REPORT

Final Report for Facilitator within Clean Technology in India – Pulp and Paper

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Executive summary

The facilitator within Clean Technology in India – Pulp and Paper project was initiated by Sida to facilitate the exchange of knowledge between India and Sweden on clean technology for the pulp and paper (P&P) sector. Indian P&P sector needs to install cleaner technology in order to deal with environmental challenges and scarcity of raw material, water and energy. As the sector is growing, the challenges grow too. Sweden, having P&P as one of the corner stones of its economy and a history of technology development, has a lot to offer the Indian P&P sector at the same time as that sector constitutes great opportunities for Swedish technology providers. In addition to addressing direct environmental challenges, the indirect effects of higher energy, water and raw material efficiency is a better quality of life for citizens in villages and towns in the vicinities of the mills, thus increasing the social welfare, which is one of Sida's main overall goals.

The project group consists of two Swedish partners, IVL Swedish Environmental Research Institute and Innventia, and two Indian partners, CII and IPMA. Together, the project group has worked with seminars, work-shops, mill visits, head to head meetings, conferences etc. to facilitate business contacts between Indian P&P companies and Swedish technology providers. In parallel to facilitating industrial contacts and knowledge sharing, we have also worked with investigation of suitable business models for Swedish companies wanting to establish themselves in India or through other means enter the Indian P&P sector.

The project has had high credibility from both Indian and Swedish stakeholders. This is to a large extent an effect of the composition of the project group, consisting of partners that have excellent reputations among industry within their respective area of expertise. This credibility has allowed a rapid introduction to the Indian P&P companies as well as to the Swedish technology companies. The project has resulted in an understanding from the Indian side of the need for cleaner production technologies in the P&P sector and from the Swedish side, the opportunities that the Indian P&P sector offers as an important industrial sector of a growing economy. Business leads include process equipment, auxiliary equipment that enhances performance of the main process, simulation software, water treatment and water circulation closures. The project has resulted in five closed or nearly closed deals and a number of ongoing discussions that have good chances of continuing without the support of the facilitator group.

In addition to the benefits for the industrial partners, the project partners have benefited from the project and all can see opportunities for further work – both together and in new constellations.

The project has been successful and created many opportunities for both business and R&D work.

Contents

1 Background and context of the project

When the call was launched within the PDC program for a facilitator program on clean technology for the Indian Pulp and Paper sector, IVL, together with Innventia, CII and IPMA applied for the project.

Contacts between IVL and CII were established during 2008-2010, when IVL coordinated a Sida financed project called "Capacity building on Cleaner Production in the Hyderabad Region". During this project, contacts were developed with the Indian Pulp and Paper (P&P) sector which was interested in the potentials of cleaner production to be of value to their sector and the challenges they are facing.

IVL and Innventia have been working together in other projects and knew each other well already at the time of planning the project.

CII and IPMA are since long working closely together in the development of the Indian Pulp and Paper sector.

The project group thus had a flying start in terms of experience from working together and could thus quickly focus on the actual work, having clearly defined roles and with expertises that together cover all aspects of the work.

Indian P&P industry has shown a steady growth during the recent years and demand for paper has also increased manifold. In spite of this growth, the sector is facing lot of challenges with respect to cleaner production technologies, environmental regulation, and availability of energy and water and raw material shortage. This facilitator project, initiated by Sida and partnered by CII, Innventia, IVL and IPMA, is therefore a right step which introduces relevant technologies to Indian P&P sector and also helps them towards their goal of achieving world class standards. In addition to that role, the project has also helped in providing solutions to many of the key issues which essential for survival of paper industry.

2 Purpose and objectives of the project, by objective

The project's role has been, according to the Terms of Reference, to act as an initiator and facilitator between a broad range of Indian and Swedish actors in the Pulp and Paper sector. As facilitator, the project group will act as catalysts in the establishment of contacts and partnerships between Indian and Swedish companies that will lead to collaborations of both development and business to business type. The expected results, specified in the Terms of Reference document, are establishments of partnerships of mutual interest in the P&P sector, focusing on transfer and sharing of knowledge and technologies best suited for the Indian context. Mutual interest in this context is defined as willingness to invest in project activities.

In addition to the above mentioned goals, the project group has specified and communicated to Sida the following goals, ranging from quantitative goals to description of activities to be performed:

1) Environmental
   Facilitate the initiation/commissioning of projects that:

- reduce the emissions of CO2 eq with > 20% and/or

- reduce the water consumption /ton produced product (pulp/paper) with >20% and/or
- provide technology, know and solutions reduce environmental impact with respect to toxicity to air and water, including solid waste.

2) Economy

- To facilitate project generation and bilateral partnership that provides technology, know-how and solutions that minimise the production cost with 10% to 20%
- To facilitate project generation and bilateral partnership that provides technology, know-how and solutions enabling sustainable production accounting for both the environment and economic result.

3) Social welfare

- Assure that the projects and initiatives generated through the facilitation role will result in sustainable and competitive solutions, thus in the long term also improve quality of life (less pollutants and more water etc.) as well as secure employment for the citizens.

4) Dissemination and exploitation

- Arrange/attend a minimum of 15 seminars/workshops, in total involving minimum 30 Indian organizations and 30 Swedish organisations.
- Arrange matchmaking meetings between Indo-Swedish organisations
- Facilitate more than 10 Indo-Swedish partnership that will lead to short and long term collaboration on specific demonstration projects.
- Facilitate more than 5 agreements of institutional /agency corporation
- Facilitate more than 10 Business to Business agreements

Among the tasks associated with the above mentioned objectives was to suggest and discuss some business models alternatives that could help the establishment of businesses for Swedish companies in India.

The technologies we have worked with relate to several of the goals above, see Table 1. In fact, they do more or less all relate somewhat to all goals, but Table 1 shows the main goal relevancy. The gain in social welfare is a consequence of increased raw material use, more efficient use of water, lower emissions to air and water, etc.

Table 1. Technologies and companies that we have worked with the most.

			Primary goal relevancy					
Company	**Technology/equipment**	**Technical area**	**CO2**	**Water**	**Emissions**	**Economy**	**Social welfare**	**Comment**
AkzoNobel	Process chemicals, water treatment	Paper making		X	X			
Anox Kaldnes	Active sludge	Waste water		X	X	X	X	
ATEK	Aeration	Waste water		X	X			
Aqua-Q	Real-time monitoring of water quality	Water					X	Alarm system for bacterial contamination of water and optimization of chemical dosage
Cellwod	Energy efficient machinery	Paper making	X			X		Pulping rotors, high density cleaners, deflakers, screw presses, dewatering, etc.
Chemrec	Black liquor gasification	Bioenergy			X			Only for wood based pulp mills
Cortus	Biomass gasification	Bioenergy	X		X	X		Up to 20% moisture in feedstock OK.
Elof Hansson	Equipment	P&P process	X	X	X	X		Machinery, chemicals, spares, instruments, service etc
Entrans	FlexiGen	Heat recovery	X		X	X	X	Based on Organic Rankine Cycle
Frontway	Process simulation	P&P process	X	X	X	X		Simulation results in optimization
GLV	DUFLO, DUALOX, Celleco,	P&P +water	X	X	X	X	X	Office in Pune
Kemira	Chemicals and water	Bleaching, WWT		X	X	X	X	Techniques to close water loops.
Lorentzen&Wettre	Optimization equipment	P&P	X	X	X	X		Quality control and process optimization
Mantex	DXA scanners	Biomass	X	X	X	X		Measures moisture content online
Metso	Equipment	Paper making	X	X	X	X		Top of the line machinery.
Noss AB	Turn-key installations	Fibre management	X			X		
OneWell	Revive	Water treatment					X	Water treatment, water restoration etc
Purac	DAF, Flofilter	Water, biogas		X	X	X	X	Separation and biological water treatment
Sootech	HISS sweep	Sooting of boilers	X	X	X	X	X	Steam efficient sooting increases boiler capacity with 3%.

At the time of submission of the mid-term report in February 2013, the project goals were revised as follows:

- Reach between two and five partnerships that will lead to short and long term partnerships.
- Reach between three and five business to business agreements.

3 Project structure and methodology

3.1 Project group

The four project partners constitute a broad and profound knowledge resource to work successfully towards the project objectives:

- IVL Environmental Research Institute is a non-government, non-profit organization that acts in both research and assignment projects. IVL has a profound knowledge of state-of-the-art in several technology areas relevant to the P&P sector, including water management, waste water treatment, energy systems, clean-tech, life cycle analysis and environmental declarations and process development aiming at "closing the loop", i.e. minimize discharges from the system and maximize recirculation of process flows. IVL has a broad contact network with technology providers and researchers – both within Sweden and abroad - within these areas.

- Innventia is one of the most skilled paper technology institutes in Europe and has, as such, a unique track record in developing new and more efficient techniques and processes for paper making and related processes including biorefinery concepts. Activities range from basic research to direct assignments along the entire value chain. Innventia works close to industry, e.g. through research work in clusters involving both research and industry partners. Innventia's contact network is both national and international.

- CII works to create and sustain an environment that enables Indian industries to grow and develop. Among their role is to be a link between industry and government through advisory and consultative processes. CII is a non-government, not-for-profit, industry led and industry managed organization. CII Sohrabji Godrej Green Business Centre is a Centre of excellence for energy and environment, and is India's premier developmental institution, offering advisory services to the industry on environmental aspects and works in the areas of Green Buildings, Energy Efficiency, Water Management, Renewable Energy, Green Business Incubation and Climate Change activities. CII Godrej GBC is active in the work to make the Indian Pulp and Paper sector world class by facilitating continuous improvements in the sector. CII Godrej GBC has an extensive contact network in the sector.

- IPMA, Indian Pulp and Paper Manufacturing Association, is the umbrella organization for the Indian P&P sector and has been partnering with CII in the above mentioned work on the development of the sector. Their engagement in the project has constituted the "entrance ticket" to all industry visits, the direct contacts with CEOs and technical managers at the mills, the possibility for the project to have such a prominent role at the PaperTech conferences and also attracting the Indian P&P companies to come to the workshop organized in Stockholm in April 2012 (see section Analysis of results).

The project partners' respective competences and roles have ensured the shortest possible distance between decision makers in both Swedish and Indian companies and to the credibility of the project, thus enabling straight forward and straight to the point discussions, which has been invaluable for the progress and success of the work.

3.2 Methodology

An important factor for success in this type of work is personal relationships between stake-holders and a mutual trust. Therefore, the prime focus of the project group has been to establish close and personal relationships between the companies and the project group and then build further work on these contacts.

The project group has selected Indian paper mills with varying challenges related to the cleantech field and also having shown a willingness to invest both time and resources in improving their processes in order to decrease the environmental burden of their production. Many of these mill visits were agreed upon during PaperEx 2011, where the project group visited as many paper companies as possible and presented the project and the aim of the work. The project group has then visited several mills (see section Analysis of results) and has there got a detailed picture of their situation, challenges and own suggestions. These visits constitute one of the corner stones of activities, without which the fruitful meetings and discussions we have had at, e.g., conferences would not have been possible.

We have had individual meetings and discussions with Swedish companies to give them an understanding of the Indian situation and how they can contribute and use our facilitator programme as a step towards establishing business contacts in the Indian market.

Workshops have been arranged in order to get representatives from companies in both countries to meet.

The project group has successfully invited Swedish companies to participate and present at conferences and work-shops in India, and for companies not able to attend themselves, offered to represent them. For example, at PaperTech 2012, over 10 Swedish companies presented their services.

We have attended conferences and seminars, as described in the Objectives section.

Numerous head to head meetings with Indian P&P companies have been arranged in conjunction with conferences and CII has had frequent contacts with many of them in order to ensure that tentative contacts have not been unintentionally "lost". The follow-up work after visits has been extensive from both the Indian and Swedish partners.

In the start-up phase, there was a wish from both the project group's, Sida's and Energy Agency's sides for this project to work in collaboration with the Waste to Energy project. This has been kept in mind and whenever possible, coordination of activities and contacts was to be taken into consideration. See section Analysis of results for evaluation.

Originally, the project was given a budget of SEK 3 996 194, with the possibility of, if found motivated, extending it with a phase 2 with further fundings of SEK 1 700 000 to either the same or to another industrial sector. As the project proceeded, the facilitation work proved to be more

complex than initially thought and therefore it was a wish from the project group to dedicate also the phase 2 budget to the Pulp and Paper sector and thus continuing and intensifying the work that had already started and progressed. Sida approved and the phase 2 funding was decided for in April 2013. During the process of extending the budget, the tasks and the work plan were partly revised, which is why the analysis of the results will not be made by objective, but rather by activity – but related to the original objectives.

The project group has worked with several methods, of which the main ones are visits to mills, follow-up work both on telephone and visits, work-shops, seminars, conferences, news-letters, information leaflet, compilation of Best Practice Manuals published for the PaperTech conferences and also delegations coming to Sweden. In these manuals, companies having the best technologies available relevant to the P&P sector are presented with description of their equipment and/or technologies and examples of what can be achieved in a mill using their services. These manuals have been well received among the conference attendants. The first mill visits were made by representatives from IVL, Innventia and CII and the follow-up visits were managed by CII and often made as part of visits with also other matters on the agenda. The telephone-based follow-ups were directed to both Swedish and Indian companies. The details of each event and activity result are given in the Project Wide Results section.

One important part of the methodology has been to explore different and possible business models which can be helpful in achieving the goal of establishment of Swedish cleantech companies in India.

3.3 Development of the general situation in the field during the course of the project

During the course of the two year period of the project, things develop and the situation for the industry has somewhat changed.

For example, the Indian Government has taken a variety of initiatives in the field of renewable energy. Lot of benefits has been provided through subsidies and accelerated depreciation tax benefits to motivate industries to invest in renewable energy. The Government of India has also come up with policies like Solar Purchase Obligation and Renewable Purchase obligation to further strengthening the drive towards implementation of renewable energy projects in India. Government of India has also launched The Jawaharlal Nehru National Solar Mission on the 11th January, 2010. The Mission has set the ambitious target of deploying 20,000 MW of grid connected solar power by 2022 is aimed at reducing the cost of solar power generation in the country through (i) long term policy; (ii) large scale deployment goals; (iii) aggressive R&D; and (iv) domestic production of critical raw materials, components and products, as a result to achieve grid tariff parity by 2022. Mission will create an enabling policy framework to achieve this objective and make India a global leader in solar energy. For the P&P sector, this legislation enforces the sector to use 6 % of their energy from solar by December 2013 and 12 % by December 2014, which is an increase that demands a lot of both focus and budget from the companies affected. One mean to more easily accomplish this quota is of course to decrease the overall energy use, thus minimizing the need of solar power installed. Energy efficiency therefore remains a prime goal for the sector.

From the Swedish side, we have seen a slight, but still clear, increase in the interest towards India during the time of the project. This is valid for both small and large companies, although the smaller

ones face somewhat different challenges than the larger ones, e.g. when it comes to marketing and presence in India.

Though there are challenges related to the cost benefit and the availability of services locally for those technologies, the Indian industry has been always open to explore the possibility of adopting the foreign technologies. During the course of the project, however, the exchange rate of the Indian rupee has developed in a, for Indian companies, unfavorable way when it comes to international business deals. This has constituted a significant challenge in the realization of a few of the leads

4 Project wide results

4.1 Baseline scenario

The Indian Paper Industry accounts for about 1.6% of the world's production of paper and paper board. The estimated turnover of the industry is Rs 350 billion (USD 7 billion) approximately and its contribution to the exchequer is around Rs. 30 billion (USD 0.6 billion). The industry provides employment to more than 0.37 million people directly and 1.3 million people indirectly. The mills use a variety of raw material viz. wood, bamboo, recycled fibre, bagasse, wheat straw, rice husk, etc.; approximately 35% are based on chemical pulp, 44% on recycled fibre and 21% on agro-residues.

Major Deterrent – Fibre Deficiency

Wood: India's wood resources are limited and therefore, cost of wood is much higher in global comparison. Wood based segment of the paper industry meets its current wood requirements mainly through social/farm forestry and supplements with purchases made from the State Forest Development Corporations. Mills are not allowed to own land or forest and can therefore not be self-sufficient in feedstock.

Bagasse/ Straw: Though annual availability of agro residues is large yet, this may not be able to sustain the future growth of the Industry, taking due account of the quality of paper required, environmental issues involved, etc. Moreover, bagasse is increasingly used by sugar mills for co-generation of power and is no longer easily available to the paper mills as raw material.

Waste Paper: Recovered fibre consumption is going up globally. In India about 850,000-1,000,000 tons of waste paper is currently being recovered annually. The recovery rate works out to about 20% which is much lower in comparison with 65% recovery achieved by many global players. Low recovery is on account of alternate use of paper in wrapping, packing, etc. The utilization rate of recovered fibre is only 47%. Paper mills are heavily dependent on imported waste paper which commands exorbitant price due to inadequate availability. India needs a well-defined and aggressive system for collection, sorting, grading and utilization recyclable waste paper to contain imports.

The challenges faced by Indian Pulp and Paper Industry are:

- Enhancing Industry's competitiveness to face global competition
- Economies of scale: many of the mills are small
- The sector is fragmentised
- The mills need modernizations
- Need for building new capacities
- Meeting incremental demand of paper

- Productivity/quality must improve
- Creation of a robust raw material base is crucial
- **The mills need environmental upgrading with green technologies**
- Setting mechanism for collection, sorting, grading and utilisation of recyclable waste paper

India has a paper consumption of 7.7 kg/person and year, which can be compared with 350 kg/person and year in the developed countries. Given the overall expected economic growth in India the Indian paper industry is poised to grow from the present annual production level of 9 million tonnes to 14 million tons within 5 years. Buoyed of the growth prospects, companies in the paper industry are in the midst of a massive capacity expansion. The value of all the projects, which have either been announced or are currently under implementation, is 900 billion rupees (130 billion SEK).

The future road map undertaken by the Indian paper and pulp industry does not only impact the sector itself, but also the water availability to remaining society and industrial sectors as well as employment and societal development locally and nationally. Indian P&P industries have expanded in steps from smaller single machine set up to large multiple machines plants. The focus of Indian P&P industry so far has been mainly on expanding the capacity as the sector has experienced steady increase in demand. The industry has now come to accept also the need for improvement in their production technologies however as many mills consume large amounts of energy and water and have poor waste water treatment processes. As Indian paper sector is facing a rapid growth it must, due to scarcity of e.g. water, introduce new, clean, technology in several areas of its production processes in order to stay competitive, which implies both lessen the environmental burden and be cost effective.

Sweden, being a world leader in paper production when it comes to energy and resource efficiency, can therefore significantly contribute in this field to the Indian paper sector with a wide range of technologies. A long-term relationship between Swedish and Indian companies within the sector will also contribute to mutual benefits for both countries, as the spreading of Swedish technologies will boost development and help Swedish companies in the sector being attractive for countries with other prerequisites than Europe and the Western world, thus staying competitive on a globalized market. For Swedish companies, India is not the first international market to approach. Larger companies, like Kemira, Metso, Noss etc have the “strength” to get enough business in India to establish their own offices, whereas smaller companies are not in that position. (However, also these larger companies have profited of the project to further extend their business network.) For the SMEs, the lack of knowledge on suitable business models have been one of the major obstacles to establish in India, together with the work intensity needed.

The baseline scenario includes that Indian P&P industry being fully dependent on the selected technology suppliers for the supply of process related technologies and the equipment. The industries are in desperate need of improving resource efficiency including energy, water and waste management and also to meet the regulatory requirements with respect to stringent environment norms. The original technology suppliers are not supplying the required cost effective technologies for meeting their requirements with respect to resource efficiency and environment management. Indian P&P industry is well aware of the need for adoption of cleaner production technologies. The

industry is looking forward to affordable cost effective solutions which would help the sector to improve their competitiveness to global standards.

4.2 Analysis of results

An analysis of the results relative the objective needs to be based on the activities performed, which are described in the sections Objectives and Methodology.

As a mean to achieve the goals, the project group has visited the sites of approximately 10 mills of varying sizes and processes (waste paper mills, pulp and paper mills). Mills visited include Tamil Nadu Newsprint and Papers Limited, Star Paper, Westcoast Paper, Yash Paper, Décor, Ruchira Paper, Seshasayee Paper & Boards, Sirpur Paper, Andhra Pradesh Pulp&Paper and Khanna Paper.

The main objectives of the visits were to:

- Understand the present status of each plant with respect to environment and resource utilization
- Discuss and deliberate with the plant teams about their expectations and needs
- Make a broad analysis of the services which a sector would need and are of immediate priority list for the plant team
- Create a base for match making opportunities between Indian and Swedish companies

These visits have given significant momentum to the project and lot of interactions happened between the project partners and plant teams. The group of companies was also selected keeping in mind that they may cover the whole spectrum of paper mills, i.e. different raw materials and different products. The list includes very large paper mills like TNPL, West Coast Paper Mills, APPM and a very small paper mill like Ruchira Papers. The visits also covered one of the largest waste paper mills, Khanna Papers, and a craft paper mill, Yash Papers. The visits to these companies have given a clear indicative notion of the issues and challenges faced by them. Depending upon their locations and nature of operations, the issues were also of varying nature even though common challenges are those related to energy, raw material and water efficiencies. Some of the specific findings from the visits are as follows:

1. Khanna paper has expressed a strong need towards fibre recovery and water management.
2. Ruchira paper is looking for an innovative solution which would help them in installing lime kiln of smaller size. They are also open for a discussion to have a common lime kiln for multiple smaller mills in their vicinity.
3. West Coast paper mill has also indicated strong interest in waste and waste disposal techniques.

A detailed discussion on the needs of all the plants visited has been conducted within the partner group and suitable Swedish companies who can help Indian plants have been identified and provided with the information. The Swedish companies have then contacted the Indian plants and further talks are in progress for suitable solutions.

The project has built a strong consortium with not only a broad competence range, but also a very good credibility in the P&P industry. Some Swedish companies active in the sector were already, before the project start, established and active with a part of their product range in India, e.g. Noss

and Kemira, whereas others have expressed strong interest in doing so, as they see a large potential in India and its Pulp and Paper sector. One example is PulpEye, who now has a contract with an Indian representative. Companies already established have seen the project as a possibility to increase their presence in India. An example is Kemira, who sells process chemicals but so far has not established themselves as a strong provider of services for water treatment, in which area they are strong in Sweden. They consider this project as a good channel to expand in India. Apart from the technology suppliers, solution providers like Frontway, which offers software solutions for energy and resource optimization, finds significant business opportunities in Indian pulp and paper industry. Some of the Indian companies like Forbes Marshall have shown interest in collaborating with Frontway and offer solutions to Indian pulp and paper Industry.

In parallel to this facilitator project, Sida has financed the project Waste to Energy, lead by the Swedish Energy Agency. As some of the issues regarding energy efficiency relate to both projects, some events have ben co-arranged by these two projects: the seminar and work-shop during the Nobel Week 2011 and a delegation to Sweden in 2013. During the projects, there have been regular contacts between IVL and the Swedish Energy Agency to learn from each other and exchange experiences, which has been beneficial for both projects.

4.3 The facilitator role

The facilitator role of the project group has developed during the project and constitutes the foundation of the project work:

- Project partners have, during the project, established strong relations and a thorough understanding of how Swedish technologies can contribute to the environmental performance of Indian P&P sector. The project consortium has a thorough knowledge of environmental clean technologies, paper making, the Swedish and Indian situation and how existing technologies can be adapted to the needs of Indian P&P sites. Also, the extensive contact networks of the project group have helped in quickly defining the most suited technology providers to approach for each case.
- There is, in both countries, an understanding of achievable benefits of cleaner technologies in the sector and a clear interest from companies in both countries to establish business relationships: From the Indian side, there is an interest for collaborations in the perspective of the need to stay competitive and lessen the environmental impact of the P&P sector, and from the Swedish side, India is an interesting market offering new possibilities for growth. However, approaching the Indian market can be difficult and time consuming without a catalyst such as the project group. The competence of the project partners, the obvious good collaboration between IVL, Innventia, CII and IPMA and also the obvious engagement and belief in the project objectives at all partners is definitely one of the main reasons for the smooth and successful establishment of good contacts between the project group and the industries contacted. This has proved to be a reason for trust in the project at both Swedish and Indian companies.
- The project group has had the role of catalyst as intended in the Terms of Reference (ToR) as it has successfully assisted in the communication between several P&P companies in India and Swedish technology providers.

4.4 Environment and economy goals

The fulfillment of these goals as they were put in the agreement is hard to follow up as there has not been enough numbers of closed deals to evaluate. But the potential remains and the project group has, to the Indian P&P companies, communicated several solutions that, if implemented, would clearly achieve both the environmental, social and economic goals. It is our hope that initiated discussions between Swedish and Indian companies will continue and result in business deals contributing to the project objectives.

As stated above, in the Objectives section, many technologies offered by the Swedish technology providers address several of the goals.

Techniques related to the economic and environmental goals include energy and water treatment techniques. We have approached Kemira, ÅF, Anox Kaldnes and Mercatus and others who have shown interest in writing offers to Indian companies. However, at the time of writing, they have not received information precise enough to write any formal offers.

Another way of increasing energy and environmental performance of a P&P mill is to monitor and/or simulate the process carefully. Such monitoring and simulation allows a more in-depth understanding of the process and the effects of, e.g. variation of incoming raw material. Monitoring and simulation will enable a mill to optimize process parameters according to the current composition of incoming feedstock in order to adjust cooking time, white liquor composition, steam for drying etc. thereby maximizing yield and ensuring that more product meets quality specifications. This, in turn, increases energy and water efficiency, thereby reducing CO_2 emissions and avoiding unnecessary use of scarce water. This means that water can be used for other purposes, thus increasing the quality of life for citizens in neighboring villages experiencing water scarcity, i.e. the simulation technology also “spills over” on the social welfare goal.

Today there are few, if any, mills that use such techniques, which results in an end product of varying quality that often does not meet specifications, or specifications are set unnecessarily low and therefore sold to a lower price than it could have if the specifications would have been higher. The project group has worked intensively to attract interest and understanding for such techniques that are installed at almost every Swedish mill but still rare in India. Frontway, Mantex and PulpEye are examples of companies providing such simulation, monitoring and controlling technologies and equipment. Of these examples, PulpEye is the lead that has come the furthest way and is therefore described more in detail, with focus on the energy saving potential.

4.4.1 PulpEye

As a result of this facilitator project, Pulpeye, SPB and Innventia wrote an application to Tillväxtverket (Swedish agency for Economic and Regional growth) for financial support for a planning-project. The aim of that project was to evaluate how well the measurement system by PulpEye could be applied on Indian pulps and installed at an Indian mill.

Tests were performed that showed that the measurement system could characterise different hardwoods and bagasse and that the data could be used to monitor the percentage of bagasse in a mixture of bagasse and hardwood. The actual mix between bagasse and hardwood is important for the specification of different paper grades and low control can result in large amount of broke (out of paper) that then has to be re-processed at the mill.

Naturally, reducing broke is a good way to reduce the energy consumption at the mill. Although the fibre material is not lost as the broke is recycled and feed to the paper machine again, the fibres are still recycled and thus of lower quality compared to the virgin pulps in the mill. Furthermore, the energy required to run the machine and, not the least, dry the paper that became broke is lost. Generally, for any levels of broke changing the level by 1 %-units would lead to about 2%-units in energy saving per tonne shipped paper, as the broke is converted from pulp to paper at least twice in the paper machine. For example, going from 30 to 25% broke reduces the energy consumption with 300 kWh/tonne shipped paper, i.e. an energy saving of about 10% per tonne shipped paper. For a mill producing 100 000 tonnes per year it would result in 30 GWh savings of which most would be as reduced consumption of fossil fuels that would have been used for the drying of paper. It is thus clear that monitoring equipment like PulpEye can significantly reduce consumption of energy and water in an Indian pulp mill.

4.5 Social welfare goals

Even though the main focus of the technological solutions presented and suggested to the Indian P&P sector has been economy and environment, an increased social welfare is a direct consequence of these. Less discharge to water and air will contribute to an increased quality of living in the areas surrounding the mills. This is especially true for the mills that are situated close to cities and villages, which is a common situation in India.

4.6 Dissemination and exploitation goals

- The goal was to arrange/attend a minimum of 15 seminars/workshops/meetings, in total involving minimum 30 Indian organizations and 30 Swedish organizations. The project has attended and/or organized the following conferences, seminars and work-shops:
    - Nobel week at the Swedish Embassy in Delhi, November 2011. In conjunction with this event, a workshop was organized. See program in Appendix A. A part of the outcome of that workshop was that the participants agreed on certain issues being among the most urgent to deal with for the Indian P&P sector. Among these were color in effluents, energy consumption reduction in agro-based mills, adaptation of technologies to Indian conditions, sludge disposal and raw material availability.
    - PaperEx conference in Delhi, 2011. The project group met with many paper companies and established first contacts. This was when several of the mill visits were agreed upon.
    - Arranged a work-shop in Stockholm in April 2012 which both Swedish and Indian companies attended. Head to head meetings were arranged during the event. The program is given in Appendix B.
    - IPMA board meeting with CEOs of the IPMA members in Hyderabad 2012. At the meeting, the project was given a lot of attention with possibilities to explain the purpose in detail – both the plans and the work performed so far.
    - PaperTech in Hyderabad 2012 with invited Swedish companies and arranging head to head meetings. The conference was arranged by CII and IPMA and attended by the majority of the Indian P&P mills and thereby associated technology providers. The project group had also invited Swedish companies to join for the conference and for industrial visits. Kemira joined for both and Chemrec, Noss, Innventia (partly on behalf of Metso) and Swedish Exergy attended the conference and presented their

services. In conjunction to the conference, head to head meetings were arranged between Indian industries and the project group. At several of these meetings, representatives of the present Swedish companies attended.
At the Papertech conference, a Best Practice Manual was released, including the description of technologies provided by several Swedish companies that had been invited by the project group to present their products and services: ÅF, AkzoNobel, AlfaLaval, Andritz, Aqua-Q, Cellwood Machinery, Chemrec, Cortus, Elof Hansson, Entrans Group, GL&V Sweden, Kemira, Lorenzon&Wettre, Meva Innovation, MoRe Research, Noss, Promt and Frontway, Purac, Somas, SootTech, Swedish Exergy and UMV Coating Systems. This manual can be downloaded from CII's homepage and constitutes a thorough presentation of the best available technologies in the P&P field.

- Cleantech Venture Day, September 2012, where Jonas Röttorp, IVL, and S. Ragupathy, CII, held presentations.
- Nobel week at the Swedish Embassy in Delhi, October 2012. The project was not an arranging partner as in 2011, but held a short presentation and had the opportunity to meet stake-holders interested in both the P&P and the clean-tech sectors.
- Joint event with the Waste to Energy delegation in May 2013, where the delegates visited several different sites in Sweden related to the WtE theme, among which was the Billerud Korsnäs Skärblacka mill. A successful "speed dating" event was arranged with Mantex, Atek and AquaQ from the clean-tech side.
- PaperTech in Hyderabad 2013. Representatives from Frontway and Xylem were present, Innventia represented PulpEye and IVL included techniques from Atek in their presentation. The role and importance of the project was mentioned and in the introduction speech by Mr Sanjay Singh, vice president of IPMA and Mr Kasi Viswanathan, Deputy Managing Director of SPB. Fruitful meetings were held, strengthening established contacts. Some new leads were also started. This conference further strengthened the position and credibility of the project by the presence of both IVL and Innventia as well as the representation of Swedish companies. It meant that our presence at PaperTech 2012 was part of something continuous and more than a once-only event that does not merit attention from the Indian companies. A Best Practice Manual was released as a CD.
- Workshop on simulation, arranged by Frontway in conjunction to the PaperTech conference 2013. Some 20 participants from both P&P and consultant companies attended this interactive event. The outcome from the simulation workshop was that Frontway was given the opportunity to send quotations to some of the participants. Out of the requests that were received, a few are still under discussion and hopefully can some of the deals be closed in the near future.
- PaperEx in Delhi, October 2013. Some 50 companies visited our stand, of which some were representatives from a few of the strongest leads developed during the project.
- Three workshop sessions as webinars with raw material and energy efficiency as theme were arranged in December 2013. The webinars were held during the 3rd to the 5th of December. The aim of the presentations was to address alternative cleantech solutions and resources for a more effective energy and raw material usage in the Indian P&P industry. Presentations were held from Sweden by Billerud

Korsnäs, Frontway, Innventia, PulpEye, and Metso. From the Indian side participants from the Pulp and Paper sector from the whole country were invited by CII to listen to the webinars. In total, approximately 50 people were attending each webinar. As a first follow up, some initiative for further discussions have been taken between Indian and Swedish companies and hopefully this will generate future business opportunities between the participating companies.

In addition to the above listed activities, the project group has attended numerous smaller meetings with one or a few companies at a time, with relevance to the project. Therefore, the goal related to dissemination and exploitation can be considered fulfilled.

Appendix C contains a list of all Indian and Swedish companies having been involved in the project activities.

4.7 Business contacts

The facilitation work has led to the business contacts and discussions listed in this section. Due to the relative short project time, the following deals and discussions are considered as achieved results:

- PulpEye evaluation of installment of a measurement device at SPB. PulpEye has also found a sales representative in India, which ensures a continuation of PulpEye activities in India even after the end of the project. For supporting the development of establishment in India, PulpEye has received funding from Tillväxtverket (Swedish agency for Economic and Regional growth). PulpEye has also made an agreement with Conteq as a sales representative in India for their equipment.
- TNPL and Purac – TNPL has shown interest in utilizing the technology offered by Purac Pure gas for purifying the gas produced from anaerobic digestion process and use the same for auto fuel. TNPL has shared the preliminary data with PURAC who has made a preliminary suggestion of exploring the feasibility of their technology model CAPure 600S. Purac has also suggested TNPL to work with their local partner IL & FS in India, Presently TNPL is in discussion with IL&FS.
- TNPL and Atek has had discussions. These were interrupted due to a communication issue, which has been corrected. Potential for continued discussions.
- TNPL and Metso have discussed a Lignoboost equipment and a tissue machine. The lignoboost discussion resulted in a quotation that was rejected by TNPL. The discussion with the tissue machine did not proceed due to other prioritizations from TNPL.
- ITC and Mantex: ITC sent a representative to Mantex to look at one of Mantex's installed devices at one of the Swedish mills. No deal, however.
- Installation of Innventia's Optitopo at CPPRI.
- Onewell and University of Kerala. A co-operation was initiated towards the water treatment area.
- Yash – Xylophane: Serious interest to collaborate regarding bio-based packaging. Due to certain properties of the Xylophane material and the market situation in India, there is currently no window of opportunity. Contacts are however stable and can probably persist even after the end of this project.

- Frontway has had a workshop where their software was showed in an interactive workshop with some 20 participants. Currently planning for a follow up work-shop and possible installation at a mill.
- A new board mill will be constructed in the Hyderabad region and the mill has asked the project group to plan for the water treatment plant. Data will be sent so that a first draft of layout for the WTP can be made. This lead has a high probability of continuation after the end of the project.
- ITC has a long-term commitment (3 years) with a research program at Innventia, in which numerous other both Swedish and international P&P companies are involved.
- Khanna Paper requires solutions regarding water treatment and management. Strong contacts have been established with the project group, so this lead will probably continue during the year of 2014 and hopefully develop into a project.
- Frontway and Sheshasyee Paper Board -— Dr Ram from SPB has shared their operating data with Frontway for developing the simulation model. Frontway had used their data for developing the model and conducting the workshop. Frontway also has given their offer to SPB for conducting a detailed simulation study. Presently SPB has kept this in abeyance because of other priorities. However, the discussions are still ongoing.
- Green Elephant is a Swedish company already established in India, active in the biogas field. Their main clients are found in the sugar cane sector, but Green Elephant has, through the project, established preliminary contacts also with the Indian P&P sector. It is yet too early to say if these contacts will be persistent or not.

Due to a relatively short project time – at least when it comes to establishment of business relations – and challenges described below, the goals related to the number of closed deals, contracts and demonstration projects have not been met in spite of intense work by the project partners to facilitate and encourage contacts and sending data to mills and technology providers. However, the above listed contacts constitute a good ground for the awareness from both the Indian and the Swedish sides for the existence of potential business contacts and it is the conviction of the project group that these contacts are highly valuable even though only few of them have so far led to closed deals.

It would be interesting to be able to show some figures on the scale of business achieved during the project. However, as the situation is now, only reflections on such sums can be made. We have not set any lowest limit on which business to consider, since a first, small, deal can result in future, larger ones. For example, a Mantex desktop scanner, which can be used on part of feedstock streams, costs between 5000 and 6000 €. At the other end of the scale are the businesses that ITC and Innventia have, worth around 150 000 €. And in the middle, an estimation of the upcoming Frontway business, is around 50 000 €. An installation of a new wastewater treatment plant, as discussed with Gandhi Paper, would be a really large investment, but not possible to estimate today.

On the same ground, it is not possible to do a cost-benefit of the project, but if a third of the leads mentioned above are turned into business, and maybe some research project being started, the total value of the businesses made will exceed the project budget and significantly contribute to the development of the Indian P&P sector to world class and being competitive.

4.8 Business models in India

Throughout the project we have communicated and disseminated the skills of Swedish environmental technology suppliers regarding their products and services as well as research, development and demonstration activities regarding resource efficiency (including water, energy and raw material) that are going on in Sweden. In this section we will highlight the level of engagement to develop successful business in India based on experience in the project and feedback from the Indian P&P sector. The business models are given in the order of degree of engagement from the Swedish companies' presence in India.

The support required for establishment and/or setting up demonstration sites depend on the technology in question and on the business model chosen. The most important is to be present in India more or less constantly – according to either of the strategies presented in this Business model section. It is therefore difficult to give any estimation of sums.

A main issue for the Indian P&P industry is the ROI. The potential savings in the mill follows the same mechanism in India as in Scandinavia, however the circumstances are different regarding labor cost, raw material supply and infrastructure. It is difficult to communicate the basis for the calculation of ROI in a way that makes this clear. From a Swedish perspective, it can be interpreted as a reluctancy to understand that there are direct savings and profits to be made that exceed the investment costs. The way to give support to the SME in this case is to bring equipment to India and run it in a selected mill for demonstration purpose. In the case of PulpEye this would typically require something between 50 and 70 k€ to transport, install and run a demonstration in one mill. For any additional mill, the cost would increase with around 10-15 k€ for each mill.

4.8.1 Informing about the company services through Indian seminars and meetings

Probably the most common way to start and try to get successful business in India is to give presentations of the products and services and have meetings with potential Indian customers. In most cases there is a mutual understanding of the added value of these products. For many of the products and services that the Swedish clean-tech companies offer, these have not been implemented and demonstrated at Indian pulp and paper sites before. There is thus a barrier that needs to be forced through successful demonstration in order to prove that the products work on an Indian site. As many of the innovative Swedish clean tech companies are small they have difficulties providing the equipment with an initial negative cash flow. Financing models like credits along with strong contracts of payment could be a tool for successful implementation in these cases. If the products are very well known and unique with a strong IPR, this model alone might lead to successful business. However, in most cases these initiatives are rarely enough to close deals but should be considered as a starting point in the development of a business strategy. Thus, we believe that the Swedish product and service providers that receives a positive response at this initial stage should have a plan on how to enter into the Indian pulp and paper market. The following sections discuss some different approaches of how to enter the Indian market on a more permanent basis.

4.8.2 Subcontractor to larger Swedish or other international companies

In the pulp and paper sector there are large international well known suppliers like Veolia, Metso, Andritz etc. providing key components to pulp and paper producers like boilers, paper machines, fiber management systems and wastewater treatment solutions. One approach for Swedish clean tech companies is to have a tight dialogue with these leading companies and develop the business

through subcontracting, providing the auxiliaries, like Sensors, Mantex, PulpEye ,Cerlic etc. Other examples of Swedish companies within the water treatment sector are Kemira, Anox Kaldnes, Purac etc. that also could provide wastewater treatment solutions along with large major investments on the pulp and paper manufacturing process.

4.8.3 Collaboration with local Indian partner

All Indian pulp and paper companies we have been in contact with would like to have a local contact with the Swedish supplier in India. One way for the Swedish companies to arrange with local presence without taking the decision of setting up an actual office or company in India is to agree on a collaboration setup with a local partner/distributor. There is a strong interest among Indian environmental technology companies to collaborate with Swedish partners distributing their products towards the Indian P&P sector. PulpEye has such an agreement with an Indian company (Conteq). This model will also give a direct access to the local marketing network through the knowledge of the local partner. Initial investments will be needed in terms of time on education and training of the local products. To be successful the Swedish companies also need to spend time on finding the right partner for successful access to the market, as well as successful implementation.

4.8.4 Establishment in India

The above described steps are all possible way to start the business to reach the Indian market. If these initial steps are successful the most appropriate way of expanding will be to make a transition into the setup of a locally owned company in India. Typically the initial stages will generate an after sales market which could carry the revenues for the local setup. The local registration of the company will also strengthen the direct dialogue with existing and new customers. We believe that all companies that take the first steps towards the local market in India should have the final objective to set up their own business in India. That is most likely the only way to sustain the business on a long term in the Indian market.

5 The overall goal of Swedish development aid: Poverty reduction

Production of pulp and paper is resource and energy demanding. Without proper technologies, it also has a significant environmental impact through emissions to both air and water. With modern techniques and technologies, it is possible to decrease these emissions drastically and also reduce energy needs and amounts of water per ton pulp/paper produced. This is very important also in the light of the expansion that the Indian P&P business is facing, which will increase environmental impact if measures are not taken in time.

Availability of paper is not given in many parts of the world. Yet paper has many applications associated with basic needs: news spreading, hygiene and education, for example. It can therefore, in a perspective of fairness, be considered important to have a sustainable and competitive P&P industry in India, contributing to local availability of this presumably basal commodity.

A stable P&P sector is also important for the work force, as described under “The perspective of the poor and the rights perspective”.

The pulp and paper business in India is experiencing a steady growth and the plants are also expanding their capacities accordingly. As there is going to be increasing burden on the environment,

Indian Pulp and Paper industry needs to be sustainable. The project initiated by Sida is a significant step which has not only made Indian plants aware of the technical know-how by which they can enhance their sustainability but also contributed for the creating of employment opportunities for local people in the implementation of project activities. The reduction in environmental impact will improve the quality of life for the people. The Project, by facilitating introduction of P&P technologies that are among the best in the world, can contribute to lowering the environmental burden of the P&P sector, thus increasing the availability of energy and water for other purposes. That, in turn, increases the possibilities for growth of other industry sectors, and can also increase the availability of water for the communities around the P&P mills, which helps the Indian economy and improves quality of life in the country.

6 Challenges

A number of challenges can be listed- both relating to the P&P sector and the work of the facilitator project. The former category has been difficult to tackle for the project group, whereas the latter have had a higher chance of being met by the project.

With the forecasted growth in paper consumptions from today's levels, the following challenges are obvious:

- Availability of raw materials and the cost for manufacturing paper will be a challenge for the future. Effort is needed to work on fast growing plantation, improved recovered paper collection, utilization of non-wood material, and in worst case import of fibers from other markets.

- Energy and water issues will be in focus. The energy and water consumption of integrated wood based paper mills in India are in general higher compared to mills abroad. In order to be competitive new clean technologies and solutions need to be implemented.

- Paper will need to be produced with a social responsibility and in an environmental friendly way. Especially small paper mills that lack infrastructure, technical manpower, R&D, and resources are facing significant challenges. Small mills also have poor machines with high energy consumptions with more waste generation and lack the means to meet up with the new energy directives.

- Existing paper companies need to adapt to the higher demands from the Indian government regarding regulations and policies.

- The cost associated with the technologies is the key challenge faced by Swedish technologies. The traditions of how you look at investments differ between India and Sweden: In India, many companies look only at the investment costs and find the equipment/technologies too expensive, whereas the tradition in Sweden is to take the future economic advantages of the equipment/technology in account. The Swedish companies tend to take the Swedish way of looking at costs for granted and are not aware that, when presenting their services in India, they need to highlight the economic advantages of their technologies. This would, however, be easier to do and give very straight forward information on the economic benefits if they had access to specific data so that they could assist in doing cost-benefit analyses for specific mills. It has, though, unfortunately been hard to achieve such specific mill data. This is a reason why the clean technologies are

perceived as too expensive, when, in fact, earlier installations elsewhere have proven that they more than pay off.

- Another challenge faced by the project is that Indian companies also look for a continuous presence of Swedish companies in India. If a direct presence is not possible, a sales representative is the second best option, like PulpEye has done. The project group has assisted as far as possible to find solutions for this, e.g. by using contact networks to find representatives (Frontway) or by applying for funding for demonstration project that can constitute a first establishment on the Indian market (PulpEye).

- Establishing new business contacts between companies in countries as different as India and Sweden is a cultural challenge that must not be neglected. For example, hierarchy is more pronounced in Indian companies than in Swedish, which can be experienced by the latter as a barrier for direct and smooth technical communication. Overcoming the cultural barriers is time consuming and it is our belief that without the facilitator work that has been performed by the project partners, none of the above listed contacts would have come as far as they have during the two years' time of the project, thereby significantly shortened the time to possible deals.

- Tackling the differences in expectations of the industrial partners has been a challenge: One may be more eager than the other and when things develop at a different pace than expected, partners either get less interested as they think the slow process is a sign of low interest or might step back if they experience that the others are too "pushy". This has been easier to monitor and handle in cases where the project group has been more involved in the dialogues, whereas in other cases the partners have had direct contacts on their own, after having been introduced to each other by us, and we have not learned about the interrupted contacts until they have become a fact.

- Even though the project has two Indian partners, the effect of lack of continuous presence of the Swedish partners in India has been obvious. With a possibility to work longer, continuous periods of time locally in India, we would have gained more credibility from the Indian P&P companies and could have concentrated and thereby intensified our work. This is mentioned also in the "Lessons learned" section.

Some of the challenges listed above have been overcome during the project and some of them have not. They have, however, all added to the amount of work and efforts needed to achieve the results obtained within the project.

7 Lessons learned

Although there is a strong potential for Swedish innovative technologies within the clean-tech sector to improve competitiveness in the Indian P&P industry, there are a few lessons that we have learned during the course of the project:

- Indian Pulp and Paper Sector has welcomed the initiative taken up by Sida and other partners and shown keen interest in Swedish cleaner production technologies.

- The Project has provided a learning to Swedish companies and Swedish partners in understanding the needs and requirement of Indian pulp and paper sector.

- More frequent and longer presence of the Swedish project partners in India would have boosted the process for two main reasons: the work would have been more intense during the work time in India compared to when the Swedish partners work from Sweden and we would also have gained more credibility from the Indian P&P sector as representatives of the Swedish technology companies.

- As already mentioned, processes before actual deal have been longer than anticipated. Swedish technology suppliers must be very patient and long term view in their relations with Indian companies, to an extent that they might not be used to. Stronger presence of Swedish technology providers in India, e.g. on conferences and mill visits would have increased the success rate, but at the same time, such a presence is costly and in practice impossible for many of the companies.

- There should have been more focus on encouraging establishment of presence on site in India of Swedish technology suppliers – either directly or through local representatives (see the Business model section).

- Through mistakes, we have learned that the project group must ensure that the contacts between the Indian and Swedish companies go through the right persons. As an example, ATEK made contacts with ITC during the WtE delegation to Sweden and discussed aeration needs of the latter. Further contacts were delayed and it took some time before we understood that the ITC representative was not directly involved in the operation of the mill and internal communication was interrupted. (We have corrected that during PaperEx and hope that new contacts will continue.)

- In India, there is a tradition of expecting short payback times from investments, and when it comes to clean technologies, investments are often associated with longer payback times. A stronger presence in India of the Swedish project partners would have enabled more intense and continuous contact with the mills, making economic advantages obvious using mill specific data, thus facilitating the necessary decision making at the mills.

- In general, it is tough for Swedish companies to compete for consulting assignment due to high difference in costs between engineers in the two countries.

- Before entering the Indian market, a clear business model needs to be in place including marketing plan, risks, and barriers.

- The lessons learnt by Indian Partners during the project are as follows:

    - The technical knowhow and the benefits of Swedish technologies in Indian pulp and paper sector has been well understood by the project partners

- The project partners then identified focus areas where Swedish technologies can make significant contribution in improving the competitiveness of Indian Pulp and Paper Industry
- The Indian partners have also understood the specific needs of Indian pulp and Paper industry and also learnt about the technologies which can solve the issues related to pulp and paper industry
- The Indian Partners have also learnt about concerns and challenges which may act as a barrier in technology transfer from Sweden to India
- Presence of marketing personnel in India for constant follow up with Indian companies
- Innovation in technologies to make them further affordable for Indian companies

To summarize, Indian pulp and paper industry is open to adopt Swedish cleaner production technologies, however, constant follow up and marketing efforts are required from the sales' side. The adjustment in cost of these technologies suiting to Indian environment can make the technologies more acceptable for Indian companies.

8 Partner Driven Cooperation

The project has been conducted under the Sida programme Partner Driven Cooperation, in which projects are based on the partners' own initiatives and interest in working together on a topic relevant for the people living in the countries included in this programme. For this project, the initiative to work together on the cleaner production in the Indian P&P sector has come from earlier experience, as described earlier in the report. The importance of this collaboration for each partner is given in this paragraph.

IVL – IVL has worked in India before, e.g. through the Capacity building project described in the introduction section. During that and this current project, we have built many good and stable relationships that will constitute an excellent starting point for further collaborations. The relationships established within the project group will certainly continue and be advantageous to IVL and together IVL will look for opportunities for future collaborations.

CII – Godrej GBC has always welcomed the efforts put up by Sida, Innventia, IVL and IPMA in bringing innovative technologies to India. The project also matches with the overall objective of goal set up by CII – Godrej GBC in making Indian Pulp and Paper World Class. The cooperation has definitely led to a sustainable and long term relationship between CII- Godrej GBC, Sida and other partners. The relationship and cooperation will continue after the project by providing all possible support to Sida and other partners as and when needed. CII – Godrej GBC would also be waiting for other opportunities to work together again on this on new assignments.

Innventia – Innventia has not been very active on the Indian market before this project, so this co-operation initiated by Sida has been a first introduction towards the Pulp and Paper industry in India. The co-operation has been very fruitful for Innventia and has led to an establishment of long term relationship between both the project group and towards Indian Pulp and Paper companies.

Initiatives and ideas for collaborations on how to preserve and develop this cooperation even further in the future are in progress.

9 Benefit to partner organizations

Benefits to CII

- Improved knowledge based about cutting edge technologies and enhanced the knowledge of CII staff about the sector
- The project has significantly contributed in achieving overall goal of CII towards resource conservations and environmental improvement. CII – Godrej GBC has a long term vision to make Indian Pulp and Paper sector world class. The project has not only made CII – Godrej GBC team aware about cleaner production technologies but also helped in disseminating knowledge about the technologies through publications and events to Indian Pulp and Paper sector.
- The project has supported CII to serve one of its key focus sector and helped the pulp and paper industry to understand the difference which these technologies can make in their units. For example, the project team has visited various paper mills including Khanna Paper Mills Limited. The paper mill is facing severe problems with respect to disposal of waste water and fiber recovery. The team has not only given a clear idea about the loss quantum, but also given a complete solution which can solve their water related problems.
- This project has also created opportunity for CII-Godrej GBC to develop and strengthen the partnership with the Swedish Energy Agency and many Swedish companies working in the area of waste to energy. The cooperation with the Swedish Energy Agency has led to the launch of “Indo- Swedish innovation platform” for promotion of innovative clean technologies in Indian industry. This will definitely lead to a long team relationship between Swedish companies and CII – Godrej GBC. The long term relationship and reach which CII have, will definitely help Swedish companies to establish their businesses in India. CII – Godrej GBC has made all project documents available on its website and these documents are accessible to Indian Industries. CII – Godrej GBC will also be working with innovation platform and will continue to promote Swedish technologies in India.

Benefits to Innventia:

- Deeper knowledge about the Indian P&P sector in terms raw material, water, and energy supply.
- A unique platform to promote Swedish cleantech solutions towards the Indian P&P industry
- Inputs for future activities and projects together with Indian P&P companies and Swedish cleantech companies.
- The cooperation has also led to some concrete deals. Indian companies are now taking part in multilateral projects at Innventia, where ITC is one example who has decided to join a larger research project. Measurement devices developed at Innventia has been purchased by Indian companies, where the Optitopo device has been purchased by CPPRI Saharanpur as one example. Furthermore and based on this cooperation, a project was started between Innventia, PulpEye, and Seshasayee Paper and Boards Limited (SPB), with the target to look on how to characterize and optimize the present raw material and energy usage in the mill at SPB. The project was financed by the Swedish Tillväxtverket.

Benefits to IVL:
IVL has understood that research activities in India on cleaner production do not match the need of the industry. This constitutes an opportunity for IVL in, e.g., the following ways:

- IVL can do contract research work. We have got clear indications that more than one mill is willing to pay for contract research work on their specific issues.
- IVL can arrange capacity building education programs. IVL is already arranging such programs on various themes in Sweden, and the same concept can be used, with some adjustments, in India. For this, the contacts we have made with CII will be valuable.
- IVL can start a Cleaner Production Audit program – analogous to the energy audit programs we have in Sweden and China. One purpose of such audits can be to help individual mills to prioritize investments so that the effect per spent rupee is maximized. For such a program, cooperations with Innventia and CII will be valuable.

10 The thematic priorities

1) How has the project taken aspects of gender into account? To what extent has gender equality and participation of women been integrated in the project
The gender aspect has not been the focus of this project. However, it is well known that increased standard of living is often associated with increased equality between sexes. A successful growth of the P&P industry in India, contributing to the overall economy of the country, will in the long run also contribute to the country's need for female workforce, thus making women more economically self-sufficient, thereby contributing to the equality of the sexes.

2) How has the project taken aspects of environment into account? Has the project, directly or indirectly, addressed environmentally sustainable development and can be assumed to contribute to it?
The environmental aspect is one of the main foci of the project! As described above, the P&P industry is associated with significant emissions to air and water and also consumes large amounts of energy and water. Water is scarce in India, and energy is to a large extent based on coal (53%) and oil (31%). Therefore, efforts resulting in decreased use of water and energy have direct and obvious effects on the environment. In addition, modern P&P clean technologies contribute to a reduction in amounts of chemicals used, increase the recovery of chemicals in the process and improve waste water treatment, which also contributes strongly to decrease the environmental burden and allow an expansion of the economically important P&P sector without increasing the environmental impact to the same extent as without such technologies. This has been demonstrated in Sweden, where energy consumption and emissions to air and water have decreased significantly per tonne paper produced with the introduction of modern technologies. For example, the use of fossil energy has decreased 80% since 1970 and emissions of AOX, i.e. chlorinated organic substances arising from the bleaching, have gone from 20 to zero kg/tonne pulp since 1978. This is a good example of the opportunity that modern technology offers for the P&P sector.

3) How has the project taken aspects of Democracy and Human Rights into account?
Introducing clean technology in a resource intensive industry increases the competitiveness of the P&P industry and thereby also both secures and increases employment for the citizens in the sector.

One indirect result of the introduction of clean-tech is an increase of the security at the mills, which contributes to a safer work environment, which is a part of Article 23 of the Human Rights. Safer work environment also contributes to a more stable private economy for the employees, which in turn can improve the possibilities for education for both boys and girls, as is stated as a human right in Article 26.

11 The perspective of the poor and right perspective

As described earlier, the project, although not having human rights as first priority, can contribute to enforcement of the Human Rights by increasing quality of life for ordinary people through less pollution to air and water, a safer work environment. A more stable private economy for the employees also contributes, in the long perspective, to an increased control and development of, above all, the next generation who will, through increased possibilities to education, be in a position to control their lives.

When planning the project, opinions of the Indian partners (CII and IPMA) have been taken into account as they know the Indian P&P business very well and have deep knowledge about what issues and challenges are the most important to focus on in order to get as much profit (not only economical, as described above) as possible from the money and work put into the project. Through them, the project has reached the attention of more or less all the CEOs in the P&P sector in India, which would not have been possible without their participation in the project already at an early stage of planning. This attention is a prerequisite for the project to be successful and achieve its goals and thereby have the potential impacts as described above.

The Indian P&P sector constitutes one of the largest employers in India. A stable, and even economically growing, P&P sector will therefore contribute to lowering the unemployment, which is beneficial in the strive of reducing poverty. Moreover, a stable P&P sector will contribute to employment security of the work force, thus enabling them to feel that they can afford education for their children and other long-term actions in order to steadily increase their quality of life.

It is yet too early to evaluate how the results of the project has had impact on peoples' daily life and will not be possible within the frame of the project as business relations take longer times to build and have the impacts described in the paragraphs above than the time frame of the project. Chances are high though, that the relations built between the project partners and the industries involved will be long-lasting, thus enabling an informal follow-up.

12 Concluding remarks

The project has been an eye opener for Indian Pulp and Paper Industry and given a new prospective to Indian Pulp and Paper industry the way they should be thinking in addressing the problem related to cleaner production. The project clearly demonstrates that solutions are available which can help the Indian pulp and paper sector move towards sustainability. The key benefits which can be clearly derived from the project activities are:

1. Dissemination of knowledge in the P&P sector through manuals, conferences, head to head meetings, webinars etc. about cleaner production technologies to Indian pulp and paper industry.

2. Making Indian industry understand about the need and benefits of various Swedish technologies and how they can contribute to the development of the sector.

3. The project has given a clear roadmap which can improve the environmental competitiveness of India at a national level.

4. The work has resulted in both some established business relations and prerequisites for initiating more in the future.

5. Swedish technology providers – both small and large ones – have had an extraordinary opportunity to present their offers directly to executives and through the project group also to technical directors and other decision making staff at the Indian mills, which would not have been possible without this project.

6. Presence in India has proved to be the single most important factor for a successful establishment on the Indian market. A number of business models for this are reported in this document.

7. The project group itself has benefited from the project and all see opportunities for further work – both together and in new constellations.

8. As the results achieved are in fact business discussions, there are details that cannot be described in the report. For more information, please contact the project coordinator.

The project will definitely have significant long term positive impact not only to Indian Pulp and paper Industry but also to the Nation as a whole.

For the Swedish stake holders, the project has constituted an opportunity to approach the Indian market in a way that would never have been possible without the facilitation of the project partners as the doors to CEOs and other decision makers of the Indian P&P companies have been open in a way that is not generally the case.

13 Appendices

Appendix A: Program for Nobel week 2011.

Appendix B: Program for workshop at IVL, April 2012

Appendix C: List of all Swedish and Indian companies involved during the project.

Appendix D: Project information leaflet

Appendix E: Selected photos from the project

Appendix A

Program for cleantech seminars during Nobel Week 2011.

Symbiocity - Sustainability by Sweden
focus on Waste to Energy and Clean Production
Sovereign I
Le Meridien, Delhi

October 19, 2011

10.30 –	Registration and tea
11.00 – 11.15	Keynote Address – Sri Tripathi, chief Secretary,
11.15 – 11.45	Setting the scene - Symbiocity – Mikael Kullman, Counsellor, Environment, Energy, and Climate Change

CLEAN TECHNOLOGY – PULP AND PAPER

11.45 – 13.45	***Panel Discussion*** **Sweden** Swedish Environment Research Institute (IVL) Innventia **India** Confederation of Indian Industries Indian Pulp and Paper Manufacturing Association **Moderator** -
13.45 – 14.30	LUNCH

WASTE TO ENERGY – SOLUTION TO SUSTAINABLE URBAN PLANNING?

14.30 – 14.45	Introduction and Overview – Dr Stefan Jonsson,
14.45 – 16.30	Panel Discussion **Sweden** COWI Purac Swedish Gas Association Swedish Energy Association **India** MNRE Bharat Forge Delhi Jal Board IL&FS IGL
16.30 – 16.45	SymbioCity Conclusions Mikael Kullman, Embassy of Sweden, New Delhi Jonas Röttorp, IVL Dr Stefan Jonsson,
16.45 – 17.30	Refreshments and Networking

Appendix B

INDO - SWEDISH FACILITATOR PULP & PAPER - CLEANTECH

Workshop and matchmaking event

April 20th 2012

Facilitator within clean technology in India – Pulp and Paper invites you to attend a one day workshop and matchmaking event in Stockholm on 20 April 2012

IVL Swedish Environmental Research Institute and Innventia, on the Swedish side, together with Confederation of Indian Industry (CII) and Indian Paper Manufacturers Association (IPMA) are working to provide platforms for exchange and technology dissemination in the pulp and paper sector in India and Sweden. This is part of the strategic collaborations between the countries; on the Swedish side supported through The Swedish Development Collaboration Agency (Sida) and the Swedish Energy Agency (SEA). The project team would like to invite you to a one day workshop and matchmaking event with the main objective to create business opportunities on cleaner production solutions for the Indian pulp and paper industry. As facilitator, we will present a number of prioritised projects and potential business opportunities, and we hope that you have products and solutions to present that can be of interest to the Indian pulp and paper industry.

Programme

09:00 – 9:30	Registration and coffee
09:30 – 13:00	Presentation of the project "Facilitator within clean technology in India – Pulp and Paper" *IVL Swedish Environmental Research Institute*
	Business experience of cleaner production in India – A biogas case *Swedish Energy Agency*
	Presentation of listed projects in the Indian paper and pulp industry *Confederation of Indian Industry, Innventia and IVL Swedish Environmental Research Institute*
12.00 – 13.00	LUNCH
13:00 – 18:00	Introduction and overview of the Indian Paper and Pulp Industry *Indian Paper Manufacturers Association and Confederation of Indian Industry*
	Short presentation of cleaner production solutions by Swedish environmental technology companies. Ten minutes per company
	Matchmaking activities between Indian and Swedish companies

Venue: IVL Swedish Environmental Research Institute, Valhallavägen 81, Stockholm
To register: http://kunskap3.ivl.se/intern_courseinfo.asp?CPID=522001

For information about the workshop please contact *Jonas Röttorp*, phone: +46 8 598 563 02

Coming up!

- June 2012: International Paper Physics Conference & 8th International Paper and Coating Chemistry Symposium Welcome to Stockholm June 10-14, 2012: http://www.paperconferences2012.com/
- June 2012: Papertech conference in Hyderabad
- Autumn 2012: Swedish delegation giving seminar and presentation of Swedish cleaner production and energy saving solutions for the Indian pulp and paper sector.

Appendix C

List of all companies participating in the various activities of the facilitator project.

Indian Companies

Andhra Pradesh Pulp&Paper
Bilt
Century Pulp and Paper
CPPRI
DCL Group
Emami Paper
ITC
JK Paper
Khanna Paper
Mahesh Ghandi
Naini Tissues Limited
Parason Global
Ruchira Paper
Sheshasyee Paper and Board
Shreyans Industries
Sirpur Paper
Star Paper
Tamil Nadu Newprint and Papers
University of Kerala
Westcoast Paper
Yash Paper
Other participants at PaperTechs 2012 and 2013

Swedish companies

Aerogel
Anox Kaldnes
Aqua-Q AB
ATEK Avvattningsteknik AB
Billerud Korsnäs
Cellwood Machinery AB
Cerlic
Chemrec
Cortus
EKN
Elof Hansson
Exportkreditnämnden
Exportrådet
Frontway
Imerys
Kemira AB
Lorentzen&Wettre
Mantex
Metso
Noss AB
OneWell AB
PROMT
Purac
SCA Hygiene
SootTech
Sweco
Swedark Green Home AB
Swedish Exergy
Xylophane
ÅF

Appendix D

Project leaflet

INDO - SWEDISH
FACILITATOR
PULP & PAPER - CLEANTECH

Facilitator within Clean technology in India – Pulp and Paper

WHY?

The pulp and paper sector in India is foreseen to grow significantly. To meet present and future demands, Indian paper industry must implement cleantech and process technologies to reduce environmental impact and production cost. Sweden is considered to be one of the world leaders in paper production and technology solutions. The Swedish Government, through SIDA, has taken the initiative to finance a two year facilitator project to promote sustainable solutions and business opportunities between Swedish and Indian entities within the pulp and paper sector.

HOW?

The overall objectives are the transfer and exchange of know-how and experiences, and enhancing awareness and capacity to protect the environment and manage climate change, thus contributing towards socially, economically and environmentally sustainable development in India. The facilitator project will match needs with technologies within the paper and pulp sector and help find business opportunities by arranging seminars, business events and matchmaking activities, as well as conduct industrial visits and pre-feasibility studies.

IVL Swedish Environmental Research Institute and Innventia, on the Swedish side, together with Confederation of Indian Industry (CII) and Indian Paper Manufacturers Association (IPMA) are working to provide platforms for exchange and technology dissemination in the pulp and paper sector in India and Sweden. This is part of the strategic collaborations between the countries; on the Swedish side supported by the Government through The Swedish Development Collaboration Agency (Sida) and the Swedish Energy Agency (SEA).

Activities, Possibilities and Services

- **We have direct contact with the 10 largest Indian pulp and paper makers and with several medium and small scale plants.**
- **For all plants we have contacted we have listed several projects where they are looking for Swedish solutions and partners**
- **We have several contacts with Indian service and technology providers whom are looking for collaboration with Swedish partners**
- **We attend and arrange seminars and matchmaking activities to put the Swedish organisations in direct contact with Indian customers**
- **We are producing newsletter and sending information direct to customers that we believe have the solutions**
- **We provide you information about potential projects and partners upon request**

Please contact us for more information or to discuss how we can help you in your business in India!!

FOR WHOM?

On the Indian side the project welcomes pulp and paper industries that have identified needs in their processes or that are interested in finding possibilities for process improvements, as well as partners and entities that would like to collaborate or contribute with products and services within the field of sustainable solutions for the Indian pulp and paper sector.

PROJECT PARTNERS

IVL Swedish Environmental Research Institute is Sweden's leading organisation for applied environmental research and has been working in the fields of pulp and paper and cleantech since 1967. www.ivl.se

Innventia is a Swedish research institute and one of the world's leading companies in R&D related to pulp, paper, graphic media, packaging and bio-refining. www.innventia.com

CII Confederation of Indian Industry Sohrabji Godrej Green Business Centre is India's premier developmental institution, offering advisory services to the industry on environmental aspects to create and sustain an environment conducive to the growth of Indian industry. www.greenbusinesscentre.compaperboards.

IPMA Indian Paper Manufacturers Association is a national level organisation and represents the paper sector in India. The members account for more than one-third of India's production of paper and pulp. *www.ipma.co.in*

CONTACT

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INNVENTIA

Confederation of Indian Industry

IVL Swedish Environmental Research Institute

IPMA

Appendix E

Photos from the project

Mahesh Puranami, Richard Holm, S. Karthikeyan

Project members from CII, IVL, Innventia and the Swedish Embassy

Paper machine at TNPL.

Incoming raw material to a pulp mill

Discussions during PaperEx 2013

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