adidas

ENVIRONMENTAL GOOD PRACTICE GUIDE & TOOLKIT

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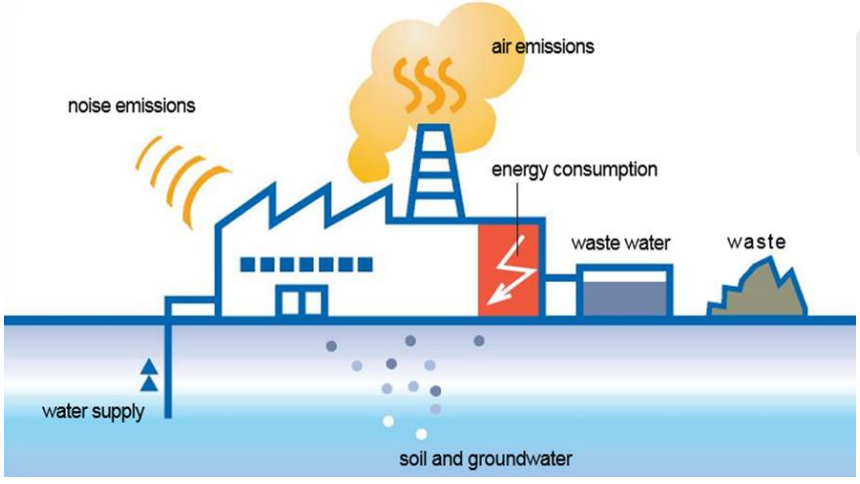
CONTENT

PURPOSE

We know that in a production setting, industrial activities can affect the environment in different ways, that is why adidas developed the Environmental Good Practice Guide (EGPG) & toolkit for our supplier partners. The EGPG toolkit serves as a manual that outlines potential saving opportunities and improvements a facility can implement, demonstrating the intention to create sustainable actions and more resource efficient production. The outlined savings are referenced in the Saving Opportunities and Toolkit section.



Our supplier partners should aim for progressive improvement in their environmental performance. This includes: integrating principles of sustainability into business decisions, responsible use of natural resources, adoption of cleaner production and pollution prevention measures, and designing and developing products, materials and technologies according to the principles of sustainability.

As our supplier partners, you are encouraged to obtain further information by consulting third party technical advisors to advise your facility on factory specific efficiencies, cost savings and country regulations.

DISCLAIMER OF THE EGPG & TOOLKIT

This Environmental Good Practice Guideline ("EGPG") recommends good practices for reducing the environmental impact of factory operations. This EGPG does not provide exhaustive guidance of all good practice activities and standards for all circumstances. This EGPG also does not provide exhaustive interpretation of all applicable legislations or regulations and users should seek advice from qualified professionals whenever necessary.

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EMS

ENVIRONMENTAL MANAGEMENT SYSTEM

ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) helps organization identify, manage, monitor and control their environmental issues in a holistic and systematic manner. It can be used by any organization that wants to enhance resource efficiency, reduce waste, and drive down costs. There are specific management system that support EMS for example ISO 14001; Chemical Management System in ZDHC Energy Management System ISO 50001 , Waste Management System and further guidance can be found in the SAC (Sustainable Apparel Coalition) How to Higg.org etc.

EMS requires organization to continuously improve its environmental performance by implementing the cycle of Plan-Do-Check & Act.

PDCA Cycle for Environmental Management System
The guiding principle of an EMS is a continual environmental improvement cycle based on Plan-Do-Check-Action Model

ENVIRONMENTAL TOOLS (ACTION PLAN, INVESTMENT PLAN & EFFICIENCY CALCULATOR)

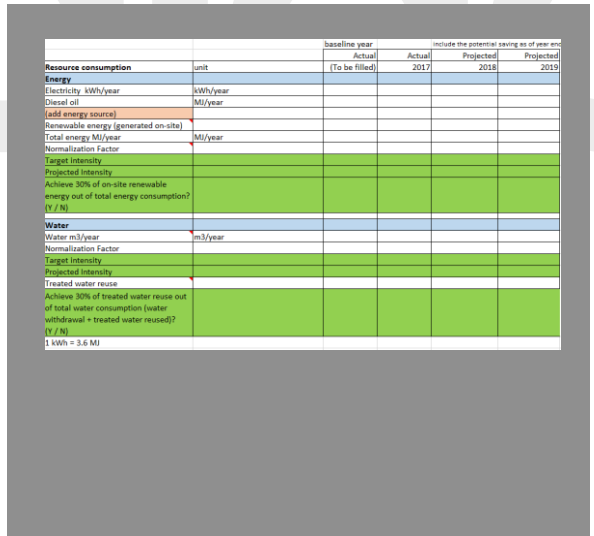
It is important to understand your facilities environmental impacts and where efficiencies can be gained. To support facilities, adidas has developed action & investment plan templates for the below purpose:

- standardize approach
- improve quality of action & investment planning
- identify and align (with adidas) priority actions within the facility to drive change/performance and also reflect adidas targets.
- tool to track and forecast the performance
- identify the responsible person and the necessary resources to achieve the desired results

For further reference and details please click on the below icon to access the individual tools:

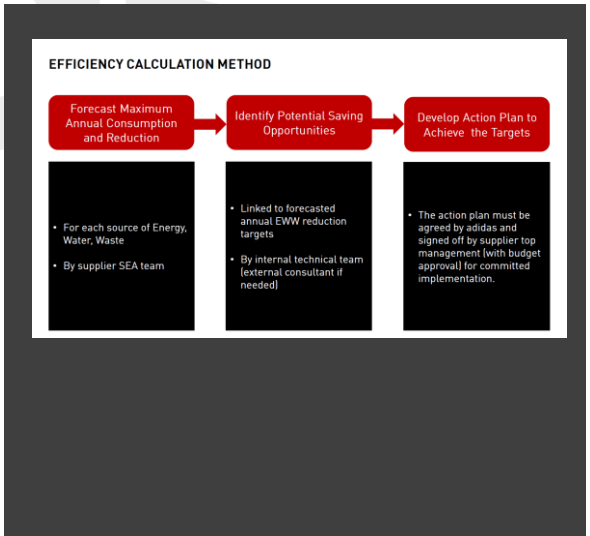
ACTION PLAN

INVESTMENT PLAN



		baseline year		include the potential saving as of year end	
		Actual	Actual	Projected	Projected
Resource consumption	unit	(To be filled)	2017	2018	2019
Energy					
Electricity kWh/year	kWh/year				
Diesel oil	MJ/year				
(add energy source)					
Renewable energy (generated on-site)					
Total energy MJ/year	MJ/year				
Normalization Factor					
Target Intensity					
Projected Intensity					
Achieve 30% of on-site renewable energy out of total energy consumption? (Y / N)					
Water					
Water m3/year	m3/year				
Normalization Factor					
Target Intensity					
Projected Intensity					
Treated water reuse					
Achieve 30% of treated water reuse out of total water consumption (water withdrawal + treated water reused)? (Y / N)					
1 kWh = 3.6 MJ					

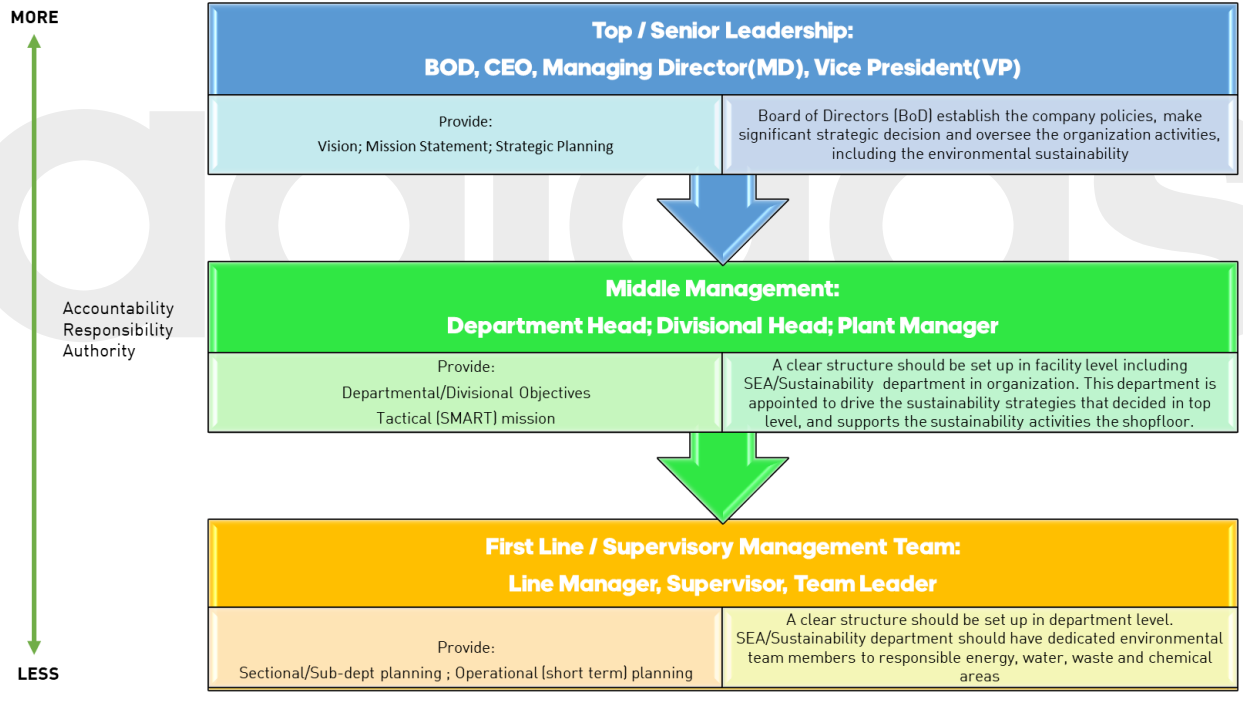
EFFICIENCY CALCULATION



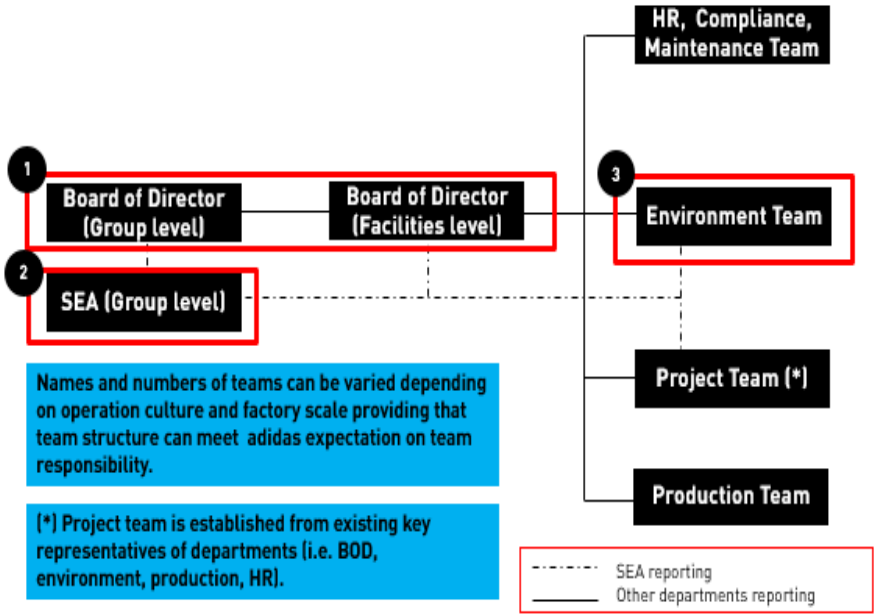
ESTABLISHMENT OF AN ENVIRONMENTAL TEAM

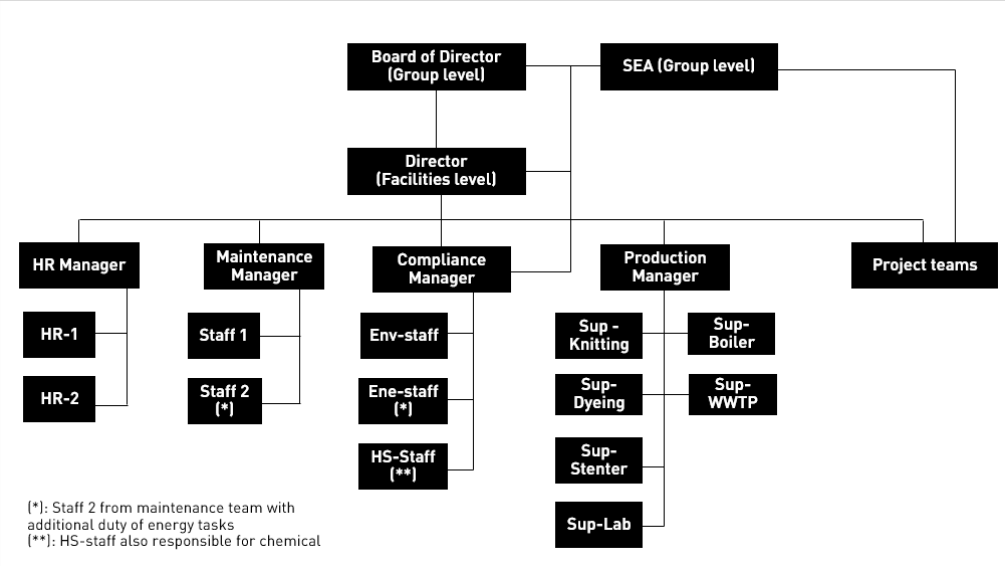
The **establishment** of the environmental organization in a facility is critical in such a way that management, employees and resources are clearly arranged and show the key positions of responsibility so that the facility can achieve its objectives.

The core environmental (SEA) team can be part of a wider organization within a facility which can include representatives from other operational areas such as HR, Global legal, Maintenance, Production etc.



ENVIRONMENTAL TEAM
RECOMMENDED STRUCTURE





DATA MANAGEMENT

EMERET
SUB-METERING

EMERET
REDUCTION TARGETS DATA SCOPE & REQUIREMENTS

SCOPE: consumption & generation that occurs within the **4-walls of the facility**, including the production building, dormitories, canteen & company vehicles

ENERGY

- **Direct Energy (Fuels)**
  Stationary (Nonrenewable/ Renewable)
  Vehicle (Non-renewable/ Renewable)

- **Indirect Energy (Electricity/Steam)**

- **Self-generated Energy**
  Renewable (Solar PV / Wind / Hydro)
  Non-renewable (fossil fuels)

- **Sub-metering Record**
  Production
  Non-production

WATER

- **Water Withdraw (A)**
  Fresh incoming water
  Condensed water from purchased steam
  Bottle drinking water

- **Water usage (B)**
  Production usage
  Non-production usage (canteen/dormitory)

- **Wastewater (C) (Untreated)**

- **Treated Wastewater (D)**
  Discharge volume
  Reuse volume

WASTE

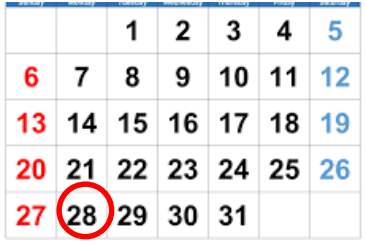
- **Non-hazardous Waste**
  Waste from production line
  Defective products
  Boiler Ash
  Domestic waste*
  Other non-production*
  Sludge (Non-hazardous)

- **Hazardous Waste**
  Sludge
  Chemical wastes
  Containers/contaminated materials
  Non-production related *

* Positions EXCLUDED from intensity calculation

ON-TIME REPORTING & DATA ACCURACY

Data scope: monthly data for Energy, Water, Waste, and normalization factors



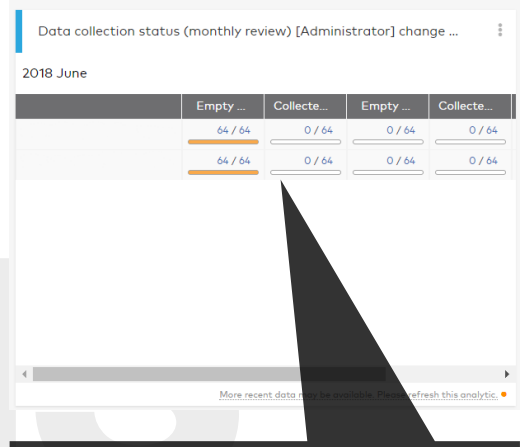
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Input & Release data: on or before 28th of the following month

Unrelease requests to correct any existing input in EMeReT should only happen within 21-28th of the month. More details available at the below Guideline link.

At the EMeReT data acquisition sections list mouseover the status bar to see the status of data collection:

green=released; **orange=collected**; **grey=not collected**



Use this portlet in EMeReT Dashboard to check the "release" status of your questionnaire

NOTE: Regardless of "release" or not, your data will be automatically included in the Dashboard. "Release" of the data is mandatory to ensure data integrity.

DATA VALIDATION GUIDELINE

DATA ACCURACY

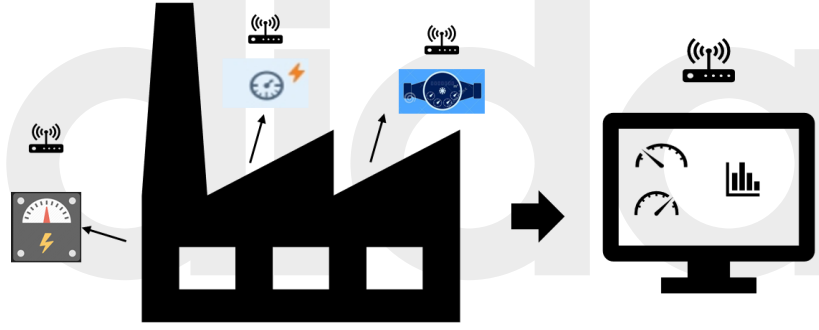
Alignment	Single document for data validation	Improve accuracy	Support Public Reporting
			

SUB-METERING

ADIDAS SUBMETERING GUIDELINE

adidas has developed a simple process to help suppliers to understand when and how to introduce additional sub-metering of energy and water to support more effective management of utility costs and determining environmental footprint.
Sub-metering refers to the installation of additional meters beyond the main feed to break down to individual and granular insight on all types of energy and water consumption.

HWYKTBPIYDKTD : How Will You Know The Bigger Picture If You Don't Know The Detail



Benefits of having sub-metering:

- Lead to cost reduction through identification of excess energy / water usage.
- Give measurement and verification (M&V) ability by letting internal team to verify the energy and water savings of an implemented project, and to provide justification for projects;
- Assist top management to identify further investment to continuously reduce cost.

ADIDAS SUB-METERING LEVELS

adidas expect its supplier to achieve submetering level 2 in 2018.

LEVEL 1: FACTORY LEVEL

Scope:
Main utility consumption on the factory
Cadence:
1x every 1-3 months
Benefit:
Cross check bills accuracy
Limitation:
Only measure factory wide consumption, don't have visibility on workshop level

LEVEL 2: WORKSHOP LEVEL

Scope:
Individual energy & water meter in each building or workshop and main utilities (Air compressor, WWTP, boiler, etc.)
Cadence:
1x every day or week
Benefit:
Can be used to track energy and water KPI in workshop / department level.
Limitation:
It can't exactly pinpoint the process or machine that use significant amount of energy or water

LEVEL 3: MACHINE / LINE LEVEL

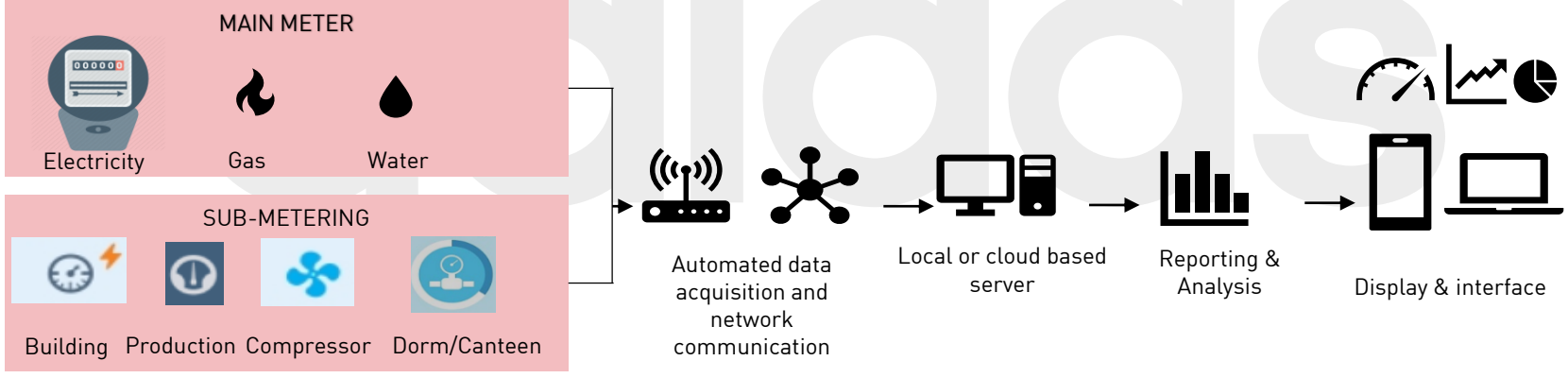
Scope:
Individual electric and water meter in production line and significant energy usage machine
Cadence:
Daily or even real time (If networked meter system available)
Benefit:
Easier to find out where is energy and water inefficiency hot spot.
Ability to instantly measure and verify whether the saving measure is effective or not.
Limitation:
It will need lots of manual work if there is no networked metering system which allowing automatic data acquisition.

NETWORKED METERING SYSTEM

Background:
Many adidas suppliers still rely on manual data collection and use paper based recording which is not reliable and cannot provide real time situation of resource usage

Opportunity:
Networked meter consists of smart meters for electric and water usage reading, a communication system to local or cloud server, automated data reporting and analysis system. The system allowed:

- Real-time data acquisition that hindered manual labor to do data collection.
- The data reading can be display in PC or Mobile screen and can be access anywhere and anytime.



Benefit:

- Improve resource efficiency by proactively manage energy and rather than firefighting approach since the resource usage profile and analysis are immediately available.

WASTEWATER MANAGEMENT

STANDARDS

INTRODUCTION

Textile industry is one of industry with high environmental impact, e.g. significant amount of pollutants discharged in wastewater. It is important for facilities to control and secure the quality of wastewater discharge is up to the standard.

To synergize the industry efforts and align the expectation on wastewater quality standard, adidas has committed to adopt the ZDHC Wastewater Guidelines (WWG) which aims to unify the wastewater parameters, limit values and test method.

The limit value of wastewater parameters set in WWG are in three level approach: 1) Foundation, 2) Progressive, and 3) Aspirational. The intent of three-level approach is to encourage the facilities actively execute a continuous improvement plan to reach next level.

For complete overview of the wastewater parameter limit please refer to: https://www.roadmaptozero.com/fileadmin/pdf/Files_2016/ZDHC_Wastewater_Guidelines.pdf

**Wastewater means all different types of wastewater is generated from manufacturing operations, including process wastewater, sanitary wastewater, wastewater from utility operations, runoff or storm water.*

ZDHC WASTEWATER GUIDELINE LIMIT LEVEL

Foundational

At a minimum, meets legal discharge requirements and ensures effective control of ZDHC MRSL chemicals

Progressive

Demonstrates increasing knowledge of chemicals management and applies advanced wastewater treatment process.

Aspirational

Demonstrates best-in-class performance and strives for continuous improvement in both chemicals and wastewater treatment process knowledge; creates industry best practices.

WASTEWATER MANAGEMENT BASIC EXPECTATIONS

Basic expectation in ZDHC Wastewater Guideline

- Have a valid license to operate
- Comply consistently with wastewater discharge permits
- Generated wastewater should be treated on-site or send out to centralized treatment plant for treatment. Not allow any by-pass of wastewater treatment system.
- No dilute wastewater discharge with incoming water as means to achieve compliance to concentration-based discharge permit
- Avoid uncontrolled air emissions of volatile chemicals from wastewater treatment processes
- Ensure sludge from wastewater treatment are disposed of in compliance with local regulatory requirements and with due consideration for the protection of public health and safety.

WASTEWATER QUALITY MONITORING

A clear monitoring program on wastewater quality should be developed on site to clearly identify and document for followings:

1) Testing parameters

Parameters should include two categories: a) Conventional, b) ZDHC MRSL restricted substances.

Details of recommended testing parameters can be found in ZDHC WWG Appendix A table 1 , and Table 2A-N

2) Testing frequency

Frequency of monitoring should take into consideration of processing characteristics and seasonal process variations in your facilities. More frequent and closely monitoring program is required for highly variable processes.

adidas requires our facilities to provide their monitoring data in end of Apr and end of Oct per year.

3) Sampling location

Sampling should occur at the closet point of discharge where waste water leaving the facility boundary. Sampling point is not limited to the final discharge point, it also depends on the testing parameters and objective of testing. For details, you can refer to ZDHC WWG for further guidance.

4) Testing method

Testing method should follow the internally recognized standard as well as the government recognized standard in EU, USA and China. Recommend to conduct wastewater testing under ZDHC accepted labs and adidas approved one.

WASTEWATER TREATMENT TECHNOLOGIES

A proper onsite wastewater treatment plant is critical to secure wastewater treated up to standard. Performance of wastewater treatment plant depends on the adequacy of its design, equipment selection as well as proper operation and maintenance. Facilities should ensure their wastewater treatment plant are operated under following conditions :

Have appropriate design on the capacity and technology

- Facility should seek technical and engineering advice in the design and selection of appropriate wastewater treatment systems and technologies base on their process characteristics

- ZDHC groups also publish a document "ZDHC wastewater treatment technologies" to help industry to close the knowledge gap on wastewater treatment and assist the facilities to operate the wastewater treatment plant up to ZDHC WWG.

Source: https://www.roadmaptozero.com/fileadmin/pdf/Files_2018/Wastewater_Treatment_Technologies_for_the_Textile_Industry-FINAL.pdf

Competence treatment plant operator

- Treatment plant should be operated and monitored by a qualified, technical competent and well-trained operators.

- Operators may exposed to physical, chemical and biological hazards depending on the design of treatment plant. A safety measure and guidance should be well-developed in facility.

GREEN BUILDING

STANDARDS

INTRODUCTION

- This section provides an overview of green buildings for new constructions with a particular focus on the Leadership in Energy and Environmental Design (LEED) certification for building design and construction (LEED BD+C).
- A green building is a building that, in its design, construction or operation, reduces or eliminates negative impacts and can create positive impacts on the environment and employees' quality of life, including:

Energy | **Water** | **Indoor air quality** | **Waste** | **Materials**

- Multiple standards exist on green buildings, including international and national standards:

USGBC's LEED: (new.usgbc.org/leed) | UK's BREEAM (www.breeam.com) | World Bank & IFC's EDGE (www.edgebuildings.com) | IGBC Green Building Rating (igbc.in/igbc/) | China'Green Building Label

- A majority of these standards will have specific requirements and will evaluate new constructions with the use of a scorecard. Ratings and labels are also sometimes leveraged to differentiate projects (e.g. Platinum, Gold, Silver).

Source: LEED Reference Guide for Building Design and Construction v4 edition

LEED BD+C SCORING METHODOLOGY

Projects are evaluated based on the project scorecard below and rated based on total points achieved.

LEED BD+C project scorecard

Section	Possible points	% of total possible points
Location and transportation	16	15%
Sustainable sites	10	9%
Water efficiency	11	10%
Energy and atmosphere	33	30%
Materials and resources	13	12%
Indoor environmental quality	16	15%
Innovation	6	5%
Regional priorities	4	4%
Total	**110**	**100%**

LEED BD+C ratings

Certified	Silver	Gold	Platinum
40-49 points	50-59 points	60-79 points	80-110 points

Remark: The LEED BD+C project scorecard includes one additional point for "Integrative thinking".

EXAMPLE OF REQUIREMENTS

The LEED BD+C standard applies to all buildings, regardless of their location or operations. Some of the LEED BD+C requirements are more relevant for apparel, textile and footwear facilities and are presented in the table below.

Section	Category	Requirements
Water efficiency	Cooling tower makeup water	Conserve water used for cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.
	Irrigation water	Reduce the landscape water requirement by at least 30% from the calculated baseline from the site's peak watering month.
	Domestic water	Ensure all selected fixtures meet the LEED prescriptive flush or flow rate thresholds.
Energy and atmosphere	Metering	Support energy management and identify opportunities for additional energy savings by tracking building-level energy use.
	Refrigerant	Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.
Sustainable sites	Open space	Outdoor space is greater than or equal to 30% of the total site area (including building footprint). A minimum of 25% of that outdoor space must be vegetated (turf grass does not count as vegetation).
Indoor environmental quality	Lighting	Connect building occupants with the outdoors reinforce circadian rhythms, and reduce the use of electrical light by introducing daylight into the space.
	Ventilation	Prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

Source: LEED Reference Guide for Building Design and Construction v4 edition

BENEFITS OF GREEN BUILDING CERTIFICATION

Cost savings

An upfront investment of 2% in green building LEED design results on average in life cycle savings of 20% of the total construction costs*

Energy, water and resource efficiency

LEED certified new buildings have to be at a minimum 5% more energy efficient and reduce landscape water requirement by at least 30% compared to baseline

Reputation and leadership

Be recognized for your commitment to environmental issues across the industry

External verification

Receive third party validation for accomplished achievements

*: Source: U.S. Green Building Council.

LEED BD+C V3 CASE STUDY – APPAREL MANUFACTURER IN BANGLADESH

Plummy Fashion Ltd. achieved a Platinum LEED BD+C: New Construction v3 certification with a total of 92 points out of 110.

Environmental achievements

40%
energy use reduction

41%
water use reduction

35%
carbon footprint reduction

62%
adequate open area

100%
air cooling factory

Key environmental reduction measures

- **ENERGY USE**
  - LED lighting
  - Energy efficient machinery, including low energy servo motors
  - Prismatic dome skylights installed for maximum day lighting
  - 65 KW capacity solar power plant which produces 13% of total power required
- **CARBON EMISSIONS**
  - CFC-free refrigerants for chillers, A/C and insulations
  - CO2 monitoring system and sensors to regulate fresh air flow
- **WATER USE**
  - Rainwater harvesting and recycling for toilet flushing and irrigation
  - Efficient water fixtures
  - Water efficient landscaping

LEED scorecard

Section	Points achieved
Sustainable sites	25 of 26
Water efficiency	10 of 10
Energy and atmosphere	31 of 35
Material and resources	7 of 14
Indoor environmental quality	10 of 23
Innovation	5 of 6
Regional priority credits	4 of 4
Total	**92 of 110**

ENERGY

EFFICIENCY MEASURES & OPPORTUNITIES

INTRODUCTION

Most energy efficiency opportunities are relevant to all suppliers regardless of their facility size, type and operations. Suppliers can prioritize saving opportunities as per the most significant sources of energy consumption. This section presents energy efficiency opportunities that are widely adopted, scalable and replicable across apparel, textile and footwear facilities.

The next few slides show the typical energy consumption breakdown by manufacturing process for Apparel Tier 1, Apparel Tier 2 and Footwear suppliers. The breakdown was based on 2017 data from those suppliers participated in IFC (International Finance Corporation) assessments in Vietnam.

Conducting an energy assessment would help suppliers to identify potential energy efficiency opportunities and quantify associated savings and payback periods.

ENERGY BREAKDOWN BY SUPPLIER TYPE
APPAREL TIER 1 SUPPLIERS

- For APP T1 facility that has centralized boiler system using diesel oil, gas, or coal as its energy source could consist of at least 40% of total energy consumption. The efficiency could be potentially improved by:
  - increasing the thermal efficiency of boiler
  - preventing steam leakage, and
  - properly insulating pipes,
- The graph on the right illustrates the electricity breakdown of the 60% of the total energy consumption of a typical APP T1 facility. Sewing, air compressor and lighting account for majority of the electricity consumption.

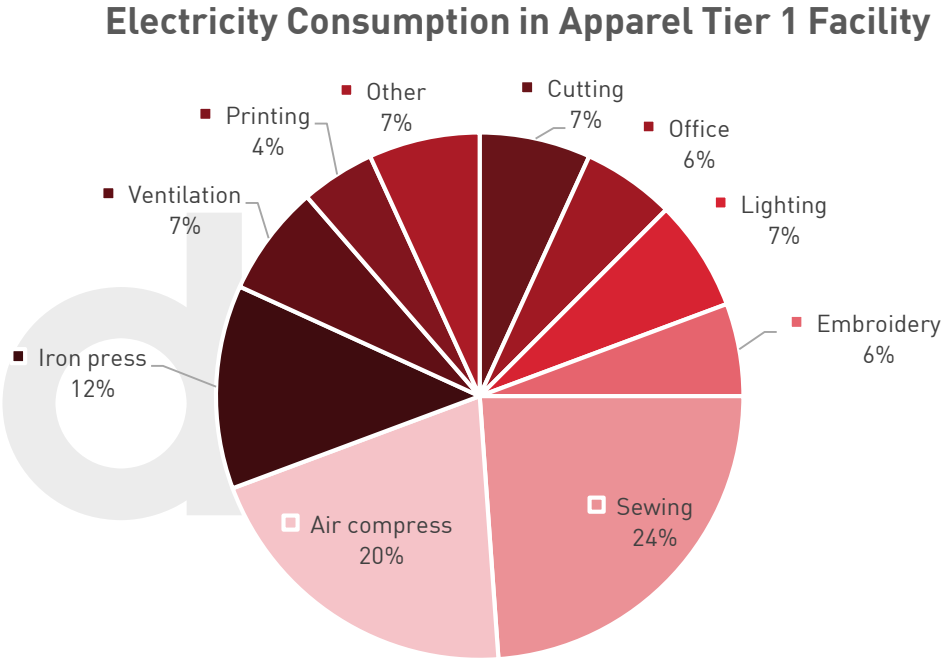
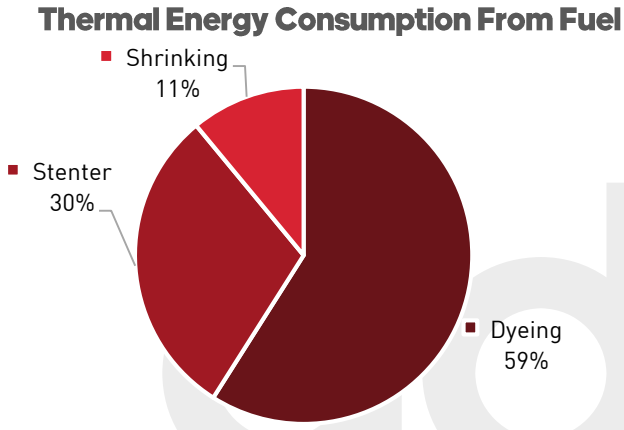
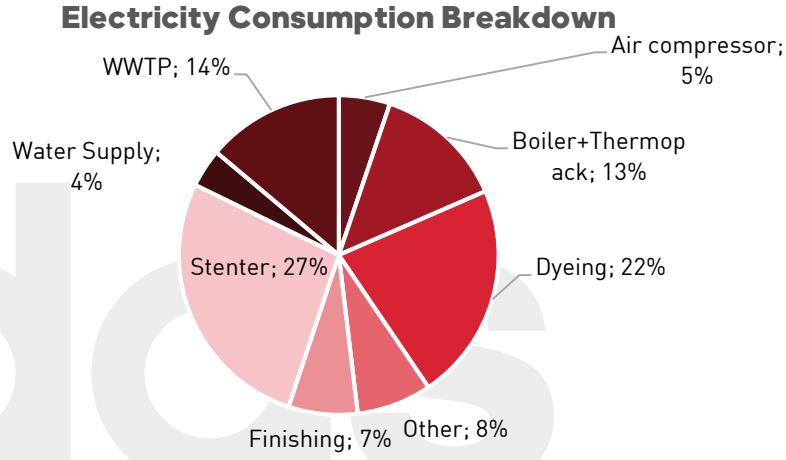


Fig.: typical electricity consumption for an Apparel Tier 1 facility with centralized boiler (fuel based)

ENERGY BREAKDOWN BY SUPPLIER TYPE
APPAREL TIER 2 SUPPLIERS





- The majority of energy consumption of a typical APP T2 (textile wet process) is from fuel.
- Those fuel is used in APP T2's thermal process, to heat up water (into steam) and remove water (drying process) – which accounts for **90% of total energy usage**.
- By improving thermal efficiency through reducing energy wastage in generation and distribution, facilities could increase energy efficiency significantly.

- The rest (10%) of the energy consumption comes from electricity.
- The graph on the right shows the electricity consumption breakdown of an APP T2 facility where dyeing, boiler and stenter account for almost two third of APP T2 facility's electricity.

ENERGY BREAKDOWN BY SUPPLIER TYPE
FOOTWEAR SUPPLIERS

- Majority of Footwear facilities exclusively use electricity.
- The facility's main manufacturing processes consist of assembly, outsole production, cutting and printing.
- Assembly and outsole production account for almost two-thirds of the Footwear facility's electricity consumption.
- Energy efficiency improvement can be achieved by improving air compressor and motor efficiency.

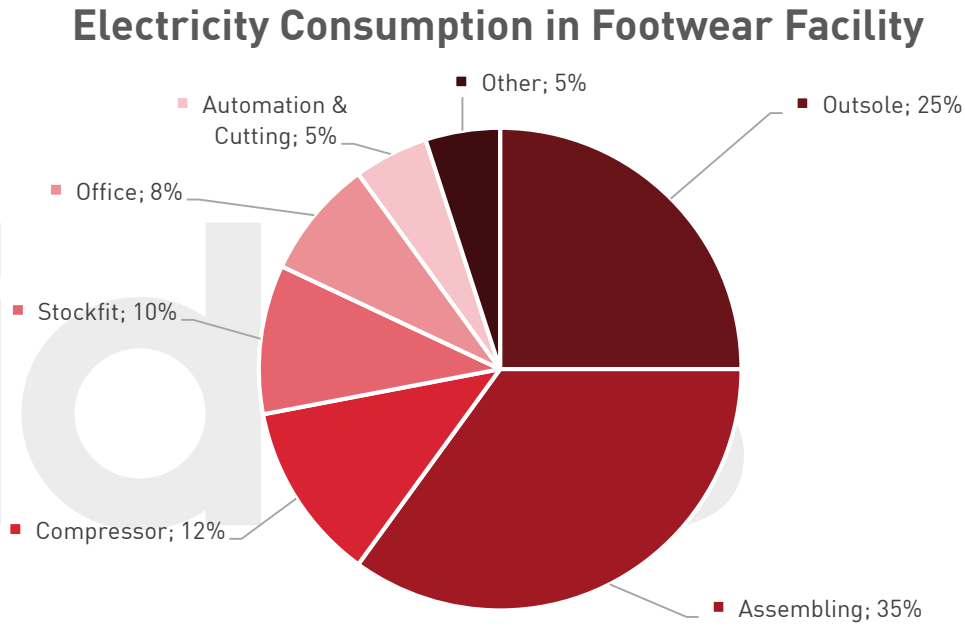


Fig.: typical electricity consumption breakdown of a typical Footwear facility.

'Other' includes 1.43% dormitory, 1.33% entertainment, 1.20% cutting, 0.87% printing and 0.14% packaging.

ENERGY REDUCTION OPPORTUNITIES (1/3)

#	Category	Saving Opportunity	Page #
E-01	General Operations	Turn off (automatically) machines when not in use	38
E-02		Set up auto turn-off system for HVAC at lunchtime and after working time	38
E-03		Adjust working hour schedule for workshop area to maximize the utilization of the production line	38
E-04	Lighting Efficiency	Replace fluorescent lamps with LED lamps	39
E-05		Turn off lights when not in use	40
E-06		Install motion sensors to optimize on/off time for lights	40
E-07		Install additional light switches for better zoning control	40
E-08		Eliminate double layer lights	40
E-09		Lower the lighting fixture height level	40
E-10	Maintenance	Introduce regular steam trap check/repair program	41
E-11		Introduce regular steam leakage check program	41
E-12		Introduce Total Preventive Maintenance Program	42
E-13		Introduce regular Thermal Imaging Checks Program	43

ENERGY REDUCTION OPPORTUNITIES (2/3)

#	Category	Saving Opportunity	Page #
E-14	**Air Compressor**	Lower inlet air temperature into air compressors by diverting hot exhaust air outside	44
E-15		Optimize the compressed air distribution piping system	45
E-16		Introduce regular compressed air leakage check program	46
E-17	**Boiler / Thermal**	Install steam trap on condensate pipe to limit flow of steam for ironing process	47
E-18		Proper insulation for thermal systems (piping, valves and flanges)	48
E-19		Install economizer for heat recovery of exhaust air	49
E-20		Optimization of air-fuel ratio for boiler or oil heater	50
E-21		Reuse condensate and cooling water	51
E-22		Heat recovery from hot wastewater	52
E-23	**HVAC**	Install temperature/humidity control for optimizing HVAC system	53

ENERGY REDUCTION OPPORTUNITIES (3/3)

#	Category	Saving Opportunity	Page #
E-24	**Motor & Drives**	Install Variable Speed Drive (VSD) for cooling tower fan to lower fan speed	54
E-25		Install VSD and modulating valve for air handling unit (AHU)	54
E-26		Install VSD for chiller water pumps	54
E-27		Install VSD for condenser water pumps	54
E-28		Install VSD for air compressors	54
E-29		Replace induction motor with servo motor for sewing machines	55
E-30		Replace hydraulic motor with servo motor for cutting machines	55
E-31		Replace low efficiency motors with high efficiency motors	56
E-32	**Power Quality**	Install capacitor bank for power factor correction	57
E-33	**Process Equipment**	Stenter exhaust heat recovery for air preheating	58
E-34		Dryer control enhancement	59

E-01 to E-03

GENERAL OPERATIONS

Background: Machinery usage is often not optimized (e.g. machine running when not in use), resulting in unnecessary electricity costs.

Opportunities: There are multiple opportunities to improve machinery usage and general operations listed in the table below:

Saving opportunity	Opportunity ('How to')	Benefits	Electricity consumption savings	Payback period	Technology availability
Turn off (manually or automatically) machines at the end of the day and when not in use	1. Train officers and employees to enhance awareness on energy savings and improve management practices. 2. Conduct regular checks and manually turn off machines when not in use. 3. Install timers on machinery and/or HVAC system to automatically turn off during lunch time (12:00 PM – 1:00 PM) and after work hours (5:00 PM – 7:00 AM).	• Electricity and cost savings; • Increased equipment lifespan; and • Increased employee productivity.	1-5%	0-3 months	High
Set up auto turn-off system for optimizing Heating, Ventilation and Air Conditioning (HVAC) system					
Adjust working hour schedule for workshop area to maximize the utilization of the production line	1. Separate production teams into production groups. 2. Define start and finish times for each production group. 3. Communicate the start and finish times to production groups , including with the use of signage in the facility.			Immediate	Not applicable

Install timer to automatically turn off machinery and/or HVAC system

GROUP A	GROUP B	GROUP C	GROUP D
AREA: Material Preparation Start: 07.00 Finish: 15.00	AREA: Upper Stitching Start: 07.15 Finish: 15.15	AREA: Assembling Start: 07.30 Finish: 15.30	AREA: Finishing & Packing Start: 07.45 Finish: 15.45

Change working hour schedule for shop floor area by production group

E-04

REPLACE FLUORESCENT LAMPS WITH LED LAMPS

Background

- Many factories use Compact Fluorescent Lights (CFLs) which are less efficient than Light Emitting Diodes (LEDs), although more efficient than incandescent lighting.
- A facility replaced 500 T8 fluorescent lamps with LED tubes and achieved electricity savings of 42,000 kWh per year.

Opportunity ('How to')

- Replace existing florescent lights with Light Emitting Diode (LED) tubes.

Benefits

- Increased lightbulb lifespan (LEDs last for three times longer than CFLs) and more precise electronic control; and
- LEDs are mercury-free, resulting in a safer work environment and no recycling fees for disposal.

Lighting electricity consumption savings	20-40%
Payback period	15-30 months
Technology availability	High

	Incandescent	CFL	LED
Approximate cost per bulb	$1	$2	$8 or less
Average lifespan	1,200 hours	8,000 hours	25,000 hours
Watts used	60W	14W	10W
No. of bulbs needed for 25,000 hours of use	21	3	1
Total purchase price of bulbs over 23 years	$21	$6	$8
Total cost of electricity used (25,000 hours at $0.12 per kWh)	$180	$42	$30
Total operational cost over 23 years	**$201**	**$48**	**$38**

Comparison of costs for different types of light bulbs

LIGHTING EFFICIENCY

E-05 to E-09

- **Background:** Lighting accounts for nearly 20% of Apparel Tier 1 facilities.
- **Opportunities:** There are multiple opportunities to improve lighting efficiency listed in the table below:

Saving opportunity	Opportunity ('How to')	Benefits	Electricity consumption savings	Payback period	Technology availability
Manually turn off lights when not in use	1. Train officers and employees to enhance awareness on energy savings and improve management practices. 2. Conduct regular checks and manually turn off lights when not in use and after work hours (e.g. 5:00 PM - 7:00 AM). 3. Install motion sensors to automatically turn lights off when no movement is detected, particularly in intermittently occupied areas (e.g. stairways, storage rooms).	• Electricity and cost savings; and • Increased lightbulb lifespan.	1-5%	Immediate	Not applicable
Install motion sensors to optimize on/off time for lights				< 12 months	High
Install additional light switches for better zoning control	1. Install multiple switches to adjust luminescence levels in different areas. One switch can control one lamp or group of lamps. 2. Note that each group of lamps should have its own switch.	• Electricity and cost savings; and • Improved worker wellbeing.			
Eliminate double layer lights	1. Measure the lux level of areas with double layer lights and compare it with the lux level required by client(s) and/or local standards. 2. If the lux level is higher than required, remove the top layer lamps.			Immediate	Not applicable
Lower the lighting fixture height level	1. Lower the height of light fixtures to around 2 meters to increase the lux level of lit areas and minimize light dispersion.			4-6 months	

MAINTENANCE - INTRODUCE REGULAR STEAM TRAP AND LEAKAGE CHECK/REPAIR PROGRAM

Steam leakage

Background

- A small steam leak (detectable by sound) can waste 800 liters of fuel oil per year, and a steam leak visible to the eye can waste 2,000 to 4,000 liters of fuel oil per year.

Opportunity ('How to')

1. Understand current steam leaks, and calculate leakage rate and cost of steam lost by conducting a desktop calculation (Steam Leak Detection, Calculation, & Prevention).
2. Prepare a regular stream trap and leakage inspection plan and procedure for a check/repair program.
3. Use a combination of thermal imaging and stethoscopes to detect steam leaks (i.e. opportunity E-13).
4. Repair steam traps (A Guide to Steam Trap Testing, TLV).

Benefits

- Steam and cost savings; and
- Prevent operation-wide disruptions

(e.g. a broken steam trap can damage a pipe or boiler, shutting down the entire system).

Opportunity	Steam consumption savings	Payback period	Technology availability
Regular steam trap check / repair programs	1-5%	0-3 months	High
Regular steam leakage check / repair programs	1-5%	0-3 months	High

INTRODUCE TOTAL PRODUCTIVE MAINTENANCE PROGRAM

Background

- TPM is a holistic, proactive and preventative maintenance framework.
- Note that this slide provides a high-level overview of TPM. For more information on designing and implementing a TPM program: TPM, Lean Production and Lean & Energy Toolkit, EPA.

Opportunity ('How to')

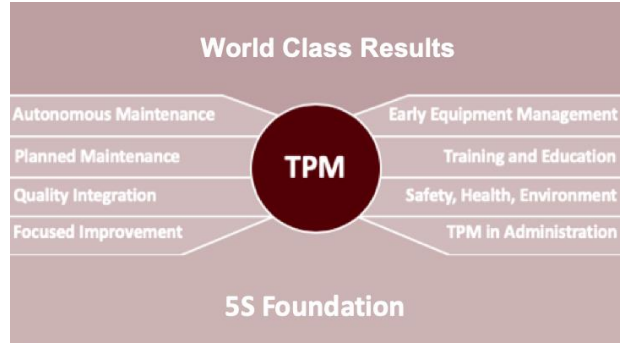
1. Identify pilot area and target equipment (i.e. easiest to improve, constraint / bottleneck, most problematic).
2. Restore equipment to prime operating condition through the 5S foundation (Sort, Set in Order, Shine, Standardize and Sustain) and autonomous maintenance.
3. Measure Overall Equipment Effectiveness (OEE), where: OEE = Availability x Performance x Quality*.
4. Address major losses through focused improvement.
5. Introduce proactive maintenance techniques.

Benefits

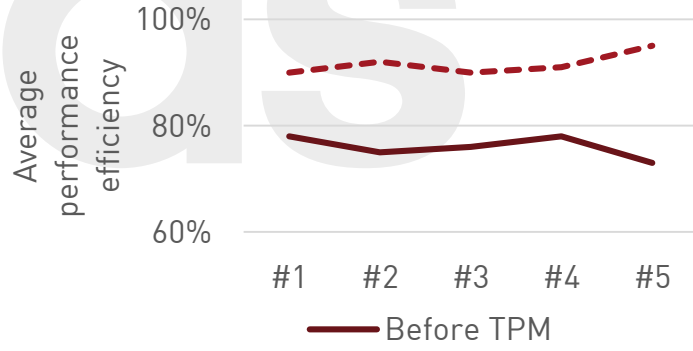
- Optimized production (i.e. no breakdowns, defects, interruptions or slow running) and operational efficiency; and
- Safe working environment.

Case study: An Indian garment factory improved efficiency of sewing machines by 15-30% after implementing a TPM program (For more information: Research Gate).

*: An OEE score of 100% is perfect production, 85% world class for discrete manufacturers, 60% fairly typical for discrete manufacturers, and 40% not uncommon for manufacturers without TPM and/or lean programs.



TPM conceptual model (Source adapted from: Lean Production)



Comparison of performance of sewing machines before and after TPM at an Indian garment factory

INTRODUCE REGULAR THERMAL IMAGING CHECKS PROGRAM

Background

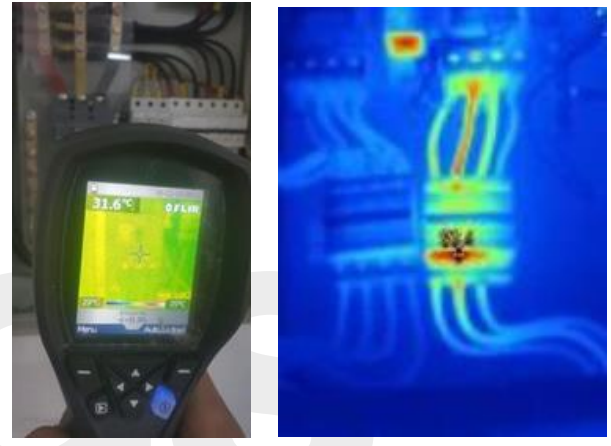
- Thermal imaging camera is a reliable and user-friendly solution to obtain single spot temperature readings.

Opportunity ('How to'):

1. Check the temperature of all pipes, valves, traps and fittings in the steam distribution system using a thermal imaging camera to predict potential failures.
2. Monitor the operating conditions and temperature of electrical and mechanical devices (e.g. motors, equipment, electric panels).
3. Take corrective actions in time when excessive heat is detected and components are about to fail (e.g. basic maintenance, replacement). Keep records of broken equipment and replacement parts.
4. Reinforce staff training to prohibit wasteful practices.
5. For more information: Thermal Imaging Guidebook for Industrial Applications

Benefits

- Energy and cost savings;
- Improved production efficiency; and
- Enhanced workers' safety.



Thermal imaging camera for electric panel checking

Energy savings	1-5%
Payback period	0-3 months
Technology availability	High

LOWER INLET AIR TEMPERATURE INTO AIR COMPRESSORS BY DIVERTING HOT EXHAUST AIR OUTSIDE

Background

- Compressors produce a significant amount of heat. For every 5.5°C increase in intake air temperature, compressors consume 1-2% more electricity.

Insufficient ventilation in compressor room

Compressors with hot air ducted outside

Opportunity ('How to')

1. Estimate the effect of intake air temperature on compressors' power consumption as shown in the table on the right.
2. Install duct to divert hot air from the compressor to the outside.

Benefits

- Energy and cost savings; and
- Improved compressor efficiency from reduced ambient temperature.

Compressor electricity consumption savings	1-5%
Payback period	2-4 months
Technology availability	High

EFFECT OF INTAKE AIR TEMPERATURE ON POWER CONSUMPTION

Inlet Temperature (°C)	Relative Air Delivery (%)	Power Saved (%)
10.0	102.0	+ 1.4
15.5	100.0	Nil
21.1	98.1	– 1.3
26.6	96.3	– 2.5
32.2	94.1	– 4.0
37.7	92.8	– 5.0
43.3	91.2	– 5.8

OPTIMIZE THE COMPRESSED AIR DISTRIBUTION PIPING SYSTEM

Background

- The size and layout of the compressed air distribution piping system have major impacts on the compressed air flow, pressure drop, installation costs and long-term performance of the system.
- For example, with a decentralized system, equipment further away from the air compressor typically receive an insufficient supply of air and high pressure drop.

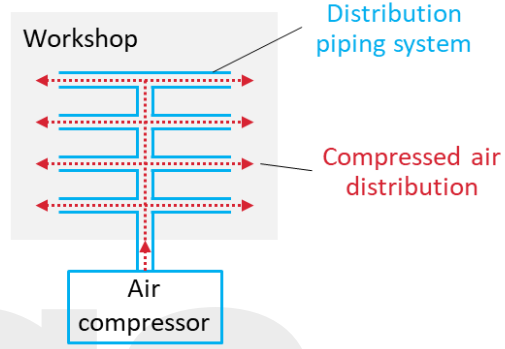
Opportunity ('How to')

1. Install a closed-loop piping system and provide a two-way flow to any point in the compressed air distribution piping system (i.e. centralized system).
2. Design the length of compressed air pipes based on pressure drop in the network and inlet air pressure (Compressed air distribution, Atlas).
3. Note that this opportunity pertains to the distribution piping system only. For more information on system design: Top 5 compressed air system design considerations.

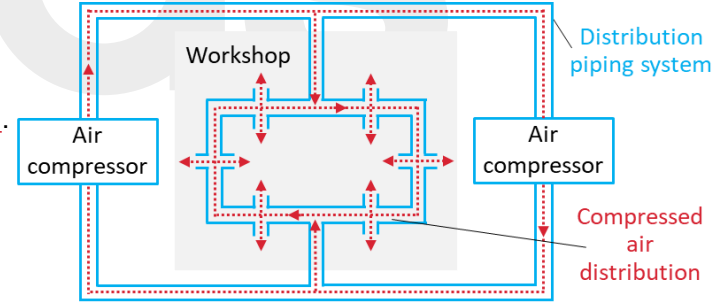
Benefits

- Energy and cost savings; and
- Minimized pressure drop (e.g. less than 0.15 bar for a well-designed piping system).

Compressor electricity consumption savings	1-10%
Payback period	15-30 months
Technology availability	High



Example of a decentralized compressed air distribution system



Example of a centralized compressed air distribution system

INTRODUCE REGULAR COMPRESSED AIR LEAKAGE CHECK PROGRAM

Background

- A 2 mm compressed air leak-can waste up to 13,600 kWh every year.

Opportunity ('How to')

1. Estimate compressed air leakage rate and associated loss of energy and costs (e.g from LubsTech website).
2. Prepare an inspection map and regular inspection plan including but not limited to: threaded connection points, rubber hose connections, valves, regulators and seals.
3. Use a combination of sensory and ultrasonic checks to detect compressed air leaks. Train workers to identify air leakage noise.

Benefits

- Energy and cost savings.

Compressed air pipe connection point to be checked for leak

Compressor electricity consumption savings	5-10%
Payback period	Immediate
Technology availability	High

INSTALL STEAM TRAP ON CONDENSATE PIPE TO LIMIT FLOW OF STEAM FOR IRONING PROCESS

Background

- A majority of Tier 1 Apparel facilities do not install steam traps on condensate pipes, which results in fresh steam flowing into the condensate pipe when the ironing equipment is on standby and excessive steam discharge.

Opportunity ('How to')

1. Estimate steam saving with the following formula: Steam savings = A x B x C, where:
   - A = Steam flow rate reduction for each iron. For example, steam flow rate could be reduced by 3 kg / h after steam trap installation (Steam consumption for some Typical Steam Heated Consumers) (in kg/h);
   - B = Operating hours (in hours); and
   - C = Number of irons (in no.).
2. Evaluate and select the type and size of steam trap(s) to install on the condensate return pipe of each iron (Steam Trap Selection: Understanding Specifications, TLV).
3. Choose high quality steam traps to prolong life span and avoid unnecessary replacements.
4. Conduct regular monitoring and maintenance of steam traps (opportunity E-10).

Benefits

- Heat loss prevention and warm condensate water capture.

Steam consumption savings	10-20%
Payback period	6-12 months
Technology availability	High

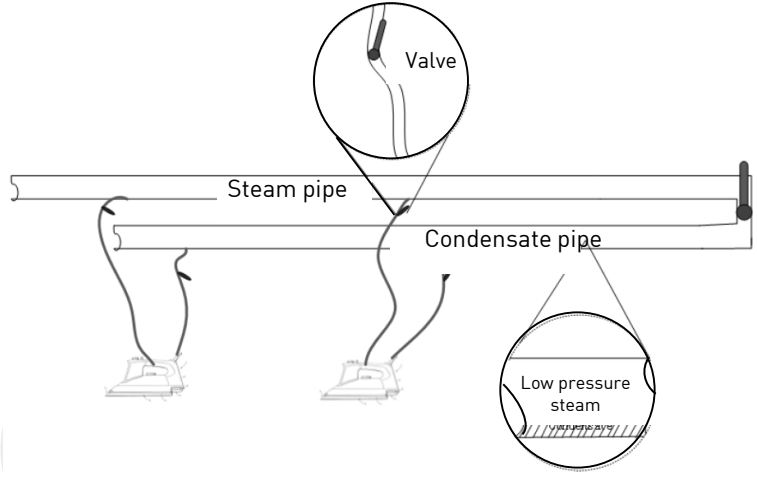


Diagram of a condensate pipe for ironing process without a steam trap

Picture of a condensate pipe for ironing process with a steam trap on condensate pipe

PROPER INSULATION FOR THERMAL SYSTEMS (PIPING, VALVES AND FLANGES)

Background

- Uninsulated steam / thermal oil distribution lines are a constant source of wasted energy. For example, 100 feet of uninsulated 1-inch steam line can result in annual heat losses of 300,000 MJ (c.f. table on the right).

Opportunity ('How to')

1. Use a thermal camera to identify points of surface heat loss on the steam / thermal oil distribution lines.
2. Select and install high-quality insulation materials (insulation box or jacket) for steam / thermal oil pipes, valves and flanges (e.g. Insulation Jacket Brochure, spirax sarco, Thermaxx Jackets).
3. Develop a regular insulation monitoring and maintenance program.

Benefits

- Energy loss reduction of up to 90% and steam pressure optimization (Source: U.S. Department of Energy).
- Improved worker safety (uninsulated valves are considered as a safety hazard).

Steam consumption savings	1-4%
Payback period	6-12 months
Technology availability	High

Various insulation jacket configurations over valves

Heat loss estimation table

Heat Loss Per 100 Feet of Uninsulated Steam Line

Distribution Line Diameter, inches	Heat Loss Per 100 Feet of Uninsulated Steam Line, MMBtu / yr			
	Steam Pressure, psig			
	15	150	300	600
1	140	285	375	495
2	235	480	630	840
4	415	850	1,120	1,500
8	740	1,540	2,030	2,725
12	1,055	2,200	2,910	3,920

Based on horizontal steel pipe, 75F ambient air, no wind velocity and 8,760 operating hours per year.

Source: U.S. Department of Energy

INSTALL ECONOMIZER FOR HEAT RECOVERY OF EXHAUST AIR

Background

- Facilities should install a boiler economizer (heat exchange device that uses the exhaust gases from the boiler to preheat the cold feed water) if flue gas discharge temperature exceeds 140 ºC.

Opportunity ('How to')

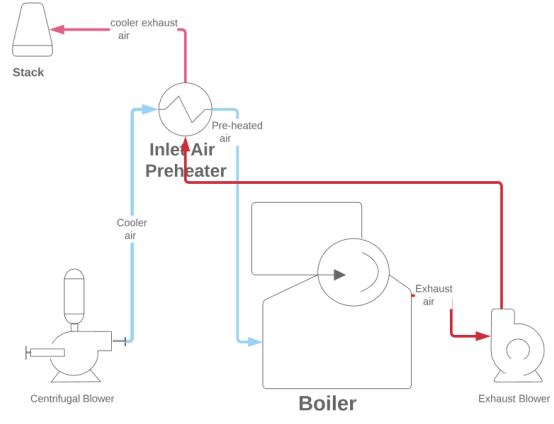
1. Install an economizer on the boiler's exhaust (Exhaust gas economizer).
2. Recover heat to preheat: i) boiler feed water or ii) fresh water for process use or staff showering.

Benefits

- Increased boiler system efficiency and energy savings (Note that reducing a boiler's workload is one of the most cost effective opportunities on-site to reduce energy consumption);
- Heat recovery; and
- Removal of oxygen dissolved in boiler feed water.

Fuel consumption savings	5-8%
Payback period	12-24 months
Technology availability	High

Boiler economizer tubes



Boiler system optimization schematic

OPTIMIZATION OF AIR-FUEL RATIO FOR BOILER OR OIL HEATER

Background

- Boilers and oil heaters are conventionally operated at a constant frequency, regardless of the combustion level, oxygen content and pressure of the furnace.
- The air-fuel and air ratio should be optimized to maximize combustion efficiency by providing just enough excess air to assure complete combustion.

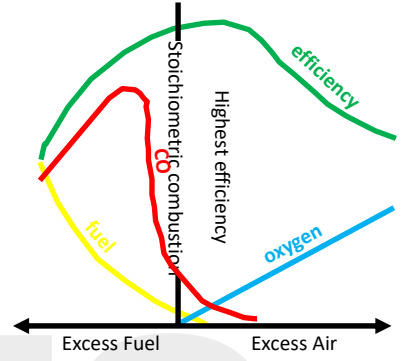
Opportunity ('How to')

1. Measure the oxygen (O) and carbon monoxide (CO) content of flue gas with the use of a gas analyser to estimate boiler combustion efficiency (For more information: Boiler efficiency, The Engineering Toolbox).
   - For example, the recommended oxygen content of a natural gas-fired boiler is 2-5% (For more information: NG-Fired Boiler's Combustion Efficiency).
2. If the estimated boiler combustion efficiency is lower than the equipment's rated efficiency (information available from supplier), install a Variable Frequency Drive (VFD) control on exhauster and blower.
3. Continuously monitor boiler combustion efficiency (i.e. Step 1) and adjust air volume of blower and exhauster accordingly.

Benefits

- Improved boiler combustion efficiency; and
- Fuel and cost savings.

Fuel consumption savings	5-15%
Payback period	12-24 months
Technology availability	High



Combustion efficiency under different air-fuel ratios (Source adapted from: The Engineering Toolbox)

Gas analyser and fuel gas analysis results

E-21

REUSE CONDENSATE AND COOLING WATER

Background

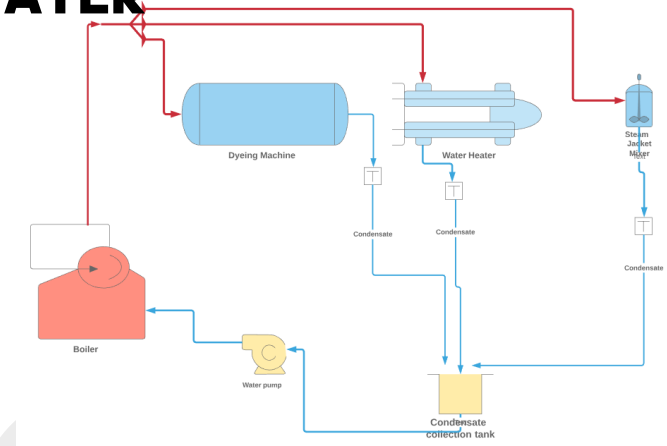
- Condensate and cooling water are characterized by high temperature and purity levels and can be collected for reuse.

Opportunity ('How to')

1. Estimate energy savings with the following formula: A x B x C, where:
   - A = 4,184 J / (kg·°C);
   - B = Temperature differential between condensate / cooling water and cold water (°C); and
   - C = Mass of water (kg).
2. Reuse hot condensate and cooling water in processes requiring a heated water supply, including:
   - Returning high-temperature condensate to the boiler with a steam trap for reuse as illustrated on the right; and
   - Reusing hot cooling water for processes such as de-sizing, washing, rinsing and scouring.
3. Ensure that pipes and storage tanks are well insulation when constructing condensate and cooling recycling systems.

Benefits

- Energy and cost savings (condensate and cooling water is already hot and requires less energy to be heated than newly introduced cold water).
- Significant water savings from reusing condensate water.



Cutaway of a boiler and condensate recovery system

Condensate collection unit and pipework pumping condensate to centralized collection tank

Fuel consumption savings	2-3%
Payback period	10-24 months
Technology availability	High

HEAT RECOVERY FROM HOT WASTEWATER

Background

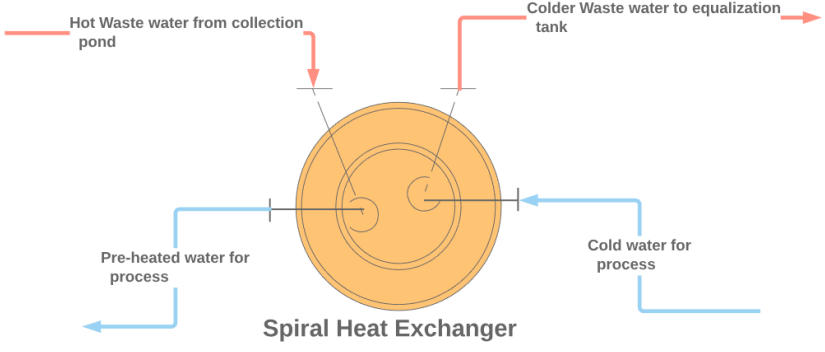
- Facilities typically install a cooling tower to cool down hot wastewater before discharging it into the wastewater treatment plant.

Opportunity ('How to')

1. Estimate potential annual savings with the following formula: A x B x C x D, where:
   - A = 4,184 J/(kg · °C);
   - B = Temperature differential between wastewater water and cold water (°C);
   - C = Mass flow of water (kg/hr); and
   - D = Annual operation hours.
2. Recover heat from hot effluent to heat fresh cold water by installing a heat exchanger. It is recommended to use a spiral-type heat exchanger (Spiral heat exchanger, Alfalaval) to prevent fouling from dirty hot liquor wastewater.

Benefits

- Reduced energy use for heating cold water; and
- Reduced electricity consumption of cooling tower as the wastewater temperature will decrease to 35-45° C after the heat



Energy consumption savings from hot wastewater	40-60 %
Payback period	12—18 months
Technology availability	High

INSTALL TEMPERATURE/HUMIDITY CONTROL

Background

- Many older Heating, Ventilation and Air Conditioning (HVAC) systems have humidity and temperature sensors which cannot control the system's settings, resulting in overcooling and higher electricity costs.
- For instance, an increase of 1°C in the HVAC temperature set point will result in an increase in electricity consumption of 5 to 10%.

Temperature set point

Opportunity ('How to')

1. Install temperature and humidity sensors in the center of workshops (i.e. optimal distance from the HVAC units).
2. Establish set point for temperature (e.g. 28-30°C) and humidity (60-70%) on sensors.
3. Connect the temperature and humidity sensors to the HVAC system to automatically turn the HVAC system off when the set points are met.

Benefits

- Electricity and cost savings; and
- Improved employee wellbeing.

HVAC electricity consumption savings	5 - 10 %
Payback period	More than 12 months
Technology availability	High

E-24 to E-28

MOTORS AND DRIVES – VARIABLE SPEED DRIVE (VSD) APPLICATION

- **Background:** Fixed speed drives and motors have a lower capacity and will constantly run at 100% of their capacity, regardless of the system's energy demand.
- **Opportunity:** VSDs can be installed on different types of electric motors to adjust the motor's power based on energy needs.

Saving opportunity	Opportunity ('How to')*	Benefits	Electricity consumption savings	Payback period	Technology availability
Install VSD for cooling tower fan	1. Install a VSD for the cooling tower fan to lower the fan's speed. 2. Install a temperature sensor to automatically control the fan's speed when the temperature set points is reached.	Electricity and cost savings.	10-30%	12-24 months	High
Install VSD and modulating valve for air handling unit (AHU)	1. Install modulating valve and actuator for every AHU. 2. Install VSD and controls for all AHU blowers to ramp down the speed of blower when set point temperature is reached.				
Install VSD for chiller water pumps	1. Install a VSD for the chilled water pump to lower the chilled water flow rate to the chiller's optimum point. 2. Adjust speed of VSD automatically based on load by using the differential delta temperature.		15-30%		
Install VSD for condenser water pumps	1. Install a VSD for the condenser water pump to lower the condenser water flow rate to the chiller's optimum point. 2. Adjust speed of VSD automatically based on load.				
Install VSD for air compressors	1. Install one VDSD for each set of compressors. 2. Link the discharge pressure with variations in the pressure requirement.		10-35%	15-30 months	

*: For more information: Application of VSD in HVAC, EMSD, VSD vs fixed speed, Atlas

REPLACE INDUCTION AND HYDRAULIC MOTORS WITH SERVO MOTORS

Background

- Motors of machines with intermittent operations and almost constant power consumption (e.g. sewing machines, cutting machines) should be replaced with servo motors which automatically stop when the machine is not in use.

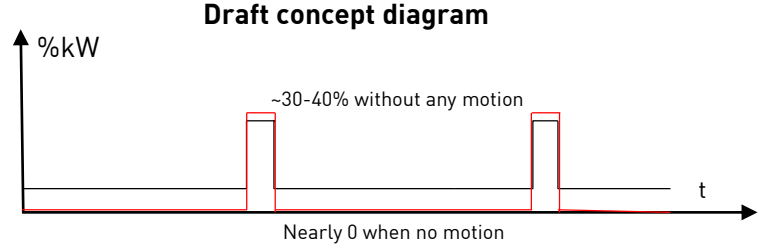
Opportunity ('How to')

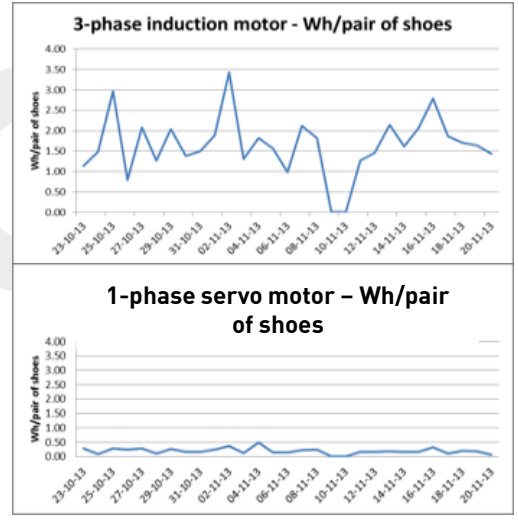
1. Identify the number of induction and hydraulic motors (e.g. for cutting, injection and/or sewing machines, air compressors) to be replaced with servo motors.
2. Select the appropriate servo motor(s) based on their type and size (Selection of servo motors for sewing machine; Selection of servo motors for cutting machine).

Benefits

- Avoid unnecessary energy consumption in 'idling' periods (e.g. using a servo motor can result in electricity savings of up to 80% compared to a conventional clutch motor).

Sewing/cutting machine electricity consumption savings	50-70 %
Payback period	24-36 months
Technology availability	High





Monthly power consumption of a shoe sewing machine with induction motor (above) and servo motor (below)

REPLACE LOW EFFICIENCY MOTORS WITH HIGH EFFICIENCY MOTORS

Background

- Motors are classified into fours levels of efficiency in standard IEC 60034-30-1.
- While the initial costs are high, upgrading an inefficient motor can save a significant amount of money over time. The energy cost to run a motor for two months can be greater than the initial purchase price (Source: Siemens).

Opportunity ('How to')

1. Estimate the efficiency of electric motors (Electric Motor Efficiency).
2. Purchase high-efficiency motors to replace low-efficiency motors upon failure and for new purchases. Motors with the Premium Efficiency IE3 Standard efficiency label are recommended at a minimum.
3. Prioritize upgrading large motors as savings associated with energy efficiency gains will be more significant.

Benefits

- Energy and cost savings.

Motor electricity consumption savings	5-10%
Payback period	30 months
Technology availability	High

Efficiency Levels	Efficienc Classes	Testing Standard	Performace Standard	
3-phase induction motors	IEC 60034-30-1, 2014	IEC 60034-2-1, 2014	Mandatory MEPS'''	
(Low Voltage <1000 V)	Global classes IEC-Code	incl. stray load losses	National Policy Requirement	
Super Premium Efficiency	IE4	Preferred Method''		
Premium Efficiency	IE3		Canada	(0.75 - 150 kW)
			Mexico	(0.75 - 375 kW)
			USA	(0.75 - 375 kW)
			USA***	(0.18 - 2.2 kW)
			South Korea	(0.75 - 375 kW)
			EU 28*	(0.75 - 375 kW)
			Switzerland*	(0.75 - 375 kW)
			Turkey*	(0.75 - 375 kW)
		Summation of losses with load test: Additional losses PLL determinated from residual loss	Japan Toprunner	(0.75 - 375 kW)
			Israel	(7.5 - 375 kW)
			Saudi Arabia	(0.75 - 375 kW)
High Efficiency	IE2		Australia	(0.75 - 185 kW)
			Brazil**	(0.75 - 185 kW)
			Canada	(151 - 375 kW)
			Chile	0.75 - 375 kW
			China	(0.75 - 375 kW)
			Colombia	(7.5 - 373 kW)
			EU 28*	(IE2 + VFD)
			New Zealand	(0.75 - 185 kW)
			Israel	(0.75 - 5.5 kW)
Standard Efficiency	IE1		Costa Rica	
			Chile	(0.75 - 7.5 kW)
			Vietnam	

Minimum Requirements Electric Motors worldwide (Source: International Electrotechnical Commission)

INSTALL CAPACITOR BANK FOR POWER FACTOR CORRECTION

Background

- When the power factor is too low, the quality of electricity is affected and electricity costs are higher due to electricity loss during distribution.
- For example, increasing the power factor from 0.7 to 0.9 will improve the active power supply by 40%.

Opportunity ('How to')

1. Select the relevant capacitator bank(s) depending on the facility's electricity network and operating conditions (Guide for the Design and Production of LV Power Factor Correction Cubicles).
2. Install the capacitator bank(s) in the main panel as close to the various loads as possible.
3. Adjust the capacitor bank(s) to maintain a power factor higher than 0.9.

Benefits

- Cost savings;
- Extend equipment life; and
- Reduction in voltage drop and increased in voltage at the equipment-level.

Two capacitor banks in a facility

Electricity cost savings	1-10%
Payback period	1-6 months
Technology availability	High

STENTER EXHAUST HEAT RECOVERY FOR AIR PREHEATING

Background

- A stenter is one of the most energy-intensive devices in a facility and can discharge a large volume of hot air during daily operations with temperatures in the range of 130-210ºC.
- An increase of 1℃ in the temperature of 1 m^3 of fresh air could save around 3,000 kJ of heat annually.

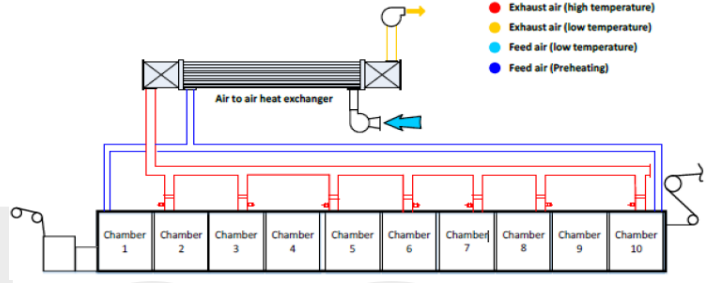
Opportunity ('How to')

- Install air-to-air heat exchanger on stenter to recover heat from hot exhaust air to heat its low-temperature feed air.

Benefits

- Increased temperature of fresh air supply;
- Significant savings in heat supply for stenter (more than 10% of the heat from exhaust air can be recovered); and
- Reduced indoor air temperature from radiating heat from the exhaust pipe.

Stenter energy consumption savings	5-10%
Payback period	18-24 months
Technology availability	High



Stenter heat recovery system

Item	Value	Unit
Feed air inlet temperature	30	℃
Feed air exit temperature	90-105	℃
Exhaust air inlet temperature	120-170	℃
Exhaust air exit temperature	70-120	℃
Mass flow rate of feed ir	6,000	m^3/hr
Mass flow rate of exhaust air	18,000	m^3/hr

Example parameters for the heat recovery system

Stenter after installation of recycling system

DRYER CONTROL ENHANCEMENT

Background

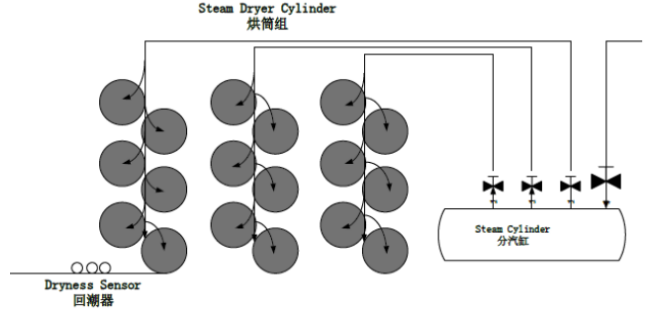
- When the drying cylinder is filled with waterlogged fabric, the drying process takes more time, consumes more energy and produces excess steam.

Opportunity ('How to')

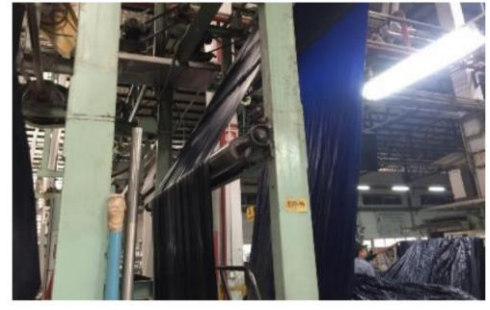
1. Install conductivity sensors at the output point of drying machines to measure the fabric's humidity level. Refer to local standards to identify suggested moisture regains of different textiles.
    - For example, according to the Chinese GB Standard 9994-1998, the conventional moisture regain of polyethylene terephthalate should be 0.4% (Conventional moisture regains of textiles, GB 9994-1998).
2. Reconfigure the steam cylinder array to be able to control groups of drying cylinders independently.
3. Connect the conductivity sensors to the steam supply valves.
4. Conduct production trials with various grades of material to prevent fabric distortion and/or damage during the drying process.

Benefits

- Energy and cost savings; and
- Prevent fabric over-drying.



Control drying by installing conductivity sensor



Waterlogged fabric

Drying energy consumption savings	5-10 %
Payback period	12—24 months
Technology availability	High

WATER

EFFICIENCY MEASURES & OPPORTUNITIES

INTRODUCTION

This guide presents water reduction opportunities that are widely adopted, scalable and replicable across apparel, footwear and textile facilities.

Although most water reduction opportunities are relevant for all suppliers regardless of their facility size, type and operations, suppliers should prioritize reduction opportunities for their most significant sources of water consumption.

The next slides show the typical water breakdown by manufacturing process for Apparel Tier 1, Apparel Tier 2 and Footwear suppliers. The water breakdown was estimated based on previous report and assessments and water meter records provided by the facilities.

Conducting a **water assessment** would help suppliers to identify and quantify potential reduction opportunities and quantify associated savings and payback periods.

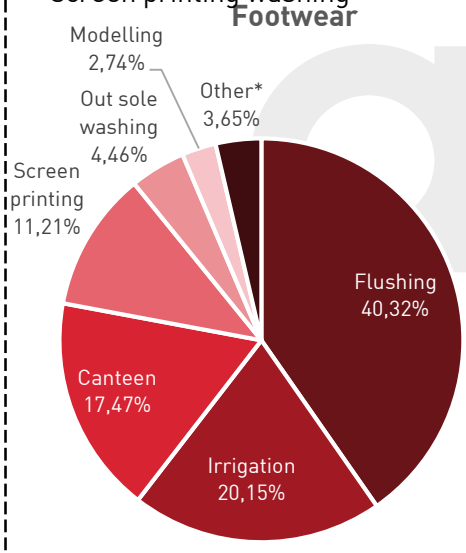
Measures to minimize water usage, opportunities for water recycle and recovery are outlined in this section.

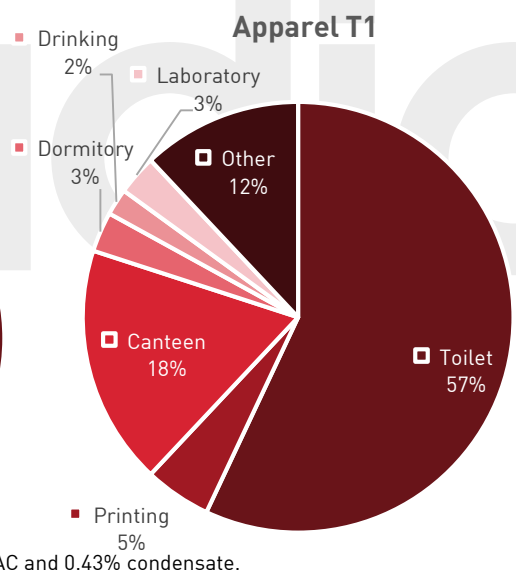
WATER BREAKDOWN BY SUPPLIER TYPE

FOOTWEAR SUPPLIERS

T1

- Majority of water usage in T1 is for domestic use – eg. flushing toilets, washing hands, and drinking water.
- For APP T1, a small portion of water consumption comes from production-related use such as boiler feed water, screen printing, and laundry.
- For FTW, production related water consumption comes from soles and/or screen printing washing

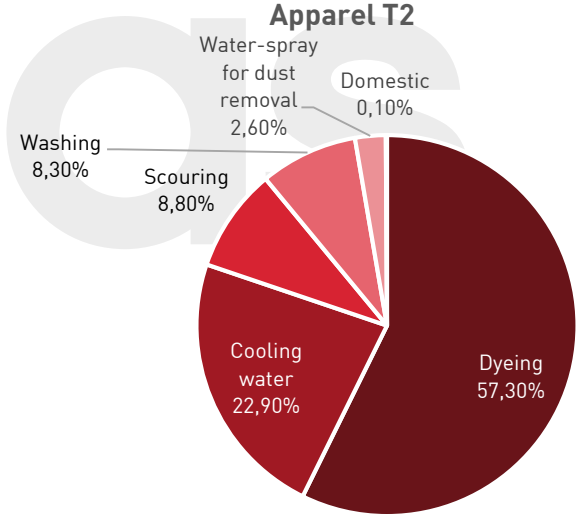




*: 'Other' includes 2.25% drinking, 0.97% MVAC and 0.43% condensate.

T2

- The facility's main wet processes consist of dyeing, scouring and washing.
- Dyeing process accounts for more than 57% of the APP T2 facility's water consumption. Altogether with the cooling tower, they make up 80% of the APP T2 facility's water consumption.



These charts represent general conditions in related industries and do not reflect absolute numbers of specific adidas suppliers

WATER SAVING OPPORTUNITIES

#	Category	Saving Opportunity	Page #
W-01	**Domestic**	Install low-flow aerators on faucets	64
W-02		Replace traditional water closets with dual-flush water closets	65
W-03	**Maintenance**	Introduce regular water leakage check program with water leakage detector (ultrasonic)	66
W-04	**Reuse / Recycle / Recovery**	Reuse washing water from dyeing machine	67
W-05		Recycle reclaimed domestic wastewater (water from septic tank excluded)	68
W-06		Recovery system for condensate water	69
W-07		Recovery system for cooling water	70
W-08		Recycle treated wastewater to production with tertiary treatment	71
W-09	**Process**	Install low-liquor ratio dyeing machines	72
W-10	**Rainwater**	Harvest rainwater for non-potable water use	73

INSTALL LOW-FLOW AERATORS ON FAUCETS

Background

- Faucets use on average 5 liters per minute (lpm) in offices and more than 8 lpm in workshops. Most faucets are currently not fitted with low-flow aerators.
- In comparison, the standard flow rate of high-efficiency lavatory faucet in LEED v4 is 1.9 lpm as shown in the table on the right.

Opportunity ('How to')

1. Install low-flow aerators on all faucets.
2. The aerator can be screwed onto existing unaerated faucets for domestic water use (e.g. kitchens, toilets, office).

Benefits

- Reduction in water usage by 15-30% with little difference in water pressure.

Example

- A facility installed 80 low-flow aerators for faucets and achieved around 30 m^3 monthly water savings.

Unaerated faucet

Aerated faucet

Faucet water consumption savings	15-30%
Payback period	1-2 years
Technology availability	High

LEED V4 Requirement

Fixture and fitting	Requirements
Public lavatory (Restroom) faucet	1.9 lpm at 415 kPa or 05 gpm* at 60 psi

*gpm = gallons per minute

REPLACE TRADITIONAL WATER CLOSETS WITH DUAL-FLUSH WATER CLOSETS

W-02

Background

- Toilets use on average 7 liters of water per flush (lpf), equivalent to running a faucet for a minute.
- The baseline water consumption of water closets in LEED v4 is 6 lpf as shown in the table on the right.

Opportunity ('How to')

1. Install dual-flush toilets which provide two options: i) full flush (6 lpf), and ii) reduced flush (3 lpf).
2. Retrofit kits are available to repurpose single-flush toilets into a dual-flush system. These kits are typically less expensive that dual-flush toilets, reducing the initial investment required, but are also less effective.

Benefits

- Water savings from adapting the amount of water to be flushed at every use.

Purpose-built dual flush toilet

Domestic water consumption savings	10-20%
Payback period based on replace dual-flush toilets	> 5 years
Technology availability	High

LEED V4 requirements

Fixture or fitting	Requirements
Water closets (toilets)	6 lpf or 1.6 gallons per flush (gpf)
Urinal	3.8 lpf or 1.0 (gpf)

INTRODUCE REGULAR WATER LEAKAGE CHECK PROGRAM WITH WATER LEAKAGE DETECTOR (ULTRASONIC)

W-03

Background

- Water distribution systems typically suffers from mild leakage, especially at points of connection including valves, fittings and screws.
- A 0.25-inch diameter water leak can result in annual losses of up to 1,181,000 gallons of water (Source: Citrus Heights Water District).

Opportunity ('How to')

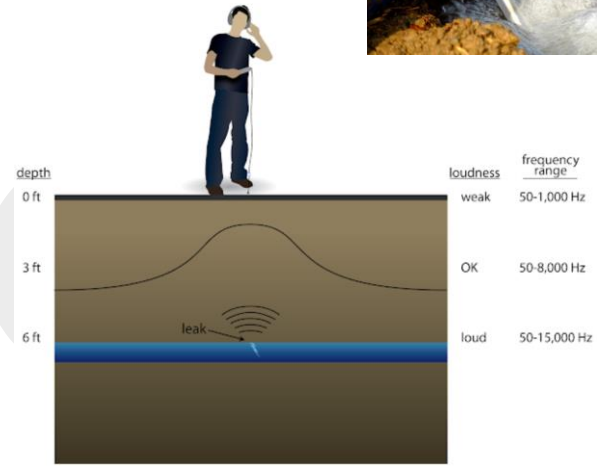
1. Install water meters to monitor abnormal water usage and leaks, and to estimate water and cost savings from leakage check program.
2. Introduce a regular water leakage check program to ensure that the system is leak-free (Management Practice: Water leak detection and repair program).
3. Conduct inspections on a weekly to monthly basis. Both visual and ultrasonic inspections (e.g. acoustic water leak detector) are required for an accurate inspection.

Benefits

- Water and cost savings.

Example

- A factory replaced three leaking valves for USD 600 which resulted in water and processing savings of roughly USD 16,000 per year.



Overall water consumption savings	1-50%
Payback period	0-3 months
Technology availability	High

Source: Underground surveying

REUSE WASHING WATER FROM DYEING MACHINE

Background

- Less polluted process water such as over-flow washing is relatively clean compared with other wastewater and could be collected and recycled in a separate system.

Opportunity ('How to')

- Evaluate and access the quality of over-flow washing water for potential reuse.
- Install a water collection tank next to each dyeing machine.
- Install piping system to collect over-flow washing water and reuse it as pre-washing water. Note that recycled over-flow washing wastewater can be reused without any pre-treatment.

Benefits

- Reduced process water consumption by up to 10-20%; and
- Reduced amount of wastewater to be treated by the facility's internal wastewater treatment plant.

Process water consumption savings	10-20%
Payback period	12-36 months
Technology availability	High

Example of facility installing water tank to collect less polluted process water for reuse

RECYCLE RECLAIMED DOMESTIC WASTEWATER (WATER FROM SEPTIC TANK EXCLUDED)

Background

- In Apparel Tier 1 and Footwear facilities, domestic water accounts for a large portion of water needs (see previous slide).

Opportunity ('How to')

1. Install on-site wastewater plant to treat domestic wastewater.
2. Reclaim domestic wastewater with primary and secondary treatment (Please refer to opportunity W-08 for more information on wastewater treatment).
3. Ensure that the reclaimed water quality meets local regulations and requirements (E.g. (1) PR China's Standards of reclaimed water quality (SL 368-2006) - the document is available in Chinese only, (2) Guidelines for Water Reuse 2012 by EPA .
4. Use reclaimed domestic wastewater for non-potable usage (e.g. irrigation, washing screen printing frames).

On-site wastewater treatment plant

Benefits

- Water and cost savings.

Non-potable water consumption savings	5-20%
Payback period based on install reclamation system in facility	12-36 years
Technology availability	High

RECOVERY SYSTEM FOR CONDENSATE WATER

Background

- A fully optimized condensate water recovery system can reuse 100% of the boiler's condensate water.

Opportunity ('How to')

1. Collect condensate water in a water tank.
2. Install a condensate water return piping connecting the water tank to the boiler's feed water tank. The piping system should be properly insulated as the temperature of condensate with low pressure is more than 100℃ (C.f. opportunity E-21).
3. If the water pressure in the piping system is too low (e.g. condensate water collection tank is too far from the boiler), install a centrifugal or turbine condensate pump to increase water pressure.
4. Note that impurities collected during the condensate recovery process should be removed.

Benefits

- Water and costs savings; and
- Reduced boiler blowdown and 2-3% energy savings.

Water consumption savings	5-10%
Payback period	10-24 months
Technology availability	High

Example of apparel tier 1 facility discharging condensate water

Condensate water recovery pipe connected to boiler feed water tank

RECOVERY SYSTEM FOR COOLING WATER

Background

- In a majority of Apparel Tier 2 Facilities, cooling water from dyeing machines is typically discharged as wastewater to the wastewater treatment plant. This results in:
  - Clean water wastage (cooling water is as clean as municipal water); and
  - Higher wastewater temperature (temperature of cooling water discharged from dyeing process is 50-70°C).
- A fully optimized cooling water recovery system would reuse 100% of the cooling water from dyeing machines.

Opportunity ('How to')

1. Install a hot water collection tank to collect cooling water from jet and yarn dyeing.
2. Install piping system to recover the collected cooling water as hot water supply for processes such as de-sizing, washing, scouring and rinsing.
3. Note that the piping system should be properly insulated (C.f. opportunity E-21).

Benefits

- Water and cost savings.

Cooling water consumption savings	1-10%
Payback period	14 months
Technology availability	High

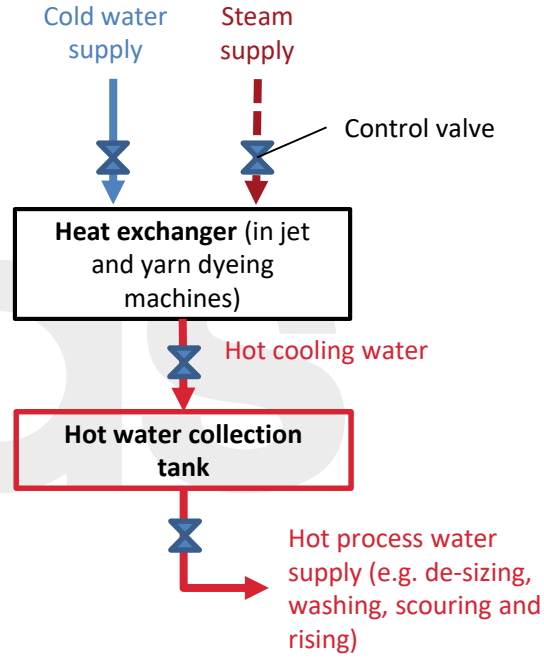


Diagram of cooling water recovery system in an example Apparel Tier 2 facility

RECYCLE TREATED WASTEWATER TO PRODUCTION WITH TERTIARY TREATMENT

Background

- Reclaimed wastewater can be treated for process water used in scouring, washing and dyeing processes.

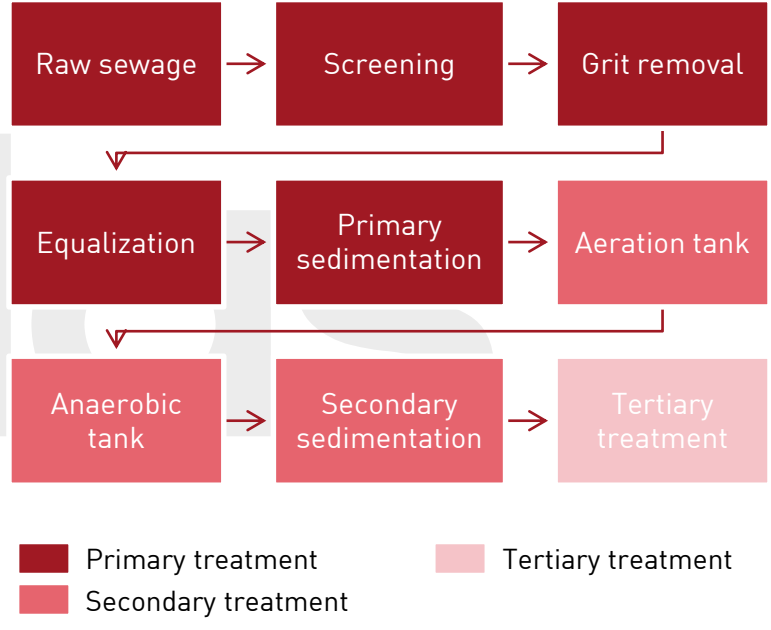
Opportunity ('How to')

1. Recycle process wastewater through an on-site wastewater reuse treatment system. This solution is particularly advisable when municipal water is expensive and/or access to clean water is limited.
2. The treatment system for waste water reuse should include the following steps:
    - Primary treatment: Chemical and physical treatment (i.e. screening, grit removal, equalization and primary sedimentation);
    - Secondary treatment: Colour removal (i.e. aeration and anaerobic treatment); and
    - Tertiary treatment: Nano filter/ micro filter or reverse osmosis.

Benefits

- Water and cost savings (Note that savings potential depends on local wastewater treatment and discharge costs).

Non-potable water consumption savings	10-50%
Payback period	3-10 years
Technology availability	High



Wastewater treatment process

INSTALL LOW-LIQUOR RATIO DYEING MACHINES

Background

- The liquor ratio is a balance of fabric weight to the weight of water and dyestuff. The liquor ratio of overflow dyeing machine is typically higher than 1:10.
- In comparison, the theoretical liquor ratio of low-liquor ratio dyeing machines is around 1:5.

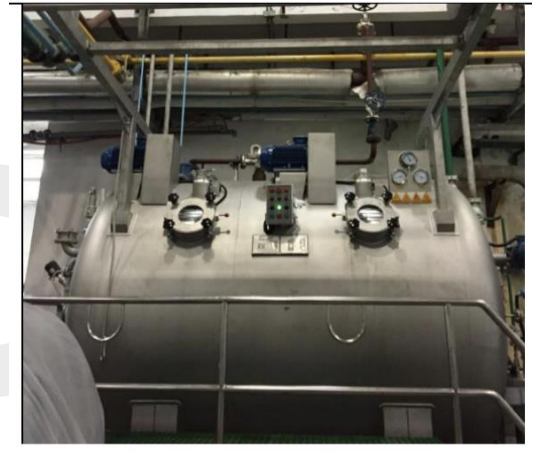
Opportunity ('How to')

1. Install a sub-water meter in one overflow jet dyeing tank to estimate the current liquor ratio.
2. Replace overflow jet dyeing tank(s) with low-liquor ratio dyeing machine(s) gradually as upfront investments per dyeing machine are relatively high..
3. Review and update current dyeing processes and amount of chemical and dyestuff used.

Benefits

- Water, dyestuff and cost savings.

Dyeing process water consumption savings	10-50%
Payback period	3-5 years
Technology availability	High



Replacement of low-liquor ratio dyeing tank

HARVEST RAINWATER FOR NON-POTABLE WATER USE

Background

- Facility roofs represent a great opportunity to collect rainwater due to their size and exposure to rainfall.

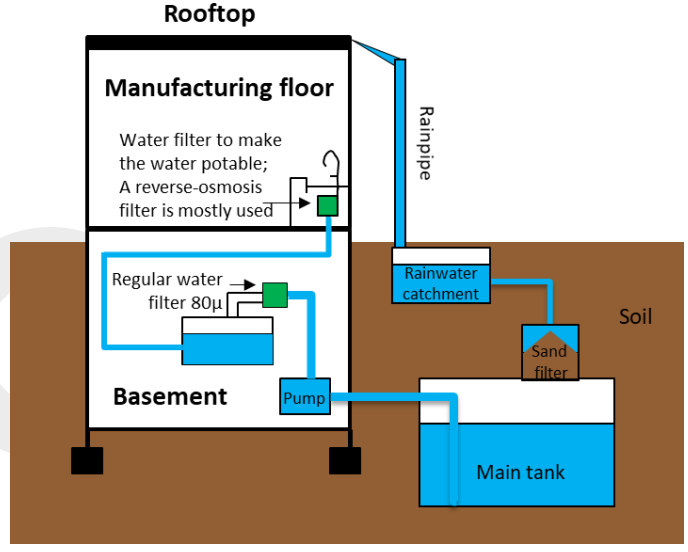
Opportunity ('How to')

1. Recover water from factory roofs through a rainwater harvesting system by installing a filtration system and rainwater storage tank or concrete basin (NSW: Rainwater Treatment Guide).
2. Estimate total quantity of rainwater to be collected and the corresponding water tank capacity (in cubic meters) using the following formula: Roof top area (in square meters) x average monsoon rainfall (in meters) x 80%.
3. Note that storage tanks can be a significant investment, as such it is recommended to install a storage tank that can satisfy one day worth of non-potable water demand.

Benefits

- Water and costs savings (Note that the facility's roof size, local climate and water market conditions will determine the storage tank size and associated cost savings).

Non-potable water consumption savings	Variable depending on local rainfall and water demand
Payback period	2-4 years
Technology availability	High



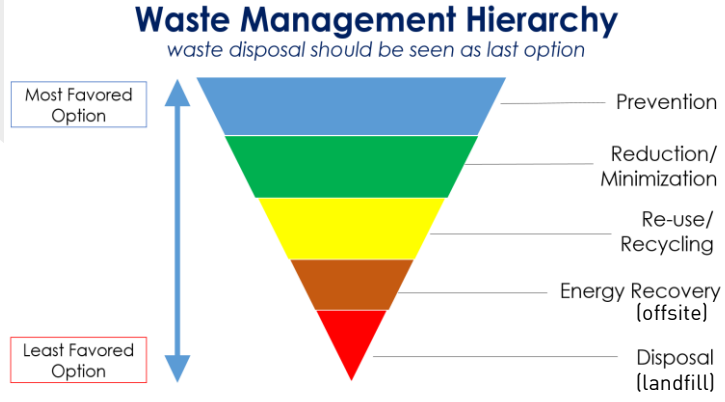
Rainwater harvesting system
(Adapted from source: G. Mackett Construction & Groundwork Limited)

WASTE

REDUCE, REUSE & RECYCLE

INTRODUCTION

- adidas has developed a Waste Management Guideline in 2018, stating the Waste Management Strategy with the details of different requirements on:
  - Waste Management Systems
  - Storage, Tracking and Disposal
  - Minimization Strategies
- This guide presents waste management, segregation, minimization and recycling opportunities that are widely adopted / scalable / replicable across diffirent facilities. Suppliers should prioritize waste handling strategies according to below chart:



- Conducting waste gap analysis assessment would help suppliers to identify and quantify potential opportunities.

WASTE SAVINGS

#	Category	Waste Management & Savings Opportunities	Page #
WA-01	Materials Management	Reduce packaging materials by improved purchasing practices (bulk purchase, etc.)	77
WA-02		Print paper double side	77
WA-03		Apply plastic free rules in canteen and offices, use reusable articles only	77
WA-04		Check incoming material quality to reject defects at the beginning	77
WA-05		Work with material suppliers to provide right material dimensions	78
WA-06	Waste Minimization	Ensure proper segregation of waste streams (increase the market value of the waste)	79
WA-07		Return leftovers, cut scraps, etc to material supplier to be recycled or reuse	79
WA-08		Purchase chemicals in returnable/reusable drums/containers	79
WA-09		Purchase yarn on returnable/reusable plastic cones	79
WA-10		Reduce wastewater treatment plant sludge by advanced treatment and/or sludge dewatering	80
WA-11		Organic waste composting system	81
WA-12	Recycle / Reuse / Recover to Energy	Internal Reuse of textile cut scraps in cleaning, spill containment, etc.	82
WA-13		In-house waste recycling systems (Rubber, EVA, etc.)	83

APPLY GOOD MATERIALS MANAGEMENT PRACTICES

WA-01 to WA-04

Background

- Applying good materials management practices will help reducing amount of materials needed.

Opportunity ('How to')

1. Engage with material suppliers to understand which materials can be packed and delivered with less and recyclable/reusable packaging materials.
2. Engage with all departments to understand the disposable plastic usage for non-production processes (workers water bottles/cups, plates used in canteen, etc). And investigate how to replace those disposable plastics with long-life materials.
3. Engage with waste disposal companies to see opportunites if wastes segregated into specific types, they will get a better market value and easier to recycle / reuse.
4. Check incoming material quality to reject defects at the beginning
5. Develop procedures and deliver trainings to support those actions.

Some of the Materials and Waste Management Practices
Reduce packaging materials by improved purchasing practices (bulk purchase, etc.)
Apply plastic free rules in canteen and offices, use reusable articles only
Print papers double-sided
Check incoming material quality to reject defects at the beginning
Do not pass the defective components to the next working station and reduce defective finished products at the end

Benefits

- Waste minimization and avoiding Landfilling
- Avoid cost of materials and disposal

Waste Reduction	1-5%
Plastic Waste Reduction	5-20%

WORK WITH MATERIAL SUPPLIERS TO PROVIDE RIGHT MATERIAL DIMENSIONS

Background

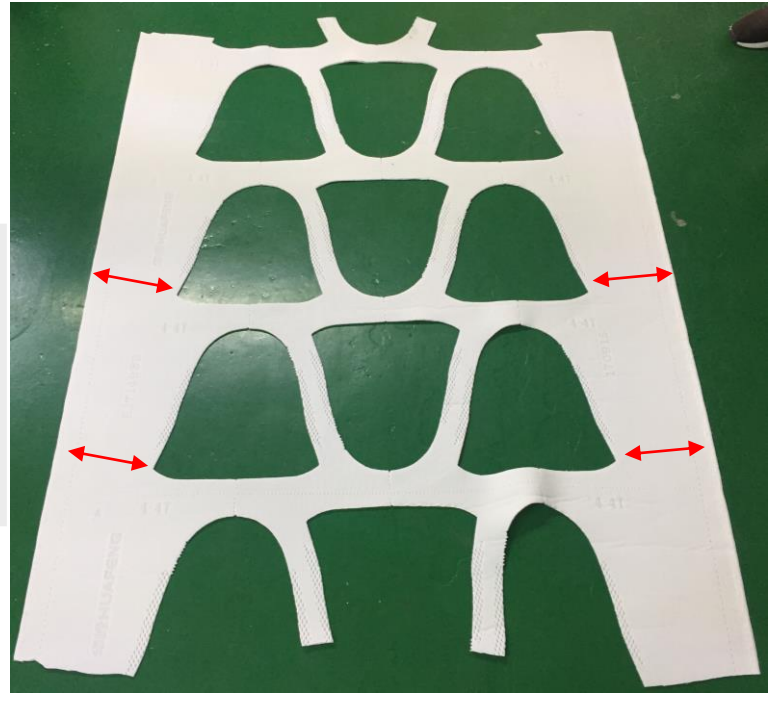
- Suppliers provide materials with some cutting margins at sides. These margins are accepted wastes and should be minimized.

Opportunity ('How to')

1. Check materials being recieved by rolls which are subject to cut.
2. Analyze the technical capacity to determine the right margins at sides.
3. Check if the cutting technology can be improved to minimize cutting margins.
4. Contact material suppliers to set the max width of the materials.
5. Develop a procedure to check the coming materials accordingly.

Benefits

- Waste and materials minimization



Waste Reduction	5-10%
Payback Period	0-12 months

WA-06 to WA-09

APPLY TAKE BACK POLICY WITH MATERIAL SUPPLIERS WHERE APPLICABLE

Background

- Leftover fabric, scraps from cutting, chemical containers and cones/rolls can be collected back and reused by material suppliers, which otherwise may become waste in your facility.

Opportunity ('How to')

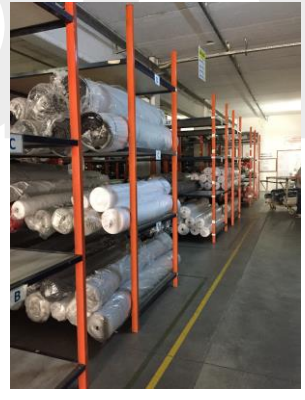
1. Engage with material suppliers to understand which materials they would take back
2. In most cases delivery truck of the suppliers would collect the take back materials from previous deliveries
3. Check local regulations for chemical containers
4. Embed this into selection criteria for new material suppliers

Benefits

- Waste minimization and avoiding Landfilling
- Avoid cost of disposal
- In some cases material suppliers may reduce the supplied material cost if you can segregate and collect the materials according to their requirements.

Waste Reduction	1-5%

Potential Take Back Opportunities	
Ensure proper segregation of waste streams (increase the market value of the waste)	
Return material leftovers and cut scraps to material suppliers	Reuse or / recycle
Purchase chemicals in returnable/reusable drums/containers	Refill / recycle
Purchase yarn/fabric on returnable/reusable cones / rolls (plastic)	Reuse



Leftover warehouse in one facility

REDUCE WWTP SLUDGE BY ADVANCED TREATMENT AND/OR SLUDGE DEWATERING

Background

- Onsite wastewater treatment plants will generate sludge which can be classified as hazardous or non-hazardous depending on local regulations and the characteristics. Sludge volume can be reduced by advanced treatment techniques or sludge dewatering.

Opportunity ('How to')

1. Contact wwtp vendors/consultants for applicable technique to reduce sludge volume.
2. Check feasibility with the cost of sludge disposal.
3. By dewatering, calorific value of the sludge may increase and can be sent to companies which use it as a fuel (mostly cement factories)

Benefits

- Waste minimization and avoiding Landfilling
- Avoid cost of disposing

Waste Reduction	5-20%
Sludge Waste Reduction	20-50%
Payback Period	12-24 months

Screw press filter + Sludge Dryer in a Textile Mill

ORGANIC WASTE COMPOSTING

Background

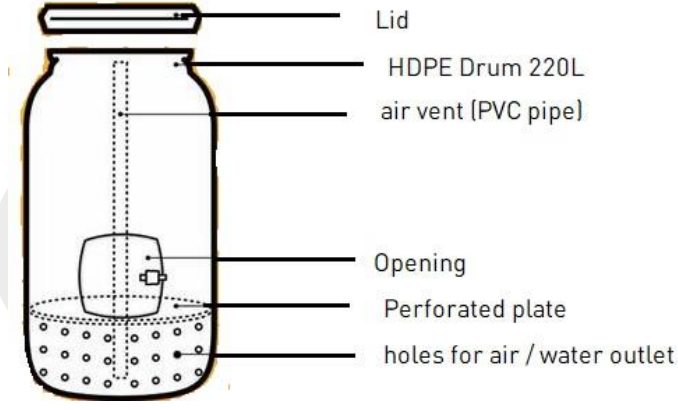
- After applying all measures to minimize organic waste generation in the facility, instead of landfilling, organic waste can be composted inside the facility.

Opportunity ('How to')

1. Analyze the sources that generates organic waste within the facility and use all measures to minimize this waste.
2. Engage with organic waste composting vendors available to your location.
3. Choose from in-house or external composting options if available.
4. Segregate and collect the organic waste seperately to be composted in the system.

Benefits

- Waste minimization and avoiding Landfilling
- Avoid cost of disposing



Utilizing 220 L HDPE Drum as Organic waste composter

Waste Reduction	5-15%
Organic Waste Reduction	50-90%
Payback Period	12-24 months

WA-12

INTERNAL REUSE OF TEXTILE CUT SCRAPS IN CLEANING, SPILL CONTAINMENT, ETC.

Background

- Some of the waste materials can be re-used internally for other purposes which prevents buying new materials and reduces the waste

Opportunity ('How to')

1. Analyze procured materials for internal uses which can potentially be replaced by clean waste materials
2. Check if the waste material type suitable for the requirements of the procured material
3. Develop a procedure to segregate and store the waste materials for internal re-use

Benefits

- Waste minimization and avoiding Landfilling
- Avoid cost of new materials

Potential Internal Re-use Opportunities
Cleaning materials
Spill containment and absorber
Hand towels at washrooms
Tablecloth at canteens

Waste Reduction	1-2%

IN-HOUSE WASTE RECYCLING SYSTEMS

Background

- When material is not contaminated and well segregated from others, it is more practical to recycle and re-use it (plastics, rubber, EVA, etc). Some waste types can be recycled by physical processing and some types may need chemical processing.

Opportunity ('How to')

1. Analyze the waste types and volumes available in the facility.
2. Contact waste recycling vendors / consultants.
3. Analyze if the recycled waste materials can be used inside facility by means of quality requirements or to be used for other purposes.
4. Contact adidas materials teams / sourcing if the recycled materials can be used in production.
5. Check feasibility of the system and update waste management procedures / practices to segregate specific waste types.

Benefits

- Waste minimization
- Avoid cost of new materials
- Avoid cost of disposal

Waste Reduction	5-25%
Payback Period	12-24 months

RENEWABLE ENERGY

MEASURES & OPPORTUNITIES

INTRODUCTION

Climate change is one of this century's greatest challenges, and adoption of renewable energy has been an industry trend for minimizing carbon footprint in the production processes.

Transition to clean and also renewable energy is not only to decrease the carbon emission but also to decouple from fossil fuel dependence.

This section outlines few applicable on-/off-site renewable energy opportunities in adidas' supply chain. Since the technology is changing rapidly, facility can consider the feasibility of adoption in long term to get the full benefit of renewable energy investment.

RENEWABLE ENERGY OPPORTUNITIES

#	Category	Opportunity	Page #
RE-01	**Onsite**	Solar photovoltaic system	87
RE-02		Biomass boiler	88
RE-03	**Offsite**	Virtual power purchase agreement (VPPA)	89-90

SOLAR PHOTOVOLTAIC (PV) SYSTEM

Background

- Decreases in PV capital and installation costs make onsite PV a cost effective power generation option for suppliers in some countries.

Opportunity ('How to')

1. Solicit desktop analysis of PV potential from local developer or consultant to provide estimate of PV system sizing, yield and payback.
2. Select preferred financing model (e.g. system procurement, lease, onsite power purchase agreement).
3. Develop detailed procurement specifications including structural analysis.
4. Issue Request for Proposal (RFP) to qualified vendors.

Benefits

- Ease of design and installation;
- Carbon footprint reductions;
- Long-term fixed cost electricity supply; and
- High levels of reliability and supply stability.

Purchased electricity consumption savings	5-40% depending on facility type*
Payback period	5-10 years
Technology availability	High

Rooftop PV array (Source: BayWa r.e.)

Location	Annual kWh / installed kWp
HCMC	1,421
Jakarta	1,326
Guangdong province	1,188
Zhejiang Province	1,107
Phnom Penh	1,529
Kaohsiung, Taiwan	1,315

Table illustrating solar yield in different manufacturing regions

*: Tier 1 facilities will have the greatest reduction potential as their ratio of rooftop area to electricity consumption is higher than for other facilities.

BIOMASS BOILER

Background

- Biomass can be used as a source of fuel for boiler combustion to facilitate renewable energy adoption.
- Most of South East Asia countries have access to low cost biomass.

Opportunity (How To)

1. Conduct a feasibility study of replacing the existing boiler with a biomass boiler.
2. Evaluate other environmental impacts, in particular air quality of boiler emissions and impact of solid waste, which need to be carefully monitored and controlled.
3. Evaluate if a reliable fuel supplier and sufficient on-site storage space are available.

Benefits

- Reduced carbon emissions compared to fossil fuels; and
- Cost savings due to reduced fuel costs.

Payback period	Variable depending on local pricing and fossil fuel alternatives
Technology availability	High

Biomass boiler in dye mill

Energy source	Rice husk (tonne)	Palm shell (tonne)	Sawdust (tonne)
Coal (1 tonne)	1.8	2.7	2.0
Natural gas (1 mmbtu)	0.05	0.08	0.06
Heavy oil (kL)	2.0	3.1	2.3

Summary table of equivalency between different energy sources

VIRTUAL POWER PURCHASE AGREEMENT

Background

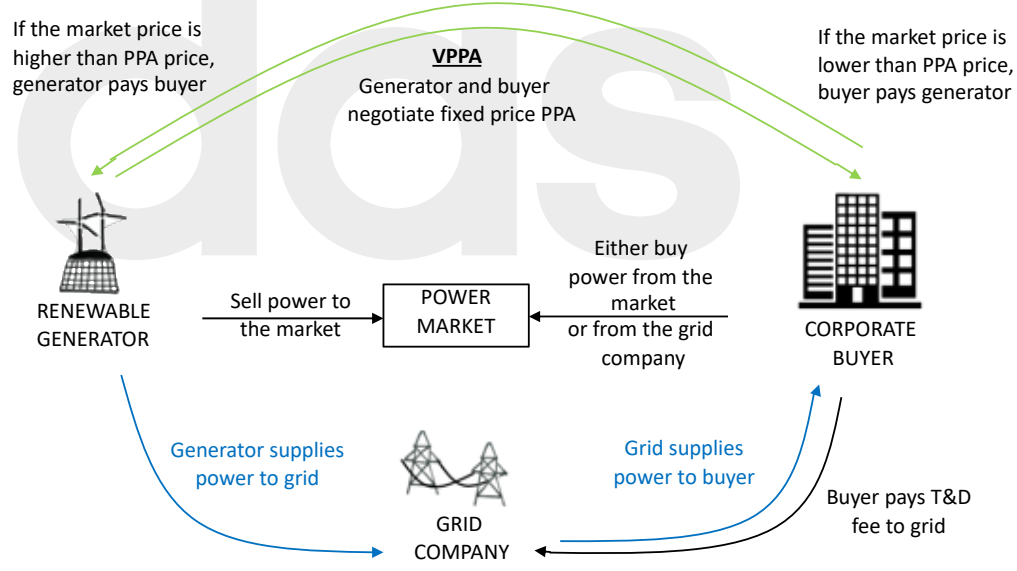
- A Power Purchase Agreement (PPA) is a contract whereby a buyer agrees to purchase renewable electricity directly from a generator.
- There are two types of PPAs:
  - Onsite or direct-wire PPA: The PPA is signed with a power system developed at the factory or with a physical power connection; and
  - Virtual PPA (VPPA): The PPA is signed with an offsite power generator using the same electricity grid.

Opportunity

- Sign a VPPA with a developer to generate renewable energy.
- PPA length is typically 10 – 20 years depending upon country power tariff.
- Note that availability of VPPAs varies by country. The next slide shows the feasibility of VPPAs in ten of the largest adidas producing countries.

Benefits

- No upfront capital investment required;
- Cost savings from utility tariff;
- Long-term visibility into and stability of electricity costs; and
- Carbon footprint reductions.



ANALYSIS OF VPPA AVAILABILITY FOR KEY PRODUCING COUNTRIES

Country	VPPA availability	Notes
Brazil		Limited use but large scale PPAs for hydro and biomass have been signed.
Cambodia		Unlikely to become available soon due to immaturity of power market. Onsite PPAs are available.
China		Corporate VPPAs under development but not currently available. China-specifc alternative procurement options under development. Evolving but uncertain regulatory environment.
El Salvador		Corporate PPAs are not currently being considered by ElSalvadorean regulators.
Indonesia		Maturing renewables markets but no legal facility yet under discussion for corporate VPPAs.
Mexico		Corporate VPPAs are available to manufacturers in Mexico. The "Wholesale Electricity Market" allows easy transactions between generators and customers.
Pakistan		Corporate PPAs are not currently being considered by Pakistani regulators.
Taiwan		Government regulations permit VPPAs but current government subsidy structure makes VPPAs more expensive than conventional power and therefore uptake is expected to be limited in the short-term.
Thailand		The Energy Regulatory Commission recently approved a system to oversee PPA proposals between 10 and 50 MW.
Vietnam		First VPPA pilot program is expected to launch in 2019.

Legend

- VPPAS are currently available.
- Corporate procurement is on the regulatory agenda and options are likely to improve in the next 3-4 years.
- No significant regulatory moves towards enabling VPPA or similar corporate procurement options.

USEFUL LINKS

ADDITIONAL INFORMATION FOR SAVING OPPORTUNITIES

INTRODUCTION

This section contains supplementary links to useful websites other than the links provided in the individual sections which provide further information on environmental management and resource efficiency. Suppliers may use these resources at their own perusal.

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USEFUL LINKS

ENVIRONMENTAL MANAGEMENT SYSTEM

Various tools and information on EMS application

http://gemi.org/

http://gemi.org/solutions/solutions-interactive/iso-14001-2015-checklist/

GREEN BUILDING

US Green Building Council Website for LEEDv4.0 and higher:

https://new.usgbc.org/

Green building information and benchmark

https://www.greenbuildingsolutions.org/

USEFUL LINKS

ENERGY EFFICIENCY
Publication and tools for manufacturing industry https://www.energy.gov/eere/amo/software-tools

WASTE
Waste minimization and resource efficiency
http://www.wrap.org.uk/collections-and-reprocessing
Resource Efficiency and cleaner Production network
http://www.recpnet.org/kms-documents/

WATER SAVING TOOLKIT
https://www.waterwise.org.uk/resource/water-saving-toolkit/

RENEWABLE ENERGY
International Renewable Energy Agency (IRENA)'s country profile for renewable energy opportunity
http://resourceirena.irena.org/gateway/#
Estimate solar PV production and grid connected system
https://pvwatts.nrel.gov/
RETSCreen (CAN) Excel-based clean energy project analysis software tool for quick technical and financial viability for renewable energy project (PV, biomass, etc)
https://www.nrcan.gc.ca/energy/software-tools/7465

REFERENCE LIST

Slide 19-23:
Content in wastewater section is adapted with permission from **ZDHC Wastewater guideline** obtained from
https://www.roadmaptozero.com/fileadmin/pdf/Files_2016/ZDHC_Wastewater_Guidelines.pdf

Slide 25-29:
Content in Green Building section is adapted from **LEED v4 Building Design and Construction** obtained from:
https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version

Slide 26:
Project scorecard for LEED BD+C is adapted from: Baillargeondoors.com. (2019). [online] Available at:
http://www.baillargeondoors.com/download/LEED-v4--Project-Checklist.pdf

Slide 29:
Case study of LEED implementation and savings in environment and energy is compiled from below sources:
Environment – plummyfashions. [online] Available at: http://plummyfashions.com/environment
Plummy Fashions Ltd | U.S. Green Building Council. [online] Usgbc.org. Available at:
https://www.usgbc.org/projects/plummy-fashions-ltd?view=overview
Textile News, Views & Articles. (2019). *Plummy Fashion Ltd. Inspiration of green industry in the world*. [online] Available at:
http://textilefocus.com/plummy-fashion-ltd-inspiration-green-industry-world/

REFERENCE LIST

Slide 39
Cost of comparison from different lightbulb is excerpted from: Green Is Better Inc. (2019). *Light Bulb Showdown: LED vs. CFL vs. Incandescent – Green Is Better Inc.*. [online] Available at: http://greenisbetterinc.com/light-bulb-showdown-led-vs-cfl-vs-incandescent

Slide 42
TPM conceptual model in Slide 42 is adapted from Leanproduction.com. (2019). *TPM is a Process for Improving Equipment Effectiveness | Lean Production*. [online] Available at:https://www.leanproduction.com/tpm.html
Case study on TPM and energy improvement is obtained from SENTHILKUMAR, B & Thavaraj, Samuel. (2014). AN EVALUATION OF TPM IMPLEMENTATION IN CLOTHING INDUSTRY IN INDIA-A LEAN PHILOSOPHY BASED APPROACH. International Journal of Industrial Engineering & Technology (IJIET). 4. 11-18.

Slide 44
Figures in the table is obtained from *EFFECT OF INTAKE AIR TEMPERATURE ON POWER CONSUMPTION IN A COMPRESSOR*. Available at: http://mechanicalgalaxy.blogspot.com/2014/11/effect-of-intake-air-temperature-on.html

Slide 46
Associated cost of leak on compressed air system is calculated from online tool in *Henkel Adhesives: We Make It Happen*. [online] Available at: https://www.henkel-adhesives.com/uk/en.html (accessed on August 2018)

REFERENCE LIST

Slide 47
Engineeringtoolbox.com. (2019). *Steam Consumption for some Typical Steam Heated Consumers*. [online] Available at: https://www.engineeringtoolbox.com/steam-consumption-d_289.html

Slide 48
Data in Heat loss estimation table derived from:
https://www.energy.gov/sites/prod/files/2014/05/f16/steam2_insulate.pdf

Slide 50
Recommended Oxygen content for effective combustion can be seen at
Combustion Efficiency and Excess Air. [online] Available at: https://www.engineeringtoolbox.com/boiler-combustion-efficiency-d_271.html

Relation of excess air with combustion efficiency graph adapted from: *Combustion Efficiency and Excess Air:Optimizing boilers efficiency is important to minimize fuel consumption and unwanted excess to the environment*. [Online]
https://www.engineeringtoolbox.com/boiler-combustion-efficiency-d_271.html

REFERENCE LIST

Slide 56
Table of *Minimum Requirements Electric Motors worldwide is adapted from* Iec.ch. (2019). IEC – https://www.iec.ch/perspectives/government/sectors/electric_motors.htm

Slide 66
Correlation water leak and associated cost is adapted from Chwd.org. (2019*). Water Efficiency | Citrus Heights Water Distric*t. [online] Available at: http://chwd.org/our-water/water-efficiency

Slide 73
Schematic illustration of Rainwater harvesting system is adapted fro*m:* https://gmconstructionkent.co.uk/rainwater-harvesting-systems/


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