The Switch-Asia Programme Impact Assessment Framework

Case Study 'Electric Motor Systems Energy-saving Challenge in China' with a focus on the impact area climate change mitigation

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SWITCH-Asia Network Facility

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About this case study

One of the major roles of the Switch-Asia Network Facility is to establish an impact assessment platform. The platform will include the impact assessment framework as well as a set of SCP indicators.

The purpose of the platform is to assist the SWITCH-Asia projects in effective communication of the impacts to their respective stakeholders. It will also give guidance to projects on how to improve their logical frameworks, set baselines, collect data and measure project impacts at the project level in linkage to the programme level. It will also be serving as platform for discussion with project representatives, delegations of the EU and the European Commission.

The SWITCH-Asia impact assessment framework is going to be continuously improved to fit to the needs of the projects and to effectively demonstrate what difference this programme is making. For this purpose the framework will be tailored to the cases of various projects in collaboration with the project partners. SWITCH-Asia impact case studies are planned for various impact categories such as climate change mitigation, resource efficiency, poverty reduction, employment generation, socio-economic development and health and safety.

The following example case study focuses on the 'Electric Motor Systems Energy-saving Challenge in China' project. It is the first SWITCH-Asia impact case study and adopts the impact indicator framework under the impact area i.e. climate change mitigation.

Table of Contents

1. Background and Objective

The SWITCH-Asia impact assessment framework has been developed to assess and describe the positive impacts of projects on consumption and production patterns in relation to the areas of climate change & environment, poverty reduction, employment generation, socio-economic development, and health and safety. The following case study shows how the framework can be applied to a specific SWITCH-Asia project aiming at climate change mitigation as highly aggregated impact.

According to SWITCH-Asia assessment framework (see Figure 1), there are three levels on which projects achieve impacts: 1) **SCP impacts** i.e. mostly project's direct contribution to environmental, social and economic performance improvements during the project implementation period or in the short term right after projects finalization; 2) **replication impacts** i.e. wider uptake of projects' outputs, increased ownership, institutionalisation and visible transformation of SME and consumer practices towards SCP, and 3) **policy uptake impacts** through better policy implementation and new policy development for SCP. For creation of case studies the indicator framework and the initial set of indicators developed for the logical framework and project application of each SWITCH-Asia project can be combined.

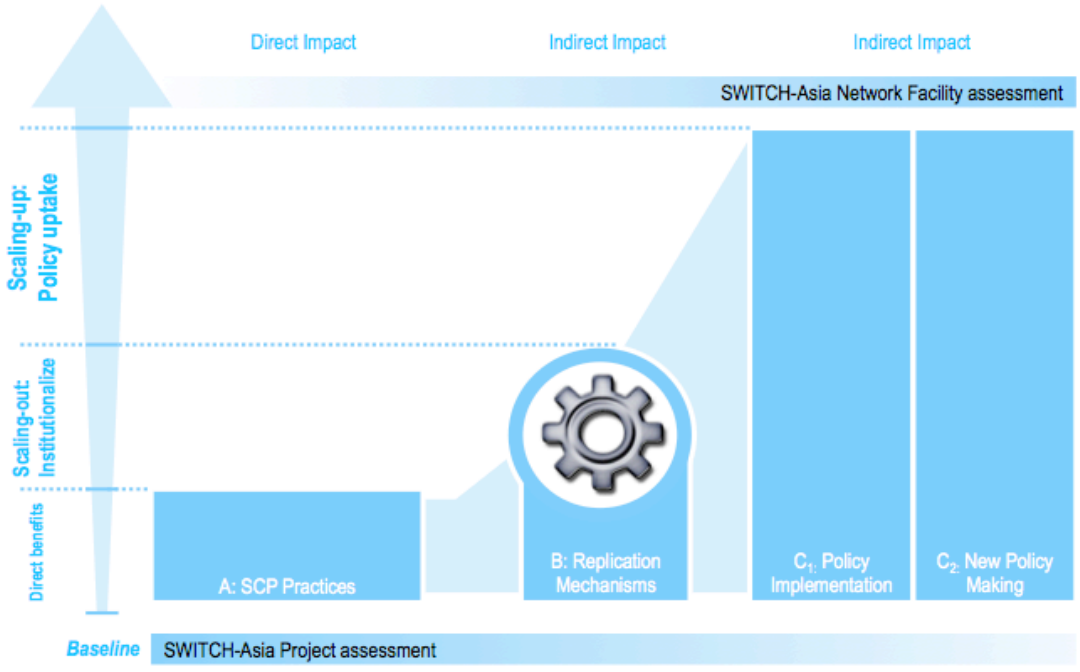

Figure 1: The SWITCH-Asia Impact Assessment Framework

Climate change continues to be high on the political agenda and becomes increasingly relevant for international development cooperation projects. Most SWITCH-Asia projects contribute to climate protection in one way or another. Climate protection is not only achieved through energy efficiency in industry, but also through introduction of sustainable consumption and production systems, for example in forestry, through waste minimisation, or promotion of low-carbon lifestyles.

The objective of the SWITCH-Asia project case studies on climate change is not merely to quantify the GHG emission reductions achieved through the projects, but also to describe in a qualitative manner the additional direct and indirect positive impacts of the project.

2. Project Description

Electric Motor Systems Energy-Saving Challenge – Improving the Operating Efficiency of Chinese Electric Motor Systems

Electric motor systems in China's industry account for about 60% of the country's total electricity consumption. Unfortunately, the actual operational efficiency of electric motor systems is about 10 – 30% below international best practice, depending on the industry. As the majority of electricity in China is generated from coal, causing the average amount of CO_2 per kWh to be higher than in developed countries, electric motor systems are a significant contributor to climate change. Certain sectors are particularly intensive users of electric motors, but are often unaware of the huge potential energy savings and quick return on investment of upgraded motor systems, particularly small and medium sized enterprises. Furthermore, the standards, labels and regulatory mechanism for electric motors in China urgently need to be revised, to phase out low-efficiency motors and encourage the market for high performers.

The project facilitates improvement of the operating efficiency of their systems for over 400 major industrial users of electric motor systems. Furthermore, it contributes to an increase in the demand and supply for high-efficiency motor systems through promotion of best practice in the design, production and application. Finally, the project actively supports the improvement of a policy environment conducive to promoting industrial energy efficiency.

The project is managed by the China National Institute of standardization (CNIS) and supported by the United Nations Industrial Development Organization, Investment and Technology Promotion Office (UNIDO ITPO), the ESCO Association of China Energy Conservation, and the Instituto de Sistemas e Robotica (ISR) from the Universidade de Coimbra in Portugal[1].

[1] For further details about this project refer to the fact sheet and the project progress on the Switch-Asia website: http://www.switch-asia.eu/de/switch-projects.html

3. Impact Assessment

3.1 From outputs to impacts

The impact chain is an essential concept to understand the links between project activities and the project's impacts. SWITCH-Asia projects are resourced through the EU and partners' own funds. Using these **inputs**, the projects launch activities that generate **outputs**. These are then utilised by target groups such as Business Membership Organizations (BMOs) and small and medium sized enterprises (SMEs) (**use of outputs**), generating **direct and indirect development impacts.**

In the case of the Electric Motor Systems Energy-Saving Challenge Project, one of the target groups of the project are electric motor system users. The project partners develop material for the training workshops (**outputs**) with the aim to train about 1000 industrial motor system users on energy saving measures at these workshops (**use of outputs**). As soon as users of motor systems undergo system upgrades, the project starts achieving **direct impacts** (see Figure 2).

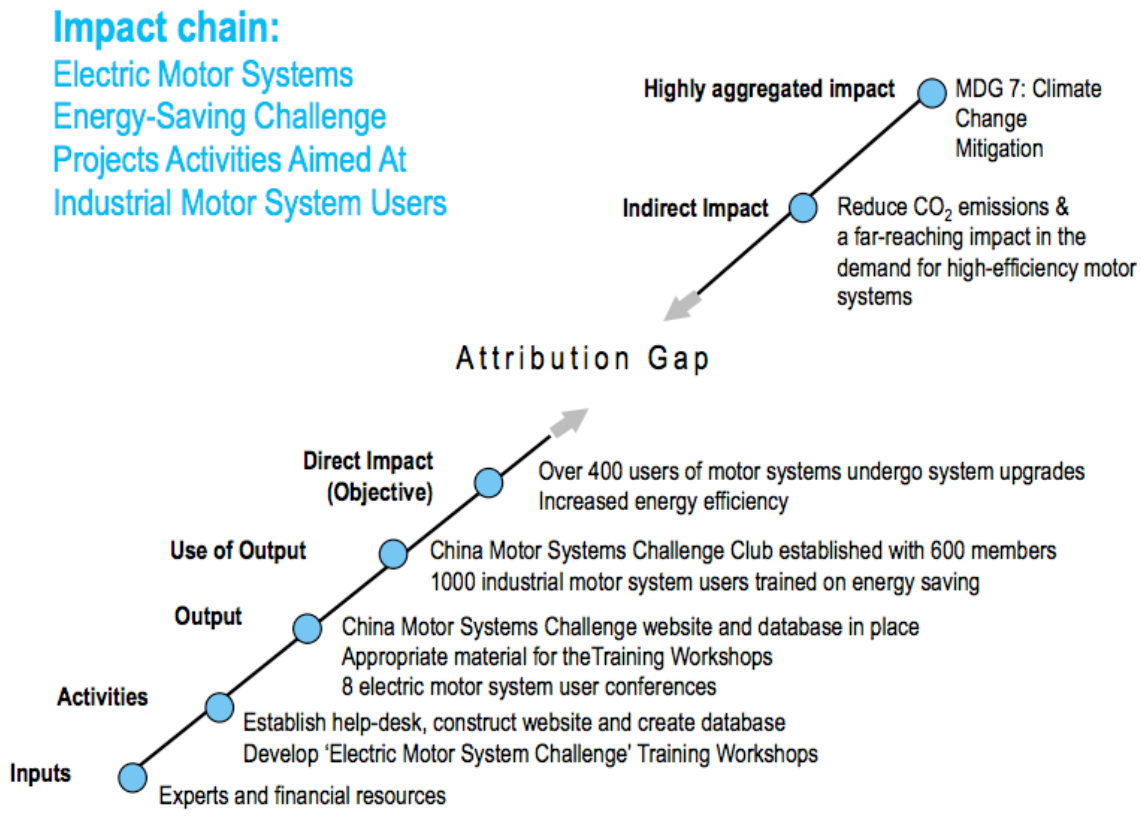

Figure 2: Impact Chain of China Electric Motor Challenge Project

The activities of the Electric Motor Systems Energy-Saving Challenge Project will also generate **indirect impacts** beyond the direct impact level – large savings of electricity and reductions of CO_2 emissions through the increased supply and demand of energy-efficient motor systems.

The project gets rather accurate data about the savings of electricity from the upgrades. As companies do the upgrades, a third party performs a check and its result is utilized for decision-making on company subsidies. However, it is a challenge to identify how many of those 400 upgrades are happening as a result of this particular project's activities (**attribution gap**). The reason is that there are many initiatives simultaneously happening in China that are trying to convince electric motor users to improve their systems. The Electric Motor Challenge project receives generic data from ESCOs, which are involved in all these initiatives. In addition to this data, follow-up surveys with and purposive sampling of project's workshop participants i.e. ESCOs and members of the Electric Motor Club might give a better indication about the indirect impacts that can be allocated to China Electric Motor Challenge project.

3.2 Sustainable Consumption and Production impacts

Measuring positive impacts towards realisation of SCP requires looking both 'upstream' and 'downstream' of the value chain. It also requires considering 'triple bottom line' aspects. This means that for a project striving to achieve sustainability impacts, what counts is not only the financial result, or 'bottom line' but also equally important the environmental and social result.

In the case of the 'motor challenge' project, the industrial upgrading and use of motor systems corresponds to the market and use phases of the product life-cycle. The manufacturing of electric motors systems corresponds to the production phase of the life-cycle. In terms of triple bottom line aspects, energy use and carbon emissions are the main focus (See SWITCH-Asia Impact Assessment Background Paper for more details on the different impact categories).

The 'motor challenge' project addresses **the 'downstream' market and use phases** of motor systems where the **direct target group** consists of **industrial users of motor systems**. The project positively contributes to climate protection through achieving organisational behavioural changes and marketing of energy efficient products. Through capacity building workshops the industrial motor system 'consumers' are not only trained about the efficient use of motor systems, but also about how to upgrade their systems. The motor system users are also provided with information of energy service companies (ESCOs) active in their area and sector, who can supply know-how, equipment and financing to realize the upgrade. Over the

three-year duration of the project, around 400 major industrial users of electric motor systems improve the operating efficiency. They upgrade an average capacity of 2,100 kW in motor systems each, which run at an average 6000 hours per year.

In addition, the project addresses the **'upstream' phases of the value chain**. 300 producers of motor systems take part in workshops on international standards and how to realise and comply with these standards in their companies. The producers will understand the latest International Electrotechnical Commission (IEC) efficiency testing methods standard (IEC60034-2-1) for motors and the IEC new energy efficiency classification standards (IEC60034-30) for motors. In addition, producers are made familiar with the latest domestic standards and labelling schemes, as well as with the EuP directive, which sets mandatory requirements of energy efficiency for motors in the EU (minimum energy performance standards – MEPS). The indicator to measure the benefits for climate change mitigation in this case is the number of manufacturers switching their production towards energy efficient motor systems.

These motors system upgrades result in an average energy saving of around 25% per system, making for a total of around 1.2 TWh saved per year. The **indirect positive environmental impacts** and contribution to climate change mitigation of the project are achieved through reduced demand of electricity generated from coal-fired power stations 'upstream' in the energy value chain. Calculated at an indicative emissions factor of 0.83 Kg of CO_2 per kWh electricity, the indirect total reductions in emissions through the upgraded motor systems are about 1 million metric tons of CO_2 per year. In addition to CO_2 emission reductions, other air pollutants related to coal-fired electricity generation are reduced, such as sulphur dioxide (SO_2), small airborne particles, nitrogen oxide (NOx), heavy metals such mercury and arsenic. The reduced consumption of coal has additional positive environmental co-benefits, particularly on water use. In China it requires approximately 2000 litres to produce 1MWh electricity from coal. The project therefore would achieve indirect water savings of about 2.40 billion litres – an important contribution to protection of already scarce water resources in China, which will be exacerbated through climate change.

3.3 Replication Impacts

Beyond the project's supervised duration, the project achieves mid to long-term positive climate impacts though strategic and operational changes in the industry by **creating institutional partnerships** among value chain stakeholders. The project has used the following two main mechanisms to involve institutional industry networks that have an outreach beyond project implementation level. The sections below answer the following two questions:

- **“How are the target groups adopting the SCP practices promoted by the project?”**
- **“Which mechanisms are in place to ensure the spread of the SCP practices by the project?”**

3.3.1 Role of Service Providers

Energy Service Companies (ESCOs) are a relatively new type of service company in China, the first ones emerged around 2004. Currently several hundred ESCOs are operating country-wide, advising companies how to improve their energy efficiency. The typical arrangement in China is that the ESCO takes on all up-front costs of the energy audit and equipment purchase, and is paid a proportion of the energy savings achieved. This contracting method is known as ‘Energy Performance Contracting’ and effectively reduces the risk for the customer. Although this provides a convenient mechanism for motor users to save energy and cost, the concept of ESCO services is new so that in many sectors they have yet to gain trust. By training and building capacity of ESCOs, the project contributes to further electricity savings of industrial motor system users beyond the direct project impacts.

The project focuses on around 80 of those ESCOs, which are active, or seek to be active, in providing services related to energy savings through motor systems upgrades. They are trained on international best practices in the design and application of energy-efficient motor systems and how to expand their business models through new services. After the trainings ESCOs are able to offer their services to a wider range of electric motor system users, which have not been involved in the project activities. The indicator to measure the positive contribution to energy savings and emissions reduction would need to account for the **number of motor system users which have been consulted by ESCOs and subsequently carry out system upgrades.**

For the training of ESCOs the Portuguese partner from the University of Coimbra, which is a leading academic institution for comparable efforts in the EU, provides technical support and shares expertise based on the European experience of ESCO business development. In the context of ESCO capacity building CNIS acts as service provider and intermediary setting a framework and providing the bridge between the target groups.

3.3.2 Engaging the supply chain

The project establishes the “China Motor Systems Challenge Club”, a national information platform with around 600 members, connecting both users and producers of motor systems as well as ESCOs and pub-

lic energy administrators. Through the Club best practices in the design and application of energy-efficient motor systems are promoted and shared. Over project period, around 3000 users are informed of the potential energy savings to be gained through motor system upgrades and of the ways to achieve these savings (i.e. through ESCO services). In addition, an annual award ceremony gives recognition to excellent cases of energy-savings achieved in the industry. In 2009, the Tianjin Iron and Steel Company's 'Power Supply System Energy Saving Upgrade Project' and Datang Generation Huayin Jinzhushan Power Plant's '600 MW Unit Induced Draft Fan Energy Saving Upgrade Project' received the awards. Furthermore, the Club gives the different value chain stakeholders the opportunity for exchange and networking, e.g. industrial motor users get to know ESCOs and can make use of ESCO services. The Club will continue to exist beyond the three years duration of the project. The indicator to measure the positive contribution to energy savings and emissions reduction of the club would need to account for the number of motor system users which as a result of being member of the club have carried out system upgrades.

Table 2.1: Summary of impacts and related indicators

Type of impact (according to SWITCH-Asia impact assessment framework)	**(Possible) indicators to assess the project's climate change mitigation contribution[2]**
Sustainable consumption and production impacts (direct impacts)	• Number of SMEs (users) trained and certificates issued for implemented energy efficiency upgrade measures for motor system products • Number of manufacturers switching towards production of energy efficient motor systems
Sustainable consumption and production impacts (indirect impacts)	• Electricity savings: 1.2 GWh per year • CO_2 emission reduction: 1 million metric tons of CO_2 per year • Reduced air pollution [sulfur dioxide (SO_2), small airborne particles, nitrogen oxide (NO_x)]:…. • Water savings (through reduction of coal use): …..
Replication impacts (direct and indirect impacts)	**Role of Service Providers** • Number of Energy Service Companies (ESCOs) with increased capacity and technical expertise to provide services on energy efficiency for motor systems users: **80** • Number of motor system users implementing systems upgrades after ESCOs provided service on motor efficiency:..... **Engaging the Supply Chain**

[2] Please note that not all numbers cannot be stated with certainty as the project has not yet been completed.

Type of impact (according to SWITCH-Asia impact assessment framework)	(Possible) indicators to assess the project's climate change mitigation contribution[2]
	• Number of memberships in the Electric Motor Club: **600** • Number of motor system users informed about motor systems efficiency: **3000** • Number of club members upgrading motor systems:.....

3.4 Impacts through policy uptake

3.4.1 Implementation of existing policy

The project contributes to the implementation of some of China's macro-level energy and climate change policy frameworks. For instance, it supports China in meeting is emissions intensity target of 40-45% by 2020. Furthermore, industrial electric motor systems form an important part of the "China Medium and Long-Term Energy Conservation Plan" as laid out in the 11th Five-Year Plan period's "Ten Key Energy-Saving Projects". The electricity savings goal through motors systems efficiency,as stated in the Plan, amounts to 20 TWh per year by 2010. With 1.2 TW/h electricity savings per year, the SWITCH motor systems project will contribute significantly to achieving the national targets.

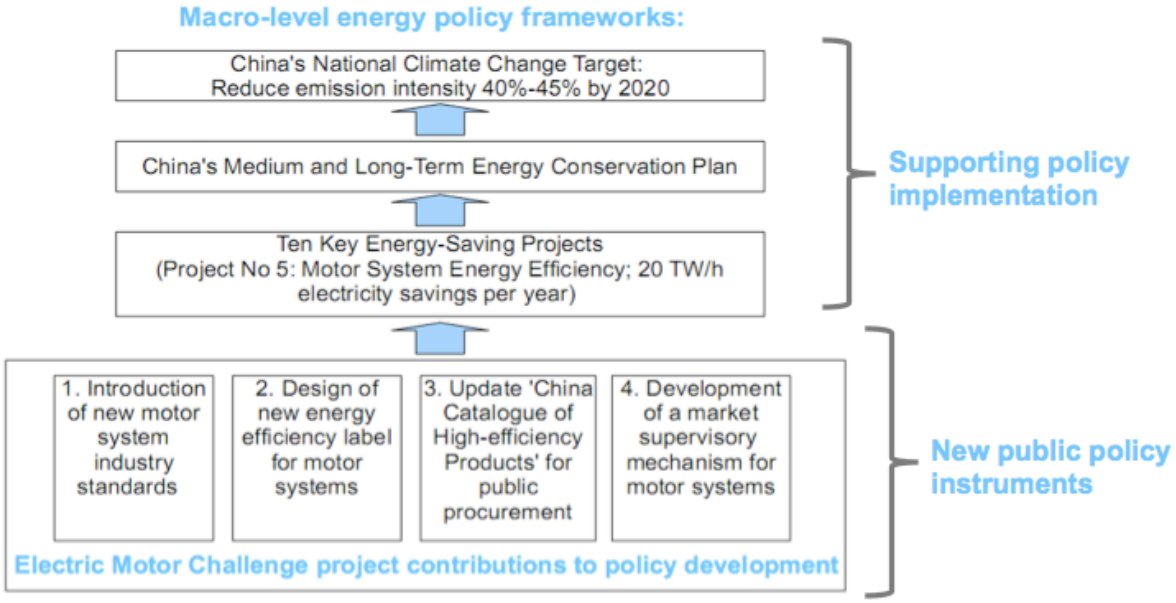

Figure 3: Policy impact framework of the 'Electric Motor Systems Energy-saving Challenge in China' project.

Furthermore, officials from several national government agencies which are involved in energy and climate policy, including the National Development and Reform Commission (NDRC), Ministry of Science and Technology (MoST), SAC (Standardization Administration Commission), AQSIQ (Administration for Quality Supervision, Inspection and Quarantine), will be informed about the project outcomes and recommendations for policy improvement are provided.

3.4.2 Development of new policies

China's current national energy efficiency standards for electric motors are outdated and need to be revised. The project supports the introduction of new national standards for motor systems, which will be based on EU standards. The project actively supports the official standard setting process taking into account the most recent work in the IEC 60034-30 Standard. This will increase the minimum energy efficiency requirements, and effectively push low-efficiency products off the market.

Furthermore, the project contributes to the redesign and promotion of new energy-efficiency label for electric motors in accordance with the new Chinese motor energy efficiency standards. Thereby the relevant industry sectors are being prepared for the upcoming new energy label in China.

The project also supports the development of other policy measures related to energy efficiency, particularly incentive policies. An example is the support to the inclusion of high efficiency electric motors into the “China Catalogue of High-Efficiency Products”, which is a relevant guideline for public procurement and will make business that buy these products eligible for tax advantages.

Finally, the project also contributes to the development of a supervisory mechanism on the market for energy-saving products. The project provides detailed policy recommendations, particularly on how to establish a workable mechanism to coordinate the work of all related organizations and to ensure consistency between producer claims and the actual product performance.