Business Case: Compressed Air Supply

Support to Safety Retrofits and Environmental Upgrades in the Bangladeshi Ready-Made Garment (RMG) Sector

It is Worth Improving your Compressed Air Supply System

Compressed air, also referred to as the "4th Utility" (after electricity, water and steam) is one of the major energy consuming utilities in the textile production. It is more or less required at every stage of manufacturing, with a particularly large volume of air required for air-jet looms in integrated cotton textile industries as well in polyester and yarn industries. In many industrial facilities, air compressors use more electricity than any other type of equipment, making inefficiencies in the compressed air systems a major source of energy waste. A properly managed compressed air system can save energy, reduce maintenance, decrease downtime, increase production through put, and improve product quality.

Advantages of Compressed Air Supply System upgrades at a Glance:

- Improved energy efficiency
- Reduced maintenance costs
- Increased production

Leaks are the major sources of energy losses in a compressed air system, wasting as much as 20%-75% of the compressor's output[1,2]. Apart from this leak can also result in:

- Fluctuation of system pressure, causing air tools and other air-operated equipment to function less efficiently, thereby negatively affecting production
- Excessive demand of compressor capacities, resulting in higher than necessary investment and operating costs
- Decreased service life and increased maintenance cost of compressed air supply equipment due to unnecessary cycling and increased run time

Leaks usually occur at system weak spots such as couplings, hoses, tubes, fittings, pipe joints, quick disconnects, FRLs (filter, regulator, and lubricator), condensate traps, valves, flanges, packings, thread sealants, and point-of-use devices. Regular monitoring and maintenance of these system parts is therefore recommended.

The volume of air losses through leaks can be further intensified by unnecessarily high compressor working pressures. As many types of machinery and tools can operate efficiently at a lower discharge level, optimising the working pressure usually leads to reduced air losses and additional energy savings.

Further options to achieve energy savings include the installation of electronic controls or variable-speed drives (VSDs) which automatically match supply and demand of compressed air, respectively reduce no-load running costs of air compressors by regulating the compressor speed. [3]

By implementing the measures mentioned above RGM factories can easily reduce their total electricity consumption by 1 to 3.9%,saving BDT 7.57 lakh to BDT 25.5 lakh per annum.[3]As the average investments for retrofit measures range from no/low cost to around BDT 16 lakh, the payback period for these retrofit varies between 1 to 12 months.

Approximate Investment Cost and Anual Savings (BDT)

Case study result from TEXTOWN Group

Detailed information about the cost and benefits of improving the compressed air system can be found on the next page, followed by a case study on page 3. Technical details on the installation and implementation process as well as legal requirements and possible means of financing can be found on pages 4 to 5.

[1] Greer, L. et al.(2013). NRDC's 10 Best Practices for Textile Mills to Save Money and Reduce Pollution

[2] US Department of Energy (2004). Compressed Air Tip Sheet #3 Minimize Compressed Air Leaks

[3] Data from 21 textile factories with an annual production volume between 506 to 33,229 tons

Saving Energy Costs and Reducing Fuel Consumption

Improving and maintaining the compressed air systemin your factory bears significant energy saving potentials. The following boxes highlight the results of different examples from the RGM sector in Bangladesh and India:

Improved Energy Efficiency:

Low-cost good housekeeping (FGS Denim Wear Ltd.)	FGS Denim Wear Ltd.(FGSDWL is an export-oriented denim and twill garments manufacturer. The factory is located in Ashulia, Savar, Dhaka with a built-up area of 3,855m^2. FGSDWL is a cutting, sewing and finishing facility with a monthly production capacity of approximately 208,000 pcs of denim and twill products. By introducing a system of regular maintenance checks for the compressed air system, the maintenance department managed to systematically repair and respond to air leakages. With this simple measure, the company saved 33.8 MWh of electrical energy per annum (about BDT 3 lakh).[4]
Upgrading airline system (Mavis Garments Ltd.)	Mavis Garments Ltd. is an export oriented Knit garments manufacturing factory, located in Joydevpur, Gazipur, with a built-up area of 3,253m^2. This factory has knitting, cutting, sewing and finishing facility with a monthly production capacity of approximately 30,000 dozen of knit garments. Due to the poor quality of piping several leaks in knitting machines and other areas of compressed air line were found in Mavis. Maintenance measures (attending to leaks) and replacement of poor airline resulted in immediate savings of around 35 MWh of electricity within the first year, reducing the energy costs by BDT 3 lakh/year.[5]
Repairs and adjusting compressor performance (Viyellatex Ltd.)	Viyellatex Lt. is a 100% export oriented knit garments factory. It has knitting, dyeing, printing, washing, embroidery and garmenting units and was established in 1996. The factory is located on 8 acres of land at 297, Khor toil, Gazipur, Tongi under Gazipur district with a built-up area of 53,375 m^2. Based on measurements of compressor outputs and compressed air requirements, repairs and adjustments were implemented by the factory maintenance team. This measure yielded savings of around 447,871 kWh/year(about. BDT 2.73 lakh/year)[6]

Other Benefits

Reduced Maintenance Costs	High capacities and runtimes significantly reduce the service life of air compressors and increase the need for maintenance. By closing leaks in the distribution network and regulating the compressors with control units and VSDs, unnecessary cycling and increased runtimes can be avoided, increasing the overall compressor service life.
Increased Production Output	Insufficient systems pressure caused by leaks in the compressed air distribution network can reduce the productivity of air operated equipment. By regularly maintaining the compressed air system an optimal production output can be achieved.

[4] PSES - Case Study FGS Denim Wear Ltd.

[5] PSES - Case Study Mavis Garments Ltd.

[6] GTZ (2010). Case Study on Energy Saving Measures in Bangladesh Readymade Garment Industrial Sector

Calculating the Cost of an Upgrading the Compressed Air supply System

The costs of upgrading the compressed air system may range from low-cost interventions (such as regular maintenance work) to BDT 16.5 lakh (for replacements of parts or compressors).

The following table shows typical investments required for the setup and maintenance of a proper compressed air system in the textile industry:

Possible investments required:

Type of Investment	Average Cost (BDT)
Variable Speed Drives (VSD) for compressors	7.5 lakh
Leak detection instrument	0.4 lakh
Airline replacement	2.5 lakh
Air valves and couplings replacement	1 lakh
Approx. Total Costs	**Up to 16.5 lakh**
Average amortization/payback period	**Immediate to 1 year**

(VFD)Variable Frequency Drive used In Air Compresser

Pressure flow meter, valve

Case Study Spotlight: Textown Group, Dhaka, Bangladesh

Description of the Factory

The Textown Group is a well-known textile- and garment exporter. The group has a full range of five production facilities located in Dhaka. Ornate Knit Garments Industries Ltd (Ornate Knit Garments) is one of the units in Dhaka, which started operations in 1990.

The factory currently employs 3,250 workers and has a monthly production capacity of 390,000 pieces.

Variable frequency drive (VFD) being used in Air Compressor

Implemented Measures

In the textile and garment sector, compressed air is often referred to as the "4th Utility" (after electricity, water & steam) and is a process consuming large amounts ofenergy.85-90% of the life cycle cost of any air compressor is due to its energy consumption whereas only 10-15% is attributed to the initial investment & maintenance. Consequently, the design and selection of the air compressor plays a vital role when setting up an air system.

Ornate Knit Garments covers its demand for compressed air by operating four units of screw-type compressors (37 kW rated power). One compressor was used as a base load compressor, while the remaining three were constantly operating in standby mode. Consequently, running power of all compressors was maintained between 33-34 kW, wasting large amounts of energy. Moreover, significant air leaks were detected in the system, especially at the valves and flanges regulating the compressed air.

As a first measure leaky valves were replaced to avoid further wastage of energy and other operating losses such asa drop in the system pressure. In a second step,Ornate Knit Garments decided to upgrade the motors of all screw-type compressors with Variable Speed Drives (VSD). Consequently, the power consumption of the compressorswas reduced from 33 – 34kW to 25 – 27kW.

Investments and Savings

Total initial investment for upgrading the air compressors to VSD driven compressors was approximately BDT 330 lakh. The modification helped to reduce the energy consumption of the compressed air system by 5,509 kW per month, translating to a reduction in monthly energy costs of BDT 44,904. The Textown Group was able to recover the investment within an 8-month period.

Before upgrade				
Description	**Comp. 1**	**Comp. 2**	**Comp. 3**	**Comp. 4**
Operating Mode	Std by	Std by	Std by	Base
Running Power (kW)	33.5	33.64	34.25	34
Operation (h/day)	24	24	24	24
Operating Factor	0.15	0.15	0.15	0.6
Monthly energy consumption (kWh)	3015	3027	3082	12240
Total Energy Consumption				21365

After upgrade				
Description	**Comp. 1**	**Comp. 2**	**Comp. 3**	**Comp. 4**
Operating Mode	Std by	Std by	Std by	Base
Running Power (kW)	26.27	25	27.5	24.35
Operation (h/day)	24	24	24	24
Operating Factor	0.15	0.15	0.15	0.6
Monthly energy consumption (kWh)	2364.3	2250	2475	8766
Total Energy Consumption (kWh)				15855
Monthly Energy Saving (kWh)				5,509
Energy Saving percentage				5.8%
Tariff (BDT/kWh)				8.15
Monthly energy cost saving (BDT)				44,904

Key Performance Measures

Before upgrading the compressed air system, Ornate Knit Garments consumed 21,365 kWh per month. By replacing the leaky valves and by introducing VSD driven air compressors, total energy consumption was reduced to 15,855 kWh per month. Additionally, introducing the VSD driven air compressors helped to reduce the compressors energy requirements from 22 kWh/t to 16 kWh/t. Last but not least this also contributed to reduce Green House Gas emissions to 44.5tCO_2per year.

A set of three (VFD) Variable Frequency Drive used In Air Compresser

References for the Improvement of Compressed Air Systems in Bangladesh

Although no binding legal references regarding the efficient use of energy have come into effect in Bangladesh yet (May 2018), the government has recognized the increasing importance of energy as a factor for economic growth and declared Energy Efficiency to be a cross cutting issue for the country. To improve the country'senergy efficiency the Sustainable and Renewable Energy Development Authority (SREDA) in 2013 published the "Energy Efficiency and Conservation Master Plan (EECMP) up to 2030". The EECMP aims at improving energy intensity (national primary energy consumption per gross domestic product/GDP) in 2030 by 20% compared to the 2013 level. Under the action-plan of the EECMP, three EE&C programs are being promoted, namely, (1) Energy Management Program, (2) EE Labelling Program and (3) EE Buildings Program. In particular, the Energy Management program targets large industrial energy consumers in Bangladesh. Policy measures which are planned to be implemented in the next years include (amongst others): (i) Mandatory energy audits, (ii) energy consumption reporting and (iii) benchmarking. Furthermore, the authority is planning to develop and recommend procedures and regulations for the implementation of minimum energy performance standards and energy efficiency labelling for equipment and appliances[7].

EGB (Exhaust Gas Boiler), Producing Steam Form Generator Exhaust

Compressed Air Flow Meter

[7] SREDA (2015). Energy Efficiency and Conservation Master Plan up to 2030

Key Steps Required for Implementation

Depending on the scope of the measures to be taken, improving the compressed air system within a factory can be realized immediately. Upgradation of compressors may take about one month (including planning and design).

In order to take advantage of this cost saving opportunity, consider the following key steps:[8]:

- **Analyse the compressed air needs in your factory**: Analysing needs carefully will ensure that a compressed air system is configured properly so that a clean, dry and stable supply of compressed air can be delivered at minimal cost.
- **Identify potentially inappropriate uses** of compressed air: Workers often use compressed air for cleaning purposes.
- **Identify air leaks**. Survey the facility and identify compressed air leaks. Leaks can be identified by various methods. The most common one is by using an ultrasonic acoustic leak detector. There are many types of such instruments available in various price ranges. For its most common application, an inexpensive hand- held meter is sufficient to identify leaks and give an indication of the size or intensity. Consider purchasing such instrument as a standard tool for your maintenance team. Also encourage your workers to report any air leaks as part of a standard preventive maintenance procedure
- **Document air leaks**. Document the location, type, size, and assess the estimated cost of the air leaks. Any documentation should be compatible with the facility's preventive maintenance programme. Consider the use of leak tags, but these should not take the place of a master leak list. If you are using the "seek and repair" method, leaks should still be documented so the number and effectiveness of the programme can be tracked.
- **Prioritize leak repair**. Fix the biggest leaks first to get the biggest savings. This will ensure a good start to the air leak programme.
- **Install and/or adjust electronic controls**. Once the leaks are fixed, adjust the compressor controls. Check with the compressor manufacturer for performance specifications at different discharge pressures. Retrofit existing compressors with variable-speed drives (VSDs) might also improve energy efficiency
- **Ensure regular maintenance of** the compressed air system to ensure maximum system performance at any time.

Availability of Materials in Bangladesh

The majority of required materials can be sourced via local traders' certain components might need to be imported. You may contact TEXTOWN GROUP Garments Industries Ltd for their recommendation.

[8] US Department of Energy (2004). Improving Compressed Air System Performance, A Sourcebook for Industry

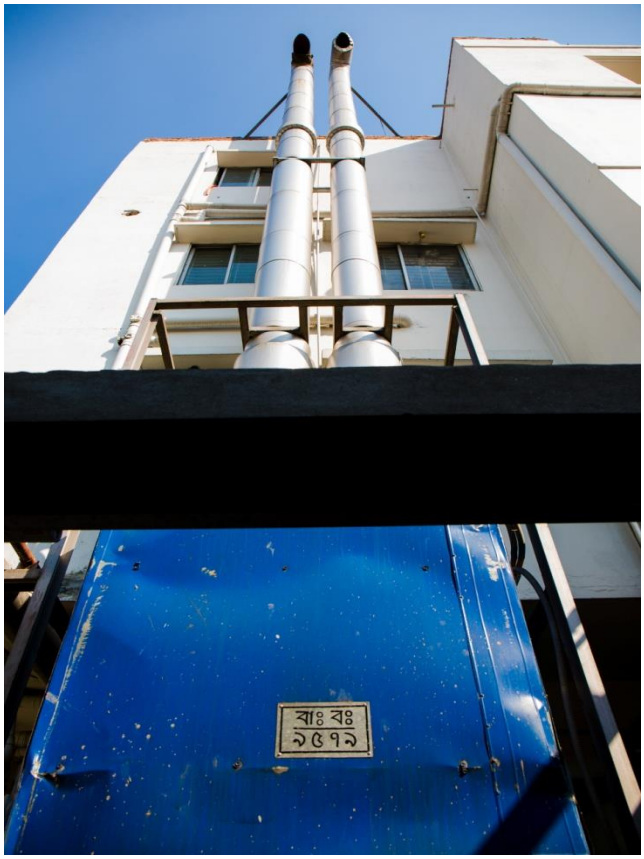
Nature of Services Required to Support the Implementation

- Pre assessment of compressed air supply system to identify leaks and weak spots can be done by internal staff with a hand-held meter
- Leak fixing service scan be conducted by in-house engineering personal.
- Installation of VSDs for air compressors can be conducted by in-house engineers or external installation service providers
- Maintenance services for compressed air supply system conducted by either in-house engineers or external service providers

Sources of technical support/expertise used

For further technical details and guidance regarding the improvement of compressed air supply systems following resources can be used:

- US Department of Energy (2004). Improving Compressed Air System Performance, A Sourcebook for Industry
- US Department of Energy (n.d.). Compressed Air Tip Sheets[9]. Two-page tip sheets which provide quick advice on how to maximum system efficiency.



Economiser for Boiler

[9] Available online at: https://www.energy.gov/eere/amo/tip-sheets-system

Possible Sources for Financing

SREUP credit line could be a good source of financing for such an investment.

Main Feature of SREUP Credit Line	
Loan Type	Normally Term Loan
Discount	Provision and possibility of 20% discount from loaned amount
Loan Tenure	3-5 years in general and in special case up to 7 years
Loan Limit	Normally up to 1 Million Euro and can be increased up to 3 Million Euro in special cases
Interest Rate	7% p.a. (maximum)
Grace period. Debt : Equity Ratio Repayment	All issues are subject to agreement between borrower and lender

Conclusion

It is a good investment for energy efficiency in RMG factories. Such investment also contributes to environment by lower carbon emission.