Towards Green Growth

Through Green Industry Development in Viet Nam

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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Table of Contents

I. List of Figures 4
II. List of Text Boxes 4
III. List of Acronyms 4
IV. Abstract 5
V. Foreword by Director-General of United Nations Industrial Development Organization 6
VI. Foreword by the Ambassador of Viet Nam to the United Nations 7
VII. Acknowledgements. 8

1. Introduction 9

1.1 Green Industry 9
1.2 A Decade of Achievement 11
1.3 Industrial Development in Viet Nam 13
1.4 Policy Advice on Environmental Management 14

2. Policy Advice for Green Industry Development 15

2.1 Policy Gap Analysis 15
2.2 Policy Framework 16

3. Resource Efficiency in the Steel Sector 19

3.1 Introduction 19
3.2 Resource-Efficiency Baseline 19
3.3 Measures Initiated 20
3.4 Benefits Achieved 23

4. Eco-City Hoi An 25

4.1 Introduction 25
4.2 Green Industry for Improved Environmental Amenity 25
4.3 Greening of the Accommodation Sector in Hoi An 27
4.4 Greening of the Craft Sector in Hoi An 29
4.5 Conclusions and Recommendations 30

5. Binh Yen Aluminium Recycling Village 33

5.1 Introduction 33
5.2 Baseline Situation 33
5.3 Technology Solutions 35
5.4 Sector Reform 36

6. Ways Forward 37

7. Bibliography 39

I. List of Figures

Figure 1. Resource Efficient and Cleaner Production 9
Figure 2. UNIDO Green Industry Themes 10
Figure 3. Energy Intensity in the EAF Steel Sector 20
Figure 4. Correlation between Scrap Quality and Resource and Energy Efficiency 20
Figure 5. Outline of Proposed Sustainable Technology Roadmap for Vietnamese Steel Industry 22
Figure 6. Energy and GHG Benefits after Benchmarking 23-24
Figure 7. Hoi An City's Environment and Energy Needs 26
Figure 8. Green Industry Action Plan for Hoi An Eco-City Development 31-32
Figure 9. Household-Level Aluminium Recycling in Binh Yen Village: Inputs, Processes and Waste Products 34
Figure 10. Chromium (VI) Reduction and Removal in a Household-Scale Wastewater Treatment System 35
Figure 11. Emissions Treatment using the Solution Absorption Method 36

II. List of Text Boxes

Box 1. Viet Nam Country Profile 13
Box 2. Draft Charter for the Green Industry Task Force 21
Box 3. Eco-Cities 25
Box 4. Accommodation Sector 27
Box 5. Resource Efficiency in Lantern-Making Households 28
Box 6. Resource Efficiency in Rice Noodle-Making Households 29
Box 7. About Aluminium Recycling 33

III. List of Acronyms

BAT	Best available technique
BEP	Best environmental practice
CP	Cleaner production
CSR	Corporate social responsibility
EAF	Electric arc furnace
ISEA/ ISEA-MOIT	Industrial Safety Techniques and Environment Agency of the Ministry of Industry and Trade
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MSW	Municipal solid waste
POP	Persistent organic pollutant
RECP	Resource Efficient and Cleaner Production
SMEs	Small and medium-sized enterprises
TOE	Tonnes of oil equivalent
VIRI	Viet Nam Rural Industries Research and Development Institute
VNCPC	Viet Nam Cleaner Production Centre
VSA	Viet Nam Steel Association
UP-POPs	Un-intentionally Produced Persistent Organic Pollutants
WEPA-VEA (MONRE)	Waste Management and Environmental Promotion Agency of the Viet Nam Environment Administration (VEA), the Ministry of Environmental Resources and Environment

IV. Abstract

This report shares the results of holistic assessments of opportunities and constraints for solving some of Viet Nam's most pressing industrial environmental problems, paying due attention to their socio-economic context. These served to inform and guide the development of a policy framework for wide-scale deployment of Green Industry approaches to ultimately achieve Green Growth in Viet Nam.

A total of three replicable pilots were undertaken, from which lessons learnt and best practices were brought together to form the basis for overall policy recommendations and quantified targets. Firstly, benchmarking against good international practices in the Electric Arc Furnace (EAF) steel sector was combined with a sectoral voluntary agreement and technology roadmap, to offer a highly innovative yet equally feasible approach for Green Industry development in resource- and energy-intensive sectors. Secondly, the determination of the local government to develop an Eco-City in Hoi An by 2030 represents a golden opportunity to realise multi-faceted development benefits in a tourism-driven regional economy, for which a Green Industry Action Plan was devised to help improve environmental amenity and foster economic growth. Thirdly, in the Binh Yen Village it was found that recycling of aluminium scrap into cookware had seemingly offered overnight prosperity, but created severe pollution which poses significant health risks and is therefore untenable from the perspective of long-term sustainable development. Villagers are caught up in a dilemma between short-term creation of jobs and incomes, and medium-term health and environmental impacts and costs, which ultimately they cannot resolve on their own.

The results of these pilots show emphatically that command and control measures alone cannot be a panacea for all of today's industrial, environmental and economic woes. It is here that Green Industry approaches to Green Growth deliver a clean break with the outmoded break-neck speed industrial development models of yesteryear and reconcile environmental and socio-economic concerns by placing them on an equal footing as opposed to dismissing one in favour of the other as antithetic objectives. The overarching policy framework suggested for adoption by the Ministry of Industry and Trade, therefore combines the setting of guiding quantitative goals for the improvement of resource productivity and environmental performance, with specific initiatives to improve policy coherence at the national and sub-national levels, improve availability and access to appropriate technologies, provide customized business advisory services, and mainstream Green Industry into sectoral strategies.

V. Foreword by Director-General of United Nations Industrial Development Organization

Green Industry is an operational strategy which industries in countries at all stages of development can use to achieve sustainable development by decoupling economic growth from excessive resource use and environmental pollution. Green industries minimize their waste generation, use energy efficiently and deploy renewable resources as input materials and energy sources. Moreover, they provide environmental goods and services, such as waste management, renewable energy, etc., in a predictable manner to ensure that work environments, local communities and nature at large are safe from dangerous environmental hazards. Green Industry is an inclusive approach that has broad ripple effects beginning and focusing on industry but touching all aspects of society. UNIDO is sure that creativity and technical innovation are the driving forces of the green industries of the future, starting today, and will in turn be the catalyst for green jobs, future growth and more sustainable development.

This report shares some of the key results and lessons learnt from UNIDO's collaboration with the Government of Viet Nam in developing an overall policy framework for Green Industry and assessing opportunities and challenges in selected sectors. This collaboration was undertaken under the One UN Initiative with funding from the Viet Nam One Plan Fund between July 2011 and June 2012. This project has shown in tangible terms the added-value that a Green Industry approach can deliver by providing in-depth insight into real time opportunities and challenges; offering policy guidance; creating a replicable sectoral benchmarking model and a roadmap to resource efficiency for the steel sector; piloting the Eco-City concept in Hoi An City; and investigating and documenting environmental pollution in micro-level household enterprises in handicraft villages around Viet Nam. It demonstrates that the Green Industry initiative that was officially launched in Manila, Philippines in 2009 can have positive additional benefits in the context of a developing country endeavouring to achieve sustainable development, regardless of such constraints as population size, natural resources limitations, grave environmental pressures and climate change.

I am delighted to share the results of our work with you, on the occasion of the launch of the Green Industry Platform at the twentieth anniversary of the Earth Summit. In doing so, I would like to stress that there is more work to be done to ensure that these results can be replicated throughout Viet Nam, and indeed in other developing and emerging economies around the world.

Kandeh K. Yumkella
Director-General, UNIDO

VI. Foreword by Ambassador of Viet Nam to the United Nations

In more recent years, rapid development and, in particular, industrialization has brought with it tremendous change to our planet. On the one hand the resulting economic growth has prompted poverty reduction and wealth creation for some, but on the other, it has provoked evermore growing concerns about climate change, the rapid depletion of natural resources, and threats to water, food and energy security for all. In this context, placing equal emphasis on economic development, social security and welfare, and environmental protection, Green Growth is now increasingly becoming acknowledged by Governments and nations around the world as the development model for the 21st Century. The Government of Viet Nam has entrusted the Ministry of Planning and Investment to develop Vietnam's Green Growth Strategy which is expected to be launched in the second half of 2012, which will provide an overarching framework for line ministries to develop and implement action plans for their respective sectors.

It should be noted that the approach of rapid and sustainable development was in fact recognized early in Viet Nam. The process of comprehensive reforms undertaken since the mid-1980s and the implementation of the Government's Strategic Orientations of Sustainable Development have brought about significant achievements as reflected, for instance, in the quite high growth rate, tangible improvement in both the material and spiritual lives of people, expansion of the social welfare and security system and greater attention to as well as progress in a number of aspects of environmental protection in the country. However, there remain numerous limitations and shortcomings that need to be addressed. Among them is the situation where the overall competitiveness of the economy is low and economic growth still based largely on the capital intensive production methods along with exploitation of natural resources. Out-of-date technology is in much use by industry exacerbating the urgent situation of environmental degradation and climate change. The Government of Viet Nam continues to put great emphasis on quality and efficiency of growth and sustainable development.

Building on a long history of cooperation with UNIDO and as a signatory of the Manila Declaration on Green Industry in Asia, 2009; the Government of Viet Nam has followed the Green Industry Initiative with a strong interest, most recently participating in the Tokyo Green Industry Conference in 2011 and the Interim Advisory Board of the GI Platform in Vienna in May 2012. Hence, release of this report summarizing UNIDO's most recent work on GI development in Viet Nam, particularly on this occasion of the launch GI Platform at United Nations Conference on Sustainable Development, Rio+20 is very timely and welcome.

The Green Industry Initiative offers concrete solutions to global and local environmental challenges and natural resource constraints with proven concrete measures for implementation of green economy in the context of sustainable development and poverty eradication. With this in mind, we look forward to further cooperation with UNIDO and sister United Nations Organizations on GI and wish the launch of the GI Platform every success.

LE Hoai Trung
Ambassador Extraordinary and Plenipotentiary
Permanent Representative to the United Nations
Government of Socialist Republic of Viet Nam

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1. INTRODUCTION

1.1 Green Industry

In 2008, UNIDO launched the Green Industry (GI) initiative as an organization-wide strategic priority to foster sustainable industrial development in developing and transition countries. As rapid industrialization has proven to be a key driver for economic growth and poverty eradication in Viet Nam and throughout the developing world, sustainable industrial development is required to meet the global aspirations for sustainable development, as reflected in the Agenda 21, adopted at the Rio Summit, and the Johannesburg Plan of Implementation, adopted at the World Summit on Sustainable Development.

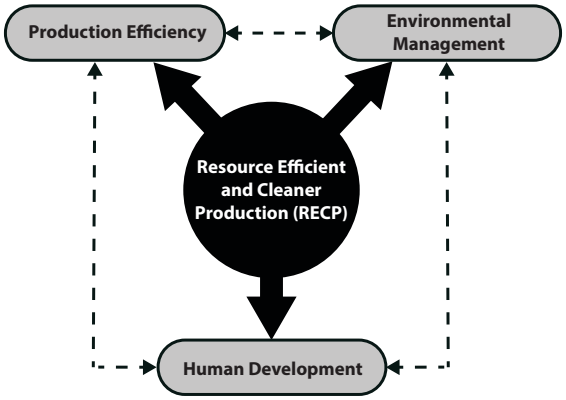
Green Industry is based on proven methods, strategies and tools and ultimately endeavours to decouple economic growth from increased use of natural resources (resource decoupling) and aggravated environmental impacts (impact decoupling). It provides a two-pronged approach for industrialization that is robust in the context of worsening environmental degradation, climate change and resource constraints:

- Firstly, Green Industry, through the 'greening of industries' achieves, on an ongoing basis, reductions in the use of natural resources and of the generation of waste and pollution in any business, including through such proven approaches as Resource Efficient and Cleaner Production (RECP) (see Figure 1), industrial energy efficiency, and chemicals management.
- Secondly, through the creation of 'green industries', Green Industry realizes the supply of high quality environmental goods and services in an effective and industrial manner, including, for example, for renewable energy, waste recycling and resource recovery, and environmental advisory services.

Green Industry is a sectoral strategy for achieving Green Economy and Green Growth in the manufacturing and related productive sectors. It assures the security of natural resources by alleviating the pressure on already-scarce resources such as water, materials and fuels, contributes to mitigation and adaptation to climate change by reducing greenhouse gas (GHG) emissions from energy and non-energy sources and at the enterprise-level, better environmental management and industrial and chemical safety. However, beyond this, achieving Green Industry is much more than just a question of environmental sustainability. It unlocks many more additional development opportunities, as a driver of competitiveness and sustainable business as enterprises improve their resource productivity and environmental performance. While also a catalyst for technological innovation, Green Industry is not just a new paradigm for industrial development, it also offers "triple bottom-line" benefits, serving as a clear strategy with defined pathways for achieving sustainable development.

Figure 1. Resource Efficient and Cleaner Production

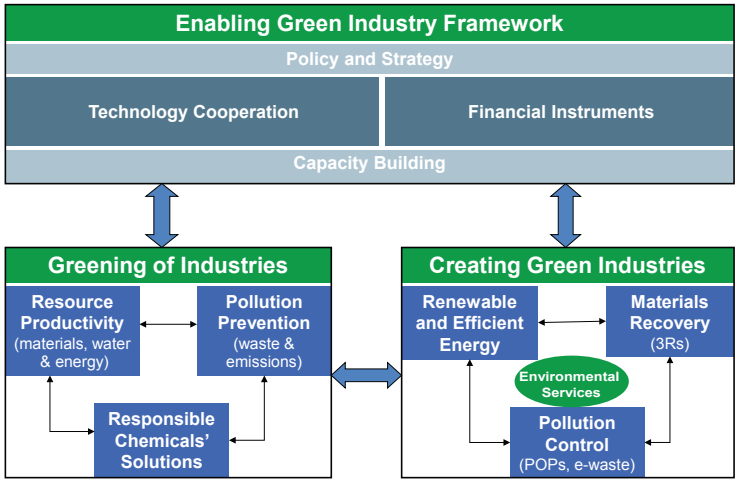
RECP refers to the application of preventive environmental management practices in industrial products, processes and services with the triple aim of improving resource productivity, environmental management and human development (www.unido.org/cp).



RECP refers to the application of preventive environmental management practices in industrial products, processes and services with the triple aim of improving resource productivity, environmental management and human development (www.unido.org/cp).

Furthering the Green Industry agenda requires action in three fields, as illustrated in Figure 2. Practical support is required to scale-up both the greening of industries, through focused activities on resource productivity, pollution prevention and chemicals management, and the creation of green industries, by supporting the supply of goods and services for renewable energy, materials recovery and pollution control. Both require an enabling framework, under which UNIDO is addressing policy and strategy, technology transfer, financial instruments and capacity building.

Figure 2. UNIDO Green Industry Themes



In specific, concrete terms, Green Industry is achieved through concerted actions that yield resource efficiency through the dematerialization of products and value chains; making use of materials with a longer service lifetime; recycling, reuse and recovery of materials, energy and water thereby reducing exploitation of virgin materials. Through improvements in process operations and application of advanced process technologies with higher efficiency and specificity, Green Industry minimizes the generation of wastes and emissions. Employing of BEPs and BATs prevents the unintentional production of POPs and other hazardous pollutants while replacement of chemical by non-chemical processes translates into real reductions in risks associated with chemicals and (hazardous) wastes. Equally important in this strategy is the creation and expansion of (new) green industries, in which there are numerous opportunities to exploit from recycling and resource recovery to B2B support in promoting and deploying industrial energy efficiency and renewable energy solutions in addition to the collection, management and disposal of hazardous wastes.

Given that Green Industry is clearly a cross-cutting priority in issues of competitiveness, innovation, trade, at a higher level, the salient use of policy in tandem and mutually supporting these two interlinked approaches is necessary to achieve a real impact. The use of fiscal policy, regulatory and market-based instruments to mainstream and embed Green Industry in industrial and related policies and strategies, along with the fostering of industry-based initiatives, ensures that enterprises have access to affordable financing, that human and institutional capacity is developed in a systematic manner and that technology diffusion and deployment are supported at the enterprise level.

1.2 A Decade of Achievement

UNIDO has a long history of cooperation with the Socialist Republic of Viet Nam dating back to 1978. One of the key pillars of which has been the implementation of technical assistance aimed at improving resource efficiency (including energy), environmental performance and industrial chemicals management to help make green Viet Nam's industrial sector and, at the same time, to help foster development of green industries that make use of waste products and deliver environmental services with the overall goal of realizing Green Growth.

Since its establishment in 1998, the Viet Nam National Cleaner Production Centre (VNCPC) has been one of UNIDO's most important assets in its work on Green Industry in Viet Nam. Going from strength to strength since its inception, the Centre has a strong record in delivery, as documented by the independent evaluation of its performance conducted on behalf of its founding donor (Government of Switzerland) and UNIDO. Published in February 2012, the report revealed that VNCPC has implemented a total of 340 consultancy projects in the form of CP Assessments (CPAs), Technology Gap Assessments (GAPs), Clean Technology Assessments (CTAs), Cleaner Technology Implementation (CTI), Financial Engineering Proposals (FEPs) and Sustainable Product Innovation (SPIN). VNCPC's outreach work has benefited numerous companies in diverse sectors from metals (19 per cent), food processing (18 per cent), textiles (14 per cent), handicrafts (11 per cent), pulp and paper (11 per cent), and construction materials (1 per cent). In addition, the Centre has trained many cleaner production specialists who have also continued to serve the local market. While it is difficult to quantify, in exact terms, the indirect beneficiaries, there are, according to the General Statistics Office, more than 2,000 manufacturing companies applying CP and potentially many more in non-manufacturing sectors.

The report also shows that implementation of CP options proposed by VNCPC has yielded tangible gains in resource savings for these SMEs, (7 per cent in electricity, 9 per cent in coal, 7 per cent in fuel, 7 per cent in diesel oil, 20 per cent in liquefied petroleum gas, 18 per cent in water and 25 per cent in chemical consumption) and helped boost the bottom lines of these companies who on average enjoy savings of US$ 75,000/year. That is to say, companies having paid approximately US$ 110,000 for the implementation of CP options were able to recoup their investments in the space of just 1.5 years (excluding the cost of capital). Beyond the benefits to local SMEs, VNCPC has served as a platform for South-South cooperation in the Indochina Peninsula, supporting UNIDO's CP work in neighbouring Lao PDR and Cambodia. Word-of-mouth is a testament to its success; VNCPC has, over the years, proven its ability as a technical service provider whose services are not only employed by UNIDO/SECO but also called upon by more than ten major donors and agencies such as CIDA, DANIDA, ILO, UNEP, WWF and the EU in the implementation of their environmental programmes and projects. Indeed, it must be noted that at least 276 of the 340 completed consultancy projects have been realized with non-UNIDO/SECO funding sources.

Viet Nam has suffered greatly, in recent history, due to the effects of persistent organic pollutants (POPs), particularly as a result of the use of chemical defoliants during the Viet Nam War. In addition to this and also of concern in more recent years has been the contribution of industry to the unintentional production of POPs (UP-POPs). The GEF-funded project: Introduction of BAT and BEP methodology to demonstrate reduction or elimination of UP-POPs releases from industry in Viet Nam (2009-2011) has helped the government in its implementation of its obligations under the Stockholm Convention, addressing the reduction of UP-POPs from the waste incineration, cement kiln (co-processing), pulp and paper, and iron and steel sectors through the introduction of best available techniques (BAT) and best environmental practices (BEP). The project also established the first database on dioxin emissions from industry in Viet Nam and built capacity for dioxin sampling and analysis in industrial emission samples.

The largest consumer of energy in the economy, industry in Viet Nam contributes two-fifths of GDP. Energy efficiency is all the more important to the greening of industries given that the growth rate of energy consumption is increasing faster than that of economic growth. Addressing the keen interest in energy efficiency measures confirmed by a survey conducted by UNIDO to profile industries on

energy efficiency achievements and investments, UNIDO is implementing the GEF-financed project: Promoting Industrial Energy Efficiency through System Optimization and Energy Management Standards in Viet Nam (2010-2014). Addressing the barriers related to technology, information, markets and finance, through capacity building interventions, the overall objective of the project is to promote industrial energy efficiency through system optimization and ISO energy management standards to companies within the food, textile, rubber and pulp and paper sectors. More specifically, the project has been promoting a system optimization approach to industrial enterprises to maximize energy savings at the systems level, while providing capacity building to adopt the ISO energy management standards for industrial enterprises to integrate energy efficiency into business and operations' management and achieve continuous improvements in energy savings.

Within the UN System in Viet Nam, UNIDO is cooperating closely with its sister agencies particularly ITC, FAO, ILO and UNCTAD, under the MDG-F-sponsored Joint Programme: Green Production and Trade to increase Income and Employment Opportunities for the Rural Poor, Viet Nam (2010-2013) to assist the Government of Viet Nam in promoting sustainable production in the handicraft and small furniture sector. UNIDO is working specifically to help build the capacity of grassroots producers of silk, lacquerware, rattan, seagrass and bamboo basketry and handmade paper to improve productivity, optimize raw material processing and apply appropriate cleaner production techniques. At the SME level, it has targeted the implementation of cleaner production methodologies to reduce chemical hazards, waste and pollution, the introduction of improved techniques and eco-design. The joint programme shows that the overall Green Industry strategy can equally be employed in handicraft sectors and thereby contribute to achieving real time benefits for rural poor households.

UNIDO's Green Industry policy-level research shows that developing countries like Viet Nam tend to rely largely on command and control measures, that is to say, specifically, on policy and regulations, even though institutions and capacities for enforcement and implementation are often ill-resourced. In contrast, the development of industry-led initiatives such as corporate social responsibility (CSR) is very much in its nascent stage compared to OECD economies (Maplesden, R., 2011). Simultaneously, however, major buyers of Vietnamese products, are tightening their procurement standards and are putting pressure on local companies, over 90 per cent of which are SMEs which do not have the capacity to comply with these stricter requirements, particularly in the fields of environment and labour. With this in mind, the EU SWITCH-funded UNIDO project: Helping Vietnamese SMEs Adapt and Adopt CSR for Improved Linkages with Global Supply Chains in Sustainable Production (2009-2013) targets SMEs from the textile and garment, leather and footwear, and electric and electronics sectors, by raising awareness and helping build a pool of experts who along with Business Membership Organizations can serve the local market as source of CSR know-how and practice.

At the same time, the project has created an online platform to facilitate information exchange, and experience on CSR implementation. The project is also helping produce an official Vietnamese translation of ISO 26000 to avoid the continued misinformation and confusion generated by the multiple interpretations of the international standard currently in circulation. Moreover, hosting the UN Global Compact Network for Viet Nam, the UNIDO Project Office is also responsible for holding CSR Calendar Forum events which were attended by more than 1,000 participants from enterprises, NGOs, government agencies, international organizations, research institutes, universities and the media during 2011.

These projects and their achievements over the years provide a rich tapestry of experiences as well as insights into the issues and obstacles relating to Viet Nam's defined strategy towards achieving Green Growth. While these projects all tackle specific aspects of Green Industry, what is still lacking is an overall and unifying strategy for the broad-based implementation of Green Industry in Viet Nam, which supports the government's commitments and efforts to achieve sustainable production. Such a strategy needs to firstly look at policy and its enforcement, identify gaps and set quantitative targets and objectives for improvement. This is the process that this project, Policy Advice on Environmental Management, funded by the UN One Plan Fund for Viet Nam, has endeavoured to kick-start over the short space of just one year.

1.3 Industrial Development in Viet Nam

Located on the Eastern Indochina Peninsula, the Socialist Republic of Viet Nam is the 13th most populous country in the world. Since embarking on the "Doi Moi" reforms beginning 1986, it has achieved remarkable progress in industrial and economic development. Rapid industrialization has, however, brought with it other challenges. Industrial clusters and parks along with craft villages have caused serious environmental pollution. Soil in suburban areas and surrounding industrial parks and clusters, craft villages and factories is affected by discharges of untreated effluents. Air pollution parameters in most urban areas exceed permitted standards and organic pollutants in surface water by as much as 2-6 times.

Against the backdrop of these difficult challenges, global climate change also poses a threat in particular since Viet Nam is one of the five countries most vulnerable to climate change, due to its long coastal lines and extensive low-lying areas, including, in particular, the densely populated Mekong Delta.

Box 1. Viet Nam Country Profile

Capital City: Ha Noi
Population: 90.5 million
Area: 321,210 KM
GDP per capita: US$ 1,224/ lower-middle income country (World Bank, 2010)
Human Development Index: 0.593/ ranked 125 of 187 (UNDP, 2011)

Although Viet Nam still maintains a high industrial growth rate, total factor productivity is low, reflecting low labour productivity and less efficient use of technology, capital, materials, and energy (Ketels, C. et al, 2011). In particular, outdated and inefficient technologies and equipment are still in operation in many areas of high-energy use such as power generation, steel, cement, and chemicals, causing significant waste of materials and fuel.

Meanwhile, Vietnamese enterprises invest very little in R&D and technology innovation, on average, only 0.2-0.3 per cent of total turnover. Wide-scale economic and efficient use of energy and materials has yet to be realized, nor have environmentally friendly and environmental services industries been developed. Moreover enterprises and industrial products are less competitive in comparison with those of other countries in the region, and industry continues to discharge into the environment untreated waste, exacerbating environmental pollution and degradation.

Realizing the urgent need to promote a shift toward more sustainable industrial development pathways, the Government of Viet Nam has paid special attention to the issue of Green Industry. It signed the Manila Declaration on Green Industry in Asia at the International Conference on Green Industry in Asia in 2009. Viet Nam thereby pledged to promote Green Industry with support from UNIDO and its partners and also participated in the Tokyo Green Industry Conference in 2011, where it reported on its in Green Industry implementation and re-affirmed its prioritization of Green Industry development.

The Ministry of Planning and Investment has been developing a National Strategy for Green Growth which is expected to be published in the latter part of 2012. Among the goals set forth in the subsequent consultation drafts of this strategy, two relate to Green Industry namely: Goal II: Greening production and Goal III: Greening life and sustainable consumption, that is providing environmental goods and services for urban residential areas, for example waste management, environmental sanitation, etc. In parallel, UNIDO provided assistance to the Ministry of Industry and Trade in the formulation of a Green Industry strategy, under its project entitled, Policy Advice on Environmental Management.

1.4 Policy Advice on Environmental Management

In line with Vietnam's policy objectives and given the importance of industry to sustainable economic development, job creation, prosperity and environmental protection, the objective of this project has been to develop a comprehensive and unifying Green Industry policy framework for MOIT, backed by replicable Green Industry pilot initiatives, implemented in parallel with the strategy formulation. These pilots addressed the following high leverage Green Industry opportunities:

1. **Resource efficiency benchmarking and Green Industry technology road-mapping for the steel sector**: an industry-driven, voluntary approach has been used, based on intra-sector benchmarking and technology-cooperation, best practice sharing and learning, the final result of which is a technology road-map up to 2020 and a proposal for its voluntary adoption by member companies of the Viet Nam Steel Association (VSA).
2. **Eco-City development in Hoi An City**: a local government-driven planning approach for Green Industry has been proposed, which benefits from economies of scale in solving environmental and climate challenges in key sectors, whilst also balancing business and community development, and enhancing income and employment opportunities, in particular, in the accommodation (hotel) and craft sectors.
3. **A model for sustainable micro- and small recycling**: Binh Yen Village in Namh Dinh Province has been taken as a case in point for an in-depth investigation into micro- to small-scale (aluminium) recycling in rural villages around Viet Nam. An in-depth analysis of the recycling and production processes has been undertaken to identify the root causes of the endemic pollution of the village environment with the aim to promoting replicable zero-emissions models.

2. POLICY ADVICE FOR GREEN INDUSTRY DEVELOPMENT

Under the precursor to the present project, UNIDO served as an adviser to the Ministry of Industry and Trade and contributed to the drafting of the "Action Plan on the Response to Climate Change by the MOIT" to help MOIT meet its obligations under the overall Government of Viet Nam's National Target Programme to Respond to Climate Change. The MOIT Action Plan contains a list of 29 priority actions to be implemented, including several aimed at fostering industry involvement and voluntary commitments to climate change mitigation and adaptation, based on improved access of appropriate technologies and financing and other support for their implementation. The Action Plan was issued by the MOIT by Decision No. 4103/QD-BTC in August 2010.

Leveraging this experience and subsequent to its commitments under the Manila Declaration, UNIDO, at the request of the Industrial Safety Techniques and Environment Agency of MOIT, provided assistance for the formulation of an overall policy strategy for Green Industry. This included a policy gap analysis, stakeholder consultations and formulation of overall goals and objectives. The overall intent was to work towards the building of a policy system for Green Industry development in Viet Nam, with an action plan up to 2020, as per the goals outlined by the Congress XII of the Communist Party of Viet Nam.

2.1 Policy Gap Analysis

The gap analysis conducted under the project served to provide a greater understanding of the regulatory and policy environment for industrial development and environmental management of industry, including the status of implementation and enforcement, which policies and strategies are in place that guide industrial development, minimize and control its adverse environmental impacts and how effectively and efficiently these are implemented. Laws and related legal documents, national strategic programs and master plans for development of specific industry sectors and concerns of environmental management in Viet Nam were also critically reviewed, the results of which have been validated through multi-stakeholder consultations held in Hanoi and Ho Chi Minh City in October 2011.

The details findings of this analysis are elaborated in further detail in the desk study on Green Industry development in Viet Nam (Maplesden R., 2011) and the policy background report (Tran H. B., 2012). A summary of key issues identified follows:

- **Policy Integration**: Viet Nam already has in place a comprehensive range of national policies, strategies and regulations to better balance environment and (industrial) development needs. State management apparatus for environmental protection has also been established, from the central down to the local levels. However, coordination and capacity constraints hinder the greening of industries. Many government agencies have mandates in the areas of environmental management and industrial development, and, as a result, coordination is an issue, as their roles and responsibilities are sometimes unclear.
- **Capacity Development**: Enforcement of regulations and application of economic- and/or market-based instruments are hindered by lack of staff capacity and institutional capacity. Further training and institutional strengthening is therefore required if environmental management functions transferred to the local administrative levels are to be implemented and enforced. SMEs in Viet Nam also appear to lack the technical capacity to adopt and absorb better operating and maintenance practices, management systems and environmental practices and technologies.
- **Financing the Greening of Industries**: A shortage of working capital is an acute problem affecting SME development, and therefore, also for the adaption and adoption of better environmental techniques and new technologies. SMEs also experience difficulties accessing other financial sources such as venture capital, foreign funds, and capital markets, and are therefore heavily dependent upon informal credit sources, often adding to the cost of capital.
- **Improving Infrastructure**: Inadequate infrastructure for waste and wastewater management needs to be urgently addressed particularly in view of the country's rapid economic growth and

urbanization. It is estimated that 70 per cent of industrial zones and 90 per cent of production units simply don't have facilities to treat wastewater (PADCO, 2005).

- **Creating Business Incentives**: Industry-led initiatives, such as CSR, eco-labelling, the adoption of ISO standards and voluntary agreements are still much in their infancy. There is scope for the government to promote greater use of these instruments as a means of encouraging good environmental practices.
- **Policy Implementation and Enforcement**: Although Viet Nam has a comprehensive range of fairly strict regulations and standards, enforcement is weak, leading to poor compliance and implementation. Overall the situation still prevails that for enterprises it is commonly cheaper to pay the penalty and to not comply with environmental standards, whereas in principle, environmental compliance should be regarded as a condition for doing business. Coordination and capacity development need to be improved if environmental policies are to be effectively implemented and enforced.

2.2 Policy Framework

Based on the gap analysis, a comprehensive framework for guiding Green Industry development has been recommended to the Ministry of Industry and Trade, in its role as focal government agency for the development of the manufacturing sector. The framework addresses cross-cutting issues (laws and institutions, technical capacity building, technology transfer, financial measures) and sector-specific issues, which are outlined below:

Guiding Targets

A comprehensive data set on industrial resource productivity and pollution intensity is not yet available. This prevents inclusion of firmly quantified and binding targets in the present Green Industry Policy Framework. As a starting point, the following guiding targets have been proposed:

- **Resource productivity**: The annual improvement rate of productivity of the use of raw materials, water and energy reaches 3.5 per cent from 2015 onwards. Based on the annual improvement rate of 1.5 per cent during the 2012-2015 period and the average improvement rate of 3.5 per cent annually thereafter (UNIDO, 2012), the intensity of raw materials, water, and energy consumption would be reduced by 22 per cent in 2020 compared to 2012 levels. The energy consumption level of industrial production in 2007 was over 14 million tonnes of oil equivalent (TOE) and this has been forecasted to reach 33.5 million TOE in 2020. This guiding target thus has the potential to help realize savings in excess of 7 million TOE annually by 2020.[1]
- **Minimization of emissions and waste**: The reduction rate of intensity of GHG emissions, waste, and effluent reaches 7 per cent per annum from 2015 onwards. Based on the average improvement rate of 3.5 per cent per year during the 2012-2015 period and the average improvement rate of 7 per cent annually thereafter, the average emission intensity for GHG emissions may be reduced by 40 per cent in 2020 compared to that in 2012. According to the Ministry of Natural Resources and Environment (MONRE), industry discharges 31 million tonnes of carbon dioxide at present, and this amount is forecasted to increase to 53 million tonnes by 2020. This guiding target thus has the potential to mitigate annual emissions by 21 million tonnes of carbon dioxide in 2020, compared to the business-as-usual scenario.
- **Increase of solid waste recycling/reuse rate**: The capacity of the recycling industry to reduce solid waste increases to 60 per cent up to 2015 through the recycling and reusing of waste materials and also energy recovery. An average growth level of 6 per cent of solid waste per annum would then be maintained from 2015 onwards. From there on, a total of 85 per cent of solid waste would have been recycled, reused or made use of for energy recovery by 2020.[1]
- **Increase in the uptake of renewable energy as a proportion of total primary energy**

1 Based on objectives and targets set forth in the National Strategy for Integrated Solid Waste Management until 2025, with a vision toward 2050.

consumption by industry: By 2015 the uptake of renewable energy sources will have increased to 4 per cent of total primary energy consumption and will maintain an average growth rate of about 0.25 per cent per annum from 2015 onwards. Renewable energy sources as a proportion of primary energy consumption will then increase to around 5 per cent by 2020 in line with Viet Nam's National Energy Development Strategy up to 2020.

- **Green Industry Award Scheme**: A Green Industry certification programme is launched in 2014; moving towards the goal of 5,000 SMEs in Viet Nam achieving green awards in 2020. The Awards would recognize enterprises that have achieved extraordinary progress in implementing Green Industry. Certificates would be valid for three years and could be renewed upon demonstration of continued progress in reducing pollution intensity and increasing resource productivity. The improvement rate to qualify for a Green Industry Award is set 50 per cent higher than the sector averaged guiding targets, resulting in a minimum of 15 per cent improvement in productive use of materials, energy and water and a 30 per cent reduction in the pollution intensity for GHG emissions, waste and effluents respectively. The guiding target of 5,000 SMEs qualifying in 2020, represents close to 1 per cent of the around 500,000 registered SMEs in Viet Nam. The possibility exists to expand the Green Industry Award to those sectors that collectively meet the criteria.

Implementation Strategies

The ambitious yet necessary vision reflected in the guiding targets for Green Industry towards 2020 calls for parallel development and coordinated implementation of measures of the government, enterprises and society at large level. This is to be achieved through a three-pronged approach, based on:

- Leadership and coordination;
- Cross-sectoral initiatives; and,
- Sector-specific initiatives.

Leadership and Coordination

Led by a Vice Minister of the MOIT, the Inter-ministerial Coordination Committee on Green Industry would include the participation of key ministries, MOIT, MONRE, MPI, etc. which would assume responsibility for guiding and directing the development of Green Industry in Viet Nam, in consultation with representatives of the business sector.

Responsibilities for the Coordination Committee might include, inter alia:

- Promulgating an action plan on Green Industry development; assigning the implementation of policies and objectives to specific ministries; and drafting and promulgating a decree to lay the legal foundations for effective implementation of Green Industry activities;
- Development of an award system as above-mentioned for Green Industry for the enterprises which can demonstrate that they have reached these award criteria;
- Organizing a survey, in-depth study, and assessment of the current status of specific industries to assess levels of resource productivity and pollution intensity, relative to international good practice and drafting a technology roadmap with resource allocations for implementing green goals in specific industries; and,
- Guiding the development of a benchmarking system for monitoring Green Industry development and be responsible for producing periodic progress reports.

Cross-Cutting Enabling Measures

Centre for Green Industry Technology: A technology assessment centre could be established to target the development and adaptation of technology with coordinating and programming responsibilities. It would initiate and supervise technology needs assessments for priority sectors, identify

and assess equipment, processes and/or products, and then engage and/or contract relevant specialist institutions to undertake applied research for the further development and trial of selected technological solutions

Business Advisory Services: Business advisory services are needed to support enterprises with the identification, evaluation and implementation of Green Industry practices and techniques, through such activities as: CP assessments; technology benchmarking and gap identification; identification and selection of environmentally-sound technologies, and development and promotion of Green Industry investment proposals.

Sector Specific Initiatives

Selected by the Leadership Committee, sectoral initiatives would provide specific focus for the accelerated development of Green Industry in prioritized industrial sectors. Technology roadmaps could be developed and on the basis thereof, specific targets agreed for implementation by respective sectors in regard to reductions in energy consumption and input raw materials; the adoption of environmentally sound technologies; and sustainable product designs.

3. RESOURCE EFFICIENCY IN THE STEEL SECTOR

3.1 Introduction

Globally, the steel sector has demonstrated consistent progress in reducing energy and resource intensity, as a result of increased recycling, new technology, better process controls and improved operating and maintenance practices. In Viet Nam the steel sector has witnessed strong growth in recent years. Liquid steelmaking production had remained stagnant at around 300 kt/a since 1975, but has grown to close to 3 Mt/a over the past decades, i.e. by a factor of ten. The subsector of Electric Arc Furnaces (EAF) (also known as mini-mills, despite capacities of individual plants exceeding several hundred thousand tonnes of steel per annum) has grown most rapidly and is estimated at 5.7Mt/a, with further continued growth expected in the near future. Whilst new capacity typically employs technology of international origin and process design standards, the Vietnamese mini-mills are reported to operate at considerably lower levels of energy- and resource-efficiency than their overseas competitors using comparable technology.

The Green Industry pilot with the steel sector was therefore initiated with the dual purpose of assessing the current performance of EAF steel sector, relative to international practice, through resource efficiency benchmarking and identifying opportunities for accelerated improvements therein, through capacity building and enhanced intra-sector cooperation, informed by in-depth understanding of technology options. The initial benchmarking covered all 18 operational EAF plants, and ten have continued to participate in the follow-up monitoring work after the training in good operating practices and technology management. In parallel, the leading sector association, VSA was supported to foster intra-sector collaboration, scope a sustainable technology roadmap and explore opportunities for a voluntary sustainability agreement.

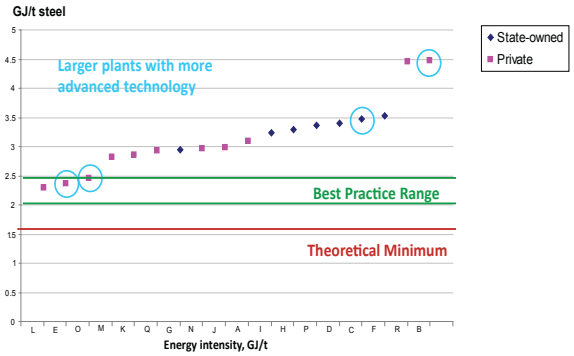
3.2 Resource-Efficiency Baseline

The baseline benchmarking study covered all 18 operational EAF plants in Viet Nam and involved collection and analysis of production and resource consumption data by a team of national and international sector experts. Data on the main inputs and outputs of steelmaking, casting and rolling were collected in a systematic way to calculate the energy used in production and to analyse influencing factors such as technology, productivity, process stability, resource use (fluxes, oxygen, etc.) and scrap quality. The analysis included comparison of performance between the Vietnamese plants and by reference to global good practice standards.

Some of the key findings for production energy in EAF steelmaking, the most energy intensive step in the process, are summarized in Figures 3-4 on the following page. Out of the 18 plants only three (16 per cent) had energy intensity comparable with international good practice, whilst nine (50 per cent) exceeded global good practice by at least 25 per cent (Figure 3). Figure 3 indicates plant age and size and demonstrates that whilst existing and new plants are able to access best available techniques (BAT) from global equipment suppliers, such does not guarantee better then average energy intensity. Steel yields (lower apparent metal losses) and energy efficiency are closely linked (Figure 4). Higher flux additions and energy intensity are linked with higher apparent metallic feed (scrap and pig iron) losses or lower scrap quality. However, the effect of ownership was salient. Nine of the ten most efficient plants were privately-owned and as such private companies appeared to perform better vis-à-vis their state-owned counterparts in terms of energy consumption.[2]

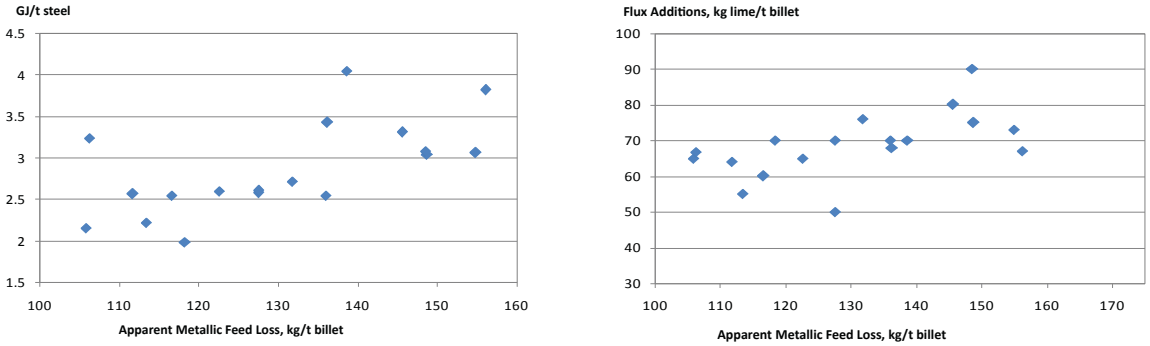
2 While the two least efficient plants were also privately-owned, these were new plants with considerable room for improvement as operational capabilities improve.

Figure 3. Energy Intensity in the EAF Steel Sector



Note: to ensure anonymity, the companies have been assigned letters to identify them and then ranked according to energy intensity

Figure 4. Correlation between Scrap Quality and Resource and Energy Efficiency



Overall it could be concluded that whilst performance in some of the Vietnamese plants is on par with global good practice, most operate at considerably lower levels.

The actual root causes for the higher energy intensity were identified as low scrap quality which increases energy consumption and also metallic feed losses; insufficient process monitoring - without which plants are unable to fully understand and improve their performance; and a lack of slag analysis; each of these is further compounded by limited basic furnace and metallurgical knowledge. Inspection of scrap yards at the plants, for example, did indeed suggest that there was a considerable amount of contamination being processed with the scrap. Moreover, scrap density is also very important; as more uniform and higher scrap density leads to greater process stability, increased productivity and improved efficiency.

3.3 Measures Initiated

As the baseline showed that even plants with more modern technology could not ensure good practice or good efficiency, it was clear that priority needed to be placed on building the sector's capabilities for acquiring/digesting new technology, managing and achieving systematic improvement in productivity and efficiency, getting the best performance from existing equipment and being able to introduce new technology efficiently and effectively.

In order to coordinate a sector-based initiative, the VSA was supported to establish a Green Industry Task Force as one of its operational and strategic working groups. So as to raise industry interest, two international training sessions were held (respectively in July 2011 and March 2012) on best

Box 2. Draft Charter for the Green Industry Task Force

A summary of the key targets, proposed solutions, performance indicators and specific steps for implementation to establish the Green Industry Task Force follows:

1. Targets:

- To achieve a Voluntary Agreement to use resources efficiently to reduce energy consumption and thus GHG emissions in line with the National Target Programme to Respond to Climate Change, 2008; and,
- To Implement the "Sustainable Technology Roadmap for the Steel Industry", striving to reduce consumption of raw materials, fuel, energy per tonne of billet steel production (see Figure 5 for exact targets); ensuring that all billet producers reach emissions standards and regulations by 2015 and upgrading to low-carbon technologies where possible.

2. Solutions:

- Greening of existing production processes, thereby reducing wastage of raw material inputs per tonne of billet produced along with waste treatment costs, increasing productivity, bringing down prices and resulting in greater competitiveness of domestic products;
- The studying and application of BAT/BEP based on BAT/BEP document from EU, 2001 and promotion of innovation and upgrading of technology where possible; and,
- Engaging in awareness raising and capacity building activities, including annual meetings of VSA or VFMSTA (Viet Nam Foundry and Metallurgy Science & Technology Association) and delivering of trainings on BAT/BEP for the technical staff.

3. Performance Indicators:

- Realisation of a permanent platform for Green Industry through the creation of a "Green Industry Development Group" involving participation from selected government and industry representatives;
- Number of demonstrations with selected pilot enterprises on the efficient use of resources (focusing on energy);
- Number of trainings provided to technical staff on EAF performance optimization, consultations with international experts, and the latest materials/guidelines on BAT/BEP and applying cleaner production for the enterprises;
- The successful transfer of the input-output benchmarking model to all member enterprises to enable self-monitoring of energy consumption allowing plants to report back to VSA and for data to be analysed and further improvements made in resource efficiency; and,
- A Voluntary Action Plan for "Green Industry Development" and "Sustainable Technology Roadmap" to help achieve defined targets (as per Item I).

4. Specific Steps for Implementation:

- First meeting of Task Force (held December 2011) to introduce and review the Sustainable Technology Roadmap, transfer the input-output benchmarking model, draft the Voluntary Agreement and to allow the international expert to provide technical advice on-site at plant visits;
- Final workshop (held March 2012) to introduce the activities of the 10 pilot enterprises with the goal of replication among the remaining billet steel producers and to present the recommendations of the International Expert on how to save energy and resources in steelmaking industry; and,
- Signing ceremony and official launch of the Voluntary Agreement.

practices in steel making, furnace design and operation and a study tour organized for sector representatives to steel companies in Japan (in November 2011). In the interim, the national experts transferred the input-output benchmarking model used for the baseline assessment to each of the companies, for which an additional workshop took place in December 2011, with a view to assist companies to measure energy and resource intensity on an ongoing basis and use the findings for real time process optimization.

At the December 2011 meeting, the participating company representatives endorsed the proposal for a Green Industry Taskforce. A draft charter was agreed upon (see Box 2). Its formalization is awaiting endorsement by the board of the VSA.

The Charter includes a commitment for a Sustainable Technology Roadmap, with the possibility to anchor its implementation in a sectoral voluntary agreement. A skeleton for the roadmap was developed on the basis of preparatory work by national consultants (on technology options, derived in the main from the technical workshops and international literature) and a road-mapping workshop with steel sector representatives, facilitated by an international sector expert. The roadmap includes targets and key technology options for accelerated improvement of resource efficiency and environmental performance of the EAF sector, based in the main on currently available international best practices and techniques. As further detailed in Figure 5, it would appear feasible to achieve, at minimum, a 16 per cent reduction in energy intensity of EAF steel making and intensity of use of other resources, by 2020 compared to 2011. Efforts are underway to formalize the technology roadmap objectives by means of a voluntary statement to which all members of the VSA would commit, with a date for the official launch such a sectoral initiative tentatively set for late 2012.

Figure 5. Outline of Proposed Sustainable Technology Roadmap for Vietnamese Steel Industry

Performance Targets (Baseline: December 2011)			Key Technology Options
Indicators	2015	2020	**Ultra-high power operation (UHP):** Installation of more powerful furnace transformers allows for reduced tap-to-tap times ("tapping" refers to the operation of tilting the furnace to pour molten steel and tap-to-tap times are used a measure of efficiency) also increasing productivity while reducing electrode consumption and waste gas emissions. **Water cooled side walls and roofs:** since the 1980's, furnace walls and roofs have been equipped with water-cooled panels to protect the refractory- (high temperature-withstanding) lining of the furnace from thermal strain and thereby allowing the use of ultra-high power furnace technology. **Oxy-fuel burners and oxygen lancing:** Oxy-fuel burners promote a uniform melting of the scrap, the oxygen reacts with the hot scrap and burns the iron to produce intense heat effectively cutting the scrap and by way of this exothermic reaction reduces overall energy consumption as less input electric energy is required. **Bottom tapping system:** First introduced in 1983, this practice minimizes slag generation from molten steel production, allowing for cost savings through a reduction in refractory materials needed, more rapid tapping and reduced energy losses. **Foaming slag practice:** Creating a foaming slag in the furnace improves the heat transfer to the charged inputs and also protects the refractory lining of the furnace. Because of better arc stability and fewer radiation effects, this practice can reduce energy consumption, electrode consumption, noise level and increase productivity.
Environmental			
Reduction in energy consumption/ tonne crude steel	10%	7%	
Reduction in GHG emissions	10%	7%	
Reduction in specific raw materials consumption	10%	7%	
Reduction in unintentionally produced POPs*	N/S**	N/S	
Compliance with national regulations (QCVN 19:2009, QCVN 24: 2009) and standards (TCVN 5939: 2005, TCVN 5940: 2005 and TCVN 5945: 2005) on solid, gas and water wastes	N/S	N/S	
Social			
In-service training (days/year)	8	10	
Reduce no. of accidents	N/S	N/S	
Economic			
Increase investment into new processes and products	5%	8%	
Increase value-added contribution of the sector to GDP	N/S	N/S	
Introduce sustainable technology	N/S	N/S	

* At present, there is no data about POPs generated during steel production. However, UNIDO has implemented the project "Introduction of best available techniques (BAT) and best environmental practices (BEP) to demonstrate reduction or elimination of UP-POPs" and is exploring the possibility for further work in this area.

** N/S – Not (yet) specified

3.4 Benefits Achieved

The calculation model for resource productivity developed for the initial intra-industry benchmarking was made available to all 18 VSA EAF member companies in the fourth quarter of 2011 and an instruction session on its use organized. Ten of the companies agreed to introduce the model in their operations and start using it on a regular basis in parallel with their efforts to implement some of the best practices promoted and discussed during the steel technology workshops in July 2011 and March 2012. Two sets of data were obtained from these companies that started to use the monitoring model on their own. The first being an 'updated baseline', essentially an improvement and update of the baseline assessment (based on data notionally for the year 2010 used in the first sector based benchmarking report) using operational data from (part of) the fourth quarter of 2011. The second data set refers to the 'after benchmarking' situation, essentially the averaged performance for the first full quarter after availing the calculation model to the steel plants (i.e. January – March 2012).

For the ten companies that provided results for the updated baseline, relative to the initial baseline, six plants increased their energy intensity, five of these by less than 10 per cent, but one by 53 per cent, whereas the remaining four plants decreased their energy intensity by 4-21 per cent. For two plants the increased energy intensity was a result of expansions in existing EAF, whereas all other changes appeared to have been a combination of improved (and hence more realistic and reliable) input data and continuous improvements already initiated after the first technical training in July 2011. The findings for GHG emissions intensity, showed a reduction in intensity in eight of the companies, in the range of 8 to 22 per cent, whereas GHG intensity had increased for the two remaining plants by respectively 22 and 66 per cent. The differences were attributed to improved and more realistic data on both energy and other GHG-intensive inputs (i.e. electrodes, oxygen, liquid steel and carbon).

In order to demonstrate the positive impact of the benchmarking work, the abovementioned updated baseline was compared with the averaged performance for first quarter of 2012 (referred to as "after benchmarking"). The results are illustrated for both energy intensity and GHG intensity in the graph below.

Figure 6. Energy and GHG Benefits after Benchmarking

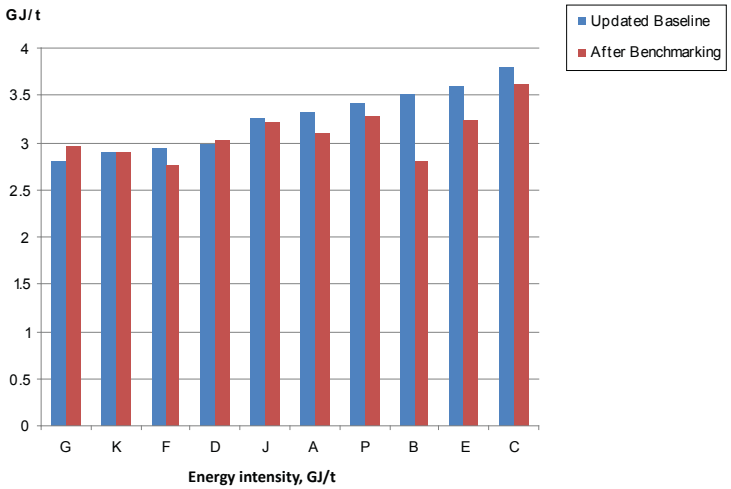
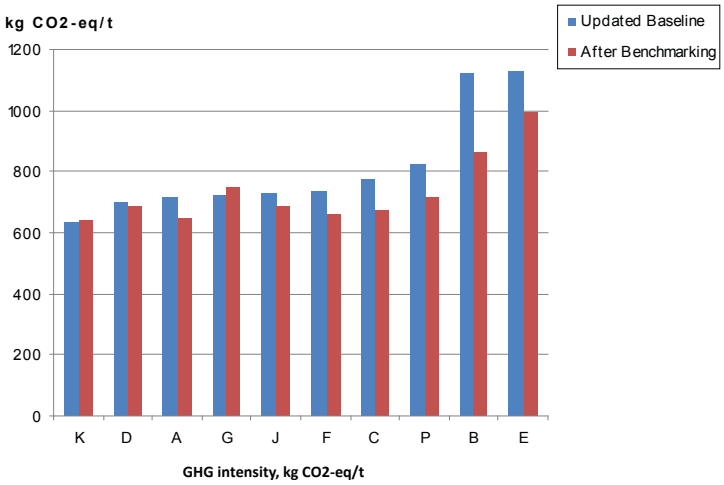


Figure 6. (continued)



Overall in promoting Green Industry, the lack of data itself in developing countries like Viet Nam hinders the development of solutions, as without data the technical reduction or improvement potential cannot be estimated. The benchmarking of the EAF steel sector therefore offered a unique insight into the performance of local enterprises compared to their international competitors in terms of energy, resource and process efficiency, as well as GHG emissions. Presented in a workshop in March 2012 to VSA and participating enterprises, it also served as a clear starting point for a voluntary agreement and preparation of a sustainable technology roadmap with quantified targets and specific solutions for technical optimization of EAF technology. Such an approach could be effectively replicated and would indeed be warranted in other resource intensive industrial sectors, for example, cement, fertilizers, chemicals etc.

4. ECO-CITY HOI AN

4.1 Introduction

The ancient city of Hoi An is located on the coast in the central Quang Nam Province and is home to both a UNESCO listed cultural heritage and a recognized biosphere reserve. An important hub for domestic and international tourism, with more than one million overseas visitors annually, tourism is the key driver for growth and employment in the city proper and its surrounding areas. However, Hoi An suffers from weak environmental planning and poor waste and wastewater treatment infrastructure, while sprawling resort developments have brought economic growth without due consideration of environmental sustainability which could also pose a threat to the development of the region.

With this concern in mind, Hoi An People's Committee has shown its determination in developing Hoi An to become an Eco-City by 2030. The concept of Eco-Cities stems from the international efforts in the field of eco-industrial development and industrial ecology.[3] At its core, the Eco-City concept aims to apply best environmental practices in service delivery to their residents and businesses, whilst also working to close material and other related resource use loops (see Box 3). Support was provided to Hoi An City to develop the Green Industry component for its Eco-City plan. Specifically it focused on opportunities for green industries to deliver environmental services to improve environmental amenity (in particular improved energy, waste and wastewater management) and create opportunities for the greening of existing businesses (with a focus on accommodation and craft sectors as key economic sectors).

Box 3. Eco-Cities

In an Eco-City,* urban planning and environmental management tools are applied in tandem to pursue synergies in resource utilization and productivity, waste management, environmental protection, industrial and economic development and a healthy living environment. At the city level, green industries provide the environmental services needed by municipalities to improve city living, such as sanitation, waste management, energy efficiency and renewable energy. Likewise, industries located in the municipalities are resource efficient and generate less pollution. While at the enterprise level, improved resource productivity and reduced pollution intensity are achieved through intra-firm measures. Precedence for such a local-planning based approach can be found in Eco-Towns established in countries such as Japan and Korea, with current trials also ongoing in others countries such as India, China and Thailand.

* UNIDO has been working with the Ministry of Environment of the Hashemite Kingdom of Jordan to promote the Eco-City model concept through annual Eco-Cities of the Mediterranean Forums, the first of which took place in Amman in 2010 and the second, in Marseilles in 2011. The Forums bring together municipalities from the region, along with local enterprises, NGOs and intergovernmental organizations, to discuss solutions to environmental challenges, which promote both economic growth and social responsibility at the city-level.

4.2 Green Industry for Improved Environmental Amenity

Hoi An suffers from systemic capacity constraints in the collection and treatment of waste and wastewater and the supply of energy, in its urban centre, but particularly in the remote communities and islands that fall under the city's jurisdiction. The present situation and required key changes in technology, policy and behaviours were reviewed on basis of available studies, policies and strategies, as captured in Figure 8. The overall situation can be summarized as follows:

- **Waste Management**: collection of municipal solid waste (MSW) is insufficient in urban areas and lacking elsewhere, leading to widespread accumulation of waste in yards, alleys and waterways, while in addition, capacity to treat and/or dispose of collected waste in an environmentally sound manner is also lacking. A nominal annual fee is collected of approximately US$ 6 per household and up to US$ 60 for enterprises and hotels. However, this does not cover the actual cost of waste collection and disposal. There is a broad-based potential for source reduction and

3 See e.g., Van Berkel, R., From Wastes to Profits, in UNIDO MakingIt: industry for development, Vol. 1, pg. 40-41.

waste segregation at source, yet this remains untapped due to the lack of awareness of urban waste management;

- **Wastewater**: wastewater is predominantly disposed of through septic tanks, or discharged into the environment after screening only, due to the absence of central wastewater treatment capacity. Approximately 40 per cent of the urban area was connected in 2011 to the sewer system, which is expected to feed into the city's first wastewater treatment plant, the estimated completion date of which is 2014; and,
- **(Renewable) Energy**: renewable energy utilization is, at present, negligible with the exception of the use of agriculture residues for household biomass stoves. There is good potential for wind and solar energy, in particular, off-grid on the Cu Lao Cham Islands (and as a model for reference, a successful existing-solar system is in place in Bai Huong,) whereas solar hot water and possibly solar cooling could be widely promoted in the urban areas, and potentially be mandated for new and existing hotels and resorts.

Figure 7. Hoi An City's Environment and Energy Needs

Area	Present Situation	Priority needs
Waste Management (Municipal Solid Waste)	- MSW collection rate estimated at 60 per cent in the inner city and lower or lacking in outlying areas. - Existing MSW treatment capacity limited at just 55 tonnes/day. - Widespread littering and indiscriminate waste disposal.	- Customized collection system covering all areas and user groups. - Expansion of MSW treatment capacity. - Strict enforcement to put an end to indiscriminate waste disposal and littering, and clean up affected areas, too. - Behavioural changes for waste reduction and separation of waste at source of generation.
Water Resources and Wastewater Treatment	- No central wastewater treatment plant, only an estimated 40 per cent of inner city recently connected to a sewer system. - At present, treatment of wastewater is charged based on water *consumption*. However, municipal-supplied water at just 6,000 m^3/day meets only 30-40 per cent of the city's demand, with the shortfall of 60-70 per cent met by exploitation of groundwater resources. - Inability to collect wastewater charges from restaurants and hotels and other service sector establishments, in accordance with the decree 67/ND-CP due to insufficient staffing levels. - Predicted increased demand against a stable supply of water would create a strain on existing water resources.	- Investment in wastewater infrastructure and related capacity development particularly in environmental management, monitoring etc. - Enforcement of fee collection for all user groups. - Stricter regulations on groundwater usage for commercial purposes and greater protection of surface and groundwater resources from wastewater pollution. - More sound planning – most of the budget earmarked for environmental protection by the Hoi An City Government is spent on MSW collection and disposal leaving insufficient funds for appropriate investment in wastewater treatment. - Further investigation to estimate the shortfall in water resources in future years. - Harvest rainwater and recycle greywater (wastewater generated from domestic activities) to help increase supply.
(Renewable) Energy	- Insufficient data on appropriate technologies, performance levels, and models using renewable energy for hotels and resorts such as those found in Hoi An. - High sunk costs combined with insufficient policy mechanisms in place to support renewable energy deployment.	- Policy incentives and awareness raising by local government. - Pilot demonstrations in the accommodation, food and beverage, and related sectors. - Business advisory services to provide local enterprises practical information on suitable renewable/alternative energy options.

In lieu of major financial investment in public facilities, the constraints on infrastructure are likely to be further exacerbated by the current projected population growth (from 90,000 in 2010, to 97,000 in 2020 and 103,000 in 2030) and the exponential development of the tourism sector (1.1 million arrivals and 600,000 overnight stays in 2010, 1.6 million arrivals and 960,000 overnight stays in 2015, progressing to 2.4 and 5.3 million arrivals and 1.5 and 2.5 million overnight stays, in 2020 and 2030 respectively). Significant investments in collection and treatment/disposal of waste and wastewater are urgently required, yet under the current project due to the extensive work required including in-depth feasibility and engineering studies, it was not possible to design and cost these environmental infrastructure investments. Capital will have to be raised from multiple sources, including the government budget, international finance (loans and/or grants) and the private sector. Unlocking capital investment will require parallel improvements in the legislative and administrative systems to create a business opportunity for potential investors, as returns need to be achieved in the main from user and discharger fees. A range of actions have been proposed to Hoi An People's Committee for the next stage of development of its environmental master plan, including capacity building for the government, hotel and craft sectors, and community outreach etc., which is conservatively costed at VND 20 billion (~US$ 962,000) until 2015 (see Figure 14 for a detailed breakdown).[4]

4.3 Greening of the Accommodation Sector in Hoi An

The second Green Industry pillar involves the greening of existing industries. In the case of Hoi An, the economy is dominated by tourism, the income from which increased 50 fold in just 15 years and reached nearly VND 1,000 billion (~US$ 48 million) in 2011. The accommodation sector provides over 3,000 rooms in some 100 hotels, over half of the rooms in the 3- and 4-star category, and just over 10 per cent in 5-star category. The workforce in the hotel sector exceeds 3,500 employees and comprises 31 per cent of total direct tourism-related employment. The sector is supported by tour and transportation services, food and beverage establishments, tailor and craft shops etc. Small-scale horticulture, animal husbandry and fishing, including processing (e.g. noodle shops) located mostly in the rural villages in Hoi An's jurisdiction provide supplies to visitors and residents, whilst in addition there is a vibrant supply of crafts, of which lantern production is traditionally best established.

Box 4. Accommodation Sector

Several of the hotels that participated in the CP assessment had not installed air-conditioning devices properly, causing high energy losses—approximately 20 per cent of electricity is wasted due to poor ventilation. On the left, the unit is installed too close the wall, resulting in poor ventilation, while the unit on the right is installed in such a position that hot air cannot escape and directly heats and damages the door while also making the ambient environment uncomfortable for guests who might want to enjoy the view.

4 Indicative costs which exclude investment in actual infrastructure and ODA committed by France for construction of a wastewater treatment plant.

Opportunities for RECP were assessed in eight hotels. It was found that multiple win-win solutions existed. Electricity was typically supplied at 10 per cent excess voltage causing 5-10 per cent extra energy consumption in equipment (refrigerators, air conditioning equipment, etc.) and 20-80 per cent on lighting, a situation that could be easily corrected with periodic voltage adjustments. Air-conditioning could be set at higher default temperatures, i.e. 25 degrees instead of 18-20 degrees, thereby yielding an average of 6 per cent savings per degree. Moreover air-conditioning units were often poorly positioned, which severely limited their efficiency and caused excessive noise and discomfort (see Box 4). A particularly promising energy option appears to be the installation of solar hot water systems in hotels. The water and wastewater situation was of further concern due to the frequent use of groundwater, and lacking wastewater treatment facilities. Water consumption could be significantly reduced with the introduction of low-flow devices, in particular low-flush toilets and low-flow showers. Waste was found to be segregated at source in most hotels, to sell as recyclable materials and animal fodder, etc.

Box 5. Resource Efficiency in Lantern-Making Households

Lantern-making households in Hoi An select the best quality bamboo wood, which is then split, cleaned, soaked and boiled with hydrogen peroxide to soften the laths. In good weather, these laths are then dried in the sun and in rainy weather, by means of a coal briquette drying chamber, after which they are cut and holes drilled, silk covers attached with glue and wooden handles then affixed. The lanterns are of a sophisticated design meaning that they can be easily assembled or folded away.

Following a CP assessment, the participating households were given practical suggestions to improve resource efficiency, manage waste properly and at the same time, improve working conditions. The help of a stand (below-left) when cutting the bamboo culms (stems), for example, would make work faster and safer, generate less waste while also saving time and electricity. A large vat over an open fire was used to boil bamboo laths wasting heat energy and fuel (below-right), whereas a properly insulated boiler could yield fuel savings of 1,250 kg/year. Likewise by installing a closed drying chamber with overhead ventilation to discharge steam and smoke, fuel could be saved and smoke would not be ejected into the work area.

Colourfully-decorated waste silk cloth which is simply thrown away could be made (or sold to other households to make) into other smaller souvenirs reducing waste and increasing income. Steps to achieving eco-friendly designed lanterns would include the use of a water-based glue as opposed to aromatic one which would contribute to a safer working environment and more sustainable materials for lantern covers instead of silk such as Poona paper (made from the wood of the Poona tree) that is tough and has a natural and beautiful colour.

Box 6. Resource Efficiency in Rice Noodle-Making Households

Rice-noodle production is a sophisticated and time-consuming process. The rice is, first of all, washed and soaked in water in large plastic vats overnight, after which it is grounded into powder and fed into gelatinizing tank to make starch. It is then pressed through a frame to make even fibres which are boiled using the remaining rice husks as fuel, rinsed in cool water and twisted into shape to make the final product.

A cleaner production assessment identified various options to increase resource efficiency and reduce waste which were shared with participating rice noodle-making households. The high-placed cooker and open stove in (above-left) resulted in high energy losses, whilst laying down more bricks would reduce heat loss and fuel consumption, resulting in rice husk savings of about 3 tonnes/year. Poor ventilation, smoke, dust and steam in the fibre-cement cladded workroom (above-right) affected product quality, food sanitation, and workers' health which could be alleviated to a certain extent by keeping windows open and routine cleaning of the floor, equipment, ceiling and walls. A more long-term solution would involve raising the roof to facilitate greater ventilation. It was also recommended that households used tap water instead of untreated groundwater to ensure food safety and product quality, and that treatment systems were installed so that wastewater high in organic pollutants would not be directly discharged into environment without any prior treatment.

4.4 Greening of the Craft Sector in Hoi An

A further assessment was also made of handicraft sector which extended to include the Hoi An – My Son corridor. Just over 2,400 households are producing crafts and generate a total income of VND 60 billion/year (~US$ 3 million, equivalent to 47 per cent of total household income in the region). In some villages, more than half of local labour is employed in handicraft production. Generally speaking, the wages of those engaged in crafts production is 3-4 times greater than those working just in agriculture. Less poverty is also seen in such villages compared to those dependent solely on agriculture.

Despite the restoration of traditional handicraft villages and the emergence of new craft villages in recent years, little attention has been paid to planning and development, and their contribution to employment. As a result, crafts production has developed spontaneously and is characterized by a micro- or small-scale production in a geographically dispersed manner. Major products included:

- Bronze-casting enterprises: bells, gongs, statues, incense burners – apart from bronze, aluminium is also used for casting of various household items;
- Textile enterprises: silk and cotton cloth (no finished products are made in villages for immediate consumption);
- Lantern enterprises: foldable silk lanterns using bamboo and wooden frames, and;

- Wooden furniture-making enterprises: statues, furniture (both modern and classic styles), boats (building and repairing).

A survey was conducted to assess the socio-economic and environmental status of the current crafts production model, and involved 268 households, plus 30 small-scale enterprises and 14 local government officials. The survey identified numerous constraints to craft sector development, in particular:

- Raw material supply: increasingly unpredictable supply and high price fluctuations for bamboo and rattan as a result of overexploitation; use of poor quality clay by the ceramics sector and declining availability and decreasing affordability of bronze;
- Environmental infrastructure: lack of facilities for collection and treatment of wastewater and to a lesser extent waste, cause environmental concerns; and;
- Market access: high transport costs lead to a focus on local markets which are increasingly dominated by more demanding international tourists.

An integrated approach to craft sector development would be required to fully capitalize on the crafts production potential of the region, and thereby create income and employment for rural communities, while also increasing income from tourism, both from sales of craft items as well as from potential contribution to increasing tourism volumes and new tourism services.

In addition, opportunities for RECP were identified for two subsectors in the craft sector, namely production of fresh rice-noodles and of lanterns. The results are summarized in Boxes 5-6. Overall it was found that RECP is a valuable tool for reducing environmental impacts and strengthening the competitiveness of crafts production.

4.5 Conclusions and Recommendations

Based on the most urgent gaps identified in the city's infrastructure, accommodation and handicraft sectors, the Green Industry Action Plan for Hoi An Eco-City development (as summarized in Figure 8) attempts to outline the key next steps the government needs to take to becoming an Eco-City. It is clear that the rather large investments required in infrastructure alone cannot deliver the desired solutions. Capacity needs to be built in many different areas including: environmental management, planning, enforcement and monitoring at the local government level, RECP and CSR in at the enterprise level and in craft villages for such investments to have lasting impacts. The results of the background analysis in this chapter gives weight to this argument and stresses the need for further situational analyses and feasibility assessments to be conducted along with systematic capacity development efforts before embarking on such a major civil engineering project.

Tourism is, at present, and is likely to continue to be the main driver for economic growth of Hoi An City. The accommodation sector without saying has been one of the largest beneficiaries of the influx of local and international visitors of recent years. Its sustainable development is therefore paramount to that of the city as a whole. The CP assessment here showed that general awareness was lacking and hotels and guest houses still have some way to go to becoming green and making their business practices sustainable. Capacity building activities targeting resource efficiency and waste minimization in this sector like those conducted under this project are important at this time given that results also show that the accommodation sector contributes significantly to MSW and wastewater which the city does not yet have the infrastructure or capacity to deal with in such large volumes.

The indirect impact of the growth of tourism is obviously the additional demand by visitors for other locally available goods and services. Apart from food establishments, shops selling handmade bamboo and silk lanterns and other such locally-made products can be found ubiquitously on the streets of Hoi An City and thus one's attention needs to be drawn also to both these sectors, given their potential for growth, jobs and environmental pollution. CP assessments of lantern-making households (Box 5) and rice noodle-making (Box 6) found again inefficient and backward production

Figure 8. Green Industry Action Plan for Hoi An Eco-City Development

Time	Actions	Actors	Estimated Budget (VND mill.)*
Measure 1: Capacity built of local, provincial and national stakeholders to design policy for Eco-City planning and development with a focus on tourism, craft villages and environmental services. *Target 1.1 Relevant stakeholders are knowledgeable in Eco-City policy design and implementation.*			
2013- 2014	Prepare training materials, deliver trainings, implement a study tour and other information exchanging activities as appropriate	Hoi An People's Committee, training institutions, and technical experts	1,050
2013-2015	Prepare a status report on Eco-City development and make recommendations based on results		
Measure 2: Improved solid waste management system. *Target 2.1 4R technical options are identified and deployed.*			
2013	Prepare and deliver trainings on waste separation at source.	Division of Natural Resources and Environment of Hoi An, Hoi An Company of Public Works, Commune People's Committee, Women's Union	500
2013-2014	Establish a model for waste management and separation in selected communities in Hoi An and replicate results.		800
Target 2.2 Methodologies for reusing waste are researched, developed and disseminated.			
2013	Carry out a situational analysis of MSW in Hoi An; identify appropriate measures to reuse waste and disseminate results.	Division of Natural Resources and Environment of Hoi An, Experts, Hoi An People's Committee, and training institutions	1,500
Target 2.3 Construction of a landfill for Hoi An City.			
2015	Develop a detailed, costed proposal for the construction and management of a landfill in Hoi An City.	Hoi An People's Committee, and training institutions	1,000
2015-2017	Initiate a stepped-up public private partnership through joint efforts of relevant authorities and businesses.		1,500
Measure 3: Effective methods for water management identified and put into practice. *Target 3.1 Database on water quality in Hoi An City constructed and operational.*			
2012	Carry out a situational analysis for the construction of a water quality database and monitoring system.	Division of Natural Resources and Environment of Hoi An	500
2013- 2014	Create a pilot water quality database and monitoring system; test and expand database to include more comprehensive parameters.		1,500
Target 3.2 Construction of a central wastewater treatment plant for Hoi An City.			
2014	Construct a centralized wastewater treatment plant for Hoi An City.	Hoi An PC	*With French ODA*
2014-2015	Initiate a stepped-up public private partnership through joint efforts of relevant authorities and businesses.		1,000
Measure 4: Effective options for reusing wastewater in practice. *Target 4.1 Wastewater reuse options identified and promoted through policy measures.*			
2013	Research and report on wastewater reuse options in Hoi An.	Division of Natural Resources and Environment of Hoi An	500
2014	Establish a pilot model for wastewater reuse in Hoi An	Division of Natural Resources and Environment of Hoi An	1,000
2014-2015	Based on the results, establish incentive measures and conduct awareness raising activities.	Hoi An People's Committee	1,000
Measure 5: RECP and CSR options widely applied in hotels, restaurants and other related sectors. *Target 5.1 Staff in hotels and restaurants are knowledgeable in RECP and CSR.*			
2012-2013	Raise awareness and deliver a series of trainings on CP	Division of Tourism and Trade of Hoi An, Hoi An People's Committee and VNCPC	1,200

2013	Set-up a committee comprising of experts and targeted businesses to advise on RECP and CSR solutions; replicate results.	Hoi An People's Committee, VNCPC and targeted businesses	700
2013-2014	Develop and propose technical regulations on RECP for application in the accommodation and related sectors.	Hoi An People's Committee	1,500
Measure 6: Awareness and wide-scale application of RECP and CSR in craft villages. *Target 6.1 Villagers in targeted craft villages are knowledgeable in* RECP and CSR			
2012-2013	Raise awareness and deliver a series of trainings on CP in conjunction with relevant authorities and international donors.	Division of Economic Development of Hoi An, Hoi An People's Committee, VIRI and VNCPC	2,100
	Set-up an advisory committee comprising of experts to assist the implementation of RECP and training in targeted craft villages.	Hoi An People's Committee and targeted craft villages	200
2013-2014	Conduct a study tour to environmentally friendly craft villages.	Hoi An People's Committee	200
	Conduct replication activities		500
Target 6.2 Results widely replicated and methodology and materials successfully disseminated to other craft villages in Hoi An City and surrounding areas.			
2013-2014	Prepare training materials, select pilot sites and deliver trainings	Division of Economic Development of Hoi An, Hoi An PC, VIRI and VNCPC	1,650
2015	Develop and propose technical regulations on RECP for application in craft villages		500
** Indicative costs are given which do not reflect actual investment required in infrastructure*			

methods that created pollution and also waste and unnecessary losses in potential income for these families.

UNIDO's Green Industry approach stresses the need for different kinds of interventions to be used together to achieve optimal results. As abovementioned, lack of policy enforcement has meant that micro and SMEs exploit groundwater resources which are essentially free, likewise hotels and such other establishments are not actually charged for wastewater treatment as authorities levy fees based on the volume of water consumed leaving wastewater infrastructure in a woefully neglected state. Stricter enforcement would not be a panacea for these problems without raising awareness and demonstrating to such businesses the means (i.e. CP solutions) and the benefits (i.e. input resource and cost reductions) of changing their behaviour.

The study on energy consumption and renewable energy showed that deployment of selected renewables in Hoi An would be feasible, while calculations in the CP assessment indicate that there would be good returns for hotels investing in solar heating and cooling. However, imperfect information, as described in the former study along with lack of technical support and maintenance, mean that this is easier said than done and it is here that business advisory services and a Centre for Green Industry Technology advocated in Section 2.2 can really offer value-added.

5. BINH YEN ALUMINIUM RECYCLING VILLAGE

5.1 Cookware from Scrap Aluminium

In the Binh Yen locality in Namh Dinh Province in Northern Vietnam, 304 (of a total of 600) households or 1,000-1,200 people approximately are involved in the production of cookware from aluminium scrap, with a total sales value of VND 53 billion (~US$ 2.6 million).[5] The personal net income of those villagers involved in aluminium recycling and cookware production averages at VND 40 million per annum (~US$ 1,920), while those relying just on rice cultivation and animal husbandry make just VND 12 million (approx. US$ 577). The spontaneous development of household level recycling is, however, causing alarming levels of environmental pollution due to use of inappropriate technology and outdated equipment and the lack of environmental awareness and checks and balances.

This pilot assessment in Binh Yen Village was undertaken to put the spotlight on communities that find themselves trapped between today's socio-economic and environmental benefits (income, jobs and aluminium recycling) and tomorrow's latent environmental and health disasters (loss of agricultural land, clean water and declining community health). It also sought to identify, and where possible, trial innovative models for resource recovery and emissions reduction and control, which in turn improve living and working conditions in villages which benefit the community as a whole.

Box 7. About Aluminium Recycling

Aluminium is a versatile, widely-used light-weight metal, essential to the manufacturing of aircrafts, automobiles, packing materials and more than half of the kitchenware on the market is made from aluminium. As recycling does not damage the metal's structure, aluminium can be recycled infinitely and today two-thirds of aluminium ever produced since 1886 is still in use. (Source: Greg Zelder and Sebastian Africano, San Francisco University, 2003). According to the International Aluminium Institute (IAI), environmental benefits from aluminium recycling are notable. Secondary smelting for aluminium production from scrap generates only about 5 per cent of GHG emissions compared to primary metal production starting from bauxite. Collection and recovery rates for aluminium are generally high across the globe. In developing countries scavenging for aluminium scrap is an important source of income for the urban poor.

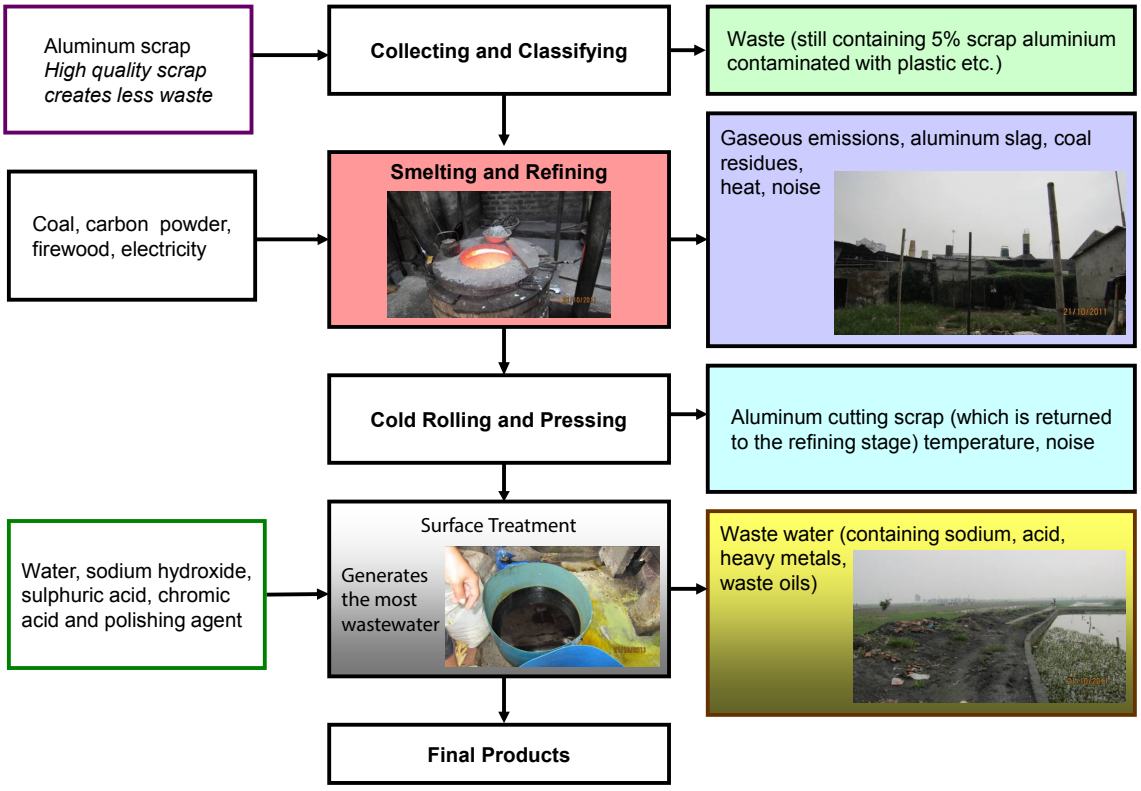
5.2 Baseline Situation

Families purchase aluminium scrap and material from which they recycle aluminium to produce cookware. Production techniques are traditional, simple in design, rely on manual labour, and can be operated at the household level. Wastewater from production processes is discharged directly to canals, rivers and open sewers without any treatment and likewise solid waste is simply dumped by roadsides. The growth of recycling has, however, has played an important and positive role in local socio-economic development, creating employment, with approximately 1,000-1,200 jobs working in the sector and an annual turnover of over VND 53 billion (~US$ 2.6 million). In the Nam Thanh commune, the aluminium recycling activities of the Binh Yen Craft Village are the largest and best remunerated employer. The question however, is whether these short-term benefits outweigh the potential medium- to long-term negative environmental and health impacts, and how Green Industry can contribute to ensuring a positive outcome now and in the future.

Figure 9 provides an overview of the recycling and cookware production chain. This also lists the main inputs and environmental concerns. Households are normally specialized in one main stage of production, in particular: smelting and refining (107 households), rolling and forming (37 households), and surface treatment (170 households).

5 On average, Binh Yen Village processes 1,400 tonnes of scrap aluminium each month purchased at a price of approximately VND 32 million (~US$ 1,539) per tonne, efficiency is low at 60 per cent, from this they make just 880 tonnes per month of finished products, which is then sold at a price of VND 60 million per tonne (~US$ 2,885).

Figure 9. Household-Level Aluminium Recycling in Binh Yen Village: Inputs, Processes and Waste Products



Data Collection Results and Analysis

To estimate the scale of the pollution impacts, spot samples were collected in and around the village—30 samples of surface water taken both up and down stream and 20 samples of solid waste and soil taken in different areas around the Binh Yen Village. High levels of all measured parameters were reported and surface water pollution was shown to be extremely serious. Particularly worth noting was that in 20 of the 30 water samples, levels of Chromium VI were found to be 5-2,820 times the legal limit of 0.1mg/L, nitrite and nitrate concentrations were between 1.5-50 times,[6] and Chromium VI levels in solid waste samples 3-284 times higher than the legal limit, while levels of 18 of the 20 soil samples showed Cadmium levels in excess of legal limit by some 1.5-14 times.[7]

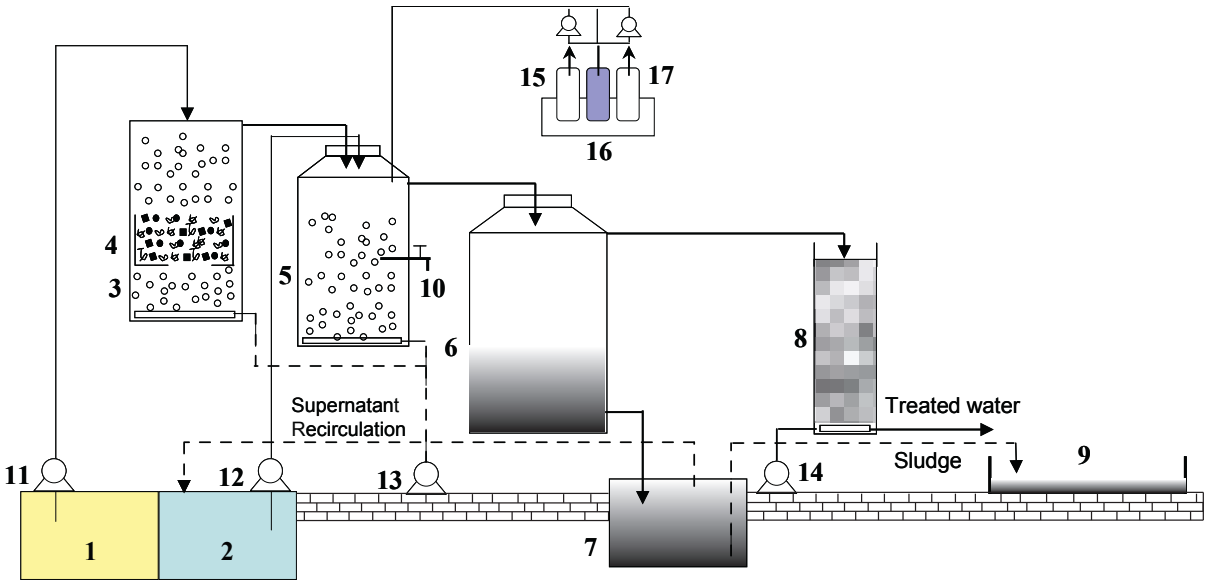
These results are of grave concern and more so in light of the State of the Environment Report (2008) which noted a high incidence of neurological, respiratory and dermatological complaints and high incidences of deafness and cancer in villages engaged in metal recycling. In the Binh Yen Village, all domestic, production and livestock wastewater along with rainwater from the village enter a common drainage system which is channelled into a reservoir behind the village. Overflow from the water reservoir runs into the rice fields and its contamination has already rendered 8 ha of farmland unsuitable for rice cultivation. The high concentrations of pollutants in solid waste and wastewater samples are evidence that the pollution is, at present, not contained and has started and will ultimately leach and migrate further, causing environmental havoc in an expanding geographical scale unless. A significant clean-up operation will be required to remedy such a situation.

6 Viet Nam Technical Regulation QCVN 40:2011/BTNMT (B); note that separate values for nitrate and nitrite are not given but total limit for nitrogen levels is.
7 Viet Nam Technical Regulation QCVN 03:2008/BTNMT for agricultural soils

5.3 Technology Solutions

In looking for a short-term solutions to prevent further spreading of the hazardous hexavalent chromium (from surface treatment) and toxic fumes (from smelting), key criteria were ease of operation, affordability, maintenance requirements and effectiveness in achieving the limits set through the National Technical Regulation on industrial wastewater or emission gas (QCVN). The combination of chemical precipitation with reduction (which makes use of waste iron shavings and activated carbon powder allowing for a reduction in costs when compared to other options) was recommended to allow the detoxification (through the conversion of Chromium VI to Chromium III) and complete removal of Chromium (as Chromium III). A pilot system has been set up and, training and monitoring are being provided to ensure the equipment has been installed properly, that the treated wastewater meets legal requirements and that villagers are able to confidently operate the treatment system. Upon completion, the prototype will have a capacity of 10 M^3/day and will therefore be able to meet the wastewater disposal needs of three households. However, also worth noting is that such technology is used in full-scale industrial plants and the model can easily be replicated at a much larger scale which would also effectively bring down costs.

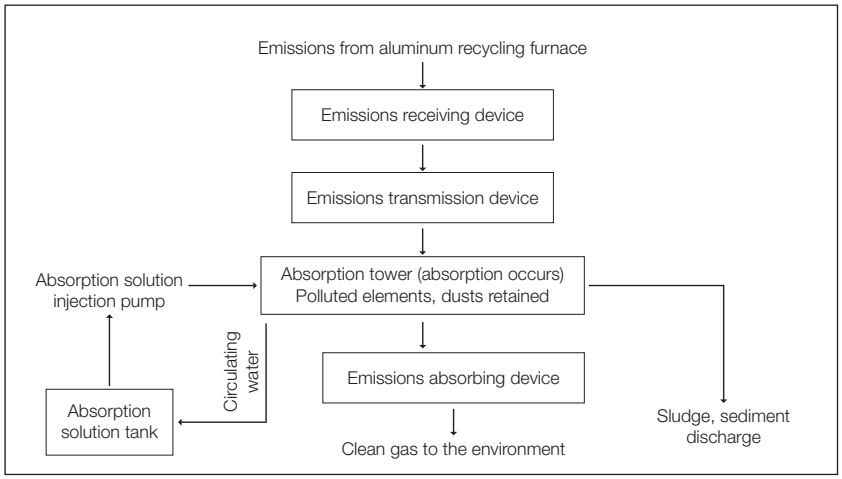
Figure 10. Chromium (VI) Reduction and Removal in a Household-Scale Wastewater Treatment System



1	Tank for storage of H_2SO_4 and Cr wastewater	10	Sample ports
2	Tank for storage of NaOH, $NaNO_2$, $NaNO_3$ wastewater	11	Pump for drawing wastewater from tank 1 to the reduction tank
3	Chromium reduction tank	12	Pump for drawing wastewater from tank 2 to neutralization tank
4	Chamber for contain Fe shavings and powder activated carbon	13	Air compressor
5	Precipitation and neutralization Tank	14	Back washing pump
6	Settling tank	15	Metering pump and H_2SO_4 chamber
7	Sludge tank	16	pH controller
8	Rapid filtration column	17	Metering pump and NaOH chamber
9	Sludge-drying bed		

A flue-gas scrubbing system, as depicted in Figure 11, was also suggested for use at the household-level to treat waste gas emissions, which comprise mainly of carbon dioxide, carbon monoxide, nitrogen dioxide, other unburnt volatile compounds and fly ash particles. The absorption method was chosen here due to its low operating costs, relatively high levels of efficiency and again, ease of operation. The process itself is divided into physical and chemical absorption, the former relying on the dissolving of exhaust gas substances with a liquid solvent and the latter involving chemical reactions between the absorbed and absorbing substances or components effectively removing them. Unfortunately, due to both time and financial constraints, it was not possible to construct a pilot before the end of the project.

Figure 11. Emissions Treatment using the Solution Absorption Method



5.4 Sector Reform

Technology solutions such as the Chromium VI removal and gas scrubbing system are useful to limit the further environmental degradation, yet insufficient as a long term and sustainable development option for income and job creation and aluminium recycling. A comprehensive solution would have to encompass:

- Concentration of the productive activities in a central location/workshop, with the triple benefits of (1) achieving a scale of operations that could warrant investments in cleaner and energy efficient techniques and waste and emission controls; (2) removing hazardous chemicals and activities from residential areas and thereby reducing exposure of vulnerable segments of the population in particular (including children and the elderly); and, (3) improving productivity and product quality;

- Discontinuation and dismantling of household-level equipment and facilities in order to ensure that production within the village is indeed and forever discontinued; and,

- Environmental rehabilitation to contain or where possible remove historic contamination to terminate ongoing exposure of the population to environmental and health hazards and prevent further leaching of pollution. This is likely to require removal of top soil in village residential areas, ditches and ponds.

Within the present mandate and scope for the Green Industry initiative it was not yet possible to develop a costed plan for comprehensive restructuring and clean up of the village. Such would also require supportive changes in policy and incentives, and potentially organization of the activities of the villagers into a cooperative.

6. WAYS FORWARD

Under this project, an in-depth review and analysis of policies on industrial development and environmental protection were carried out to find out the strengths and weaknesses in the implementation of policies promoting environmental protection in the industrial sector and overcoming consequences of environmental pollution caused by industrial activities. Through analyzing the trends and experiences of Green Industry development of specific countries in the region and around the world, UNIDO has proposed concrete targets on resource efficiency together with policy recommendations to support MOIT to build a strategy for Green Industry development in Viet Nam. In particular, it is noted that the technology and information gaps identified could be effectively addressed in a cross-cutting manner through the establishment of a Centre for Green Industry Technology in addition to business advisory services. Sectoral strategies and regional approaches which make coordinated use of Green Industry strategies like those used in this project have the potential to offer practical and lasting solutions, the details of which are further elaborated upon below.

The lack of data on industrial and environmental indicators in developing countries like Viet Nam makes such development problems harder to solve, as without a baseline there can be no reliable assessment of the technical improvement potential, or subsequently a grounded cost-benefit analysis. The benchmarking of the EAF steel sector therefore allowed a unique insight into the performance of local enterprises compared to their international competitors in terms of energy, resource and process efficiency, as well as GHG emissions. Presented in a workshop in March 2012 to VSA and participating enterprises, the results also served as a starting point for deliberation on a voluntary agreement and a sectoral technology roadmap with quantified targets and actual solutions for the technical optimization of EAF technology. Such an approach has successful precedence in many other countries and could be effectively replicated with good results in other industrial sectors in Viet Nam.

In the complex process involving numerous separate but interlinked assessments, in-depth analyses and feasibility studies behind the drafting of the proposed Hoi An Eco-City Green Industry Action Plan, what is apparent, in the final analysis, is that the environmental services offered by green industries are decisive in delivering solutions to fundamental problems such as MSW and wastewater. Beyond this, it is also clear that while tourism has promoted economic growth it has also been a source of stress on the city's wastewater and MSW infrastructure. Apart from promoting cleaner production in such sectors as accommodation to relieve pressure, such measures should also be extended to the food and beverage, and handicraft sectors. In terms of greening production processes, the cleaner production options identified by the VNCPC are of direct relevance to many other establishments in the accommodation sector. More specifically, the proposed Hoi An Eco-City Green Industry Development Plan would be useful to Da Nang which also has already a plan to achieve Eco-City status, in addition to other localities such as Nha Trang and Cat Ba Island (Hai Phong City).

Metal-recycling is without a doubt an important green industry that provides employment, good incomes and minimizes the use of virgin resources. It is not, however, a given that green industries are inherently sustainable and automatically make use of green production methods. This study of micro-scale metal recycling, as typified by the Binh Yen Village who from waste materials, namely, scrap aluminium have been making cookware shows that development of green industries must go hand-in-hand with appropriate policies and planning at a national level and guidance and support from local authorities. In light of these findings, household-level production in villages and rural areas and the concomitant cause for concern they prompt in terms of environmental pollution and community health is all the more so pertinent given that apart from the 1,000 or so officially recognized villages, there are an estimated 3,000 other unofficial villages engaged in such productive activities, employing, in total, some 11 million workers.

Government policy enforcement efforts have often targeted big businesses, while micro and small enterprises far away from big cities have managed to escape notice. However, findings provided by this study show these household enterprises can be the cause of serious and pervasive environmental

degradation of local communities. While in the short-run they are indeed achieving incomes much higher than farming villages, locally-sourced raw materials are approaching critical levels and out-of-date production methods and technology means that their practices simply cannot be sustainably passed down to future generations. Quantifying the scale of the endemic pollution problems in a typical metal-recycling village, the study lays the groundwork for future and urgently needed interventions that need to be carried out in Binh Yen Village and in other such villages engaged in production at the household-level around Viet Nam.

Overall, these findings offer important insights which can add momentum to the political dialogue on Green Growth and sustainable development while also bringing to the table, tried and tested Green Industry strategies as solutions to some of the most pressing issues of the day in Viet Nam and other countries up against similar such challenges around the world.

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