, climatic conditions and unfair competition policies. The price of manufactured goods tends to be more stable than that of commodities, as unfair competition policies have distorted prices around the world, limiting the potential for export growth in some commodities. Our figures also show that the growth in manufacturing exports is a sustained one, with an average global growth of 10 percent between 2000 and 2011.

At the global level, the chemicals industry has fared even better than the average manufacturing exports, with an average global growth in demand of 10 percent. This trend is set to continue with the industry establishing extensive upstream and downstream links with growing industries including agriculture and food manufacturing, construction, textiles, pharmaceuticals, metallurgy, plastics, etc., which the chemical industry provides both intermediate and final products to.

We also want to determine how the ASEAN region has responded to the increasing demand for chemical products. Between 2000 and 2011, Thailand held the largest share of the world's growing market for chemical products, with a growth of 0.66 percent in the world market. Malaysia and Indonesia follow with a growth of 0.36 percent and 0.16 percent, respectively. Viet Nam and the Philippines lag behind with only a minor increase of 0.08 percent and 0.06 percent, respectively.

Hence, the chemical industry is a "champion" industry in each of the countries examined in this report. Global demand for products from the chemicals industry has been growing at a higher rate than the average growth rate of the manufacturing sector on the whole, and all five countries increased their share in world exports from the chemicals industry over the respective time period.

2.3.2 Analysis of domestic demand

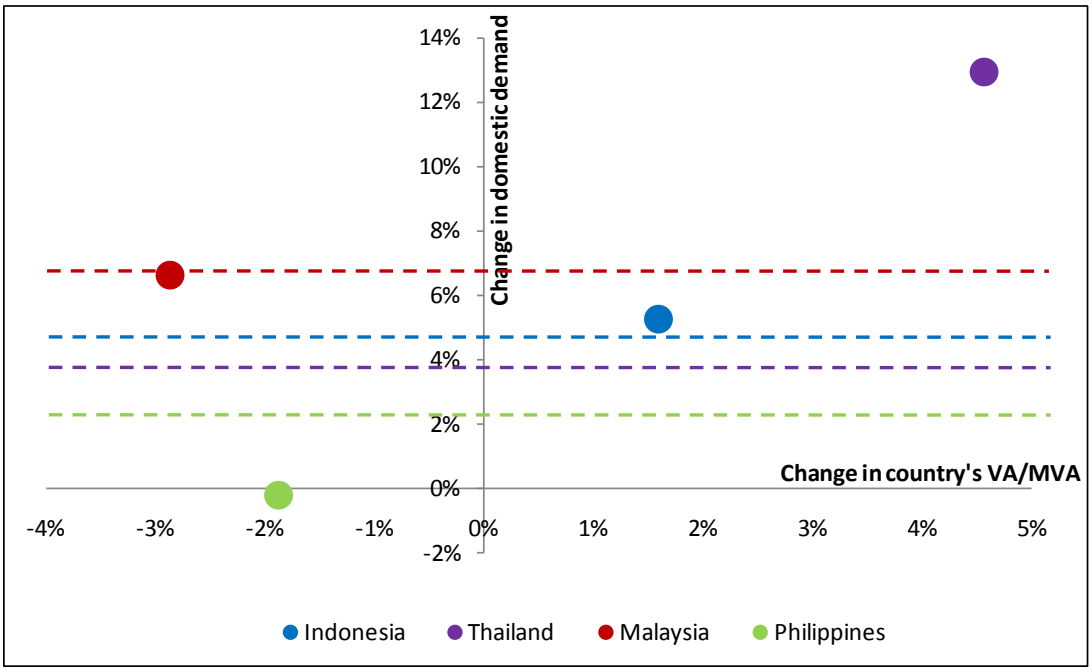
In the previous section, we analysed the chemical industry's performance with respect to the export performance dimension. In this section, we apply a similar analysis, but at the domestic level.

This section explores how local demand for products of the chemical industry grew over time and how the chemicals industry responded in terms of adjusting its production capacity. Furthermore, we track the development of domestic demand for products of the chemicals industry (measured by the industry's annual growth in the domestic market) relative to domestic demand for manufactured goods in general.

For this analysis, we use input-output tables to calculate the growth rate of domestic demand as the sum of intermediate and final demand for products of the chemical industry. Unfortunately, no input-output table was available for Viet Nam. Moreover, due to the reliance of our analysis on input-output tables, it covers a period of 10 years, from 1990 to 2000. We used INDSTAT data to determine the industry's value added.

To conduct the analyses, we created a graph (Figure 3) with the following description: the y axis indicates the changes in domestic demand for products of the chemicals industry and the x axis shows the changes in the value added of the chemical industry in the country's total manufactured value added. The dotted line represents the average domestic growth of the manufacturing sector demand during the same time period.

Figure 3 Domestic demand analysis



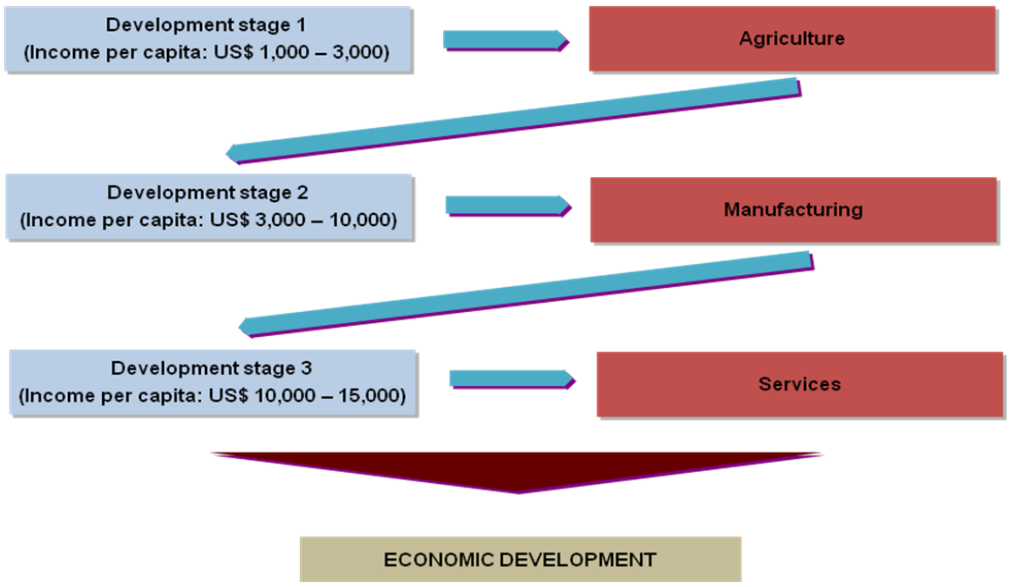
Those industries that registered a growth in demand relative to the manufacturing sector's average (i.e. above the dotted line) while simultaneously recording a positive change in the ratio of the industry's value added to total manufacturing value added, will be termed a 'local champion'. We find that the chemicals industry in Thailand and Indonesia emerges as a 'local champion'. Though the growth in domestic demand for products of the chemical industry is highest in Malaysia, the domestic industry did not increase its production capacity considerably (i.e. the share of the chemical industry's value added in total MVA declined), suggesting a possible import dependence to meet domestic demand. However, in contrast to Malaysia, Indonesia's chemical industry witnessed an increase (1.5 percent) in contribution to total manufacturing value added over the reporting period. Thailand experienced the highest increase in domestic demand and achieved the largest increase in the share of value added in total manufacturing value added. In the Philippines, the relative industrial capacity of the chemicals industry saw a decline in addition to stagnation in domestic demand.

2.3.3 Analysis of structural change

It is important to compare the evolution and performance of different manufacturing industries with that of other countries that are in a similar stage of economic development or with countries that have successfully transformed themselves through manufacturing growth and are therefore considered a role model. The structural change analysis presented in this section is used to conduct a comparative analysis. The analysis builds on a comparative advantage argument and is

based on the assumption that income level is associated with the country's endowment structure, which denotes differences between countries in terms of supply of labour and capital, as well as the necessary capabilities. These in turn determine what countries are able to produce and relate to structural change. If countries are able to perform well in industries that are aligned with their endowment structure, they can accumulate capital and their income per capita grows. The implication is that the country's endowment structure also changes as the country accumulates capital and its labour force acquires higher skills. As countries' endowments change, they move to more technologically sophisticated industries with higher capital intensity.

Figure 4 Mechanics of structural change



(GDP ranges are subject to change – this is just for illustrative purposes)

The figure above shows that in development stage 1 (which roughly corresponds to a GDP per capita range of between US$ 1,000 and 3,000), a country's endowment in terms of labour and capital is more aligned with agriculture. As countries grow in agriculture, they are able to move to the next development stage. The assumption is that during the growth of agriculture, countries begin investing in hard and soft infrastructure which changes the country's endowment structure, aligning it more with manufacturing and later with services.

We apply this logic to the manufacturing sector and demonstrate how manufacturing industries move through pre-takeoff, growth and decline at different income levels. It is assumed that more labour-intensive industries have higher growth rates at lower income levels and that they start declining as income grows, while more capital-intensive industries can sustain high growth rates over a longer income range.

We identified the income stage of selected ASEAN economies which have suitable industries given the countries' income level and analysed the industries' deviation from the benchmark patterns in the given industries, which we identified above.

The structural change assessment methodology is based on the following steps:

1. Step: Identification of relevant country groups with similar exogenous characteristics based on size, resource endowment and other relevant factors. Statistical testing indicates that three major groups share similar patterns of structural change:

    - Large countries: More than 12.5 million inhabitants
    - Medium countries: More than 3 million and less than 12.5 million inhabitants
    - Small countries: 3 million and less inhabitants.

All countries selected for this research fall into the large countries category.

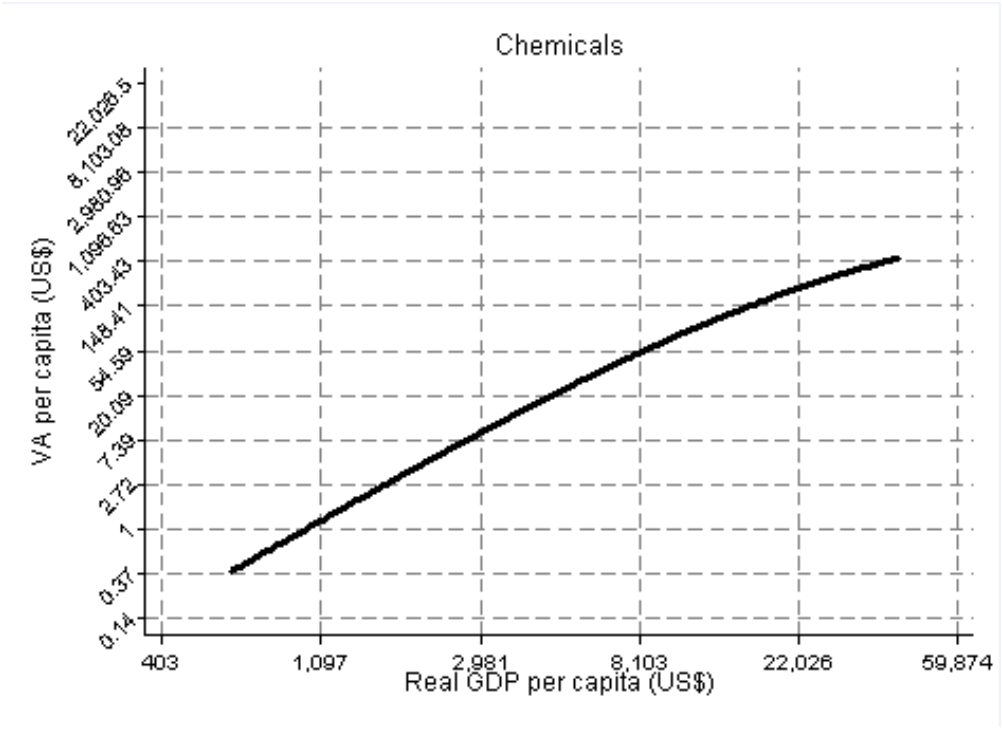
2. Step: Estimation of value added shares and growth patterns of manufacturing industries at different income levels (development stages) for the identified country groups using the following model:

$$\ln X_{ct}^{i} = \alpha_1 + \alpha_2 * \ln RGDP_{ct} + \alpha_3 * \ln RGDP_{ct}^2 + \alpha_4 * \ln RGDP_{ct}^3 + \alpha_c + e_{ct}^{i}$$

    - Where *X* stands for dependent variable: value added share in MVA and value added per capita.
    - It is assumed that industries move through three development stages—pre-takeoff, growth and decline—following a pattern of a cubic function. Therefore, we use the cubic functional form with real GDP per capita (PPP adjusted): *RGPD* as the independent variable.
    - α represents any unobserved effects attributable to country-specific conditions.
    - Both dependent and explanatory variables are expressed in logarithmic terms to measure the elasticity of each variable.

The resulting pattern for the chemicals industry is shown in the following figure.

Figure 5 Estimation of value added shares and growth patterns in the chemical industry



3. Step: Classify industries into early, middle and late industries. The 18 manufacturing industries covered in this report are classified into early, middle and late industries, depending on whether an industry reaches its highest share in total manufacturing value added before a GDP per capita of US$ 5,000, between US$ 5,000 and US$ 20,000 or after US$ 20,000, respectively.

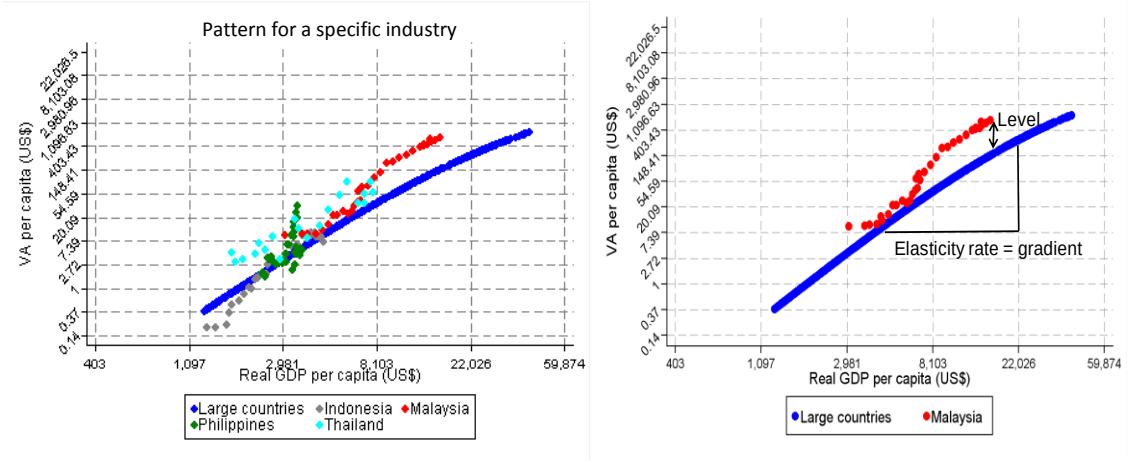
Given the income levels of the five selected ASEAN economies, we determine that the Philippines, with a real GDP per capita of US$ 4,790.58, and Viet Nam, with a real GDP per capita of US$ 3,742.71, have endowment structures that are more conducive to the development of early industries. Indonesia (real GDP per capita of US$ 5,185.75) and Thailand's (real GDP per capita of US$ 5,185.75) endowment structures are more conducive to the development of middle industries, while for Malaysia's endowment structure, with a real GDP per capita of US$ 1,789.27, is more conducive to late industries.

Table 2 Industry classification

Real GDP per capita (PPP adjusted) range in US$	Industry
Early industries - real GDP per capita (PPP adjusted): 0 - 5,000 US$	Food and beverages Tobacco Textiles Wearing apparel Wood products Printing and publishing Coke and refined petroleum Non-metallic minerals Furniture, n.e.c.
Middle industries - real GDP per capita (PPP adjusted): 5,000 - 20,000 US$	Paper Basic metals Fabricated metals Precision instruments
Late industries - real GDP per capita (PPP adjusted): 20,000 US$ and onward	Chemicals Rubber and plastic Machinery and equipment Electrical machinery and apparatus Motor vehicles

By plotting the time series data of individual countries for GDP and value added per capita on the same graph as that of their country group, we can compare the country's performance relative to the average benchmark of its country group in terms of levels and elasticity rates.

Figure 6 GDP per capita



The level difference is calculated by

$$D = VApc_{country,latest} - VApc_{benchmark,latest}$$

The elasticity rate is calculated by

$$E_i = \frac{\frac{VApc_{latest} - VApc_{initia}}{VApc_{initia}}}{\frac{GDPpc_{latest} - GDPpc_{initia}}{GDPpc_{initia}}}$$

Interpretation:

- If **E>1,** the industry is growing faster than the economy
- If **1> E>0**, the industry is growing, yet slower than the economy
- If **E<0**, the industry is declining.

This methodology could only be applied to the chemicals industry of four of the five countries reporting our study, since long time series data were not available for Viet Nam. On the other hand, the Republic of Korea was included in our analysis as a "role model" in the region against which to benchmark performance other than the average of all "large countries". The analysis was also limited to the time period for which data was available for the different countries.

Table 3 Level of difference in VA per capita

Country	Last year of available data	For last year of available data (measurement point of level)			Level difference (VApc in US$)
		GDP per capita (PPP adjusted) in US$	Country's VApc in US$	Country group's VApc in US$	
Indonesia	2003	4607	17	21	-3
Malaysia	2004	15875	128	155	-27
Philippines	1996	3481	25	12	13
Thailand	2002	7528	41	49	-8
Republic of Korea	2004	21332	677	210	467

Table 3 analyses the level difference in the value addition per capita of each country with that of its respective country group. In terms of levels, we find that for the last year of analysis, none of the countries deviated much from the benchmark average of "large countries". By contrast, the value addition per capita of the "role model" country (the Republic of Korea) was found to be much higher than the benchmark average by US$ 467 per capita.

In the time series analysis illustrated in Figure 7, the average growth rates of the chemicals industry for Indonesia and the Republic of Korea were found to be significantly higher than that of the benchmark average of "large countries". During this period, the Republic of Korea maintained a constant growth rate, while Indonesia started at a significantly lower value added per capita level, but evened out its industry's performance to the benchmark average of "large countries" according to the last year of available data (2003). The chemical industries of Malaysia, Thailand and the Philippines all had an elasticity rate that was relatively close to the benchmark average of "large countries". Indonesia and the Republic of Korea, on the other hand, registered considerably higher elasticity rates in comparison with their country group average.

Figure 7 **Average growth rates of the chemical industry**

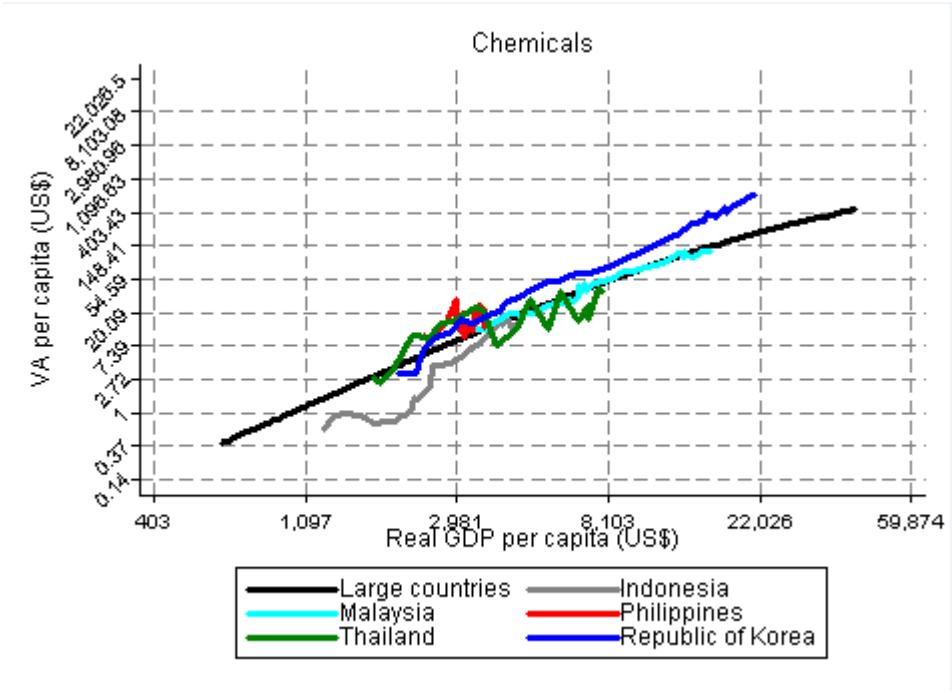


Table 4 **Elasticity rates**

		Time period analysis of elasticity rates		
	Time period analysed	**GDP per capita (PPP adjusted) range in US$**	**Elasticity rates of industry in country**	**Elasticity rates of industry in country group**
Indonesia	1970 – 2003	1236 - 4607	10	4
Malaysia	1970 – 2004	3041 - 15875	2	4
Philippines	1963 – 1996	2396 - 3481	3	2
Thailand	1968 – 2002	1712 - 7528	4	4
Republic of Korea	1968 – 2004	2599 – 21332	9	4

2.3.4 Analysis of interdependence of industrial sectors

In addition to the above analysis, we seek to examine the impact of the chemical industry on other manufacturing industries in the country. Which production linkages exist among manufacturing industries, or whether any interdependencies between the manufacturing industries exist at all is of crucial significance with regard to policy purposes.

Defining these linkages and their changes over time is only possible using input-output tables, which contain a detailed account of the economic structure in terms of demand and supply at the sub-industry level. Flows from one industry to another within the country can be examined as well as inter-industry flows between one country and another.

Table 5 presents manufacturing linkages. The calculations are based on backward linkages. Backward linkages exist when the growth of an industry leads to the growth of the industries that supply it. Hence, the values in Table 5 indicate how much an increase of US$ 1 in the respective industries' output would increase demand for inputs from all other manufacturing industries, including both direct and indirect effects. Direct effects are purchases of resources (inputs) by an industry from all industries to produce one unit of output. Indirect effects are purchases of inputs by an industry that influence the growth of another industry which in turn influences yet another industry. There can be multiple chains of indirect linkages.

All manufacturing industries are complementary, and not a single industry has a negative effect on the manufacturing sector as a result of its own growth. However, what we do notice is that some industries have a bigger impact than others on the growth of the manufacturing sector as a whole.

By contrasting the individual linkages with the average, it is possible to determine which industries have higher than average linkages and are therefore more likely to generate higher than average spillovers to the rest of economy. Industries with above average interlinkages are classified as 'high impact' industries. In Table 5, we highlight the 'high impact' industries in each country in yellow. The chemical industry emerges as a high impact industry in Malaysia, the Philippines and Thailand, where a unit increase in the chemicals industry would trigger an increase of 0.15, 0.11 and 0.13, respectively, in the countries' manufacturing sectors on the whole.

Table 5 High impact sectors

	Indonesia	Malaysia	Philippines	Thailand
Food, beverages and tobacco	1.18	1.19	1.18	1.18
Textiles, leather and their products	1.15	1.12	1.08	1.16
Lumber and wood products	1.17	1.16	1.13	1.10
Pulp, paper and printing	1.12	1.12	1.09	1.10
Chemical products	1.13	1.15	1.11	1.13
Petroleum and its products	1.10	1.14	1.04	1.03
Rubber products	1.13	1.15	1.06	1.17
Non-metallic mineral products	1.15	1.14	1.16	1.14
Metal products	1.15	1.09	1.11	1.09
Machinery	1.12	1.06	1.04	1.07
Transport equipment	1.14	1.10	1.13	1.11
Other manufacturing products	1.13	1.10	1.06	1.12
Average	**1.14**	**1.13**	**1.10**	**1.12**

All highlighted sectors are 'high impact' sectors.

2.3.5 Macroeconomic linkages

It is important to analyse the macroeconomic position of each industry. We do this by looking at the industries' contribution to exports, manufacturing value added and employment. Table 6 provides the data necessary for such a macroeconomic linkage analysis of the chemicals industry in the five ASEAN countries.

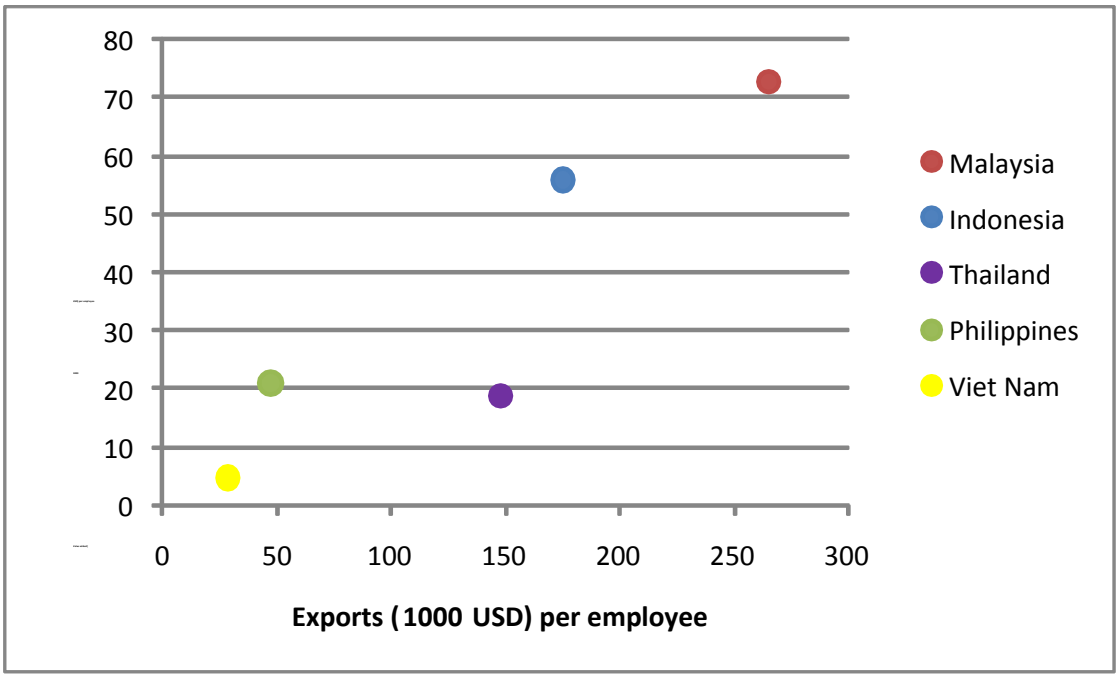
In Thailand, the chemical industry accounted for 11 percent of the country's total manufacturing exports (23 billion USD) but only 6 percent of the country's value added share (2.93 billion USD). Such a phenomenon is typical of an industry with resource-based manufactured products which have a high inherited value content, such as phosphate and gypsum-based chemical fertilizers. Thailand is also rich in gypsum and fluorite, which is a raw material for the basic chemical industry. An exports value that is higher than the value added is also common in industries in which multi-nationals operate an export platform by importing intermediate goods, adding minimal value and re-exporting the goods, such as packaging of pharmaceutical goods. This also appears to be the case, albeit to a lesser extent, in Indonesia with 11 percent of the country's total manufacturing exports (US$ 13.29 billion) but only 7 percent of the country's value added share (US$ 4.25 billion). In Malaysia, the chemical industry accounts for a larger share of the country's manufacturing value added (12 percent, US$ 5.03 billion) than that of

manufacturing exports (10 percent, US$ 18.31 billion). The same is true for Viet Nam and the Philippines, but to a much lesser extent.

Table 6 Industry profile for 2011

	Country's chemical industry exports (billion USD)	Chemical industry's share in country's manufac-turing exports (%)	Country's VA from chemical industry (billion USD)	Chemical industry's share in country's manufac-tured value added (%)	Country's employment in chemical industry (1000 of people)	Chemical industry's share in country's manufactured employment (%)
Thailand	22.94	11	2.93	6	155	4
Indonesia	13.29	11	4.25	7	76	2
Malaysia	18.31	10	5.03	12	69	4
Philippines	1.89	6	0.84	6	40	4
Viet Nam	1.617	3	0.27	6	57	4

Figure 8 Value added per employee in the chemical industry



The chemical industry accounts for about 4 percent of total manufacturing employment in the majority of countries considered here, except in Indonesia, where it is 2 percent. The chemical industry in Thailand employs the highest number of workers, but is not the most labour-intensive, which is claimed by Viet Nam with low exports and value addition per employee. At the other end of the spectrum, Malaysia displays the highest labour productivity both in terms of exports and value added. The country's high exports and value addition per employee is attributable to the vertical integration of the industry within the economy, whereby intermediate goods downstream in the value chain are sourced from within the country itself. This is the case in the chemical industry due to the operation of a cracker plant in Indonesia. The country is well on its way to achieving high exports value and high value addition per employee for its chemical industry.

2.3.6 Country level summary of the economic analyses of the chemical industry

1. **Indonesia**

    - The chemical industry emerges as a champion industry in terms of exports. It is a dynamic industry in the world market and Indonesia has been expanding its world market share.

    - The chemical industry emerges as a 'local champion' in terms of domestic demand. Indonesia was able to improve its local production capacity in response to increased local demand for chemical products.

    - Even though Indonesia's value added per capita is lower than that of the country group average, the elasticity rate of the industry's value added per capita with respect to GDP growth per capita has been quite high (even higher than that of the role model country). This indicates the expansionary momentum of the industry.

    - In terms of domestic demand, the industry displayed linkage effects that are marginally lower than those of the manufacturing average.

2. **Malaysia**

    - The chemical sector emerges as a champion industry in terms of exports. It is a dynamic sector in the world market and the country has been expanding its world market share.

- Although domestic demand for products of the chemical industry increased at a rate proportional to that of the manufacturing average, the chemical industry did not increase its capacity relative to manufacturing's overall capacity (measured by industry VA /total MVA). This could indicate increased dependence on imports.

- Malaysia's value added per capita is lower than that of the country group average; at the same time, the elasticity rate of the industry's value added per capita with respect to GDP growth per capita is lower than the country group average, which implies that the value added per capita will in future drop further than the country group average.

- In terms of domestic demand, the industry displayed linkage effects that are higher than those of the manufacturing average, hence, the chemical industry emerges as a 'high impact' industry.

3. The Philippines

- The chemical industry emerges as a champion industry in terms of exports. It is a dynamic industry in the world market and the country has been expanding its world market share.

- In terms of domestic demand, the demand for products of the chemical industry increased at a rate lower than that of the manufacturing average, and the country's domestic chemical industry decreased its capacity relative to that of overall manufacturing (measured by industry VA /total MVA).

- The Philippines's value added per capita is higher than that of the country group average, at the same time, the elasticity rate of the industry's value added per capita with respect to GDP growth per capita has been marginally higher than the country group average, which implies that the value added per capital will in future increase further than the country group average.

- In terms of domestic demand, the industry displayed linkage effects that are marginally higher than those of the manufacturing average, hence, the chemical industry emerges as a 'high impact' industry.

4. **Thailand**

- The chemical industry emerges as a champion industry in terms of exports. It is a dynamic sector in the world market and the country has been expanding its world market share.

- In terms of domestic demand, demand for products of the chemical industry increased at a rate that is much higher than that of the manufacturing average, and the country's domestic chemical industry increased its capacity relative to that of overall manufacturing (measured by industry VA /total MVA).

- Thailand's value added per capita is marginally lower than that of the country group average, while the elasticity rate of the industry's value added per capita with respect to GDP growth per capita is similar to that of the country group average.

- In terms of domestic demand, the industry displayed linkage effects that are marginally higher than those of the manufacturing average, hence, the chemical industry emerges as a 'high impact' industry.

5. **Viet Nam**

- The chemical industry emerges as a champion industry in terms of exports. It is a dynamic sector in the world market and the country has been expanding its world market share.

- Unfortunately, due to the lack of available data, we were not able to conduct further economic analyses of Viet Nam's chemical industry.

2.4 Limitation of economic methodologies

Analysis of exports

- The methodology is useful to analyse industries that are already exporting. It does not take into account potential industries that are producing goods but are currently not exporting them. This means that only existing industries are considered, but not new ones.

- The methodology does not take into account the diversity of the industries. In cases in which the products of an industry are very diverse, variations in the performance of

these products are expected relative to the average world growth of the manufacturing sector.

Analysis of domestic demand:

- Since it is not possible to identify the types of products for which there is growing domestic demand when using this analysis, we cannot determine whether the country is importing more intermediates or more finished goods.

- It is also not possible to determine the share of an industry's manufacturing output that ends up on the domestic market when using this analysis.

Analysis of structural change

- This analysis is based on benchmarking a country's performance against the average of countries with the same endowment structure. This methodology is criticized on two issues. First, the fact that a country's endowment structure is determined based solely on income per capita, and secondly, that it implicitly sets the bar against the average performance of a given country's country group rather than against the performance of a country in which the respective industry has excelled. This also raises the question whether a recommendation should at all be made for countries to have a lower share in a given industry and a higher share in another based on the average of the countries in their country group. This analysis is therefore only used as a reference tool, not one from which any recommendations are derived.

- In addition to factor endowments, historical and socio-political factors, which can have an impact on a country's competitiveness, are not accounted for in this methodology.

Analysis of interdependence of industries

In one of his early papers, Carl F. Christ (1955) points out two major assumptions in input-output analysis. These assumptions are still applicable today.

- Constant returns to scale: this assumption is contested on the grounds that functions are more complex and that production processes cannot be realistically described using simple proportions.

- No substitution of inputs in the production of any good or service is possible. According to Carl F. Christ, "the second assumption is sufficient to exclude any optimizing from the supply side, because it excludes all choice about the proportions in which inputs are

to be combined in the production of a given output. With such production function, all inputs are perfect complements" (p. 140).

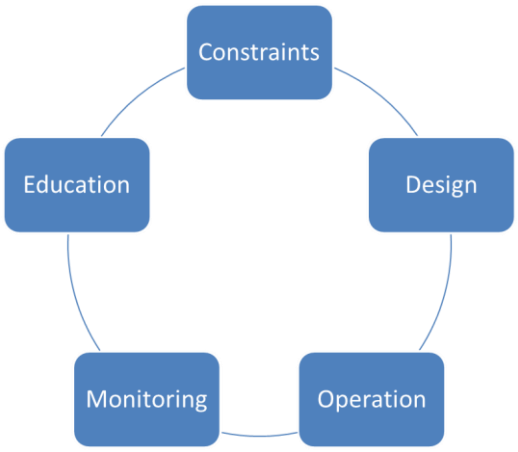
3 Environmental and social analysis

3.1 Introduction and conceptual framework

The five enabling abilities framework for analysing manufacturing processes

The structure of this analysis goes beyond the typical simple measurement of the scale of any environmental or social issues. For each of the six dimensions of environmental and social performance—energy supply, water supply, emissions to air, emissions to water, solid waste and labour—we analyse data across all five enabling abilities (where data are available). The five enabling abilities are 1) constraints, 2) planning, 3) operation, 4) monitoring and 5) education. They provide a framework to identify aspects of performance that may strongly influence the future ability to manage that aspect. For example, a country may currently be outperforming its total capacity to deliver water, but a poor score in constraints, planning and education would help identify a future water challenge for industry before it actually occurs. To understand the environmental and social dimensions in detail, we have to explore the five enabling abilities individually rather than characterize the entire industry using a single parameter.

Figure 9 **Five enabling abilities framework**



This more granular approach enables us to identify the potential for future problems, as well as the specific abilities that strongly influence a given country's manufacturing sector. It should be noted that these enabling abilities are interdependent. Manufacturing's five enabling abilities are defined below:

- **Constraint of systems**

The ability of industry X to understand current and future constraints: This ability relates to knowledge. Competent industries will understand how close they are currently operating at the limit of the natural system they are part of, and are able to extend this knowledge into the future to get an idea of how close they will be operating at the limit if a planned expansion or changes occur. This includes a need to understand system limits, which is often provided by the government, NGOs or trade bodies. Limits may be national or watershed, physical or legislative or mandated by customers; hence, awareness of limits is complex and a pre-requisite for analysis and planning.

- **Planning of systems (design of systems)**

The ability of industry X to develop a plan for a sustainable future: This ability relates to the effectiveness of those institutional mechanisms that bring together the many actors necessary for effective action. Solutions are developed and implemented by multiple actors, for example, the government issues pollution regulations which address industry and are monitored by NGOs or government bodies and felt by the local population. The solutions designed must be sensible and workable. This enabling ability is crucial for complex interactive systems.

- **Operation of systems**

The ability of industry X to deliver current value within current national limits: This enabling ability relates to an industry's current situation and its performance in terms f delivering an industrial system that can operate within the current limits. It emphasizes proximity to actual limits. If the industry is currently producing beyond its limits, expansion will be much more challenging. Equally, demonstrating competence at producing within current limits is a good indicator of the industry's ability to continue operating within the limits in future.

- **Monitoring of systems**

The ability of industry X to assess its own performance:

This enabling ability relates to the institutional mechanisms that exist for monitoring, measuring and enforcing performance. These consist of government competence in enforcing current legislation, scientific competence and the capacity to fully test and monitor whether regulations are being implemented, combined with the industry's competence to monitor adherence to regulations at the plant level (to avoid failures). The ability to collect

this data and use it to guide future action is also taken into account, as there is little value in accurate reports that lead nowhere.

- **Education for systems**

  The ability of industry X to organize and develop competence/knowledge:
  This enabling ability relates to the longer term ability to deliver the four enabling abilities already discussed. Without competent individuals, the design, operation, monitoring and understanding of constraints will be severely limited. This ability analyses national institutions' ability to develop education programmes and to encourage enrolment. This may refer to professional accreditation or degree level, and may be provided by academic institutions, trade associations or private companies.

Analysis

This study focuses on physical constraints that can deter or enable an industry's future progress. 'Physical constraints' are those national resources that are crucial for the given industry to maintain its current and future manufacturing activities. This includes labour performance as well as the use of resources and creation of waste that needs to be managed.

In addition, we analyse the relationships between government authorities, industry and the local population (including NGOs). A functioning system of checks and balances between industry, governments and citizens is helpful in establishing a robust licence for industry to operate. The proper checks and balances should result in a better environmental and social performance, as well as to an improved stewardship of national constraints.

Figure 10 A healthy industrial system

- **Analysis dimensions**

To measure an industry's environmental impact, five dimensions are selected: energy used, air emissions, water used, solid waste and wastewater. Labour is selected for the social impact analysis. The analysis dimensions allow for various situations across industries and countries to be evaluated. Scores are given using the five-ranking index shown here (except in cases in which no data are available, and which are termed 'blank spots' and result in a zero score).

Table 7 Scoring of each dimension

Scoring	0	1	2	3	4	5
(meaning)	No data available	Not desirable	Less desirable	Acceptable	Very desirable	Most desirable
Constraint	Blank spots	Very close or over constraints	Close to constraints	Neither close nor far from constraints	Far from constraints	Very far from constraints
Planning	Blank spots	Not desirable	Less desirable	Acceptable	Very desirable	Most desirable
Operation	Blank spots	Not desirable	Less desirable	Acceptable	Very desirable	Most desirable
Monitoring	Blank spots	Not desirable	Less desirable	Acceptable	Very desirable	Most desirable
Education	Blank spots	Not desirable	Less desirable	Acceptable	Very desirable	Most desirable

3.2 Methodological considerations

Lack of data

There is no institutional or international agreement on the list of data to be collected to determine environment and social impacts, especially at industry level (i.e. our analysis). Countries have no obligation to regularly report data to international entities, such as the World Bank or ADB in a form that would assist in sectoral analyses (where reporting does exist, it is typically at national level). Voluntary efforts are also extremely limited, making it difficult to create a data set for an industry level analysis of environmental and social aspects from published reports.

Environmental data is known to be notoriously scarce as it is not yet common practice to measure environmental variables, especially at different levels of aggregations. There have been some attempts at national level measurements and estimations for some environmental variables, but industry and sub-manufacturing industry level data with sufficient disaggregation and time series coverage is almost impossible to come by, whether in international or national databases. Of the variables of interest for our study, energy is the only exception, with data at the ISIC 2-digit level disaggregation available in the IEA database.

This lack of data affects our ability to conduct a purely quantitative analysis of the environmental and social impacts as originally envisaged. Qualitative research methods were developed where we encountered a lack of data. In the long term, however, it would be desirable for each country to establish its own data collection system and a centralized national environmental database to enable an environmental and social assessment of its main industries.

Pre-fieldwork

- Various chemical industry reports, national competitiveness reports and environmental or social reports for the countries included in this study were obtained and studied.
- International databases were checked for data availability.
- The main concepts and analysis methodology were developed, including detailed interview questions for government bodies, industry and NGOs.

Fieldwork of two weeks per country

- National consultants were hired to carry out the fieldwork. The national consultant helped in the process of scheduling interviews with the relevant parties and coordinating the visits.
- All researchers participated in the fieldwork to share common goals and to develop and refine the detailed approach to the fieldwork.
- Several interviews were conducted with the relevant government bodies, the private sector, industry associations and NGOs.
- A small number of forums were held to ensure that the views of firms across a wide range of firms in terms of size were obtained.

Post-fieldwork

- It was necessary to modify the research methodology to include a qualitative analysis of the data collected during the fieldwork to compensate the lack of quantitative data.

The information provided in this paper was either collected through a desk study or during a two-week fieldwork period in the countries. Ministry officials are generally in a better position to gather higher quality data due to their networks and the fact that they are not constrained by a two-weeks time limitation.

A note on Malaysia's environmental and social data and analysis

After applying the above methodology in Malaysia (i.e. two weeks of data collection in the country supported by local country experts, holding around 60 interviews and meetings with over 100 people and reviewing reports published by the Malaysian government and NGOs), we were not able to gather sufficient quantitative and/or qualitative data on the environmental performance of the chemical industry in Malaysia to conduct a robust analysis. Therefore, our report does not include an environmental analysis for Malaysia.

No comparison across countries

The objective of our research is to explore and understand the environmental and social implications of deepening the activities of a specific manufacturing industry within a country in order to inform future industrial policies and strategies. The data and information collected are therefore very contextual to a specific industry in a specific country. As a result, the methodology applied does not allow for cross-national comparison.

Reading this report

The subsequent sections follow a common format. First, each of the four countries studied is presented in turn. The analysis is presented for each country for all six dimensions of environmental and social performance – energy, water supply, emissions to air, solid waste, emissions to water and labour. The report draws conclusions from the available data for each dimension, starting with the constraints on the system (energy system, water system, etc.), followed by planning, operation, monitoring and education abilities. Each of these is assigned a score from the above table and a diagram is used to present the scores (5 = best, 1 = worst, 0 = insufficient data). Summaries of the most important limits and enablers to the chemical industry's growth in each country are provided as well.

Next phase of the methodological development

The methodology presented here discusses the chemical industry's hotspots in terms of environmental and social aspects. Future developments could include the concept of industry coolspots. Coolspots represent opportunities for a positive environmental or social impact and are related to a particular industry. The newly developed methodology is applicable not only to countries from the ASEAN region but also to other regions, including developed countries. Finally, as this was the first attempt to obtain data for this type of methodology, it should be noted that the identification and collection of data was challenging.

3.3 Indonesia

Environmental assessment

3.3.1 Energy

Analysis of enabling abilities

Constraints

Blank spots: The desk study and fieldwork illustrated that there is insufficient data relating to the exchange of information between local and national authorities and between industry and the local population about the capacity of the chemical industry to understand current and future energy constraints. It is therefore not possible to make any conclusive statement on the energy constraints of Indonesia.

Planning

Considerable efforts have been made on the part of the authorities to establish a national energy plan, including subsidies, a pricing policy and the use of alternative energy sources. The Indonesian government also acknowledges that much of the country's clean coal is exported, while dirty coal is used for domestic energy production. The National Energy Council is in charge of the national energy policy and manages the types of energy available as well as their utilization. It is unclear, however, to what extent industry and the local population are engaged in addressing energy issues in the chemical industry. Beyond industrial committee meetings, it is also not clear to what extent effective communication channels have been established between Indonesian authorities and industry and the local population with regard to energy demand, energy supply and energy saving within the chemical industry. As such, it appears that the dominant influence on the domestic chemical industry is top down policy formulated by the international community.

Operation

The Indonesian authorities have developed several policies in an attempt to encourage energy saving in industry. These efforts include the establishment of a 'green industry award', a 'new environmental law for both new and existing industries' and various activities of the 'Centre for Green Industry and Environmental Affairs'. Whilst the aforementioned policies and initiatives appear to have an influence on large national and international firms, it is unclear to what extent energy saving efforts (e.g. installing new energy facilities or general best practice operations) are being implemented by SMEs in the chemical industry.

Monitoring

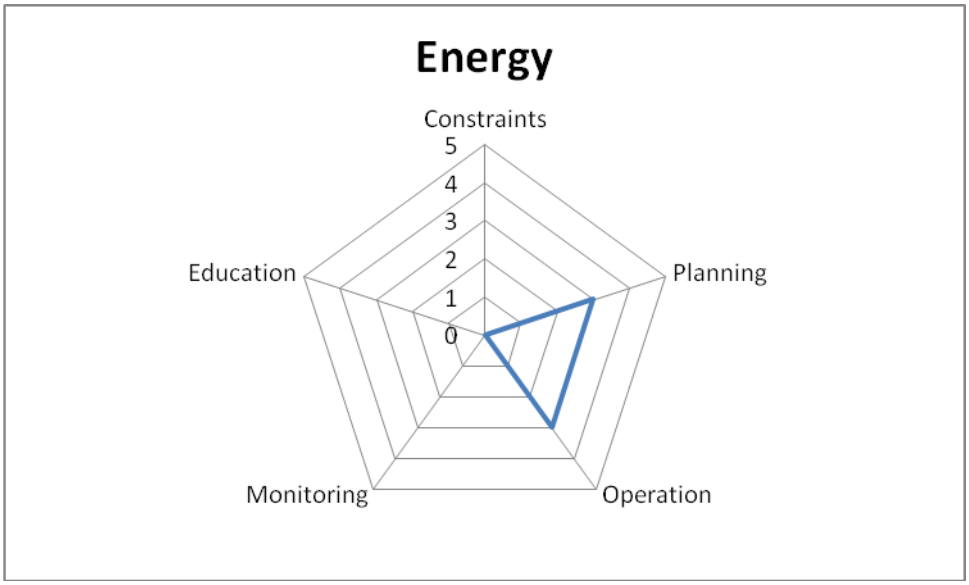
The GIZ is currently addressing energy efficiency. Companies are audited to determine whether they are complying with the regulations, and compliant companies are rewarded with preferential credit terms from the German Federal Bank. Furthermore, companies that collect energy efficiency and waste minimization data are accorded the 'Green status', whilst more advanced, high performing firms are awarded the 'Gold status'.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on energy education in the chemical industry from the shared point of view of authorities, industry and the local population . It is therefore not possible to make any conclusive statement on the energy monitoring systems in Indonesia.

Summary

Figure 11 Energy analysis of the chemical industry in Indonesia



3.3.2 Water supply

Constraints

Blank spots: The desk study and fieldwork revealed insufficient data availability on the exchange of information between authorities, industry and the local population concerning the ability of the chemical sector to understand current and future water supply constraints. It is therefore not possible to make any conclusive statement on the water constraints in Indonesia.

Planning

According to the report 'Green Growth, Resources and Resilience' (ESCAP/ADB/UNEP, 2012), Indonesia faces an urgent sustainability challenge with regard to water supply. The rise in demand for water is expected to continue into the next decade. The government is attempting to improve key utilities and is undertaking efforts to address existing problems. However, the desk study and fieldwork did not provide any reliable information on this issue, and it is therefore not possible to make any conclusive statement on the water planning system in Indonesia. The Directorate General for Water Resources, the Water Basin Authority within the Ministry of Public Works, is responsible for ensuring adequate supply of water to industry. Working in collaboration with the Ministry of Industry, the Directorate General for Water Resources is responsible for determining priorities for the annual budgets in order to put together the annual government work plan. Industrial zones are being considered for petrochemical companies based on the industrial map. The provision of adequate water supplies to these zones is being planned.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability relating to efforts undertaken by government authorities, industry and the local population to better manage and reduce water consumption. It is therefore not possible to make any conclusive statement on the water operation systems in Indonesia.

Monitoring

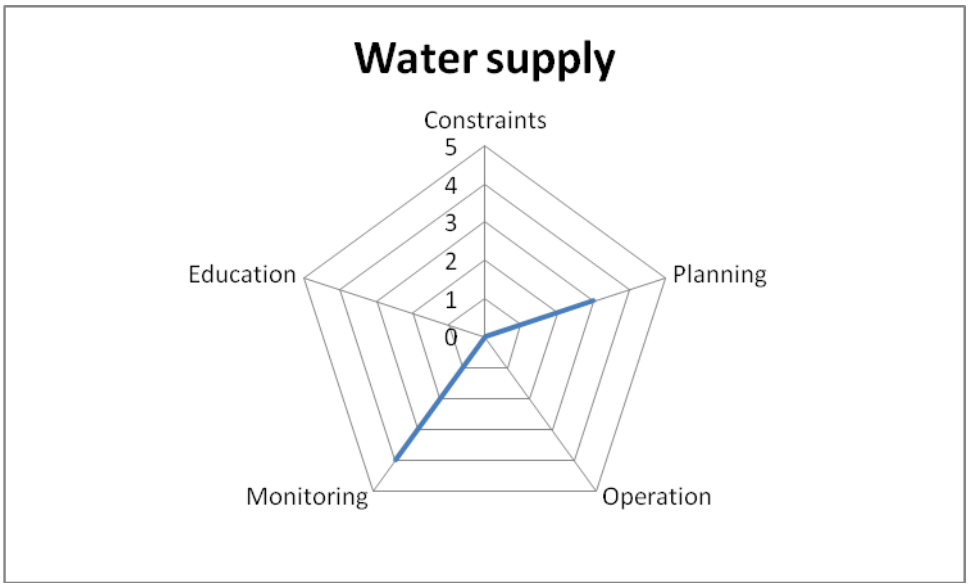
Obtaining green labels for superior environmental performance can help companies capture additional value. The Ciliwung river supplies 80 percent of the freshwater for Jakarta, but is heavily used by industry, with 20 percent of Indonesian industry (mostly textiles) located on or near the river. Recognizing the importance of clean water, the local population and NGOs have introduced a 'Toxic free water campaign' to try to improve water quality. It should be noted that this is an independent, non-governmental initiative.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts undertaken by government authorities, industry and the local population to educate one another with regard to water supply to the chemical industry. It is therefore not possible to make any conclusive statement on the education system related to water in Indonesia.

Summary

Figure 12 Water supply analysis of the chemical industry in Indonesia



3.3.3 Air emissions

Constraints

Blank spots: According to the report 'Resource Efficiency: Economic Outlook for Asia-Pacific' (UNEP, 2012), high levels of sulphur ions were detected at several sites in Indonesia, but this was mainly attributable to the large amounts of precipitation. The desk study and fieldwork revealed insufficient data availability on air emissions from the chemical industry in Indonesia. It is therefore not possible to make any conclusive statement on this issue.

Planning

The government authorities have developed a national action plan to reduce emissions (Presidential Regulation number 61/2011). The plan focuses on problematic and energy intensive industries, namely basic metals, cement, pulp and paper, glass and ceramics, fertilizers, petrochemicals, food and beverages, textiles and basic chemicals. The Ministry of Industry and the Ministry of the Environment have undertaken several studies on these issues and published assessment reports on each industry. Transportation infrastructure and the effect on logistics is one area that is particularly problematic. Any evidence of action being taken to date is very limited.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts to reduce air emissions in the chemical industry in Indonesia. It is therefore not possible to make any conclusive statement on air emission management in Indonesia.

Monitoring

Civil society and NGOs have raised concerns regarding the negative impact of coal plants, citing health issues (respiratory diseases) and loss of livelihood. Indonesia used 3,280.000 metric tons of coal in 2008, ranking fourth in the world for coal consumption by the chemical industry. Also, Indonesia is the second largest coal exporter in the world – after Australia – and coal is hence considered a driver of economic development by the government authorities. Eight-five percent of Indonesia's coal is exported, with the remainder being used domestically, although the country's reserves are depleting.

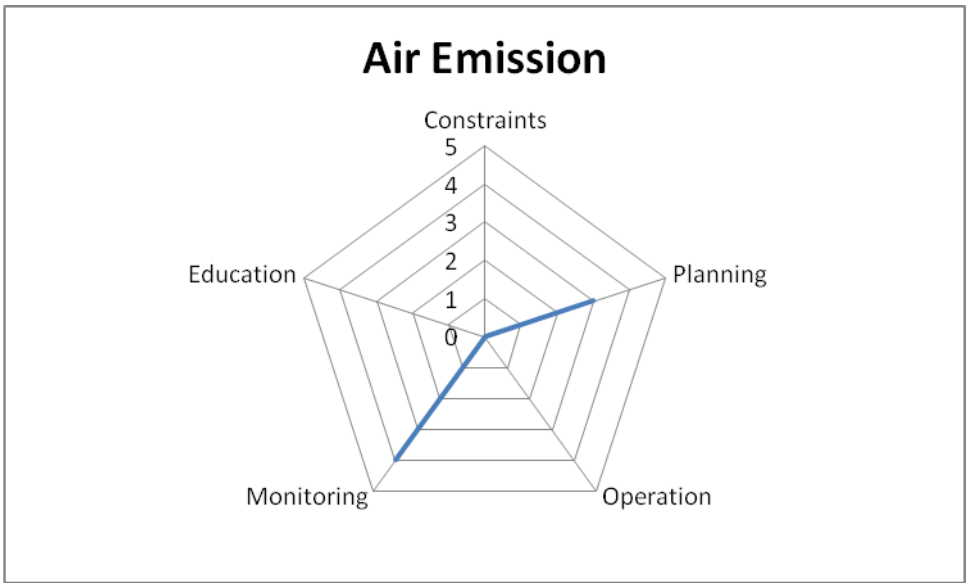
Companies that collect energy efficiency and waste minimization data are accorded the 'Green status', whilst more advanced, high performing firms are awarded the 'Gold status'.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on instruments, techniques, education programmes or best practices that are shared between government authorities, industry and the local population. It is therefore not possible to make a conclusive statement on air emission education in Indonesia.

Summary

Figure 13 Air emission analysis of the chemical industry in Indonesia



3.3.4 Solid waste

Constraints

Blank spots: The desk study and fieldwork revealed insufficient data availability on solid waste management in the chemical industry in Indonesia. It is therefore not possible to make any conclusive statement on the constraints Indonesia faces with regard to solid waste management.

Planning

From the authorities' point of view, understanding the required domestic solid waste landfill capacity necessitates two types of data from industry: future demand projections (future constraints) and investment plans. Although this data is available, there is currently no adequate system for collecting and collating such data and future projections are consequently extrapolations from current states, which themselves are often poorly evidenced.

Operation

According to government authorities, the Basel Convention Regional Centre for South-East Asia helps them manage the hazardous components of waste from all industries and other activities. In addition, according to the Ministry of Environment, it is authorized to determine standards for each industry with regard to waste. It is not clear how often this actually occurs across the chemical sector.

Monitoring

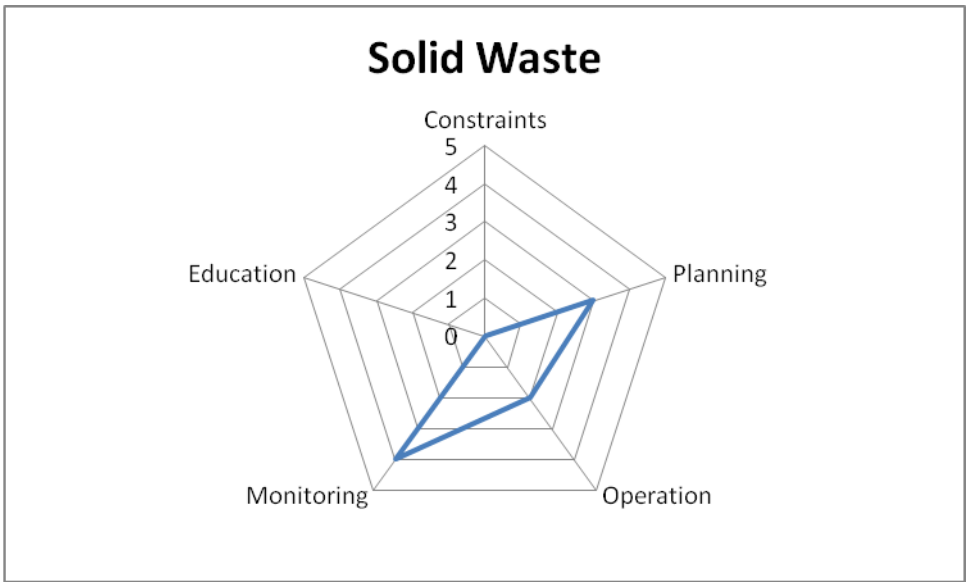
According to the Centre for Green Industry within the Ministry of Industry, the enforcement of waste management in the industrial sector is adequate.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on instruments, techniques, education programmes or best practices that are shared between government authorities, industry and the local population. It is therefore not possible to make any conclusive statement on solid waste education in Indonesia.

Summary

Figure 14 Solid waste analysis of the chemical industry in Indonesia



3.3.5 Wastewater

Constraints

Blank spots: The desk study and fieldwork revealed insufficient data availability on wastewater management in the Indonesian chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Planning

From the authorities' point of view, understanding the required domestic wastewater treatment capacity necessitates two types of data from industry: future demand projections (future constraints) and investment plans. Although this data is available, there is currently no adequate system for collecting and collating such data and future projections are therefore extrapolations

from current states, which themselves are often poorly evidenced. Wastewater is particularly challenging as the quantity and quality across many dimensions is estimated to obtain a licence to operate, but is rarely checked. Therefore, emissions to local rivers or groundwater are poorly understood, and forward planning is problematic.

Operation

According to the Ministry of Environment, it has introduced standards on wastewater, but it is unclear how the standards are assessed, how frequently and whether the system of rewards/punishment is effective.

Monitoring

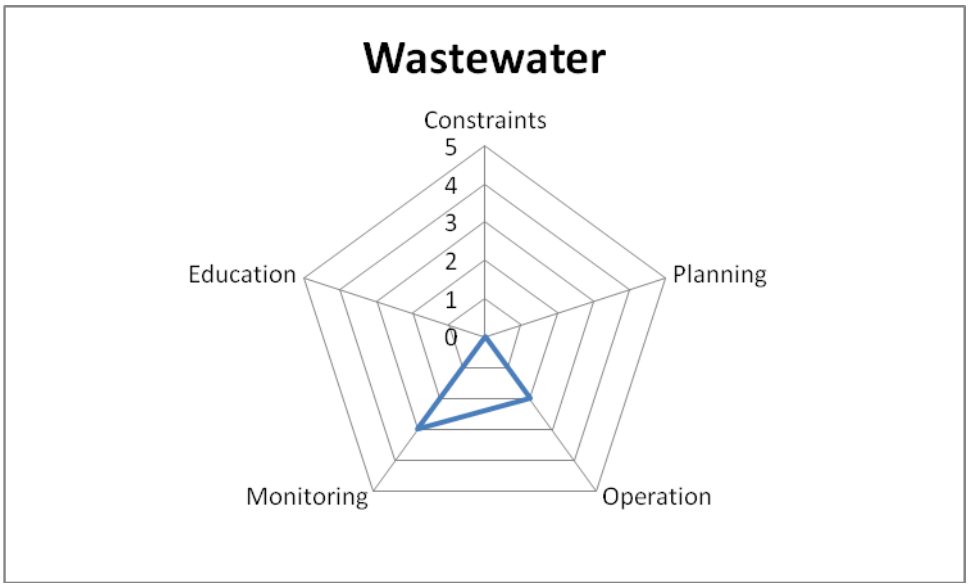
According to the Centre for Green Industry within the Ministry of Industry, the enforcement of regulations on wastewater management in industry is adequate. Industry can gain a good reputation and marketing value locally through improved environmental performance and by obtaining green labels. Recognizing the importance of clean water, NGOs and the local population have been campaigning for 'Toxic free water'. The campaign focuses on the Ciliwung River, which accounts for 80 percent of Jakarta's water supply. The region surrounding the Ciliwung River is where 20 percent of Indonesia's industry is located.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on educational programmes relating to wastewater management in Indonesia's chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Summary

Figure 15 Wastewater analysis of the chemical industry in Indonesia



Social assessment

3.3.6 Labour

Constraints

The education system in Indonesia is deemed to be adequate for the country's needs. However, it was also reported that the country is facing a "brain drain" problem, especially to the Middle East.

Planning

Blank spots: The desk study and fieldwork revealed insufficient data availability on the planning of labour needs for Indonesia's chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on the efforts being undertaken by government authorities, industry and the local population to improve working conditions. It is therefore not possible to make any conclusive statement on the labour management system in Indonesia.

Monitoring

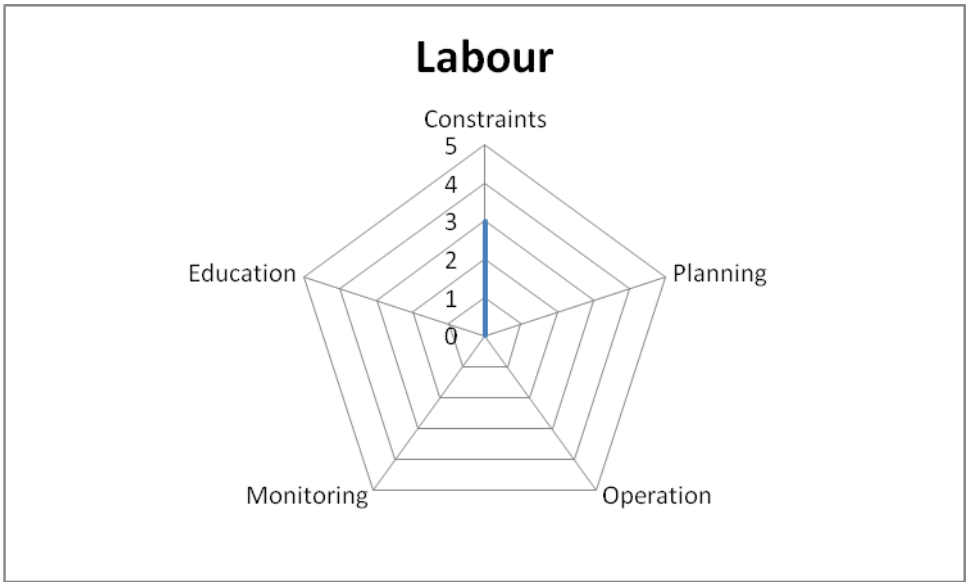
Blank spots: The desk study and fieldwork revealed insufficient data availability on the planning of future labour management and skill needs for the Indonesian chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on the level of education required by the workforce of Indonesia's chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Summary

Figure 16 Labour analysis of the chemical industry in Indonesia



3.4 The Philippines

Environmental assessment

3.4.1 Energy

Constraints

According toindustry, 'reliability/availability of power' and 'energy costs' may represent potential constraints on national environmental and social aspects.

Planning

The Ministry of Energy is in charge of energy regulations and planning. Government authorities have created industrial zones in which to concentrate industries, away from residential areas and with adequate facilities. Industry reported that various energy efficiency programmes have been

implemented, such as 'Waste Plastic to Fuel', but little evidence of cooperation was found between government authorities, industry and the local population in the development of energy supply plans. No information on the use of any form of sustainability indices to monitor environmental performance was found either at national or international level.

Local NGOs and international organizations produce energy research reports on energy use patterns and energy efficiency at the country level, including 'Resource Efficiency: Economic Outlook for Asia-Pacific' (UNEP, 2012) or 'Shaping Policy Reform and Peer Review in Southeast Asia: Integrating Economies amid Diversity' (OECD, 2008).

According to 'Resource Efficiency: Economic and Outlook for Asia-Pacific' (UNEP, 2012), the region should strengthen existing fiscal and financial instruments to incentivize renewable energy development in the Asia-Pacific region. Tax incentives, while not prominent in China, are widely used in India to attract investment. Renewable energy funds in various forms are used in economies such as China, India, Australia, New Zealand and the Philippines to support renewable energy development. Various forms of subsidies are also currently being implemented.

Furthermore, according to 'Shaping Policy Reform and Peer Review in Southeast Asia: Integrating Economies amid Diversity' (OECD, 2008), the energy development package will develop biofuels and renewables like wind, solar and geothermal energy. It will also promote oil and gas exploration, enhance energy conservation through the use of energy-efficient technologies and optimize privatization of the energy industry. In 2006, Congress passed the Philippine Biofuels Act which provides fiscal incentives to companies producing and selling biofuel-blended petrol and diesel.

Operation

According to industry, energy is not a hotspot as it accounts for only 4 percent of national demand. Some petrochemical producers have their own power plants to deal with blackouts due to breakdowns of the national grid.

Monitoring

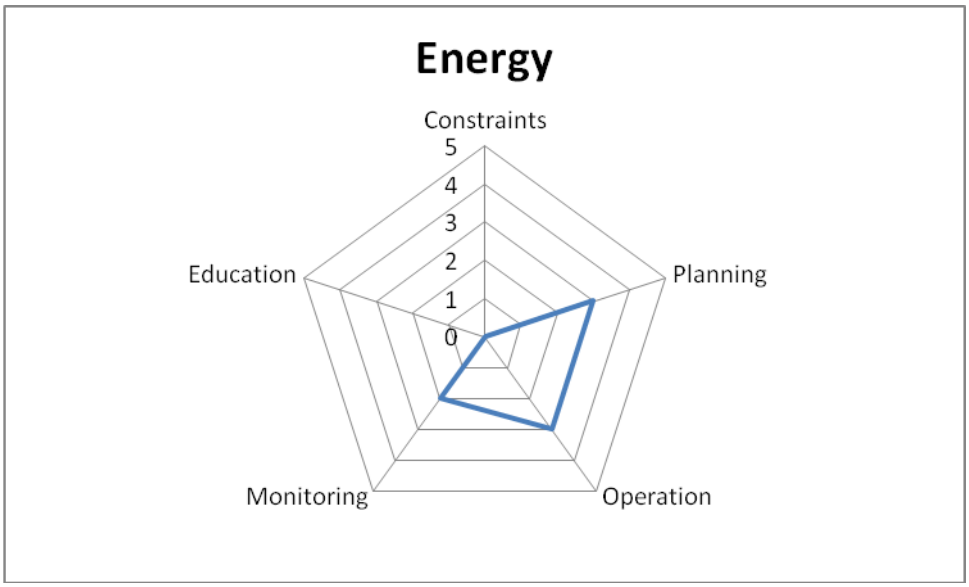
While a wide range of environmental regulations exist in the Philippines, government authorities acknowledge that there is a lack of manpower to effectivley enforce the regulations. The country therefore heavily relies on the role of CSOs to report environmental offences. In addition, concern about being sued when violating environmental regulations is widespread and acts as a deterrent.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on the efforts undertaken by government authorities, industry and the local population to educate one another with regard to energy issues in the chemical industry. It is therefore not possible to make any conclusive statement on the education system on energy in the Philippines.

Summary

Figure 17 Energy analysis of the chemical industry in the Philippines



3.4.2 Water supply

Constraints

Blank spots: The desk study and fieldwork revealed insufficient data availability on the chemical industry's water demand and how this information is shared among stakeholders. It is therefore not possible to make any conclusive statement on the education system on water issues in the Philippines.

Planning

The government authorities believe that if the chemical industry grows, water demand will rise, increasing competition between industrial and household demand. The Philippines does not apply any form of sustainability index for international comparison. According to the report 'Green Growth, Resources and Resilience' (ESCAP/ADB/UNEP, 2012), the Philippines faces an urgent sustainability challenge with regard to water supply. Specific problems the Philippines is facing include 'increasing water scarcity', 'deteriorating water quality' and the fact that the Philippines is a 'flood-prone' and 'Cyclone-prone' country.

Operation

Blank spots: With reference to water supply planning, it is not clear to what extent knowledge regarding operations in the chemical industry is shared between government authorities, industry and the local population. Additional information is needed to understand how knowledge of operations is shared among different stakeholders.

Monitoring

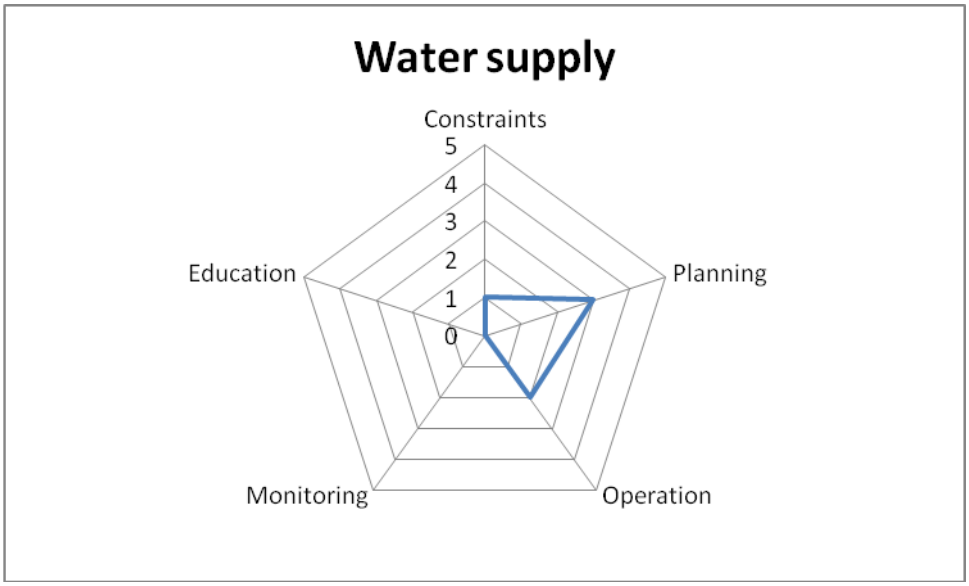
While a wide range of environmental regulations exists in the Philippines, government authorities acknowledge that there is a lack of manpower to effectively enforce the regulations. The country therefore heavily relies on the role of CSOs to report environmental offences. In addition, concern about being sued when violating environmental regulations is widespread and acts as a deterrent.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts being undertaken by government authorities, industry and the local population to share information on water issues in the chemical industry. It is therefore not possible to make any conclusive statement on education systems related to water in the Philippines.

Summary

Figure 18 Water supply analysis of the chemical industry in the Philippines



3.4.3 Air emissions

Constraints

According to the report 'Resource Efficiency: Economic and Outlook for Asia-Pacific' (UNEP, 2012), a high level of deposits of sulphur ions were detected at several sites in the Philippines. This is attributable in part by the use of coal in chemical plants, but the high concentrations were mainly due to the large amounts of precipitation in those areas. This is likely to continue, unless major changes are made and represents a limiting factor in the growth of the chemical industry in the Philippines.

Planning

It was reported that the commitments made to reducing GHG emissions are felt to be too stringent and may affect economic growth. It is not clear how the Philippine chemical industry participates in the policymaking process and how involved the local population or NGOs are. Despite the existence of international reports funded by UN agencies such as 'Resource Efficiency: Economic Outlook for the Asia-Pacific' (UNEP, 2012), it is not clear to what extent the local population and industry utilize the data from these international reports in the process of designing policies on air emissions.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on the efforts being undertaken by government authorities, industry and the local population to educate one another and improve operational competence with regard to air emissions in the chemical industry. It is therefore not possible to make any conclusive statement on the operation system related to air emissions in the Philippines.

Monitoring

Government authorities tend to believe that the threat of legal action suffices to ensure that industry and individuals conform to the regulations set down. In addition, the authorities are aware that harassment and petty corruption is a feature of the energy industry.

While a wide range of environmental regulations exist in the Philippines, government authorities acknowledge the lack of manpower to effectively enforce the regulations. The country therefore heavily relies on the role of CSOs to report environmental offences. In addition, concern about being sued when violating environmental regulations is widespread and acts as a deterrent. There is a national monitoring programme for total suspended particulate (TSP), whilst other initiatives

include the Air Quality Management Fund and the Metro Manila Air Quality Improvement Sector Development Program (MMAQISDP).

National total suspended particulate (TSP) monitoring from 2003 to 2007 showed a 33 percent improvement over the four-year period, with concentrations decreasing from 144 micrograms per normal cubic meter (µg/Ncu.m) to 97 µg/Ncu.m. Although the concentration of chemicals is decreasing, TSP geometric mean concentrations are still above the 90 µg/Ncu.m. annual mean TSP guideline value for one year averaged over time. As such, more efforts are necessary to comply with the guidelines, as set out in the General Plan of Action for Air Quality Management.

The Air Quality Management Fund (AQMF) was established as a special account in the National Treasury to be administered by the DENR to finance government containment, removal and clean-up operations in air pollution cases; guarantee restoration of ecosystems and rehabilitate areas affected by the acts of CAA violators; and support research, enforcement, monitoring activities and capabilities of the relevant agencies pursuant to Section 14 of the Philippine Clean Air Act of 1999. The AQMF can also be used by the Airshed Governing Boards. The AQMF was assigned Fund Code 155 by the National Bureau of Treasury (BTr) in April 2004.

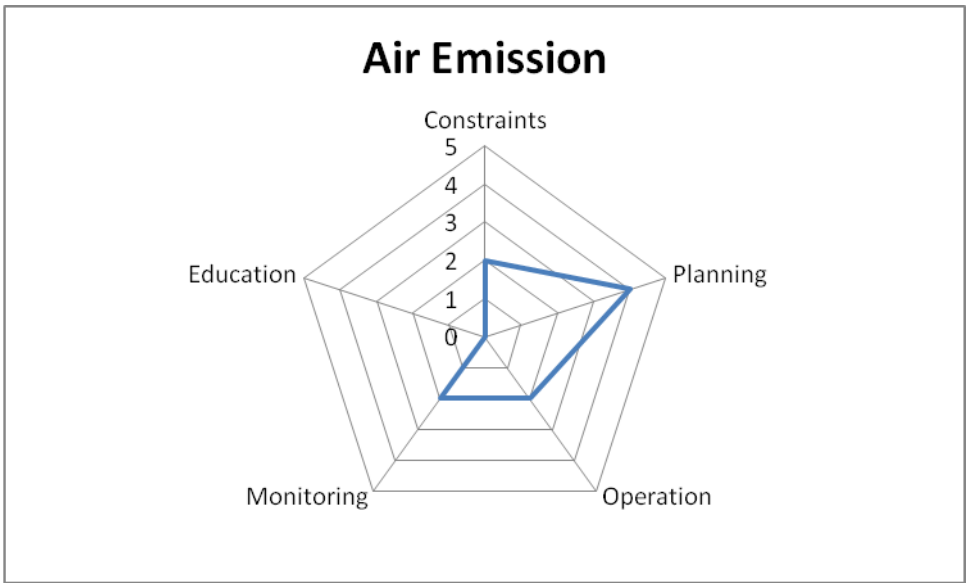
The Metro Manila Air Quality Improvement Sector Development Program (MMAQISDP) is an Asian Development Bank (ADB) loan-financed programme implemented by various national government agencies headed by the DENR. Its general objective is to promote policy reforms to improve air quality through the reduction and control of mobile and stationary sources of air pollution. It focuses on the Metro Manila air shed, the location of the main concentrations of air pollution, but policies developed have nationwide implications and/or may be replicated in other airsheds.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on the efforts being undertaken by government authorities, industry and the local population to educate one another on air emissions in the chemical industry. It is therefore not possible to make any conclusive statement on the education system on air emissions in the Philippines.

Summary

Figure 19 Air emission analysis of the chemical industry in the Philippines



3.4.4 Solid waste

Constraints

There are some examples on the valorization of waste, e.g. fertilizer companies turning gypsum into cement. However, as waste disposal is not very expensive, incentives to valorize waste are also relatively low. Many open dumps were reported to still exist, despite the availability of landfills.

Planning

Industry has implemented various efficiency programmes such as 'Waste Plastic to Fuel'. It was, however, reported that no guidance on waste minimization or waste management is offered to industry; nor does a sustainability index exist that enables national and international comparison.

Operation

Although solid waste management is managed at the local government level, the Department of Natural Resources has initiated the Responsible Care programme, requiring landfills to be established. Yet many open dumps still exist because landfill sites are filling up quickly. It was reported that the disposal of waste is not considered to be expensive and there is therefore little incentive, other than the intrinsic value, to valorize waste.

Nevertheless, some general examples of waste valorization were noted, with schemes including the resale of waste generated during shutdowns, the use of unconverted monomers as power

plant fuel and the conversion of gypsum to cement. The disposal of toxic waste, e.g. Silica chips, phosphoric acid and gypsum waste, is managed at individual plants with no pooling of resources. There are no plans for green chemistry to date. Socio-political problems surrounding the disposal of plastics were also noted.

Monitoring

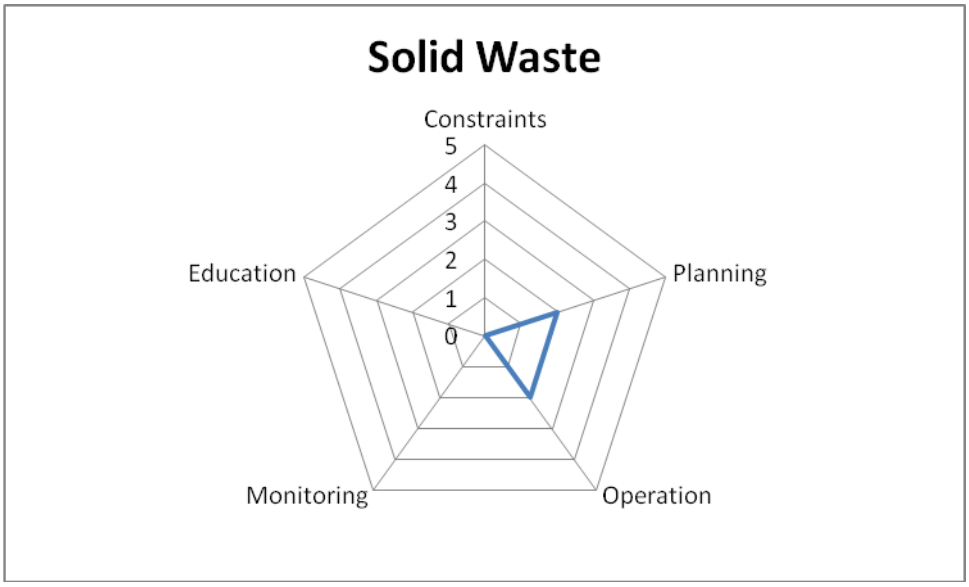
A US-Philippines full cost accounting guidebook for solid waste management was developed. Little to no evidence was found that the guidelines in the guidebook have been put into practice for industry monitoring activities. The desk study and fieldwork revealed insufficient data availability on the authorities' monitoring activities in the chemical industry.

Education

Insufficient information is available on government authorities' education programmes on waste management in the chemical industry. A guidebook has been published called 'Solid Waste Management Made Easy: A Fieldbook on Implementing a Community-Based Ecological Solid Waste Management Programme' (UNDP/DENR/NSWMC, 2012). There is, however, no information on how solid waste management practices have been affected as a result.

Summary

Figure 20 Solid waste management of the chemical industry in the Philippines



3.4.5 Wastewater

Constraints

From the information collected, the water footprint was not being used as a marketing tool due to a lack of interest/demand in the domestic market.

Planning

The Department of Natural Resources initiated the Responsible Care programme. Industrial zones in which to concentrate industries, located away from residential areas with adequate utilities, were also established by the authorities. No information was found during the desk study or the fieldwork on the use of any form of sustainability indices to monitor environmental performance, either at national or international level.

Operation

Saving wastewater with a closed loop water system was in place in some firms. Industry argues that the regulatory landscape suffers from both over-regulation and overlap between environmental regulations developed by the national and local governments.

Monitoring

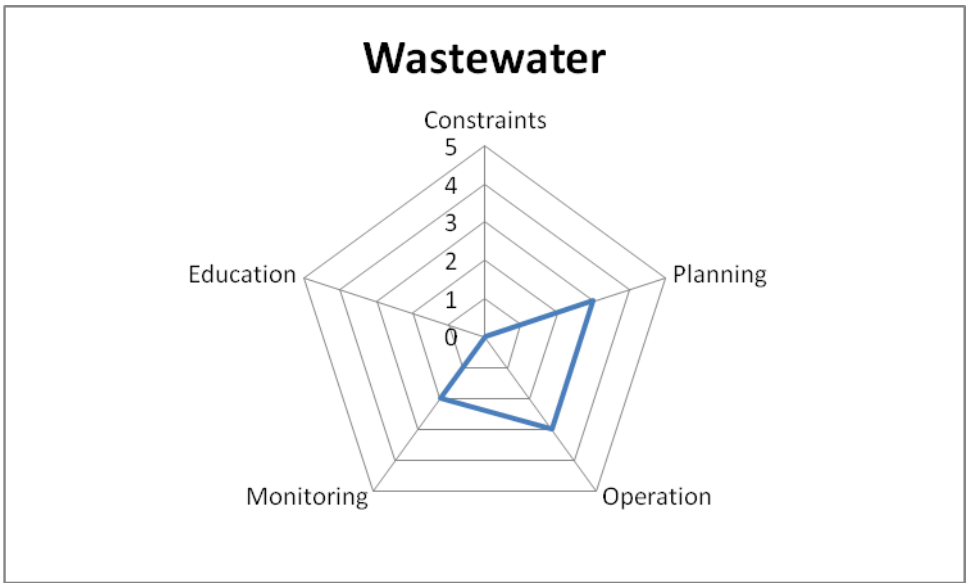
Blank spots: The desk study and fieldwork revealed insufficient data availability on the methods of monitoring wastewater management in the chemical industry. It is therefore not possible to make any conclusive statement on the Philippine's wastewater monitoring systems.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on education relating to water management in the chemical industry. It is therefore not possible to make any conclusive statement on water management education programmes in the Philippines.

Summary

Figure 21 Wastewater analysis of the chemical industry in the Philippines



Social assessment

3.4.6 Labour

Constraints

Labour skills have been identified as a key issue in the chemical industry. Whilst the cost of labour is considered relatively high, skill levels productivity and the general quality of labour is low. These factors and the high turnover of personnel in chemical firms indicate that effective training is a key requirement in the industry. Philippine salaries are considered non-competitive because skilled workers, e.g. engineers, can obtain far higher salaries (by up to 4 times) working abroad, resulting in 'brain-drain' to higher wage economies (e.g. the Middle East).

Planning

Government authorities plan to offer scholarships to support universities in the Philippines in developing next generation industry leaders. However, little evidence was found of how the government authorities, industry and the local population intend to collaborate to develop such a plan.

International reports on the Philippines' education system have been published, such as 'Shaping Policy Reform and Peer Review in Southeast Asia: Integrating Economies amid Diversity' (OECD, 2008) and 'Skills Development Pathways in Asia: Employment and Skills Strategies in Southeast Asia' (ESSSA) (OECD, 2012). The key recommendation with regard to labour based

on these reports is that under- and unqualified instructors and outdated training systems in the Philippines require upgrading.

'Shaping Policy Reform and Peer Review in Southeast Asia: Integrating Economies amid Diversity' (OECD, 2008): the Philippines has long attempted to eradicate poverty in its poorest region of Mindanao. Inequality has been persistent in countries that have the highest levels of poverty such as the Philippines.

'Skills Development Pathways in Asia: Employment and Skills Strategies in Southeast Asia' initiative (ESSSA) (OECD, 2012): Reducing skills mismatches and increasing the links between training and industry needs: the Philippines is seeking to strengthen industry education and training linkages with a focus on an enterprise-based training system.

The quality of skills training and creation of vocational pathways for high school leavers must be guaranteed. In the Philippines, despite the high unemployment rate among college graduates, vocational training paths are not chosen and high school graduates and their parents value academic studies over vocational studies, aiming for white collar jobs unrelated to industry demands. There is also a high share of low-skilled workers in the Philippines who are faced with demands to improve their skill level.

The share of micro, small and medium-sized enterprises (MSMEs) is large in the Philippines, accounting for 70 percent of total employment, 30 percent of total sales and value-added in manufacturing and 25 percent of total exports. The demand for training in the Philippines is two-fold: existing and potential entrepreneurs need business skills and knowledge to be competitive in the world market, particularly in financing, marketing, technology and human resources development; and the MSME staff need to be trained in the skills required in technology intensive industries and in improving productivity. The needs are even higher for smaller MSMEs. However, employer-provided training is very limited and the following constraints have been cited: insufficient access to finance, poor information on training needs, low perception of formal training and lack of training facilities. Government and education and training institutions, both public and private, are the major providers of the required skills training for MSMEs, with the Technical Education and Skills Development Authority (TESDA) is the lead government agency for managing TVET.

Operation

From industry's point of view, labour regulations are excessively stringent, limiting the flexibility of operations by making it difficult to shift labour when necessary and making it difficult to close companies. High workforce turnover of around 50 percent per annum puts pressure on training programmes within firms to maintain a properly skilled workforce. Industry would benefit from university researchers with stronger connections to industry.

Monitoring

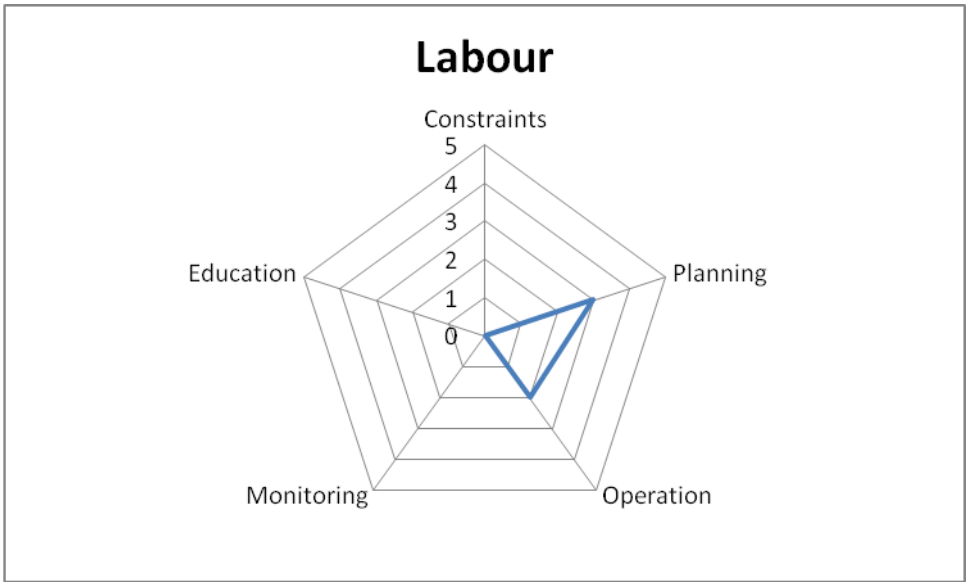
Blank spots: The desk study and fieldwork revealed insufficient data availability on the monitoring methods of labour requirements within the chemical industry. It is therefore not possible to make any conclusive statement on the monitoring of labour needs in the Philippines.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on training methods in the chemical industry. It is therefore not possible to make any conclusive statement on the need for employee training in the Philippines' chemical industry.

Summary

Figure 22 Labour analysis of the chemical industry in the Philippines



3.5 Thailand:

Environmental assessment

3.5.1 Energy

Constraints

Independent power plant production is a government policy designed to help cope with demand. It encourages private sector investment in power plants. A complicated tariff structure is controlled by national energy, with prices based on the basis of demand.

Planning

Considerable efforts have been made on the part of the government authorities to establish a national energy plan, including subsidies, a pricing policy and the use of alternative energy

sources. The Metropolitan Electricity Authority (MEA) analyses the load factors for customers and helps improve them to ensure that the load is acceptable. The ten industries with poor energy efficiency were identified as department stores (retail), automotive tyre production, metal for construction, home appliance manufacture, paper, cardboard and packaging, wire, automotive assembly, plastics and textiles. Government energy efficiency targets are set by industry in a 20-year plan (2010-2030), with the aim of reducing energy intensity by 25 percent over the period, although this has not yet been implemented.

It is generally considered easy to operate as energy capacity exceeds demand by over 10 percent. The top energy consumers are commercial services and industry, representing approximately 30 percent of demand, and residential. Calls are being made to expand the grid to support commercial services, but insufficient funds are available to invest. In total, Thailand has 400,000 manufacturing units with MEA covering around 10,000 medium and large units and 100,000 small units.

Department of Alternative Energy Development and Efficiency (DEDE)

The DEDE has set targets to reduce energy intensity by 25% over the 20-year period from 2010 to 2030. These targets vary across sectors, with industry and transport having to reduce their energy intensity by 35% to meet the targets. An energy conservation programme based on ISO15001 targets 3,500 factories that use more than 1 MW. These factories are required to submit annual energy management reports, perform annual audits and designate a person responsible for energy (PRE). Factory breakdowns by industry will be published. Accredited consultants will recommend energy saving measures, although no targets will be set. The Department will provide the PREs with energy efficiency trainings, including the dissemination of benchmarks and good practices. In addition, an alternative energy development plan sets a target of a 25% increase in alternative energy provision. Incentives have also been introduced for small and very small power producers. The overall aim is to reduce reliance on imported energy, although no specific target has been determined.

Operation

The Electricity Generating Authority of Thailand (EGAT) is responsible for electricity generation in Thailand, although distribution is carried out regionally by the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). Industry consumes 52 percent of total energy, and whilst GDP is growing at between 2 percent and 3 percent annually, regular electricity demand has been growing 5 percent annually. Demand side

management aims to minimize energy consumption, and energy efficient appliances (level 5) for the home are being encouraged. A time of use (TOU) tariff is also employed with a 30-40 percent variation in price/usage. The reliability of current electricity supply is very good, and is actually higher than that in the USA. The first 50 units of electricity are free; prices then range between 3.28 BHT for residential customers and 3.502 BHT for industrial consumers.

The maximum limit for imported electricity is 15 percent with current imports of electricity (from Laos and Malaysia) at around 10 percent. Renewables (including small hydro, wind solar and biomass) account for 5 percent of Thailand's electricity supply and hydro accounts for a further 10 percent. Local NGOs call for renewables to be given priority; others suggest that growth opportunities in solar should be limited as this could increase tariffs by 10 percent. Seventy percent of the country's gas supply is purchased from Myanmar. Whilst the long-term plan was to move towards nuclear energy, it has been postponed in the light of the Fukushima crisis in Japan. The ASEAN's masterplan is ultimately to connect the members' grids together.

Monitoring

Local NGOs have pointed out the following problems:

a. Steel and petrochemicals, in particular, consume a lot of energy and cause environmental damage, leading to destructions of local communities.

   Thailand only has scarce natural resources available for those industries.

b. All those industries have a tendency to move towards coastal areas, which causes environmental damage in those areas (fisheries) and leads to social problems, e.g., the immigration of workers from neighbouring countries, who work for less than the minimum wage.

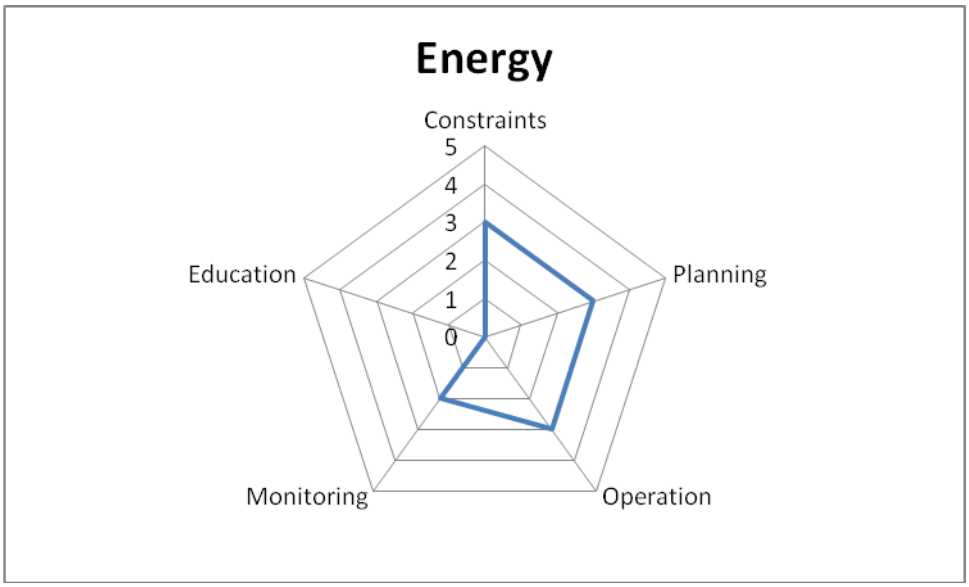
Local NGOs also argue that environmental standards in Thailand are very low in comparison to other countries', and thus allow companies to 'legally' pollute. Companies do not provide full public disclosure on how they comply with environmental standards. Moreover, the 'policing' of industries is very weak, with penalties only having been imposed on a few industries. Local NGOs assert that they support industrialization, but only if locals benefit from it.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on energy education in the chemical industry. It is therefore not possible to make any conclusive statement on energy management education programmes in Thailand.

Summary

Figure 23 Energy analysis of the chemical industry in Thailand



3.5.2 Water supply

Constraints

Government departments, such as the Pollution Control Department, acknowledge the current water problem: water extraction is close to carrying capacity in most areas, hence water intensive industries are a key issue. Poor waste infrastructure for municipal waste means that there are potential opportunities for new industries to take root in this field.

Water infrastructure poses a particular problem for small enterprises. However, government authorities do not have specific industry-level water demand and supply data. Water authorities have water data related to geography rather than industries. As in other countries, a firm that wants to build factories in Thailand needs to submit a permit request to the Department of Groundwater Resources. In the permit document, the firm needs to report its total water consumption per day and identify its water source (i.e. provide a water supply plan). However, it does not seem that these water consumption plans are being collected at the level of industry.

In Thailand there is no central unit that oversees water. Responsibility is divided for different areas across multiple organizations, including the Irrigation Department, East Water, River Basin Management and the Department of Industrial Works.

Planning

According to the report, 'Green Growth, Resources and Resilience' (ESCAP/ADB/UNEP, 2012), Thailand is one of the countries with the most urgent sustainability challenges in relation to water.

The Department of Water Resources sets standards on effluent discharge and pollution control for each industry. The Department is also responsible for monitoring these activities in the main rivers. There are plans to increase water capacity by constructing more damsdespite the existing physical constraints to this activity. Another option to increase capacity is to transfer water from neighbouring countries, e.g. Myanmar and Cambodia. There is no fixed policy on water transfer, but has been used before. In the period 2000 – 2005, there were serious water shortages in the eastern part of the country (river basin Easter Coast). A scheme by East Water (a water management company) was put in place to transfer water from other regions into this area. This resulted in major protests. Transfer of water from the Mekong river basin is being considered to supply Bangkok with water. Data for specific industries is not available, though the Institute for Sustainable Water at the Federation of Thai Industries collects some data. Some industries use groundwater and although there are plans to use different sources, these have not yet been implemented.

Local NGOs underscore the following problems:

a. Steel and petrochemicals, in particular, cause environmental damage, leading to the destruction of local communities.

b. Thailand has scarce natural resources available for those industries.

c. All those industries tend to move towards coastal areas, which causes environmental damage in those areas (fisheries).

Local NGOs also argue that Thailand's environmental standards are very weak in comparison to other countries and that legalized pollution is common among companies in Thailand. Local NGOs note that they support industrialization, but only if it benefits the local population.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on water supply operation and maintenance activities in the chemical industry. It is therefore not possible to make any conclusive statement on energy management education programmes in Thailand.

Monitoring

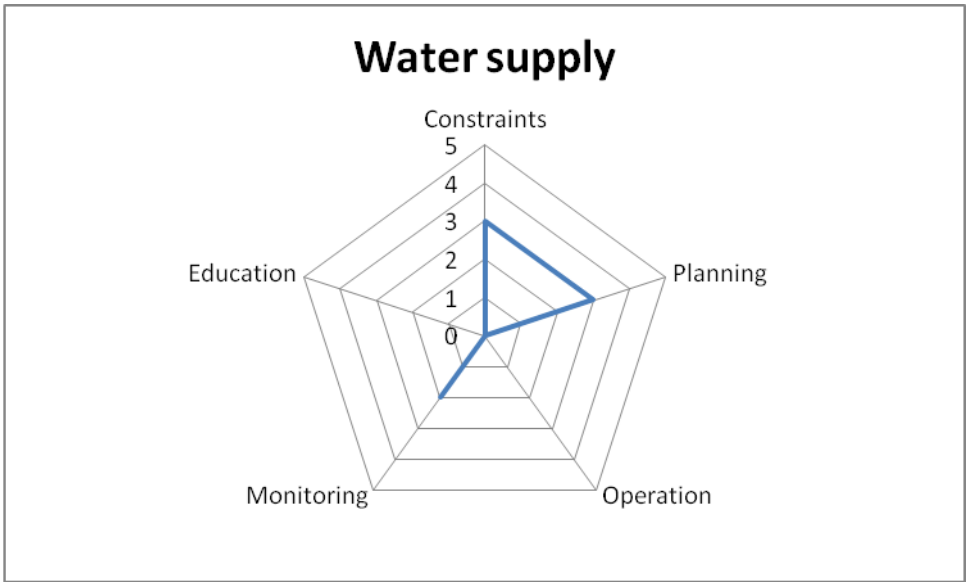
Data for specific industries is not available, but the Institute for Sustainable Water at the FTI collects some data. Water use varies across the regions and some water is transferred between regions (e.g. from Mekong to Bangkok). Some industries use groundwater and although there are plans to use other sources, these have not yet been implemented.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on water supply education in the chemical industry. No statement can therefore be made on energy management education programmes in Thailand.

Summary

Figure 24 Water supply analysis of the chemical industry in Thailand



3.5.3 Air emission

Constraints

The authorities point out that industries have been known to dump pollution. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem due to understaffing.

Planning

One of the main authorities responsible for air emissions planning in Thailand is the Office of Natural Resources & Environmental Policy and Planning (ONREP). There is an opportunity for further integration between the ONREP's plans and the Ministry of Industry's (MOI) national

20-year plan. ONREP uses both policy and regulations to fulfil its mandate, with a clear priority sequence in area planning: air pollution, water pollution, landfill and water extraction.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts undertaken by industry, authorities and the local population to reduce air emissions. It is therefore not possible to make any conclusive statement on water operation systems in Thailand.

Monitoring

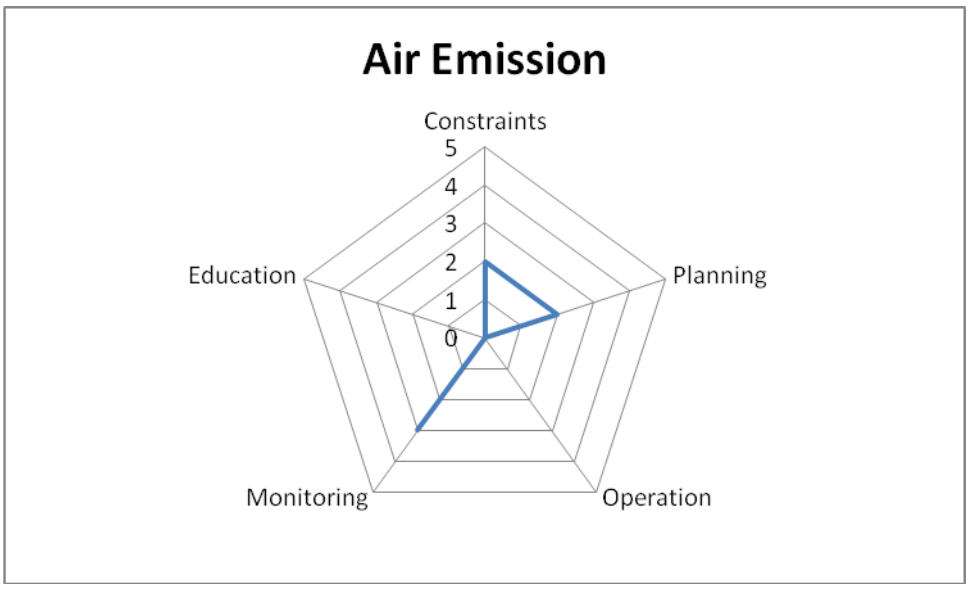
Emissions are continuously monitored by government departments, such as the Department of Industrial Works and the Department of Pollution Control. Authorities are aware that industries dump pollution. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem due to understaffing.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on air emission prevention tools, techniques, education programmes or best practices in the chemical industry, which is shared between authorities, industry and the local population. It is therefore not possible to make any conclusive statement on air emission education in Thailand.

Summary

Figure 25 Air emission analysis of the chemical industry in Thailand



3.5.4 Solid waste

Constraints

The authorities are aware that industries dump pollution. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem due to understaffing.

Planning

A Strategic Impact Assessment has been developed for the area to encourage the waste recycling industry to begin operating.

Operation

Large companies such as PTT undertake considerable efforts to reduce their solid waste: PTT has achieved a reduction of approximately 60 percent; however, this requires a much more extensive collaboration with every firm in the supply chain. It is unclear to what extent local SMEs, in particular firms not supplying large companies, are undertaking efforts to reduce solid waste to landfills.

Examples of waste treatment on industrial properties include:

- Central wastewater plant in each region
- Incinerators for general waste
- Central Disposal Unit in some areas for hazardous waste – IEA control transportation to the facility.

Monitoring

The authorities are aware that industries dump waste. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem due to understaffing.

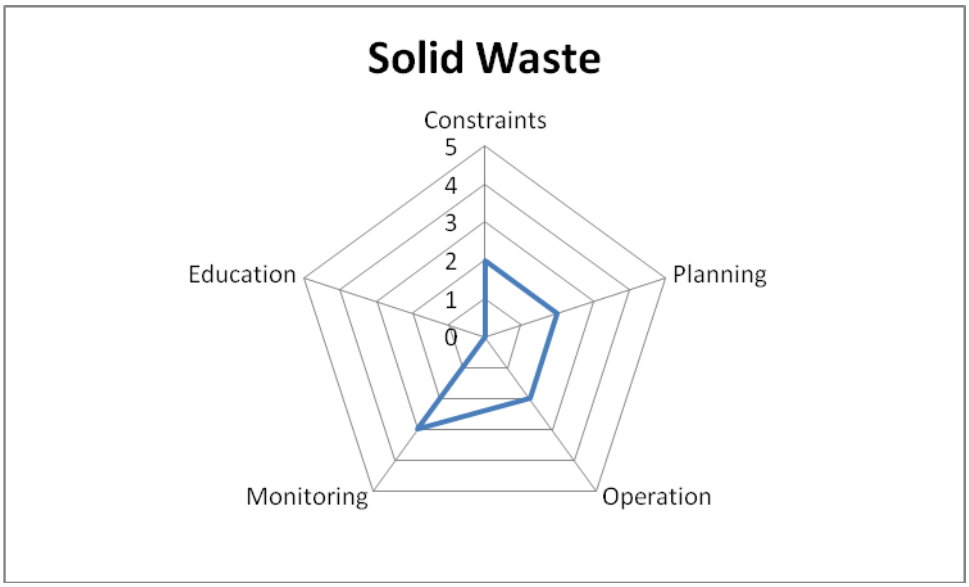
The authorities are of the opnion that the amount of waste being collected and transported from facilities is problematic. Moreover, the collection system itself is considered problematic. The authorities think that better systems for the collection of waste and increases in the capacity of waste treatment should be implemented to improve solid waste management. The Department of Industrial Works has a system in place to collect data on how much waste a factory generates. It also compiles data on the amounts of waste factories transport outside of their boundaries. The Department of Industrial Works needs to define industrial waste in a way that is consistent with industrial standards; currently, it is using a range of their own definitions.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on solid waste management tools, techniques, education programmes or best practices in the chemical industry that are shared between authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Thailand.

Summary

Figure 26 Solid waste analysis of the chemical industry in Thailand



3.5.5 Wastewater

Constraints

The authorities are aware that industries dump pollution. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem due to understaffing.

Planning

Government departments such as the Department of Water Resources, the Ministry of Natural Resources and the Royal Irrigation Department have worked together to develop a water management plan. Various elements of the plan include the centralization of water regulations, the preservation of natural water resource areas, wet land preservation, general improvements and the building of small reservoirs in rural areas. However, it is unclear to what extent the chemical industry and local population, including NGOs, are participating in the planning activities related to wastewater management. Moreover, the authorities do not have data to analyse specific industries. Companies do not provide full public disclosure on how they comply

with environmental standards. At the same time, the 'policing' of industries is very weak, demonstrated by the fact that penalties for pollution have only been imposed on a few industries.

Operation

There is a wastewater collection system in place: if a given factory breaches the applicable regulations, the authorities can fine the offender and a number of other sanctions may be applied.

Monitoring

The authorities are aware that industries dump pollutants. Thailand is reported to have tight environmental regulations covering a wide range of polluting activities. However, ensuring compliance is a problem primarily due to understaffing, but also due to limitations in terms of technical equipment and training.

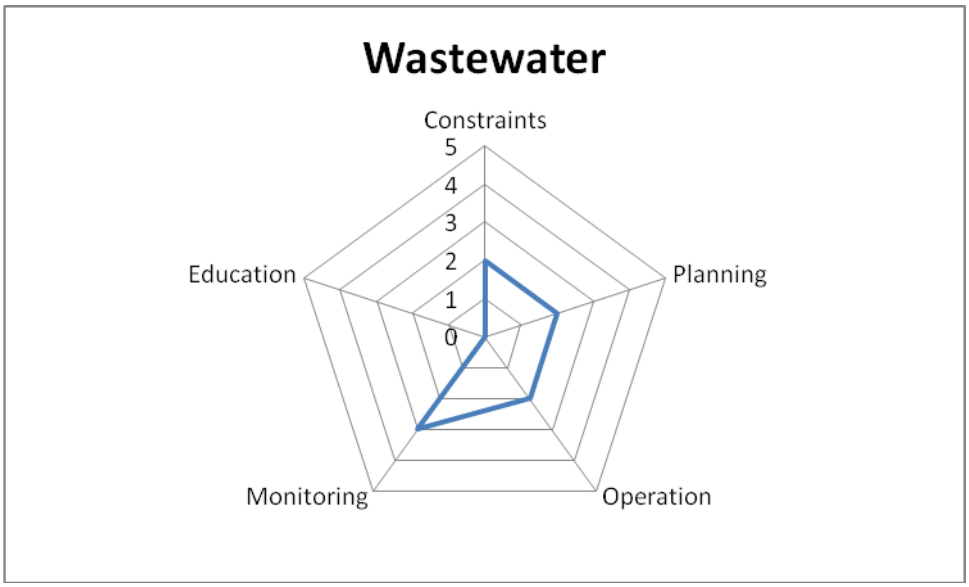
Local NGOs argue that environmental standards in Thailand are very weak in comparison to other countries, and opens the possibility of 'legalized' pollution. Companies do not provide full public disclosure on how they comply with environmental standards. At the same time, the 'policing' of industry is very weak and only few industries have been penalized to date. Local NGOs add that they support industrialization, but only where it benefits the local population.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on wastewater management tools, techniques, education programmes or best practices in the chemical industry that are shared between authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Thailand.

Summary

Figure 27 Wastewater analysis of the chemical industry in Thailand



Social assessment

3.5.6 Labour

Constraints

University graduates have to settle for jobs for which they are overqualified. Some graduates refuse to compromise and consequently either remain unemployed or migrate. Low-skilled jobs are increasingly being performed by migrant workers, a situation which has the potential of causing social problems in the future.

Planning

The Department of Skills Development (DSD) offers pre-employment training for school drop-outs. This training programme is an alternative to secondary education but has poor recognition. The DSD also provides the opportunity for employees to enhance their skills, e.g. training for entrepreneurship for domestic staff. The authorities do not keep track of the educational profiles of employees in the manufacturing industry, but keep track of how many people employed in different industries have graduated from skills training programmes. Local NGOs add that they support industrialization, but only where it benefits the local population.

Operation

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts undertaken by industry, authorities and the local population to reduce deaths, accidents and child

labour and to provide generic training. It is therefore not possible to make any conclusive statement on labour in Thailand's operation systems.

Monitoring

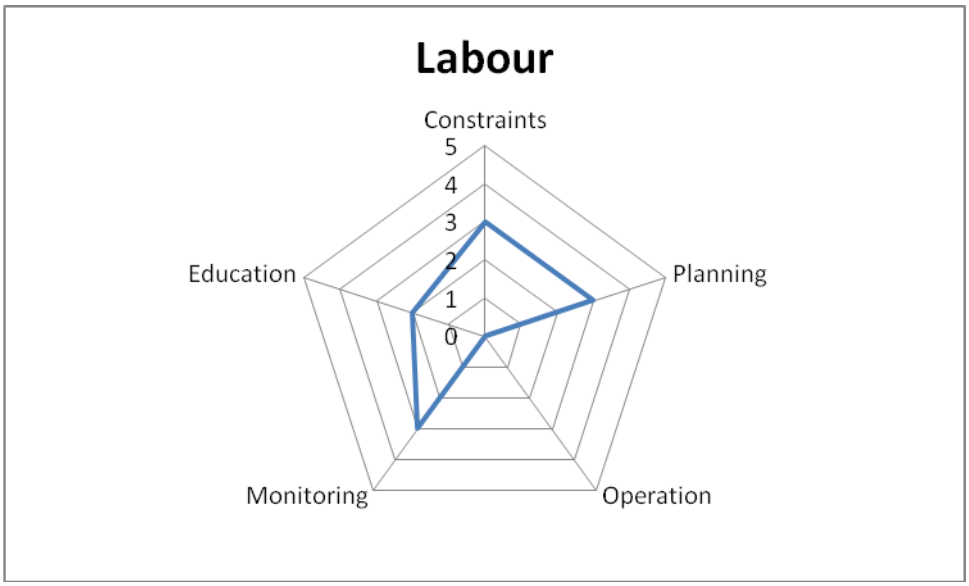
Blank spots: The desk study and fieldwork revealed insufficient data on the efforts undertaken by industry, authorities and the local population to monitor labour conditions and activities. It is therefore not possible to make any conclusive statement on Thailand's labour monitoring systems.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on efforts undertaken by industry, authorities and the local population to monitor labour conditions and activities. It is therefore not possible to make any conclusive statement on the labour education systems in Thailand.

Summary

Figure 28 Labour analysis of the chemical industry in Thailand



3.6 Viet Nam

Environmental assessment

3.6.1 Energy

Constraints

The economy has an overall growth rate of 6 percent to 10 percent annually, with the chemical industry being a major contributor. The production of nitrogenous and phosphate-based fertilizers has increased from 100,000 tonnes/year up to 2,000,000 tonnes/year, with diammonium phosphate (DAP) alone accounting for 300,000 tonnes/year. Domestic production is able to supply 100 percent of nitrogenous and phosphate fertilizer and 30 percent of organic fertilizer needed domestically. Petrochemical processing and production has developed rapidly and petrochemicals are produced for input into other industries. Plastics production has a growth rate of between 30 percent and 40 percent whilst an increase has also been observed in rubber, battery and detergent production.

- Petroleum chemical processing and production have developed rapidly and petrochemicals produced supply production of other goods.
- Many improvements have been made in other industries such as rubber, battery, detergents, etc.
- Plastic production achieved a growth rate of between 30 percent and 40 percent.

It seems that the government, industry and local population are very well aware of the increased energy demand in the chemical industry.

Planning

The government has focussed considerable efforts on the development of energy plans across a range of issues; however, there is little evidence of the authorities exchanging information with the chemical industry and the local population, including NGOs on the issue of energy supply to the chemical industry. The significance of the chemical industry is apparent, as it produces a wide range of chemicals, such as fertilizers and nitrogenous fertilizers, which can replace imported ones.

Operation

Chemical companies routinely seek to enhance their energy supply and energy efficiency. Financial investments are often required to save energy or to improve energy supply. However, the majority of SMEs do not have sufficient access to capital to adopt new energy saving technologies.

The United Nations Industrial Development Organization (UNIDO) introduced an energy productivity programme in various industries including Viet Nam's rubber and pulp industries: the project with a budget of US$ 62 million funded by the Global Environmental Fund was launched in May 2011.

Monitoring

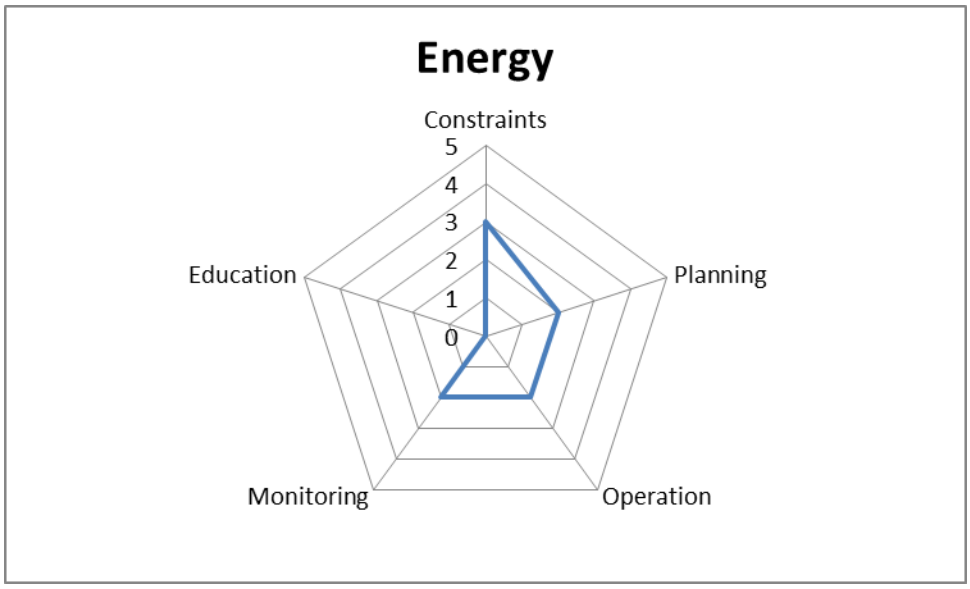
There are no financial incentives for companies to comply with the regulations issued by the government authorities and there is little government monitoring of energy supply and efficiency. There is also very little evidence of the involvement of the local population or NGOs in the monitoring of the chemical industry's energy saving activities, although international entities do play a significant role.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on energy supply, energy efficiency tools, techniques, education programmes or best practices in the chemical industry which are shared between government authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Viet Nam.

Summary

Figure 29 Energy analysis of the chemical industry in Viet Nam



3.6.2 Water supply

Constraints

The chemical industry considers some of the government's environmental policies and regulations burdensome; as these are largely regarded as being "formalities", they do not have a significant practical impact. Industry asserts that a good policy can be helpful for enterprises but that they sometimes also face financial burdens and tax problems related to environmental regulations.

Planning

Although it seems that considerable efforts have been made by the government authorities to formulate water supply plans, little evidence was found as to how the chemical industry and the local population (including NGOs) are involved in the development of these plans. Water supply data is only available according to local regions, not for the entire industry. This lack of data on the chemical industry's water demand represents an obstacle to planning water supply in the chemical industry.

Operation

The industry representatives interviewed claimed that there is a gap between the government authorities' policies and industrial reality, citing the fact that environmental policies are rarely consistently applied and do not have a clear direction. It was also noted that people working in the chemical industry are of the opinion that some environmental regulations are too stringent for most SMEs. It is also not clear what efforts are being undertaken by the chemical industry to reduce their water use in operations, in particular in SMEs. Firms need to collaborate to achieve better operation and maintenance of water supply and reduce water usage.

Monitoring

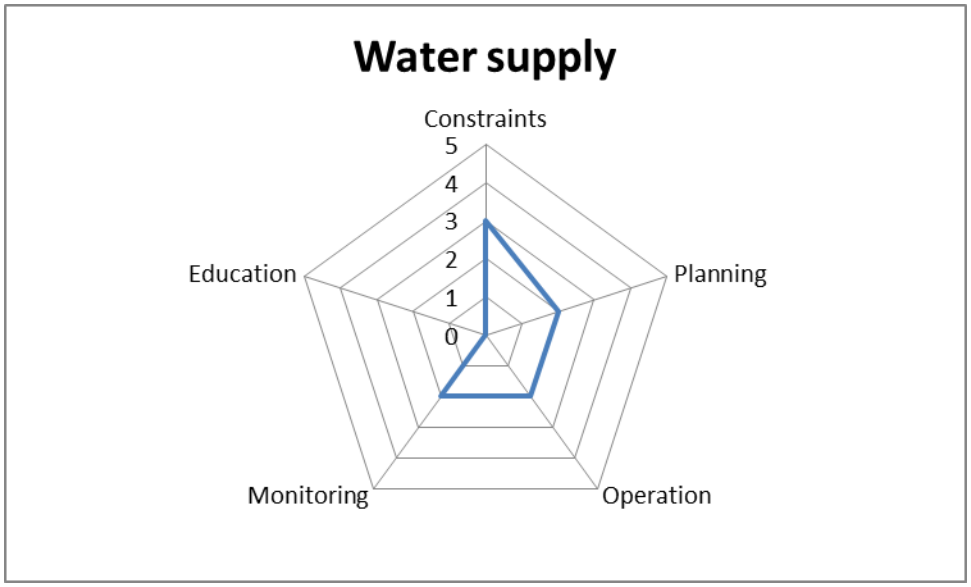
The industry representatives interviewed stated that the financial incentives for companies to comply with regulations are low. Government monitoring of water supply is negligent. There is also only little evidence of involvement of the local population or NGOs in the monitoring of the chemical industry's water supply or water usage, although international entities do play a significant role in water supply research in general. The government authorities and the Vietnam Chemical Industry Federation could potentially monitor or collect information on the annual water supply or water usage of both large firms and SMEs in chemical industry, but it seems that there is hardly any monitoring activity on SMEs' water supply.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on water management tools, techniques, education programmes or best practices in the chemical industry, which are shared between government authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Viet Nam.

Summary

Figure 30 Water supply analysis of the chemical industry in Viet Nam



3.6.3 Air emissions

Constraints

The chemical industry considers some of the government's environmental policies and regulations on air emissions burdensome; however, as these are largely regarded as "formalities", they do not have a significant practical impact. In the interviews, industry representatives highlighted the fact that good policies could be helpful for industry, but that environmental taxes can be a financial burden for businesses.

Planning

Blank spots: The desk study and fieldwork revealed insufficient data availability on the prevention of air emissions by Viet Nam's chemical industry. It is therefore not possible to make any conclusive statement on this issue.

Operation

The industry representatives interviewed are of the opinion that a gap exists between the authorities' policies and industries' reality, citing environmental policies that are seldom consistently applied and do not have a clear direction. It was also noted that people working in the chemical industry believe that some environmental regulations are too stringent for most SMEs.

Monitoring

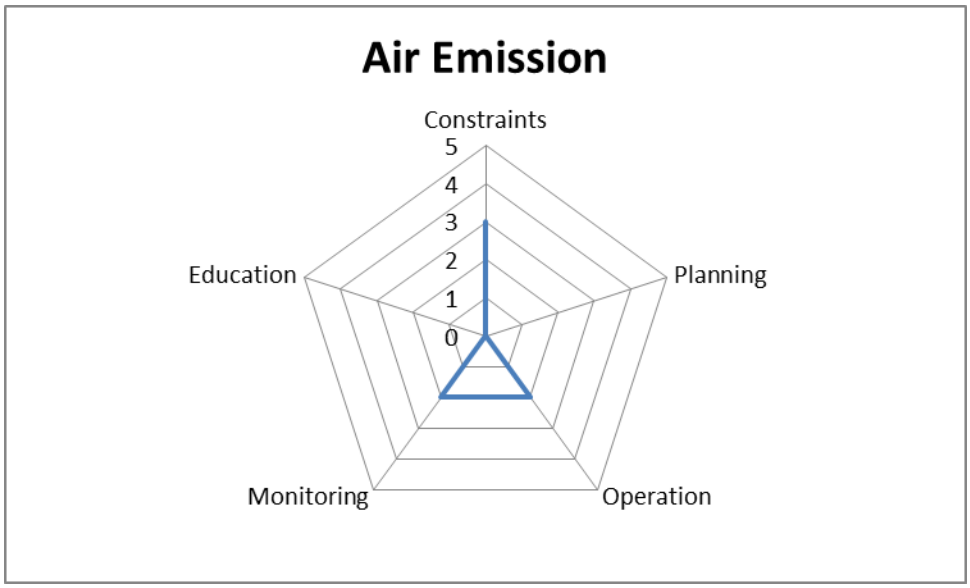
The industry representatives interviewed observed that financial incentives for companies that comply with regulations are low. Government monitoring of air emissions is negligent. There is also only little evidence of involvement of the local population or NGOs in the monitoring of the chemical industry's environmental activities, although international entities do play a significant role.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on tools to control air emissions, techniques, education programmes or best practices in the chemical industry, which are shared between authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Viet Nam.

Summary

Figure 31 Air emission analysis of the chemical industry in Viet Nam



3.6.4 Solid waste

Constraints

The chemical industry considers some of the government's environmental policies and regulations on air emissions burdensome; however, as these are largely regarded as "formalities", they do not have a significant practical impact. In the interviews, industry representatives highlighted the fact that good policies could be helpful for industry, but that environmental taxes can be a financial burden for businesses.

Planning

It is reported that the authorities undertake considerable efforts to develop plans, strategies and regulations on how to deal with solid waste, such as the "Policy on solid waste management in urban and industrial areas of Viet Nam", which was issued on 10 July 1999, in Decision 152/1999/QD-TTG of the Prime Minister and "The National Environmental Action Plan 2001 - 2005 (NEAP)", which entails five programmes, including Programme 2 on the improvement of solid waste management capacity, especially hazardous waste management in densely populated urban areas and industrial zones (The Asia-Link Progamme, 2008) .

No finding was made how the authorities communicate with the chemical industry and the local population, including NGOs, to formulate a solid waste plan for the chemical industry. The Vietnam Institute of Industrial Chemistry is responsible for drawing up the list of chemicals which the manufacturing and industrial sectors are allowed to use, as well as those which may be used for food processing and agricultural production.

Operation

Many people working in industry think there is a gap between the authorities' policies and the needs of industry. For example, some environmental policies of the Ministry of Natural Resources and Environment (MoNRE) are inconsistent with those of other ministries and no clear strategy on solid waste issues has been elaborated. The chemical industry is also concerned that some environmental parameters are too stringent for businesses to follow, and the majority of SMEs struggle to comply with these regulations.

Monitoring

The Vietnamese government monitors the chemical industry's hazardous waste in Viet Nam's major cities: 2,242 tonnes/year(Ha Noi), 3,300 tonnes/year (Hai Phong), 73 tonnes/year (Da Nang), 5,571 tonnes/year (Ho Chi Minh City), 1,029 tonnes (Dong Nai) and 879 tonnes/year (Ba Ria-Vung Tau) (Centre for Research Investment Consult for Rural Development, 1999).

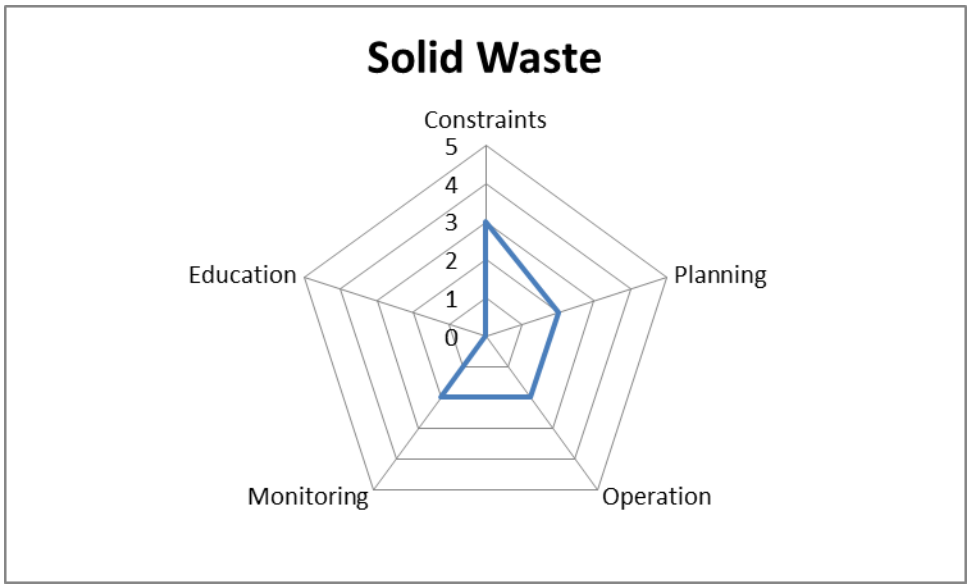
There are no financial incentives for companies to comply with the regulations issued by the government authorities. There is also limited government monitoring of solid waste. Furthermore, there is very little evidence of how the local population or NGOs are involved in monitoring the chemical industry's environmental activities and the (local) solid waste it produces.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on solid waste management tools, techniques, education programmes or best practices in the chemical industry, which are shared between the government authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Viet Nam.

Summary

Figure 32 Solid waste analysis of the chemical industry in Viet Nam



3.6.5 Wastewater

Constraints

The chemical industry considers some of the government's environmental policies and regulations on air emissions burdensome; however, as these are largely regarded as "formalities", they do not have a significant practical impact. In the interviews, industry representatives highlighted the fact that good policies could be helpful for industry, but that environmental taxes can be a financial burden for businesses.

Planning

Various government bodies, such as the Ministry of Industry and Trade (MOIT), the Ministry of Agriculture and Rural Development (MARD), the Ministry of Health (MOH), the Ministry of Science and Technology (MOST), the Ministry of Natural Resources and Environment (MONRE), the Ministry of Defence (MOD) and the People's Committee have participated in chemical management policy in Viet Nam.

MONRE takes a leading role in developing the wastewater treatment plan. It is reported that the authorities undertake considerable efforts to develop wastewater plans. However, no information was available on how authorities communicate with the chemical industry and the local population, including NGOs, on their wastewater plans for the chemical industry.

Operation

According to the chemical industry, there is a gap between the government authorities' policies and the practical realities in industry: some environmental policies are inconsistent across MOIT, MARD, MOH, MOST, MONRE and MOD and do not provide a clear environmental strategy. The chemical industry also deems that some environmental regulations are too restrictive, and the majority of SMEs struggle to comply with these regulations.

Monitoring

According to the chemical industry, wastewater from the chemical sector can often be more effectively dealt with by industry itself. People working in the private sector stated that the authorities rarely carry out monitoring of wastewater in the chemical industry.

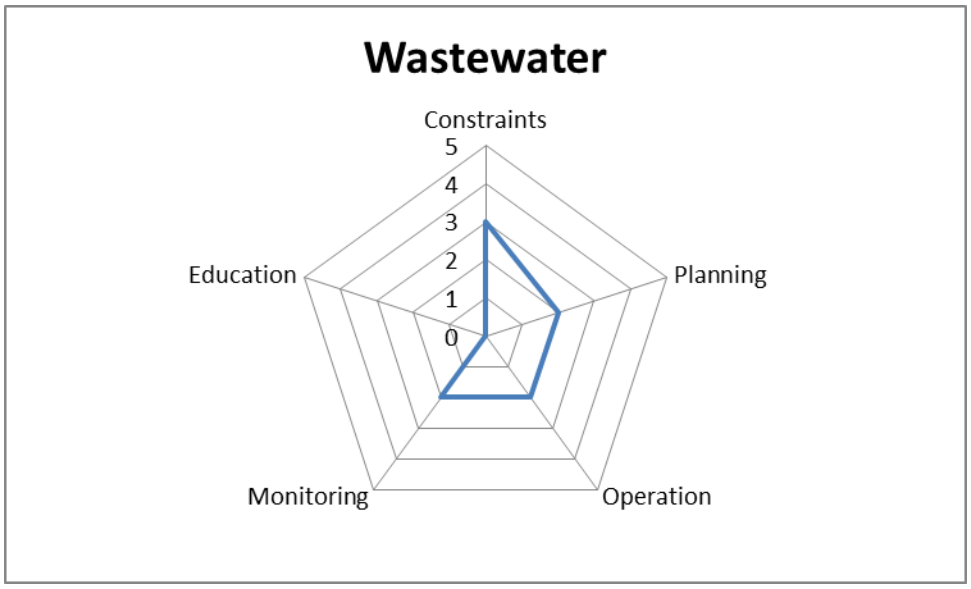
There are no financial incentives for companies to comply with the regulations issued by the government authorities. Finally, there is also little evidence of how the local population or NGOs are involved in monitoring the chemical industry's environmental activities.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability on wastewater management education programmes or best practices in the chemical industry, which are shared between the authorities, industry and the local population. It is therefore not possible to make any conclusive statement on energy-related education in Viet Nam.

Summary

Figure 33 Wastewater analysis of the chemical industry in Viet Nam



Social assessment

3.6.6 Labour

Constraints

Two issues are raised by the chemical industry: first, the available human resources do not meet the demands of enterprises; and, secondly, the chemical industry considers some of the government's environmental policies and regulations in labour burdensome; however, as these are laregely regarded as "formalities", they do not have a significant practical impact. In the interviews, industry representatives highlighted the fact that good policies can be helpful for industry, but that environmental taxes can be a financial burden for businesses.

Planning

It is reported that there are well-established communication channels between the government authorities, industry and the local population to develop labour plans.

Operation

Health and safety in operations have been improved, mostly because of recent efforts in these areas. Viet Nam's chemical industry has collaborated with international entities, including APEC, AMEICC, UNIDO, KEMI (Sweden), METI (Japan) and KOICA (Republic of Korea).

Monitoring

Some national regulations on chemical safety and laws regulating the use of chemicals have been issued:

- Environmental Protection Law
- Health Care Law
- Safety Code for production, use, storage and transportation of:
- dangerous chemicals
- Narcotics (drug, heroin) Prevention Law
- Radiation Safety Law
- Ordinance on Plant Protection
- Prime Minister's Decision on Controlling Petrol, Oil and LPG.

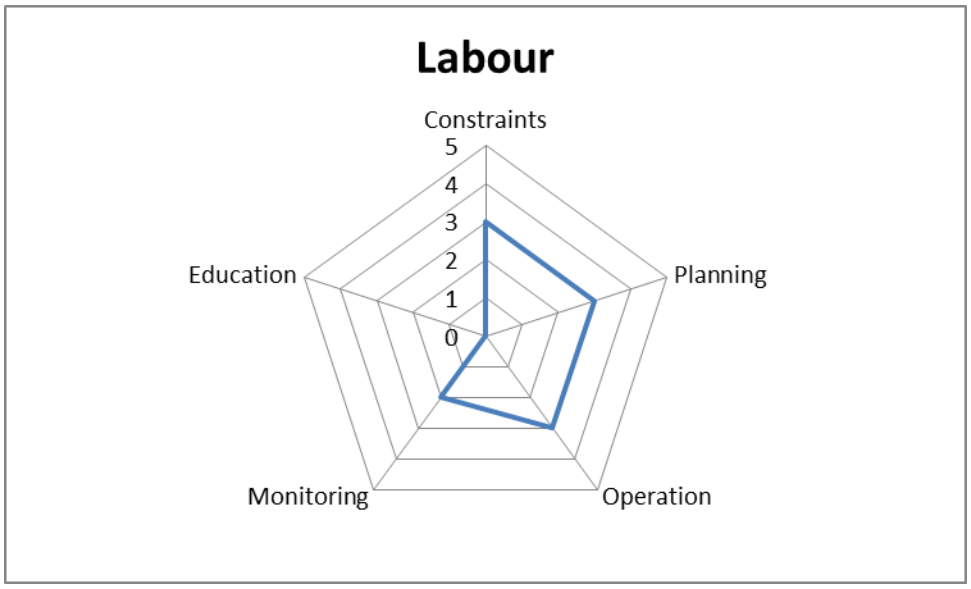
However, no evidence was obtained on how the local population or NGOs are involved in the monitoring of labour issues in the chemical industry.

Education

Blank spots: The desk study and fieldwork revealed insufficient data availability in the improvement of working conditions, labour programmes or best practices in the chemical industry, which are shared between the authorities, industry and the local population. It is therefore not possible to make any conclusive statement on labour education in Viet Nam.

Summary

Figure 34 Labour analysis of the chemical industry in Viet nam



3.7 Evolution of the methodologies:

To promote an intense discussion on environmental and social constraints and enablers, quantitative data for the energy, water supply, solid waste and wastewater systems needs to be added to the qualitative data already collected. Data availability and quality are always the main challenge in environmental analysis and our methodology has been deliberately designed to use both quantitative and qualitative data to paint the richest possible picture. Where quantitative data is missing – which is the case far too often – the methodology attempts to use qualitative data only to assess the situation. Though this can often be done, it is insufficiently robust to arrive at results. In these cases, the methodology relies on the researcher's ability to remain as subjective as possible during the course of the interviews and the forums.

Data gaps, referred to as 'Blank Spots' are highlighted to draw clear attention to this problem and encourage local improvements in data collection. Over time, the methodology is designed to encourage increased data availability and a shift to quantitative data where appropriate, and the assessments can then be used over time to demonstrate a development path for that nation and the given sector. Due to different levels and the diverse nature of data across countries and industries, cross-nation or cross-industry comparisons are not suitable.

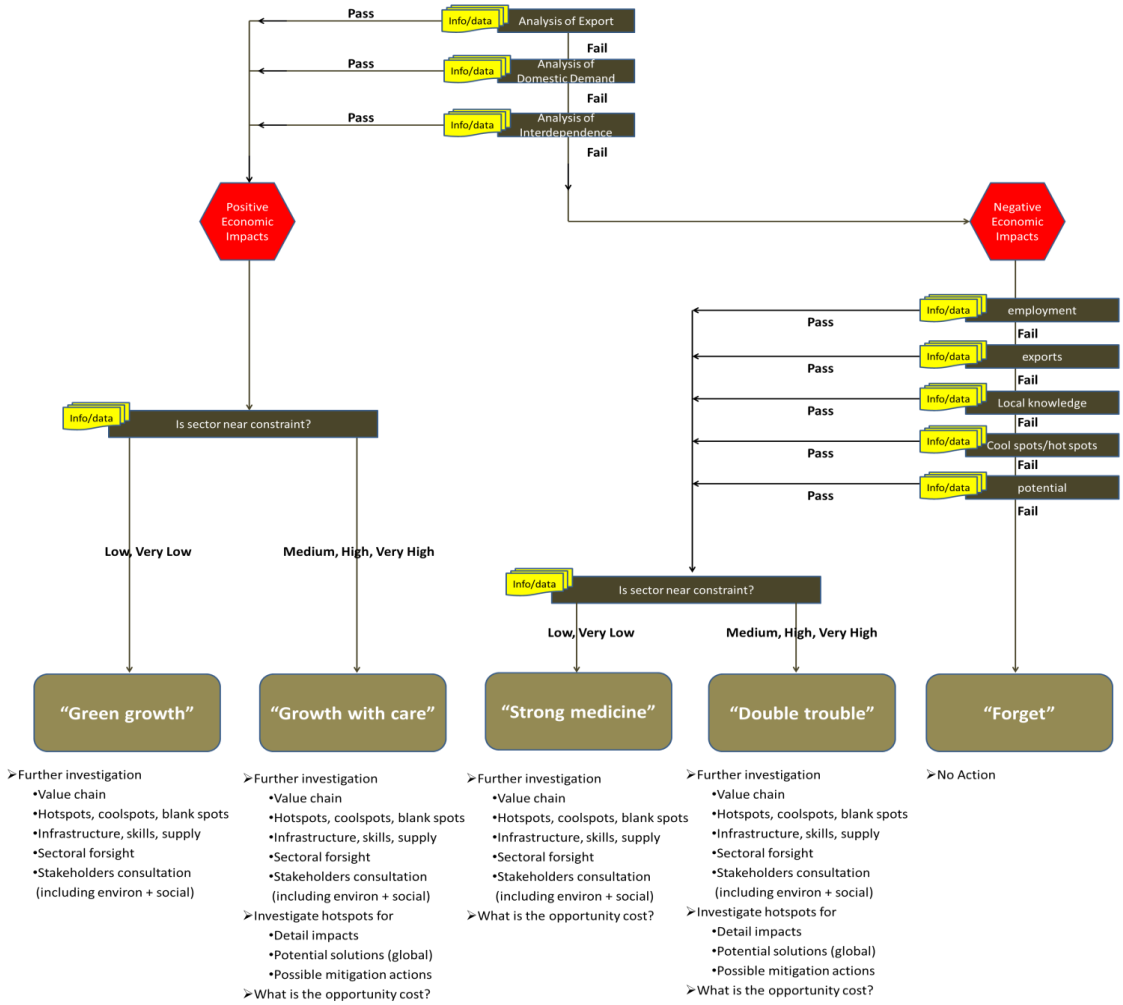
4 Synthesis of economic, environment and social analyses

In the previous sections, the methodologies were developed in order to conduct independent analyses of the economic, environmental and social components of an industrial subsector. In

this section, a methodology to combine the earlier analyses is introduced to derive policy recommendations that define potential pathways towards green growth. Bringing together these diverse aspects into a single framework is challenging and there are multiple ways to perform this task. Questions naturally arise about which aspects should be prioritized and whether these priorities need to be homogenous across countries.

In formulating this synthesis methodology, we rely on the principle that any industry with a promising potential in terms of any of the economic dimensions (namely export performance, local demand and domestic multiplier impact) deserves further policy attention. We then screen these industries looking through an environment and social lens in search of those industries that offer the greatest positive impacts with the lowest negativeeffects. It should be noted that we do not recommend the closure or withdrawal of an industry that has a very high positive economic or social impact, unless it entails the possibility of an extremely adverse negative environmental impact that cannot be mitigated. In addition, even the industries that do not emerge as clear winners in economic and social dimensions are tested in order to determine whether they have some potential environmental benefits that could distinguish them as a worthy investment. The methodology is designed in such a way that none of the policy recommendations we propose will lead to any major trade-off in the growth of the country's industrial sector as a whole. Finally, we by no means suggest a 'one-size-fits-all' policy tool; on the contrary, we have developed a synthesis framework which incorporates the country-specific context and local realities. The key advantage of this framework is the fact that the economic, environmental and social dimensions can be incorporated into one framework, a practice that is currently far from the norm in the policy arena. This incorporation is indispensable in the quest to achieve green growth, and we expect this and similar methodologies to be developed significantly further as we learn more about the practicalities of such incorporation. The overall structure of our synthesis framework is depicted in the following flow chart.

Figure 35 Step-by-step analysis of economic aspects to environment-social aspects



Step 1: The first step in the synthesis exercise is to carry out an economic analysis to test the industry's economic potential. An industry is termed an 'economic winner ('positive economic impacts' in the figure) if the industry meets any of the following criteria:

- The industry is classified as a 'champion' or 'under-achiever' in the export analysis conducted in the section 2.3.1.
- The industry has been classified as a 'local champion' based on the domestic demand and production analysis conducted in section 2.3.2.
- The industry is classified as a 'high impact' industry based on the domestic interdependence analysis carried out in section 2.3.4.

For all countries under consideration, the chemical industry is a ‘champion’ according to the export analyses (conducted in section 2.3.1), hence we can classify this industry as an ‘economic winner’ (‘positive economic impacts’ in the figure) based on the synthesis framework described above. It should be noted that the chemical industry is also a ‘local champion’ in Thailand and Indonesia based on the domestic demand analyses, whilst at the same time, it is a ‘high impact’ sector in Malaysia, the Philippines and Thailand according to the domestic interdependence analyses. Hence, the chemical industry qualifies as an ‘economic winner’ (‘positive economic impacts’ in the figure) based on multiple dimensions. We therefore immediately proceed with the environmental and social analyses.

Step 2: In the second step of the synthesis exercise, we carry out the environment and social analysis to test the industry’s environmental and social potential. The environment and social analysis focuses on physical constraints that can hinder or enable an industry’s future progress and covers energy, material and water inputs, plus air, waste and water emissions as well as labour. Classifying a sector as medium, high or very high indicates that the industry is operating at near or over the national capacity and that there is a current or imminent event that may cause a growth plan to be delayed or ceased.

If the industry is classified as very low or low in the environment and social analysis, the growth of that industry will not be constrained by national capacity.

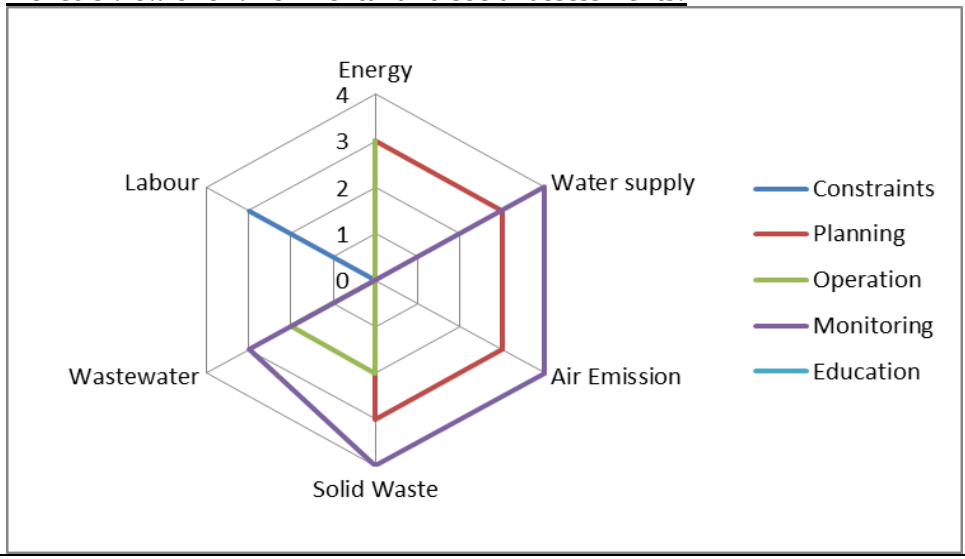
It should be noted that the analysis does not calculate future industry growth targets as the data quality is insufficient in nearly all countries, and that the actual environmental and social impacts occur as part of a larger system where multiple sectors influence national capacity.

Step 3: The third step in the synthesis exercise is establishing a recommendation category for the industry (in this case, the chemical industry) in each country. This categorization is based on the results of Step 1 and Step 2 and is described in the figure. Further analysis is recommended to identify the opportunities for improving value creation in the country and industry concerned, taking account of economic, environmental and social aspects.

- The policy recommendations are classified into five growth categories: ‘Green growth’, ‘Growth with care’, ‘Strong medicine’, ‘Double trouble’ and ‘Forget.’
- Positive economic impacts lead to one of two categories ‘Green growth’ and ‘Growth with care’, depending on the environment and social impact analysis.

Negative economic impacts lead to one of three categories ‘Strong medicine’, ‘Double trouble’, and ‘Forget’, depending on the environment and social impact analysis.

4.1 Indonesia

Indonesia	Chemical industry
Economic analysis • Export Yes • Domestic demand Yes • Interdependence (interlinkages) No **Result: Economic winner**	**Judgment:** **'Growth with Care'** These are sectors that emerged as an economic winner but are quite near the constraints defined in our environmental and social analyses **Detail suggestions for 'Green Growth':** Please see the next section, 'Policy recommendations'
Environment and social analysis • Energy 1 2 3 4 5 • Air emissions • Water supply • Solid waste • Wastewater • Labour No Yes **Result (Degree of constraints):** 0 1 2 3 4 5 6 Yes Yes Yes Yes Yes **Very High High Moderate Low Very Low**	**Holistic view of environmental and social assessments:** 

4.2 Philippines

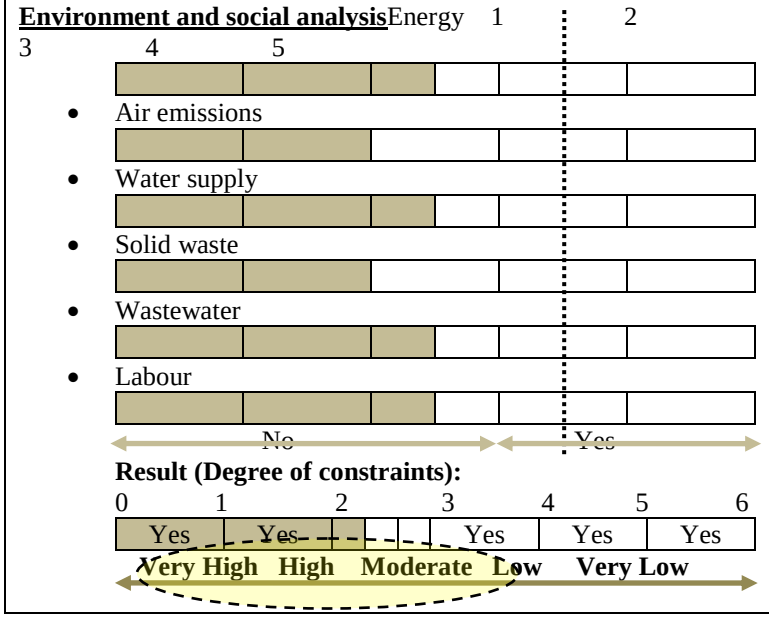
Philippines	Chemical industry

Economic analysis

- Export
  Yes
- Domestic demand
  No
- Interdependence (interlinkages)
  Yes

Result: Economic winner

Environment and social analysis



Judgement:

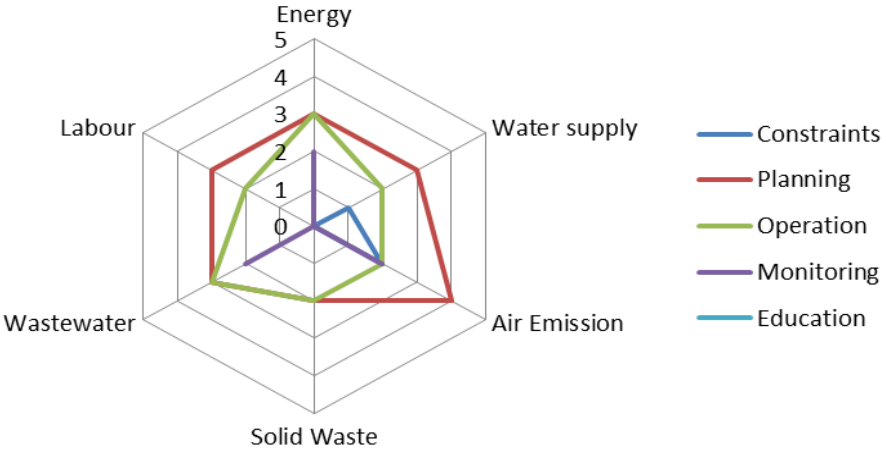
'Growth with dare'

These industries emerged as economic winners, but are quite close to capacity as defined in our environment and social analyses

Detailed suggestions for 'Green growth':

Please see next section, 'Policy recommendations'

Holistic view of environmental and social assessments:



4.3 Thailand

Thailand	Chemical industry

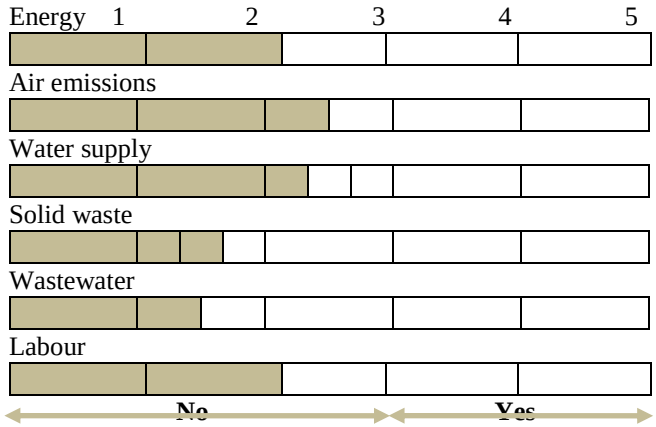
Economic analysis

- Export
  Yes
- Domestic demand
  Yes
- Interdependence (interlinkages)
  Yes

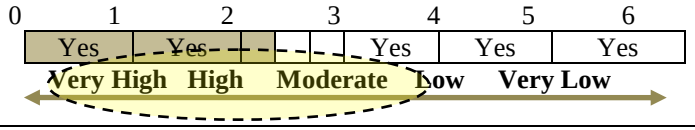
Result: Economic winner

Environmental and social analysis

- Energy
- Air emissions
- Water supply
- Solid waste
- Wastewater
- Labour



Result (Degree of constraints):



Judgement:

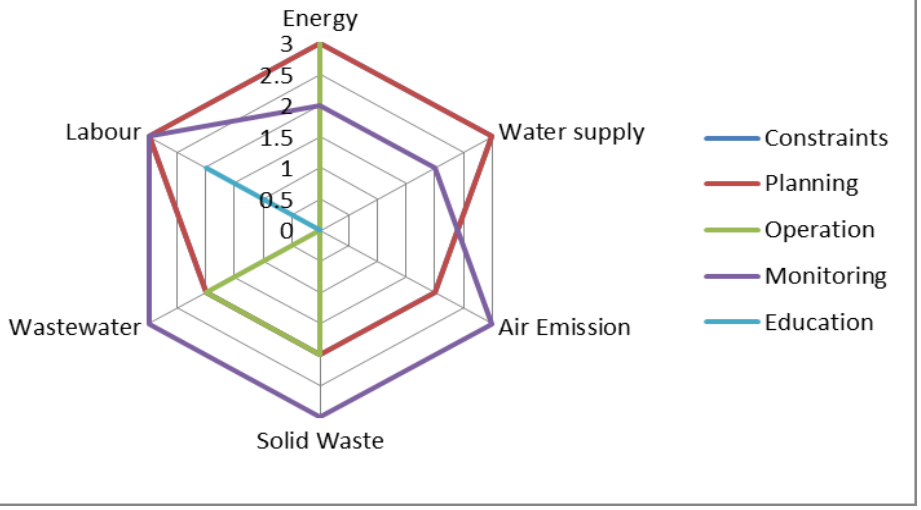
'Growth with care'

These are industries that emerged as economic winners but are quite close to capacity as defined in our environment and social analyses

Detailed suggestions for 'Green Growth':

Please see next section, 'Policy recommendations'

Holistic view of environment and social assessments:



4.4 Viet Nam

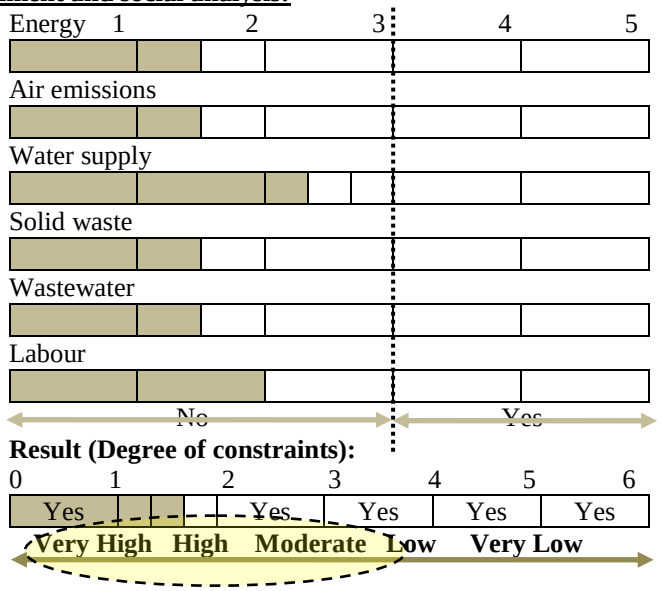
Viet Nam	Chemical industry

Economic analysis:

- Export
  Yes
- Domestic demand
  No data
- Interdependence (interlinkages)
  No data

Result: Economic winner

Environment and social analysis:



Judgement:

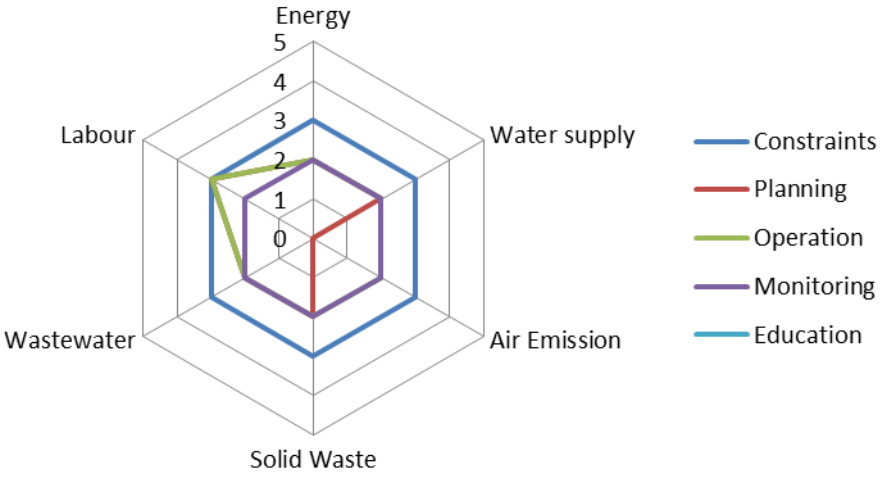
'Growth with care'

These are industries that emerged as economic winners, but are quite close to capacity as defined in our environment and social analyses

Detail suggestions for 'Green Growth':

Please see the next section, 'Policy recommendations'

Holistic view of environmental and social assessments:



5 Policy recommendations

- **The chemical industry has been identified as a 'Growth with care' industry:** these are industries that emerged as economic winners but are very close to capacity as defined in our environment and social analyses. **Policymakers should consider the following actions:**

    - Take measures to further improve the competitive positions of these industries by taking strategic policy actions.

    - Conduct an 'AEC scenario' analysis of the industry to forecast how the domestic sector will respond to the AEC formation in 2015. Take steps to prepare the industry for possibly increased competition.

    - The industry is an 'under-achiever' in the export analysis, then the country should try to improve the industry's export performance through proactive policy interventions to capture the increased world demand in this dynamic industry.

    - It is important to study the sustainability of future demand growth for these dynamic industries. If demand growth is found to be short-lived, then the country should not invest too many resources into these industries.

    - The skill requirements in these industries need to be studied and the national educational institutions must be encouraged to cater to these requirements.

    - A detailed industry-specific constraint analysis needs to be conducted and policy measures adopted to mitigate these constraints to foster more rapid sectoral growth. This is critical to ensuring that any growth policy is not thwarted by an external constraint.

    - An industry level value chain analysis needs to be undertaken to explore options of producing more value added goods within the industry.

    - Organize stakeholder consultations to explore options to minimize the hotspot impact.

    - The use of global best practices should be encouraged. The leading companies use less water and energy, and generate less waste per unit of added value. For

any growth sector, the government should promote a programme of learning about the best global standards and support programmes to enhance the skills of local staff.

- National governments should consider using local government procurement to support high levels of performance by setting clear environmental and social standards for supply where such delivery performance is feasible. Government should work with local trade associations to develop these standards.

- Trade associations and leading companies in the industry should be encouraged to develop a roadmap to adopt global levels of environmental and social performance. Such roadmaps should be endorsed by the government and made public.

- Clearly, many companies in the chemical industry suffer from poor infrastructure (at national level and at company level). Trade associations and the government should seek ways to share infrastructure resources (such as two plants jointly building one wastewater treatment facility), which may then become economically feasible due to increased volume.

- The chemical industry is failing to maximize the value generated per weight of product. This is largely due to poor quality raw materials and to limited technical competence. Poor quality processing also means that products may need re-processing, which significantly increases the costs and environmental impacts, but adds no value. Technical competence in process quality is a minimum competence and again there is considerable opportunity to improve skills and hence competitiveness.

- Finally, the chemical industry has limited capacity for companies to coordinate their use of by-products (where one plant's waste is used as input material by another). We have encountered excellent examples, but far too rarely. It is clear from other nations' experiences that government and trade associations play a key role in brokering such industrial symbiosis and this must be supported.

Local best practice

We have noted that that there is at least one company in most of our case countries that is well aware of global best practice and has has introduced an operational programme to deliver such high performance. These companies are often part of global initiatives, such as the World

Business Council for Sustainable Development. Governments would benefit from identifying these companies and encourage their participation in road-mapping at the national level.

The need for the development of measurement and monitoring competence is widespread, both within industry and government; research & development competence in the emerging field of green chemistry should also be supported.

Data collection improvement for better industry policy

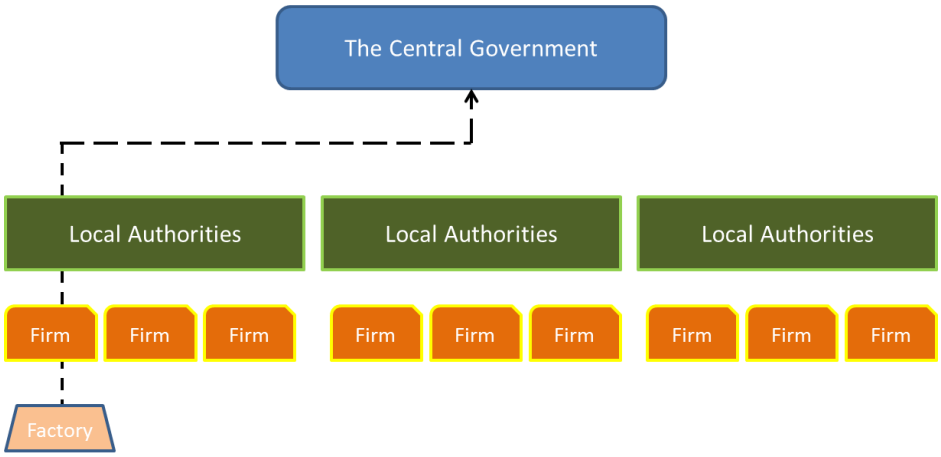
To support better policy design for industry, each country needs to further develop their national data collection system for environmental and social data. For example, if authorities want to determine water demand of a given industry, authorities can ascertain total water demand from one of two sources of information: factories' annual water demand report (for local authorities) or factories' annual water consumption (which can also be collected by local water authorities).

All the necessary data cannot be collected this way and we therefore explore an alternative approach to collect data. To measure the amount of solid waste in a certain industry is not a simple task. Local authorities and central government collect solid waste data by region. The collection of waste data at the level of industry, e.g. the chemical industry, is not only difficult, but is also not necessarily important for local authorities. However, an indirect approach can provide important evidence about the amount of solid waste and wastewater at the level of industry.

During the process of establishing a new factory, the managing company is required to notify the local authorities of the expected solid waste and wastewater production before a license to operate can be issued. The managing company needs to annually update these figures to keep their operating licence. Data that can be used for analysis exists in the countries, but is in many cases is not collected nationally or processed at industry level.

If the government collects data from waste plans compiled by local authorities, a better picture of regional and industry-based waste production can be established. The calculations based on these waste plans are unlikely to correspond to actual waste production in a given region or by a given industry, but nonetheless allows for an estimate.

Figure 36 Reporting flows of solid waste and toxic waste



There are three important implications: first, local authorities should monitor the waste produced by local factories; second, local authorities need to monitor companies' plans for annual waste production. Third, firms should have the opportunity to review their waste production amounts.

Communication between authorities, industry and the local population

This report found that there are opportunities to share information that can be used to set environmental and social targets. We strongly recommendthe formal communication between the three actors (authorities, industry and local population) across all manufacturing processes from constraints, planning and operation to monitoring and education. The three parties should understand that the five manufacturing processes are interlinked and interdependent in terms of achieving environmental and social improvement. In addition, the authorities should be aware of the fact that social awareness of environmental and social factors can help exert a positive influence on the chemical industry in the long term.

Suggestions for 'Growth with care'

- **'Growth with care' industries:** These are industries that emerged as economic winners but are quite close to capacity as defined in our environmental and social analyses. **Policymakers should consider the following actions:**

  - Take measures to further improve these industries' competitive positions by taking strategic policy actions.

  - Conduct an 'AEC scenario' analysis of the industry to forecast how the domestic sector will respond to the AEC formation in 2015. Take steps to prepare the industry for possibly increased competition.

- If the export analysis indicates that an industry is an ‘under-achiever’, the country should try to improve the industry’s export performance through proactive policy interventions to capture the increased world demand in this dynamic industry.

- It is important to study the sustainability of future demand growth for these dynamic industries. If the demand growth is found to be short-lived, then the country should not invest too many resources into these sectors.

- The skill requirements in these sectors need to be identified and the national educational institutions encouraged to cater to these needs.

- Detailed industry-specific constraints analyses need to be carried out and policy measures adopted to mitigate these constraints to foster more rapid growth in the industry. This is crucial to ensure that any growth policy is not thwarted by an external constraint.

- An industry level value chain analysis needs to be conducted to explore options of producing more value added goods within the industry.

- Stakeholder consultations should be organized to explore options to minimize hotspot impacts.

- The use of global best practices should be encouraged. Leading companies are using less water and energy, and generating less waste per unit of added value. For any growth industry, the government should ensure a programme of learning about what those best global standards are and support programmes to upskill local staff to deliver such practices.

- National governments should consider using local government procurement to support high levels of performance by setting clear environmental and social standards for supply, where such delivery performance is feasible. The government should work with local trade associations to develop these standards.

- Trade associations and leading companies in the industry should be encouraged to develop a roadmap to adopt global environmental and social standards. Such roadmaps should be endorsed by the government and made public.

- Many of the companies in the chemical industry suffer from poor infrastructure (at national level and at company level). Trade associations and the government should seek ways to share infrastructure resources (such as two plants jointly building one wastewater treatment facility), which may then become economically feasible due to increased volume.

- The chemical industry is failing to maximize the value generated per weight of product. This is largely due to poor quality raw materials and to limited technical competence. Poor quality processing also means that products may need re-processing, which significantly increases the costs and environmental impacts, but adds no value. Technical competence in process quality is a minimum competence and again there is considerable opportunity to improve skills and hence competitiveness.

- Finally, the chemical industry has limited capacity for companies to coordinate their use of by-products (where one plant's waste is used as input material by another). We have encountered excellent examples, but far too rarely. It is clear from other nations' experiences that government and trade associations play a key role in brokering such industrial symbiosis and this must be supported.

6 Conclusions

The chemical industry is a large part of the ASEAN nations' economy and is expected to play a key role in future green growth. All five nations studied face constraints that limit the ability of their chemical industry to expand; in some cases, the constraints relate to water and/or wastewater, in other cases to air emissions, etc. As such, the chemical industry has in each case country been identified as a 'Growth with care' industry, hence, industry expansion must be based on a comprehensive environment and social analysis of the growth plans. We have identified actions that focus on skills and coordination, as long-term strategic advantages can thus be achieved at low cost. However, this approach is not without challenge and should not be rushed.

Excellent companies exist in many locations worldwide. These companies are proof that local conditions are not a limiting factor for environmental or social performance (though local infrastructure poses a major challenge in many cases as does the workforce's technical competence). Secondly, these companies demonstrate that higher value creation is correlated with higher environmental performance (due to better process control). This indicates that there is no structural reason for the ASEAN chemical industry to push for lower costs, lower quality

and lower environmental and social standards, albeit being a frequently used strategy. This strategy is a 'race to the bottom' that is unnecessary and does not offer a route for increasing added value, quality jobs and exports, while improving local conditions. Thirdly, and finally, these excellent companies provide local access to knowledge, which *should* be sought, promoted and used by the nation to support progressive policies and develop practice-sharing education programmes that can help raise other companies' performance as well.

We have found evidence that governments and industry – whether individual companies and/or trade associations – are failing to produce future roadmaps. Roadmaps help industry and government better understand each other's aims and instruments and encourage efficient allocation of resources. Roadmapping can identify critical constraints and challenges (for example, skills) and offer a shared solution. Roadmaps can be negatively affected by intense lobbying from industry or a short-term outlook by politicians, and must be conducted with care, especially where there is little history of cooperative problem solving.

Many of the chemical companies in the region struggle with process quality control, which then creates more scrap and more re-working and thus uses more energy and water and generates more waste. This is both a company and national competitiveness issue, as a lack of capacity in the energy, water or waste systems means that industry growth relies on infrastructure growth. The cost of infrastructure growth is typically much higher than the cost of efficiency programmes that can produce the same capacity. We strongly recommend the development of process quality control skills and national provision of more sophisticated process quality equipment. Such education and equipment availability will also enable the long-term development of better research competence in this crucial area. These measures have the additional benefit of helping to move the industry towards higher value adding outputs.

There is a strong economic logic for supporting the ASEAN countries' chemical industry. None of the countries studied exhibited critical environmental or social conditions that would immediately limit the chemical industry's growth. However, the chemical industry in each case country is operating close to capacity in terms of resources and any growth plan must be accompanied by an equally effective plan to increase the constraining capacity.

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