WATER and ENERGY SAVING TECHNOLOGIES

Catalogue of solutions Available for the hospitality industry

ENI CBCMED
Cooperating across borders in the Mediterranean

Project funded by the EUROPEAN UNION

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

GREENinMED

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Hotel Water User/ Consumer

a. Guest room and public toilets

a.1 Faucets

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Water
Tap Aerator
water savers

Tap aerators are also known as **flow regulators**. The aerator is a small attachment that either fits onto the end of the tap or can be inserted inside of the existing spout. Tap aerators will control the amount of water that flows through the tap without affecting the water pressure as they mix the water with air. The aerator acts as a sieve, separating a single flow of water into many tiny streams which introduces the air into the water flow. Due to less space for water, the water flow reduce, resulting water saving.

Potential use in hotel industry

- Guest Rooms bathroom
- Public toilets
- Kitchen taps

Advantages	Disadvantages
Water pressure changes aren't noticeable by most people	Filling the sink to wash dishes, may take twice as long
Estimated saving is up to 1,274 litres of water per month	
Less use of gas or oil for water heating	
Lowering water bills	

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Water
Tap Aerator
water savers

Part 2 –Performance, Case studies

Water used in hotels and other lodging facilities accounts for approximately 15% of the total water use in commercial and institutional buildings in the United States.
The installation of Tap Aerators guarantees a reduction of at least 20% water-usage and perform similar or better than standard models.

Since each water savings program includes several upgrades of accessories, there are cases that only overall savings in water and costs can be shown and not each accessory by separate.
Case study 1 : Arby's Restaurant Group, a restaurant chain in the U.S and other countries (3,300 total sites including franchises) - installed high-efficiency tap aerators on hand sinks in all its restaurants • Water Savings = 107 million gallons of water between 2011 to 2016 • Costs savings= $1,200,000 between 2011 to 2016 (water and wastewater).

Case study 2 : Shari's Café and Pies, a 24-hour restaurant chain with 95 locations in the Pacific Northwest, U.S – installed 520 water-efficient tap aerators on kitchen and bathroom sinks. Kitchen sink aerators provide 1.5 gallons of water per minute (GPM) and bathroom sink aerators flow between 0.5 and 1.0 GPM• Water Savings (for tap aerators only) = 5,000,000 Gallons per year • Costs savings (for tap aerators only)= $300,000 per year in utility costs.

Part 3 –Companies manufacturing/implementing the technology

- NEOPERL , https://www.neoperl.net/en/oem/products/aerators/productlines.html
- Save water save money, https://www.savewatersavemoney.com/

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Water
Automatic faucets
water savers

An automatic faucet is equipped with a proximity sensor and mechanism that opens its valve to allow water to flow in response to the presence of a person's hands in close proximity. The faucet closes its valve automatically after a few seconds or when it no longer detects the presence of a person's hands. The proximity sensor works with batteries.
There are different faucets types: Motion sensor, Touch sensitive, Infrared.

Potential use in hotel industry

- Public toilets
- Kitchen taps
- Guest Rooms bathroom

Advantages	Disadvantages
Reducing water waste, uses the precise amount of water needed	Requires maintenance unlike manual taps
Hygienic and promotes germ-free environment	
Saves up to 50% on water consumption compared with manual taps	

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Water
Automatic faucets
water savers

Part 2 –Performance, Case studies

Several types of automatic or semi-automatic controlled taps are available :

Mechanical controlled valves

The water flow is triggered by a simple press of the user on the push button and stops automatically after a determined period.

Delayed controlled valves

A Start / Stop function enables optimize the amount of water used. The water is triggered by a simple touch of the button and stops after a pre-programmed time or at any time by a second touch of the button.

Electronic ,fully automated taps

The faucets deliver precisely the right amount of water required for each use. Without contact with the tap, the flow of water starts when a movement of the hands is detected and stops automatically when the hands are removed.

Water flow can be regulated to flow of 3 lit/min

Part 3 –Companies manufacturing/implementing the technology

- Presto, http://www.presto.fr/groupe/technologie-robinetterie
- Sanela, https://www.sanela.eu/infra-red-washbasin-taps

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Water
Washer Regulator/Restrictor
water savers

Washer regulator has dual function: **sealing and flow regulating**. A flexible turbine for secure positioning fits in various tube diameters. Typical applications are 1/2" shower handles, bib and pillar taps (male thread); these units can easily be equipped with the flexible silicone adapter before installation. There are different sizes for different heads. Important to know in advance which size fits.

Potential use in hotel industry

- Shower handle
- Kitchen and garden taps
- faucets

Advantages	Disadvantages
convenient and inexpensive	According to some users, some models can make the water flow more audible
Hidden inside– and invisible from the outside	
Easy installation	

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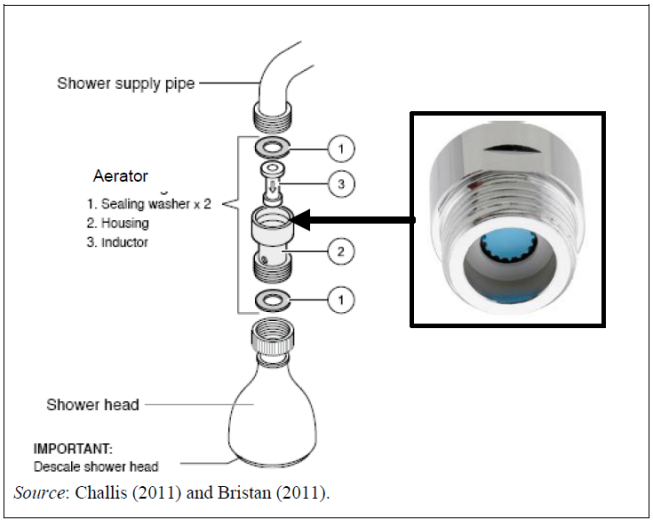
Water
Washer Regulator
water savers

Part 2 –Performance, Case studies

Table 5.10: Flow rate in response to pressure from a low-flow showerhead with flow restrictor

Pressure (bar)	0.5	1.0	1.5	2.0	2.5	3.0
Flow rate (L/min)	3.6	5.1	6.3	7.0	7.9	8.6

Source: Grohe (2011).



Source: Challis (2011) and Bristan (2011).

Figure 5.13: Installation of an aerator in a shower feed

Part 3 –Companies manufacturing/implementing the technology

NEOPERL ,
https://www.neoperl.net/en/oem/products/flowregulators/linesfeatures/pcw02washer.html
ECPLAZA ,
https://waternymph.en.ecplaza.net/products/water-saving-flow-restrictor-shower-head_3741303

Hotel Water User/ Consumer

a. Guest room and public toilets

a.2 Toilets

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Water
High-Efficiency Toilets
water savers

The principles of **high-efficiency toilet** design and operation reflect the shift from removing waste by using flush water volume to increasing flush water velocity to remove waste.
The bowl outline is more vertical to achieve the necessary increased downward velocity. It also ensures a shallow but large water surface towards the front of the bowl for adequate waste immersion. There are two types of toilets - Gravity-flow or pressure-assisted.
Key decision criteria to choose Power Flush Toilet vs. Gravity Flow: noise, number of toilets and maintenance. Power Flush Toilet make noise (becareful if it is a sleeping area) but less maintenance (more interesting if several toilets); Gravity Flow: more likely to clog

Potential use in hotel industry

- Public toilets
- Guest rooms

Advantages	Disadvantages
Reduce toilet water use by over 20% per flush	In cast iron drain lines, unlike a PVC pipe, the toilet is more likely to clog
Reduce wastewater flow and increase the available capacity of sewage treatment plants	Not suitable for non-flushable, such as paper towels
Low maintenance	

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Water
High-Efficiency Toilets
water savers

Part 2 –Performance, Case studies

The installation of High-Efficiency Toilets guarantees a reduction of at least 20% water-usage and perform similar or better than standard models.

Since each water savings program includes several upgrades of accessories, there are cases that only overall savings in water and costs can be shown and not each accessory by separate.

Case study 1 : Hilton Palacio del Rio Hotel, San Antonio, Texas - replaced 525 standard toilets which consume 5 gallons per flush (GPF) with High-Efficiency toilets 1.28 GPF • Water Savings = 26,000,000 Gallons • Costs savings= $80,000. **Simple Payback Period – in less than two years.**

Case study 2 : Holiday Inn San Antonio International Airport - replaced 297 standard toilets which consume 3.5 gallons per flush (GPF) and 100 standard toilets which consume 5 GPF with High-Efficiency toilets 1.1 GPF • Water Savings = 7,000,000 Gallons • Costs savings= $35,000. **Simple Payback Period – in less than two years.**

Part 3 –Companies manufacturing/implementing the technology

- American Standard, https://www.americanstandard.ca/bathroom/toilets?Features=WaterSense%20Certified,Water%20Efficient&page=1&plimit=21
- Ideal Standard , https://www.idealstandard.fr/accueil.html
- Dual flush conversion mechanism, https://www.fluidmaster.com/products/toilet/flush-valves/550dfrk-dual-flush-conversion-system/
- Vacuum toilet, https://jetsgroup.com/jets-group/the-highest-standards/vacuum-toilets

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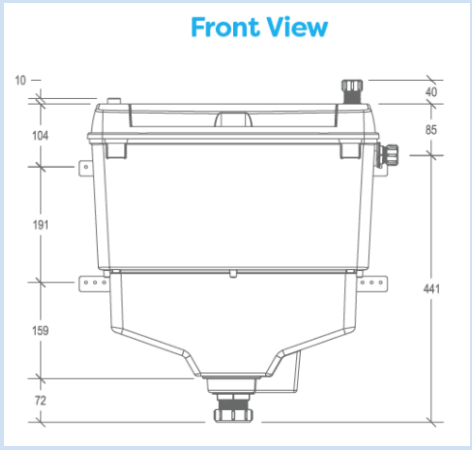
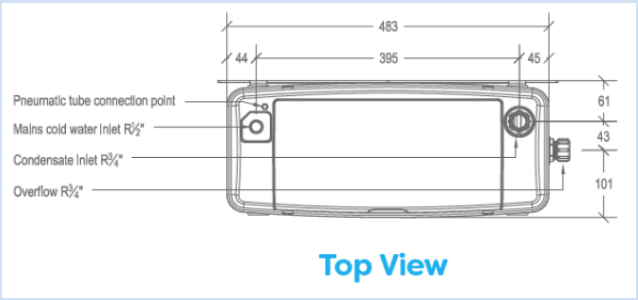
Water
Encore Cistern: Environmental Condensate Recovery System

Water savers

Encore Cistern, an Environmental Condensate Recovery system uses condensate to provide flushing water for use in bathrooms and restrooms. The system has an extra filling connection allowing the introduction of the separate water source (air conditioning unit). The dual-chamber design holds three times more water than a conventional cistern. When flushed, the lower chamber is emptied and then refilled with condensate from the upper chamber.





Potential Use in Hotel Industry

- Water efficient alternative to conventional toilet cistern
- Air conditioning condensate recovery and reuse
- Water savings

Advantages	Disadvantages
Can be used in any concealed toilet installation (retrofit or existing)	Special plumbing requirements
Simple in function	More complicated installation and extra plumbing costs
Compatible with industry standard rack mounting	
Adjustable water usage	
Cost savings	

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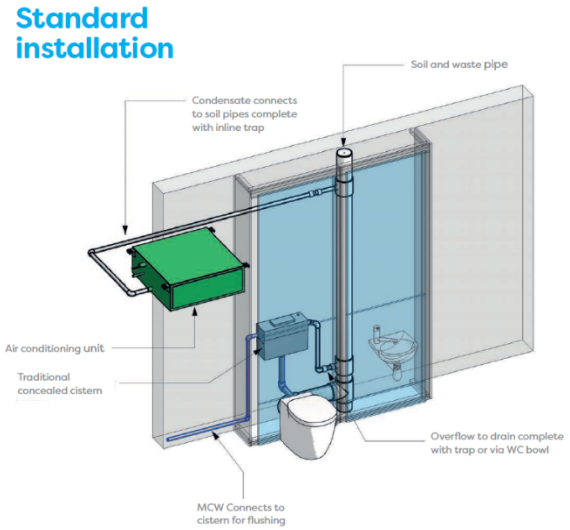
Water
Encore Cistern: Environmental Condensate Recovery System
Water savers

Part 2 –Performance, Case studies

Multinational construction firm cuts its toilet water use by more than 75% with Encore : earlong performance data collated at the company's North West England office headquarters shows standard cisterns in the same toilet block each used 61,806m³ of water.

Encore, which is the world's only cistern to use condensate from air conditioning units to flush the toilet, used just 14,695m³ – 76.2 per cent less.



Part 3 –Companies manufacturing/implementing the technology

Encore cistern, http://www.encorecistern.com/about-us/

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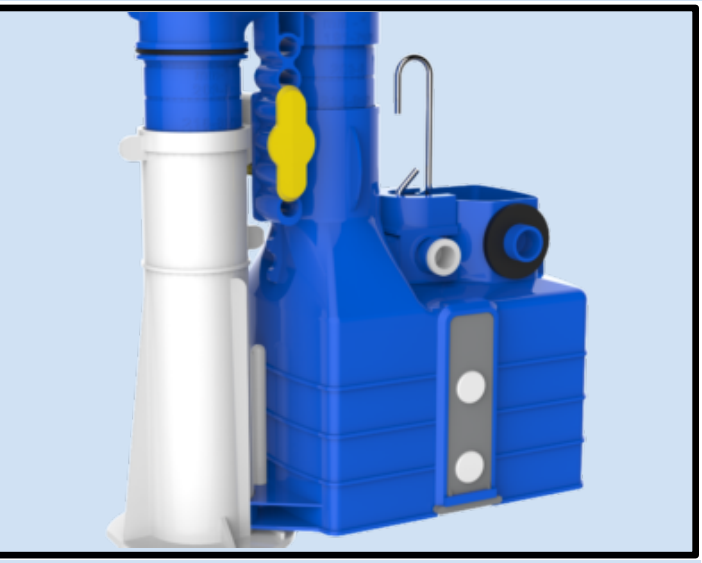
Water
Toilet Restrictors
water savers

Toilet restrictors reduce the amount of flushed water by reducing the tank capacity. There are several toilet restrictors: Dual flush syphon, Variable flush (fills the tank with air instead of water), Tank bank.



Potential use in hotel industry

- Public toilets
- Guest rooms

Advantages	Disadvantages
Save 2 to 3 Litres of water every flush	Harder to install in hidden toilet
Easy installation	Less than optimal flushing. low-flow toilets tend to clog more often
No special maintenance	

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Water
Fill Cycle Diverter
water savers

Fill cycle diverter sits on the end of the fill tube inside the toilet tank. The device diverts some of the water that would go to fill the toilet bowl into the holding tank. This reduces the amount of water inside the bowl, but has no effect on the water level in the tank or the flushing power of the toilet.

Potential use in hotel industry

- Public toilets
- Guest rooms

Advantages	Disadvantages
Saves up to 2,700 gallons of water per year, per toilet	Harder to install in hidden toilet
Low costs	Might not be compatible; Noisy when diverting water
Easy installation	
Good for upgrade	

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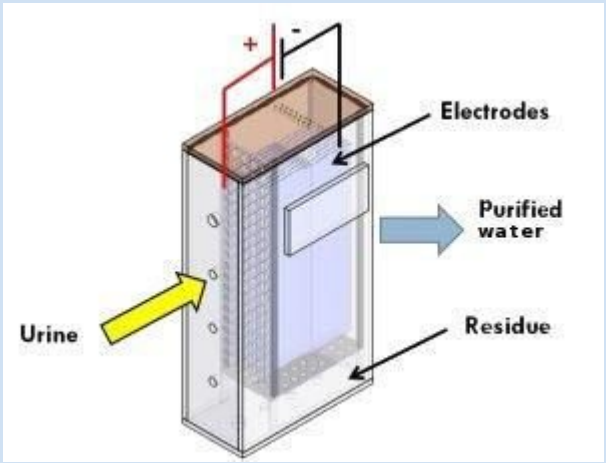
Water Recycling Toilets

water savers

After the initial use of flushing water, the water from the flush is retained treated by physico-chemical treatment processes in order to be reused for the next flushes. The filtering process disinfects the mix and kills bacteria and pathogens and lowers the ammonia concentration of urine. In the end, the process generates reusable water by an advanced treatment to the surplus water.



Potential use in hotel industry

- Public toilets

Advantages	Disadvantages
Does not create sewage	Initial investment. Return period should be calculated
Saves most of flushing water	Maintenance requirements
Contributes to the green image of the hotel	Surplus sludge removal is necessary

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Water Recycling Toilets

water savers

Part 2 –Performance, Case studies

The purification stage can last between one and four hours depending on the quantity of solids and liquids contained in the tank at the beginning of the process.
Regarding the clean water, it is treated one last time by passing through different filters (active carbon, micro-membrane). It will clean the water of all traces of bacteria. This stage also lowers chlorine concentration.
Purified water is then stocked to be re-used in the toilets. **The surplus can be used** to water plants for example.

Almost 100% water savings, however the amount of fresh water to be added and water removal requirements is not clear.

Part 3 –Companies manufacturing/implementing the technology

Weco , https://www.en.weco-toilet.com/ecological-public-toilets/functional-design/

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Hotel Water User/ Consumer

a. Guest room and public toilets

a.3 Shower

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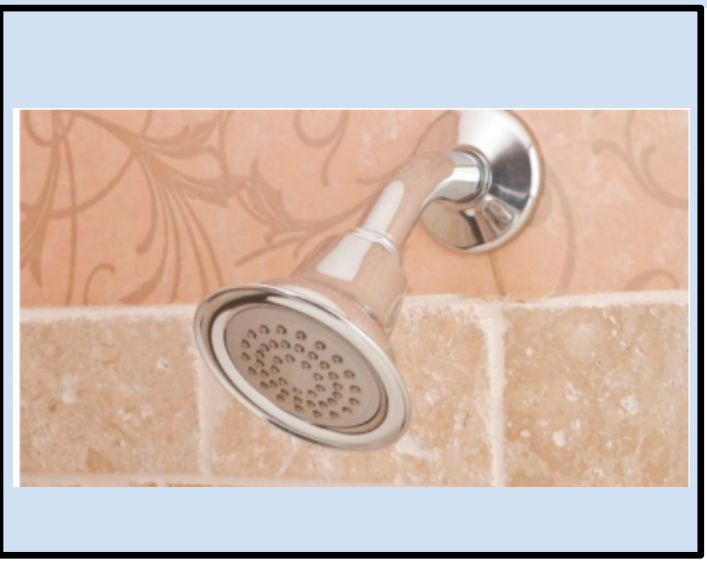
Water & Energy
Water-saving showerheads

Water & Energy savers

Water-saving showerheads designed to use 2.5 GPM or less, while also meeting performance criteria for force and coverage.
Most water-saving showerheads have 2 GPM, but some options use 1.5 GPM and capable of decreasing water consumption by 40 percent.
Showerheads use hot water, a reduction in water use will also result in energy savings.



Potential use in hotel industry

- Guest Rooms
- Public showers

Advantages	Disadvantages
Cost-savings from energy and water conservation	Lower water pressure; Slower temperature change
Compatible with existing infrastructure	
Low cost of implementation	

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Water & Energy
Water-saving showerheads

Water & Energy savers

Part 2 –Performance, Case studies

Water used in hotels and other lodging facilities accounts for approximately 15% of the total water use in commercial and institutional buildings in the United States.
The installation of Water-saving showerheads guarantees a reduction of at least 20% water-usage and perform similar or better than standard models.

Since each water and energy savings program includes several upgrades of accessories, there are cases that only overall savings in water, energy, and costs can be shown and not each accessory by separate.
Case study 1 : Hilton Palacio del Rio Hotel, San Antonio, Texas - replaced 479 showerheads flowing at 2.5 gallons per minute (GPM) with 1.5 GPM models • Water Savings = 26,000,000 Gallons • Energy Savings = 480,000 kilowatt • Costs savings= $160,000. **Simple Payback Period – in less than two years.**

Case study 2 : Holiday Inn San Antonio International Airport - replaced 397 showerheads flowing at 2.5 gallons per minute (GPM) with 1.75 GPM models • Water Savings = 7,000,000 Gallons • Energy Savings = 330,000 kilowatt • Costs savings= $68,000. **Simple Payback Period – in less than two years.**

Part 3 –Companies manufacturing/implementing the technology

- American Standard, https://www.americanstandard.ca/bathroom/shower-faucets?Type=Shower%20Heads&page=1&plimit=21

- Hydraw, https://www.hydrao.com/en/

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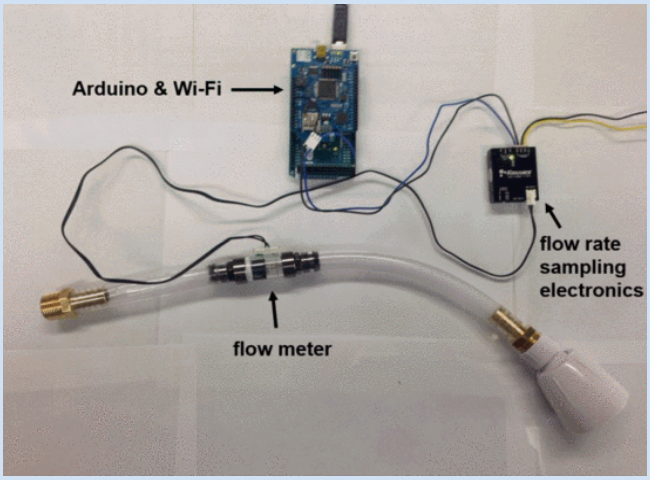
Water
Water consumption monitoring
Water save

Installing smart and device for monitoring water use from hotel room showers, which wirelessly transmits hotel guest water usage data and in some cases present it to the guests themselves promotes an increased awareness of water conservation practices among hotel guests, helping to reduce potable water consumption for hotels. The lower water consumption will also reduce energy use by decreasing the energy demand of hotel hot water heaters.



Potential Use in Hotel Industry

- Monitors individual guest water usage in showers
- Water conservation
- Energy conservation
- Public awareness
- Includes a smartphone app for guests

Advantages	Disadvantages
Minimal energy and maintenance requirements.	Limited to water monitoring of showers
Investment savings from reduced water and energy consumption	Automatic connection to a central database is still under development
Compatible with existing infrastructure	Newer technology.
Improves the green image	
Increase guests awareness	

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Water
Water consumption monitoring
Water save

Part 2 –Performance, Case studies

- **MAIN PILOT SITES**

- Hotel Vila Gale Opera, (Oct. 2016 - Dec. 2016) - Lisbon, Portugal.
- Hotel vila gale Estoril, (July 2017 - Oct 2017) - Estoril, Portugal.
- Hotel Pestana CR7, (July 2017 - Oct 2017) - Lisbon, Portugal.
- Marriott Hotel Amsterdam, (Sep 2018 - Dec. 2018) - Amsterdam, Netherlands.

- Pilot showed decreased consumptions due to guest awareness

Part 3 –Companies manufacturing/implementing the technology

Optishower, https://www.optishower.com/#tech
Lorenz, https://www.lorenz-meters.de/en/produkte/

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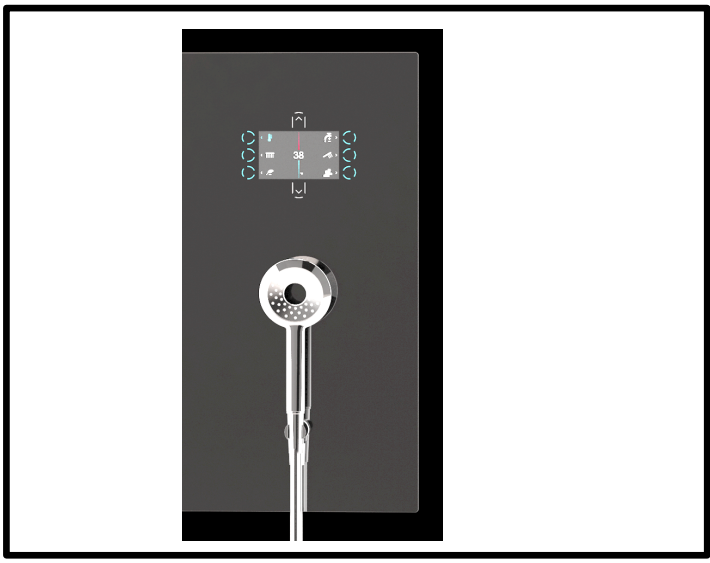
Water & Energy Controlled Shower

Water & Energy savers

Controlled shower devices include the following capabilities with regards to water savings:
Cut off when not in use : Special built-in sensors cut off the water when you don't need it, like when you're soaping up.
flow control by timer, flow meter and real-time display of water consumption and customizable controls to tailor your shower to your own needs



Potential use in hotel industry

- Guest Rooms
- Public showers

Advantages	Disadvantages
Cost-savings from energy and water conservation	Cost is higher than normal showers
"green Image" of the hotel rooms and policy	
New shower experience for users	
Hot water from the first drop	

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Water & Energy circulation shower

Water & Energy savers

A circulation shower enables the consumer to enjoy a large shower head and large water flows while saving on water and energy. In circular mode of operation, every single drop of water is used a few times. The recirculated water is filtered and disinfected and blended with small quantity of fresh water. The circular shower of the normally adds new hot water in order to correct for the decrease in temperature
Water quality has to be tested and the item should be approved by the local regulator.

Potential use in hotel industry

- Guest Rooms

Advantages	Disadvantages
Cost-savings from energy and water conservation	Cost is higher than normal showers
“green Image” of the hotel rooms and policy	Regulatory consent is necessary
Enable guest to enjoy long shows without concern	

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Water & Energy Controlled Shower

Water & Energy savers

Part 2 –Performance, Case studies

Comparison of water and energy consumption between regular and circulating shower for 8 min. shower time :

circulating shower*
Comfort: 15 liter/minute
Energy consumption: 0,9 kWh
Water consumption: 14 liter

Traditional shower*
Comfort: 8 liter/minute
Energy consumption: 2,2 kWh
Water consumption: 64 liter

Part 3 –Companies manufacturing/implementing the technology

Hamwells, https://www.hamwells.com/en/homespa/

Orbital-systems, https://orbital-systems.com/

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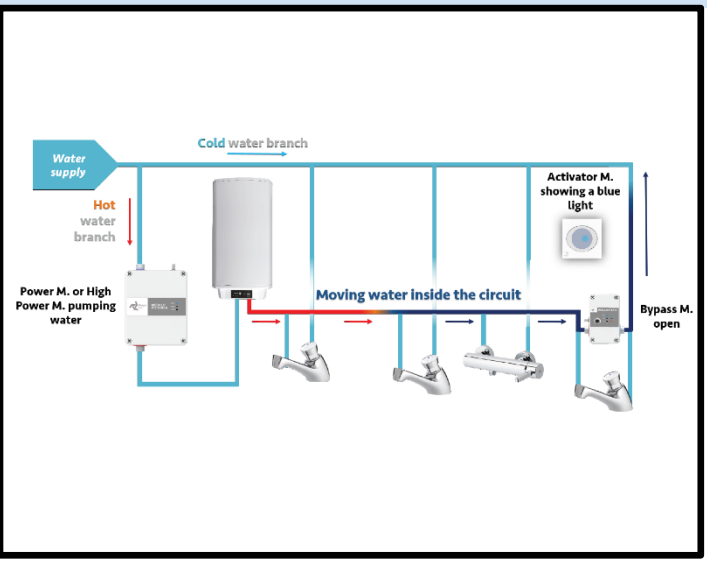
Water
Rapid hot water supply to tap*
water savers

Rapid hot water supply technology works with a device that pumps water that has cooled in the hot water pipes after the last usage, guiding it towards the cold water pipes in a recirculation process. Thus, no extra pipes or water tanks are needed, as water is only moving inside the pipes when the taps are all turned off.



Potential use in hotel industry

- Public showers
- Guest rooms

- The use may require the local regulator approval

Advantages	Disadvantages
Avoiding the previous wastage water until it becomes warm	High cost compared to saving water expenses
saves up to 56% in a typical detached house (may increase for businesses)	

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Water
Rapid hot water supply to tap*
water savers

Part 2 –Performance, Case studies

Quantity wasted when hot water is demanded: from 6 up to 25 litres (1.3-5.5 gallons) of water - perfect drinking water - in every usage. The pipe that connects the water heater with a tap is full or cold water - cold water results from previous consumption of hot water kept in the pipes

Part 3 –Companies manufacturing/implementing the technology

- Inamn, https://inman.fr/en/
- Metrica6, https://www.metrica6.xyz/news/

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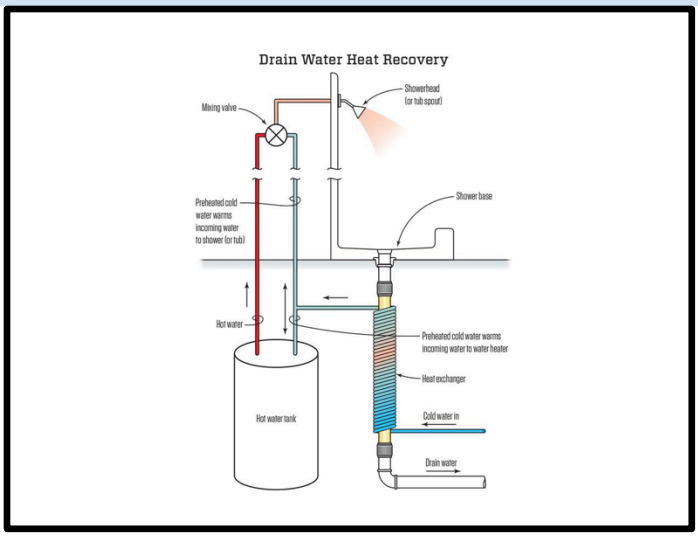
Energy/Water
Vertical Wastewater Heat Exchanger
energy saver, wastewater reuse

Vertical wastewater heat exchangers reduces hot water energy demand by preheating water for domestic use. Cold water passes through spiral pipes along the central pipe very close to the source on the sewage stacks. This along with the large contact area relative to water volume flow allows for strong temperature efficiencies (62.9%). Efficiency depends on near immediate demand for the hot water, so hotels with few guests or low demand wouldn't experience savings



Potential use in hotel industry

- **Energy savings**
- **Greywater repurpose**
- **Water heating**

Advantages	Disadvantages
High heat exchange efficiency	Shutdown stack for installation
Benefits from multiple stories	Requires cleaning
	Not fit for hotels with discontinuous hot water demand

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Energy/Water
Vertical Wastewater Heat Exchanger

energy saver, wastewater reuse

Part 2 –Performance, Case studies

http://www.diva-portal.org/smash/get/diva2:855892/FULLTEXT02

In this master's thesis a case study evaluates the possibilities for heat recovery from the wastewater of Clarion Hotel Stockholm. Three types of heat exchangers were modelled in the system dynamic modelling environment STELLA: a horizontal, a vertical and a shower heat exchanger. Recovered heat was used for pre-heating of the incoming water for domestic hot water preparation. The flows of heat through the hotel's tap water and wastewater systems were schematically modelled using system dynamic modelling, which provides a foundation for the development of mathematical models and further research into the area.

Part 3 –Companies manufacturing/implementing the technology

Showersave, https://showersave.com/vertical-wwhrs/

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Hotel Water User/ Consumer

a. Guest room and public toilets

a.4 Urinals

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Water
Urinal flushing control
water savers

The Urinal Flush Control System ensures flushing only after use. A built-in infrared PIR sensor detects persons in the toilet area and initiates a cistern fill and flush cycle a pre-set time later.
These systems are usually operated straight from the mains water supply (i.e. without a cistern) but certain models can be used with float cisterns.

Potential use in hotel industry

- Public toilets

Advantages	Disadvantages
Saves up to 80% of water costs	Requires a power supply
Maintains high level of hygiene	

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Water
Urinal flushing control
water savers

Part 2 –Performance, Case studies

A controlled urinal flushing four litres of water six times per hour, can use 105 m3 per year if operating 12 hours per day, whilst an uncontrolled urinal with a flush operational 24 hours per day could use up to 500 m3 per year.
With a use demand of 60 users, water usage per person ranges from 4 L/day for a controlled flush urinal to 13 L/day for an uncontrolled flush urinal.

Urinal flush control can be installed for a total cost of approximately EUR 200 per urinal, resulting in payback time of seven months.

Part 3 –Companies manufacturing/implementing the technology

Gentworks , https://www.gentworks.co.uk/flush-controls/

Renergise, https://renergise.ie/product-category/urinal-flushing-controls/

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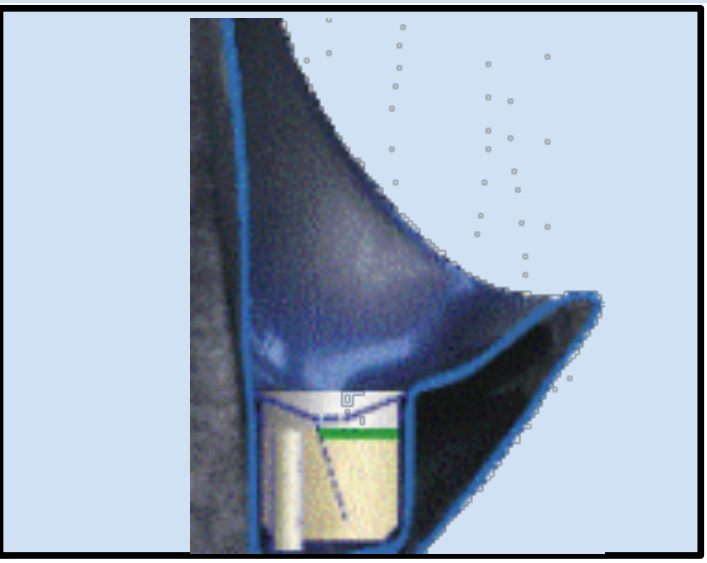
Water
Waterless urinals
water savers

A waterless urinal is designed to receive and convey only liquid waste through a trap seal into the gravity drainage system without the use of water.
In a waterless system, a trap or cylinder is placed at the bottom of the urinal and filled with a sealant. This keeps sewer odors from being released into the restroom.



Potential use in hotel industry

- Public toilets

Advantages	Disadvantages
Long lifespan and low maintenance	Requires special cleaning
Saves from 30,000 to 40,000 gallons of water per year, per urinal	Resistance and disapproval from users
	Retrofitting and installation difficulties

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Water
Waterless urinals
water savers

Part 2 –Performance, Case studies

According to “Best Environmental Management Practice in the Tourism Sector” by the European Commission - a benchmark of excellence is installation or retrofitting of waterless urinals.
Waterless urinals are universally applicable and can be realised through retrofitting existing urinal pods, troughs with modified traps or waste-pipe fans.

Potential savings for an Elementary School with 300 males and 8 urinals, where each male student uses a urinal twice daily (It was assumed that 25% of the males will use toilets due to crowding at the urinals):

School days	Gallons/ flush	Flushes/ day	Flushes/ year	Gallons/ year	Water & sewer cost/1000 gallons	Waterless Urinal First Cost Savings	Annual Savings		
							Water	Maint.	Total
180	1.0	450	81,000	81,000	$ 5	$384	$405	-$31	$374
180	3.0	450	81,000	243,000	$ 5	$384	$1215	-$31	$1184

Part 3 –Companies manufacturing/implementing the technology

WATERLESS , https://www.waterless.com/no-flush-urinals

URIMAT, https://www.urimat.com/en/products/urinals

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Hotel Water User/ Consumer

a. Guest room and public toilets

a.5 Measurement and Leaks Minimization

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Water
WCMS-Water Consumptions Monitoring System
Water Monitor

The Water Consumptions Monitoring (WCM) System is able to observe individual water consumption in public bathing facilities. The aim is to offer managers water usage information that they can use to optimize their establishment, improving water-use efficiencies to reduce water-related expenses. The WCM system includes a flow sensor, a temperature sensor and a sonar to provide information on the amount of water and energy consumed by individual users.

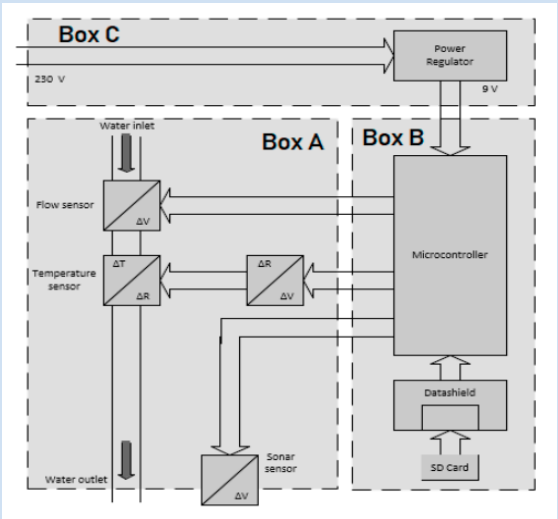

Fig 2. Representation of Box A

Potential Use in Hotel Industry

- Monitors guest water consumption
- Water conservation
- Energy conservation
- Discreet monitoring solution

Advantages	Disadvantages
Discreet monitoring: does not affect user behaviors	Provides raw data without automated information analysis
Fast and easy installation	Limited to data acquisition
Low cost with potential savings	Lacks interaction with customers
Installed in piping system so it does not affect visual esthetics	
Highly accurate: distinguishing between users	

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Water
Wireless Leak Detection w/ Automatic Shutoff
water savers

The wireless leak detection system consists of a central hub, a water shut-off valve, flood sensors, and a free, user-friendly app. If the sensor detects a leak, it signals the valve to shut off and sends its location, alarm type and valve status back to the hub. The hub sends notifications to the user via the app. Has responsive sensors with high/low temperature alerts & multiple actuators for both hot and cold water lines rated for indoor & outdoor use

Potential use in hotel industry

- **Water leak monitoring**
- **Water loss reduction**
- **Plumbing maintenance**

Advantages	Disadvantages
24/7 Monitoring	Possible build-up of scale and corrosion
Location specific alerts	Signals impacted by barrier material such as drywall v. concrete
No mandatory flow disruption	
Easy installation	

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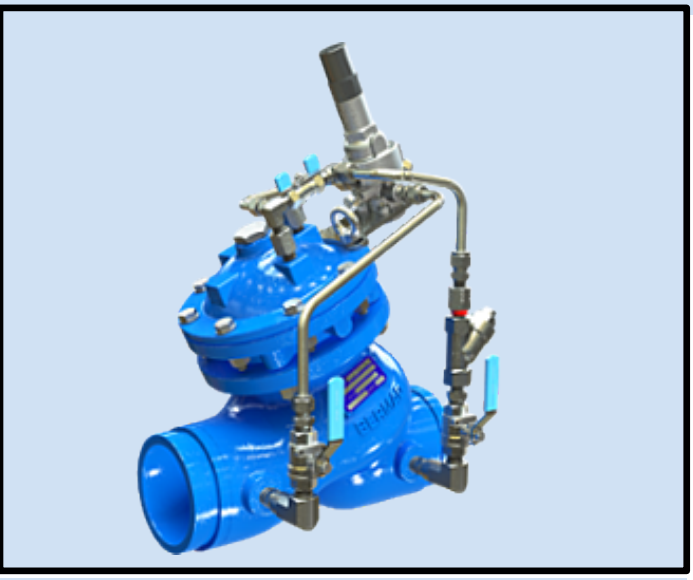
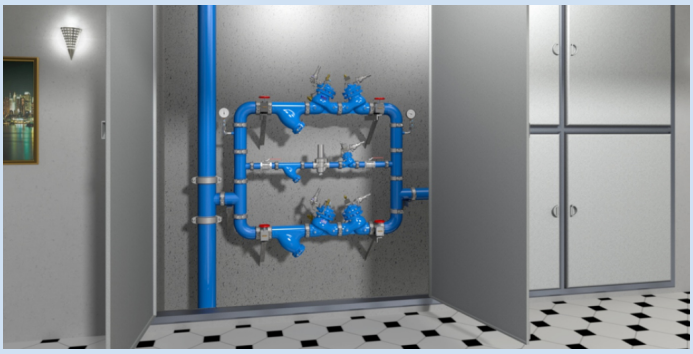
Water
Pressure control valves for Leaks Minimization
Water saver

Fixtures and pipes with low pressure grade might leak or even burst if high unwanted pressure reaches them. For this reason, appliances must be protected by pressure reducing systems to work properly for long periods of time. There are constant changes to the water demand in a building water supply throughout the day that affects the pressure. The key to a successful, cost-effective drinking water system high water consuming buildings is to install pressure safety valves in conjunction with pressure reducing valves. When there is a sudden rise in pressure, an emergency safety valve kicks in to regulate the pressure. Sometimes, a high flow rate in the system might be reduced to zero in a matter of seconds when a large fixture is turned off and this can create a water hammer. During all these flow variations, the pressure reducing systems in the building must react to regulate pressure.





Potential Use in Hotel Industry

- Controlling water pressure in each floor
- Controlling water levels in water reservoirs

Advantages	Disadvantages
Simple to implement	Space requirements
Long-term experience in pressure regulating	
Leak and pipe bursting prevention	
systems are fairly straightforward	

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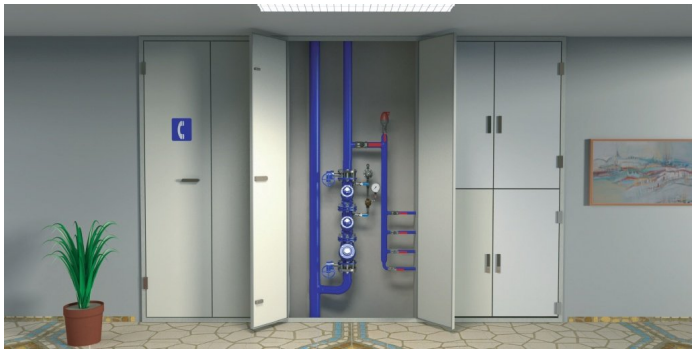
water
Pressure control valves for Leaks Minimization
Category (wastewater reuse, grey water, cooling water, smarty irrigation, water savers)

Part 2 –Performance, Case studies

Avoid excessive pressure	Install pressure reducers at relevant points and adjust to the minimum pressure sufficient to supply the maximum flow rate required at those points.	All accommodations

Source : Best Environmental Management Practice in the Tourism Sector

Hydraulically operated, diaphragm actuated pressure reducing system, consisting of a BERMAD BC-720-P PRV, the system reduces a high upstream pressure to a lower, constant downstream pressure, regardless of fluctuating demand or varying upstream pressure.



Part 3 –Companies manufacturing/implementing the technology

Bermad , https://www.bermad.com/products/buildings-constructions/potable/

Water
Leaks and water loss Minimization
Water saver

A water breaker automatically cuts the inflow of water in case of leakage or pipe bursts. The water break is also equipped with functions adapted to professional needs, notably: daily volume limitation, time programmed opening and closing. Some of which have options for Internet or technical building management connection.
Other device guarantees live monitoring and reliable results.
Another device may help to consume better and prevents leakage problems leading to overconsumption.
The smart water device permanently monitors your water consumer and cuts off water automatically in case of abnormal flow. It can protect rooms and other facilities from flooding...

Potential Use in Hotel Industry

- Prevents water loss due to leaking or bursting

Advantages	Disadvantages
Easy to install, does not need wiring or electricity supply.	False alarms may set off water breaking
Saves water and can also prevent damage of inhouse flooding	The initial investment in an auto shut off valve system is higher than both manual and remote access systems

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Water
Leaks and water loss Minimization
Water saver

Part 2 –Performance, Case studies

Leaks are water wasted with no intended use or purpose; once identified, leaks should be the first area to target from a water management perspective. Unfortunately, leaks often go undetected, particularly if a facility is not routinely monitoring its water use. On average, leaks can account for more than 6 percent of a facility's total water use.

Table 2-2. Potential Losses From Water Leaks

Malfunction	Leaking Flow Rate (gallons per minute)	Water Loss	Estimated Cost of Water Loss
Leaking Toilet	0.5 gpm	21,600 gallons per month	$2,100 per year
Drip Irrigation Malfunction	1.0 gpm	43,200 gallons per month	$4,300 per year
Unattended Water Hose at Night	10.0 gpm	5,400 gallons per day	$16,000 per year
Broken Distribution Line for: One Day One Week One Month	 15.0 gpm 15.0 gpm 15.0 gpm	 21,600 gallons 151,200 gallons 648,000 gallons	Up to $64,000 per year
Tempering Water Line on a Steam Sterilizer Stuck in the On Position	2.0 gpm	86,400 gallons per month	$8,600 per year
Stuck Float Valve in a Cooling Tower	5.0 gpm	216,000 gallons per month	$21,000 per year

Source : EPA-Watersense at work

Part 3 –Companies manufacturing/implementing the technology

- hydrelis , https://www.hydrelis.com/
- Actiral, http://www.actiral.com/innovation/

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Hotel Water User/ Consumer

b. Kitchens

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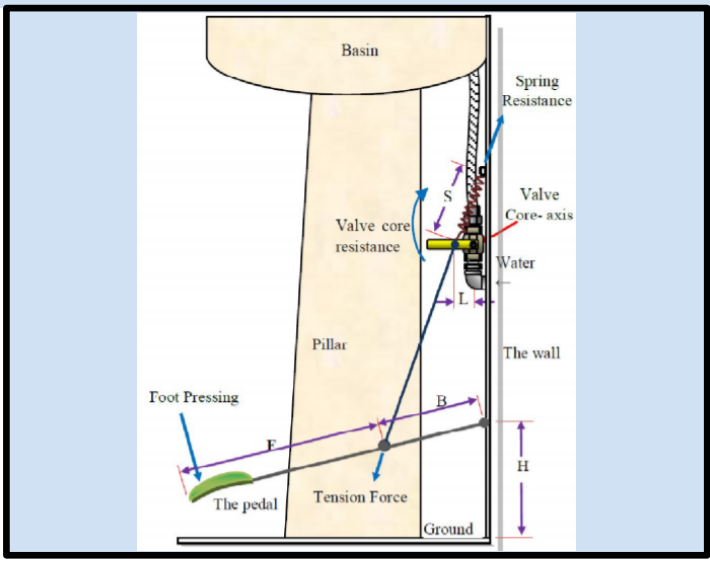
Water & Energy
Foot-Pedal operated faucet

Water & Energy savers

Foot-Pedal operated faucet requires the use of foot instead of hands, due to this method, the opening and closing operation occurs more quickly than regular taps, resulting in accurate water usage flow and decreases wastewater on every use.
Kitchens need hot water, reducing water use will reduce energy consumption for heating the water.



Potential use in hotel industry

- Kitchens
- Laundries
- Public toilets

Advantages	Disadvantages
Cost-savings from energy and water conservation	Requires space for the pedal, unlike regular taps
Compatible with existing water valves	Could be inefficient in terms of controlling water volume and temperature
Maintains high level of hygiene	

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Water & Energy
Foot-Pedal operated faucet

Water & Energy savers

Part 2 –Performance, Case studies

Example given in a Metaefficient website. In a four-person household, the use of pedal controllers in the kitchen alone can save up to 7500 gallons of water annually, as well as conserve the energy needed to heat

- **The slow timed closing foot-operated tap** avoiding water hammer.
- According to manufacturer, up to 70% water savings.

Part 3 –Companies manufacturing/implementing the technology

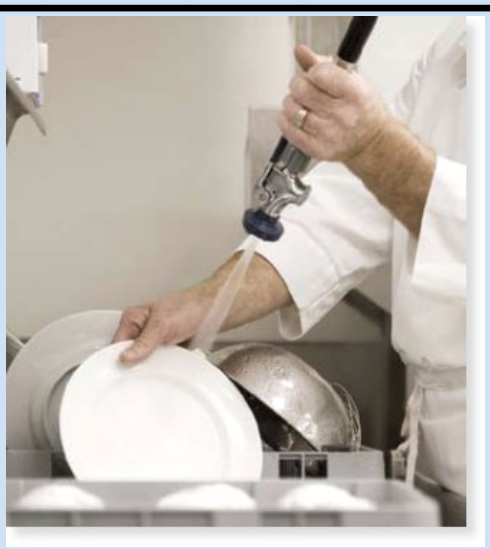
- Presto , http://www.presto.fr/presto-sol-509-robinet-encastrer-au-sol
- Roca, http://www.export.roca.com/catalogue/products/faucets/basin-faucets/self-closing/instant/foot-foot-pedal-faucet-floorstanding-505127800#!A505127800

Water & Energy
High-Efficiency Pre-Rinse Spray Valves

Water & Energy savers

High-Efficiency Pre-Rinse Spray Valves are designed to remove food waste from dishes prior to dishwashing with a maximum flow rate of 1.28 gallons per minute (GPM), unlike regular pre-rinse spray valves which have a flow rate of 1.6 gallons per minute (GPM) or more. Despite the reduction, the high-efficiency PRSV meets the required performance criteria.

Furthermore, kitchens use hot water to rinse dishes, installing a high-efficiency PRSV can



Potential use in hotel industry

- Kitchens

Advantages	Disadvantages
Cost-savings from energy and water conservation	Not compatible with existing regular valves, can replace only old PRSV
Payback period in less than a year	Inappropriate efficiency level could lead to water pressure problems and customer dissatisfaction
Retrofit programs to remain cost-effective	

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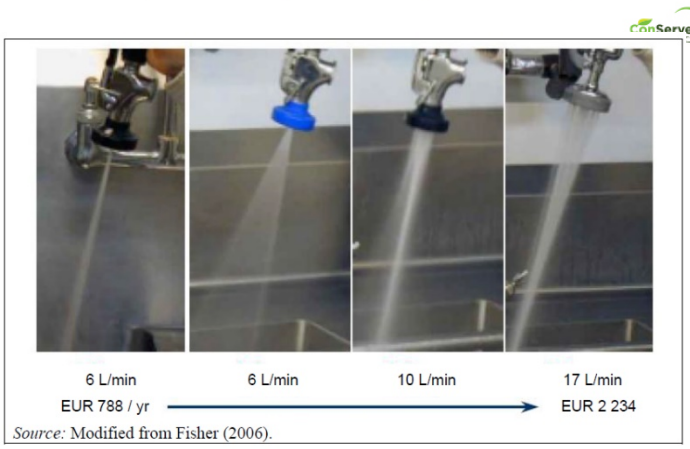
Water & Energy
High-Efficiency Pre-Rinse Spray Valves

Water & Energy savers

Part 2 –Performance, Case studies

According to the US National Restaurant Association's Conserve program: Traditional valves spray water at rates of anywhere from 2.5 to 5 gallons per minute (gpm). The recommended low-flow models use less than 1.6 gallons per minute. And the low-flow valves are designed to distribute water pressure effectively so performance isn't lost with the water savings.

Hours of Spray Valve Usage	Water Savings gallons/day	Waste Water Savings gallons/day	Gas Savings therms/day	Annual Dollar Savings
1 hour/day	60 gallons	60 gallons	0.5 therms	$300–$350
2 hours/day	120 gallons	120 gallons	1.0 therms	$600–$700
3 hours/day	180 gallons	180 gallons	1.5 therms	$900–$1050



Source: Modified from Fisher (2006).

Figure 8.21: Examples of PRSV spray patterns and flow rates, and associated annual operating costs assuming three hours per day operation

Part 3 –Companies manufacturing/implementing the technology

- T&S, https://www.tsbrass.com/sustainability/products
- Ecolab, https://www.ecolab.com/offerings/kitchen-equipment/dishmachine-parts-and-accessories/powerpulse-pre-rinse-spray-valve

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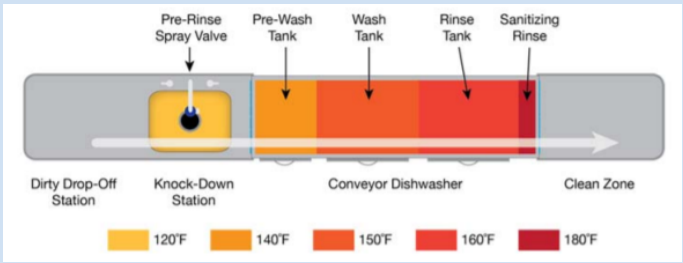
Water & Energy
Rack Conveyor Dishwashers

Water & Energy savers

Rack Conveyor Dishwashers use a motor-driven conveyor belt to move the rack loaded dishes through a large tank with separate wash and rinse compartments. This process usually uses recycled water from the final rinse. This not only reduces water use, but also reduces the amount of energy required to heat additional water.
Furthermore, all rack conveyor machines have a timer control for speed to assure proper wash and rinse times, which make conveyors more water-energy-cost effective.



Potential use in hotel industry

- Kitchens

Advantages	Disadvantages
Cost-savings from energy and water conservation (reduce energy and water use by 25 percent)	High costs
Modular dishwasher, tanks can be added to increase capacity	Requires extra devices to increase savings

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Hotel Water User/ Consumer

C. Laundry Facilities

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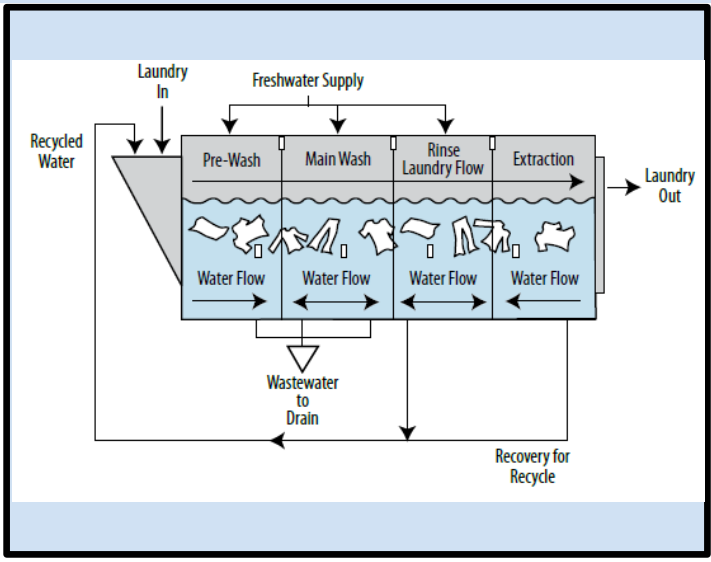
Water & Energy
Tunnel Washers

water & energy savers

Tunnel washers are large-volume, continuous-batch washers with long chambers and a series of compartments through which the laundry is pulled for soaking, washing, and rinsing. They are more water-efficient because the water moves in a counter-flow direction to the laundry starting with the last rinse, in this way the water is used through several cycles of the wash before being sent to the drain. The efficiency of the equipment allows the process to be done quickly, thus making it possible to save energy.



Potential use in hotel industry

- Laundries

Advantages	Disadvantages
Cost-savings from energy and water conservation	High costs
Reduce operating hours	Requires a large footprint

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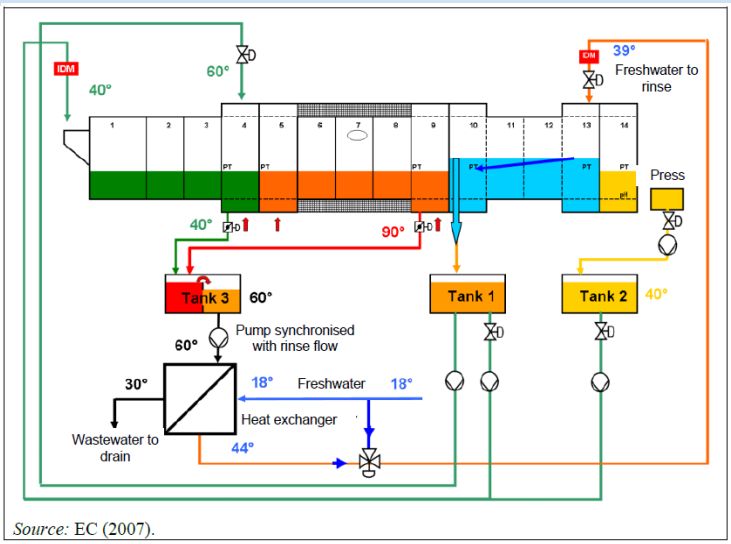
Water & Energy Tunnel Washers

water & energy savers

Part 2 –Performance, Case studies



Source: EC (2007).

Figure 5.25: Optimised water reuse and heat recovery for a 14-compartament CBW

Efficient large-scale and commercial laundry operations with a capacity of hundreds to thousands of tones of laundry textiles per year typically achieve water use efficiencies of 5 to 6 liters of water per kg of linen, compared with in excess of 20 liters per kg for non-optimised small-scale laundry operations. Specific water consumption as low as 2 liters per kg has been demonstrated following process optimization and water recycling .

Part 3 –Companies manufacturing/implementing the technology

- Milnor, https://www.milnor.com/cbw-batch-washers-pulseflow-technology/#mildata
- HJ Weir Engineering , http://www.hjweir.co.uk/cbw-batch-washers/
- Herbfitzgerald, https://herbfitzgerald.com/portfolio_category/c-catergory/

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Water & Energy
Washer Extractor

water & energy savers

Water and energy efficiency are closely related for washing machines. Hohenstein Institute (2010) report that state-of-the-art water efficiency for washer-extractors has improved considerably since 1995, and over the five years from 2005 to 2010 stood at 8 L per kg textiles. This could be further reduced through collection and recycling of rinse water.

Small washer extracor

Heavy-duty washer extracor

high-performance washer-extractors.

Potential use in hotel industry

- Laundries

Advantages	Disadvantages
Low water and energy consumption	High initial cost
Reduce operating hours	
lower operating costs	

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Water & Energy Washer Extractor

water & energy savers

Part 2 –Performance, Case studies

Water and energy efficiency are closely related for washing machines. Hohenstein Institute (2010) report that state-of-the-art water efficiency for washer-extractors has improved considerably since 1995, and over the five years from 2005 to 2010 stood at 8 L per kg textiles. This could be further reduced through collection and recycling of rinse water. Carbon Trust (2009) report that small commercial laundries and on-premises laundries processing fewer than 100 000 pieces per week consume 2.0 to 2.9 kWh per kg textiles

Part 3 –Companies manufacturing/implementing the technology

- UNIMAC, https://unimac.com/industries/hospitality/
- Aqualogic, https://www.aqualogic.com.au/products/category/washers-extractors/
- Milnor, https://www.milnor.com/product-category/washer-extractors/

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Hotel Water User/ Consumer

d. Swimming Pool

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Water & Energy

Solar pool covers

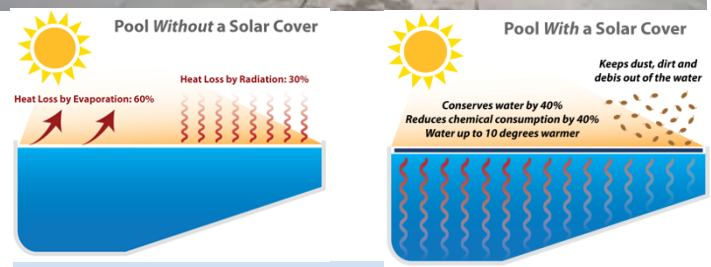
water & energy savers

A solar cover uses the sun's natural energy to keep your pool at a warm temperature. Even if there are additional heating elements such as a pool heater, a solar cover can help prevent the heat from escaping.

Solar cover can save water. The cover can help reduce evaporation that naturally occurs. In turn, less water loss can reduce the need to replace the water. The cover also protects the pool From debris & bugs.

Solar covers can also benefit by Reducing the pool's chemical consumption by 35%–60%

And reducing cleaning time by keeping dirt and other debris out of the pool.



Potential use in hotel industry

- Pool evaporation minimization
- Minimized pool top-up needs

Advantages	Disadvantages
Keeps evaporation down – may reduce the amount of make-up water needed by 30%–50%	May deteriorate with time
Easy to use	Some types can have calcium build-up
Keeps water heat – reducing energy costs	Difficult to use with irregular pool shapes
Cheap comparing to other options such as slat pool covers	

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water
Solar pool covers
water & energy savers

Part 2 –Performance, Case studies

Results from a study performed in response to the California drought show that certain pool covers can significantly reduce water loss due to evaporation when they are in place. (https://www.poolspanews.com/how-to/maintenance/evaporation-study-compares-water-savings-of-covers_o)

Part 3 –Companies manufacturing/implementing the technology

Geobubble, https://www.geobubble.co.uk/technology/

Poolwarehouse, https://www.poolwarehouse.uk.com/index.php/product-category/swimming-pool-covers/euro-solar-covers/?gclid=Cj0KCQjww_f2BRC-

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Water & Energy

Low backwash filtration

water & chemicals savers

New filter media offers optimum conditions for water to flow through the filter bed in order to retain more contaminants thus allowing for larger volumes of water to be filtered through the same filter volume as contact area is increased.

The new media operation is characterized by lower initial head loss, slower head loss build up, higher storage capacity and lower backwash rates.

These advantages result in much longer filter runs between backwashes, which means reduced energy and water consumption and higher water production, consequently giving reduced operating costs.

Potential use in hotel industry

- Pool filtration systems
- Spa water filtration

Advantages	Disadvantages
No need to rebuild and expand existing facilities	Cost of the patented media
Saves water and energy and chemicals	
Increases filters hydraulic capacity	

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Water & Energy
Low backwash filtration
water & chemicals savers

Part 2 –Performance, Case studies

In 2009, the Palmachim Desalination plant in Israel planned to increase the production capacity by 50 %. After a series of pilot trials it was decidedto replace the media inn the pre-treatment filters. This was the first full scale desalination plant in Israel to use Filtralite Pure. The installation of Filtralite Pure in the dual media filters shows that the production capacity could be increased by 50 % without building new filters.

When the media was replaced increase the filtration rate was increased from 7 m/h to 12 m/h. Runtime between backwashes increased from 30 hours to 200 hours and biofouling of the RO membranes was reduced. In the past they used Cartridge of 20 microns and those were changed every month.

Now Palmachim uses Cartridge filters of 5 microns and the Cartridges filters are changed twice a year.

Part 3 –Companies manufacturing/implementing the technology

- Filtralite, https://www.filtralite.com/en/solutions/filtraliter-pure

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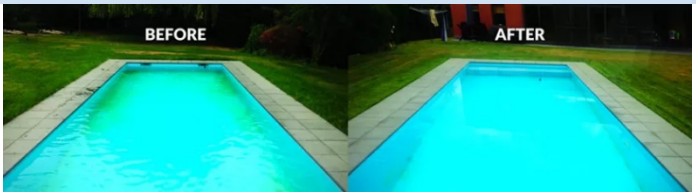
Water

Ultafiltration of swimming pool water

water & chemicals savers

Ultrafiltration system removes all bacteria, pathogens, organic matters and suspended solids from the pool water in one single pass, thanks to the small and absolute barrier. Only very small dose free chlorine (concentration of 0.2-0.3 ppm) is required to keep disinfectant action – while combined chlorine, trihalomethanes and all harmful disinfection by-products are drastically reduced. Water flows at low pressure in a circulation loop to the Ultrafiltration memebranes while the purification process takes place – without use of chemicals. Disinfectants and other salts permeates the membranes and are recycled to the pool. All pollutants are expelled from the system by a simple and regular backwash .



Industrial NUFilter plants – modular, fully automated units for **public swimming pools**

Potential use in hotel industry

- Pool filtration systems
- Spa water filtration
- Downstream separation of biologically treated Grey water

Advantages	Disadvantages
Very high water clearness and quality (< 0.1 NTU)	May be more expensive than regular filtration systems
Drastic reduction of chemical consumption	
Cut recycling water capacities and energy costs by up to 50%	

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Water
Ultafiltration of swimming pool water
water & chemicals savers

Part 2 –Performance, Case studies

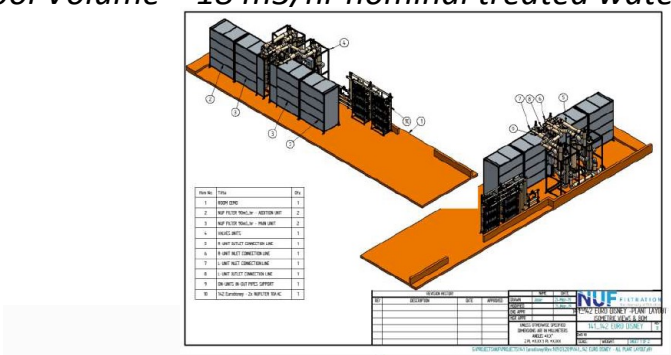
Case Study- Euro Disney (2019)

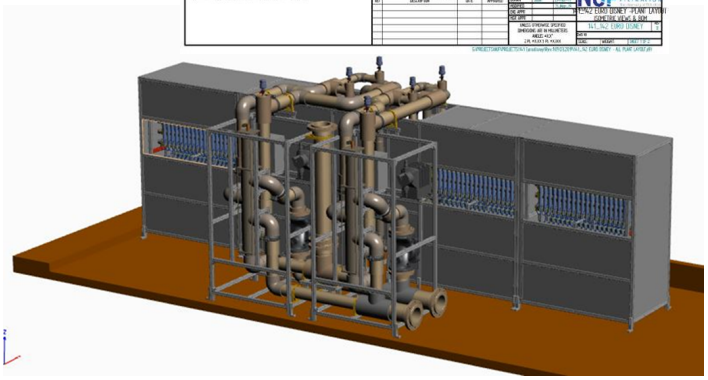
Background

• Two water purification systems by NUFILTRATION for Public Swimming Pool & Jacuzzi were installed at Disneyland Paris last July:

(1) *NUFilter System for Public Pool – 400 m3 pool Volume – 180 m3/hr nominal treated water capacity*

(2) *NUFilter System for Jacuzzi Pool – 16 m3 pool Volume – 18 m3/hr nominal treated water capacity*





Part 3 –Companies manufacturing/implementing the technology

Nuf Filtration - https://www.nufiltration.com/effluent

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Hotel Water User/ Consumer

e. Air conditioning systems

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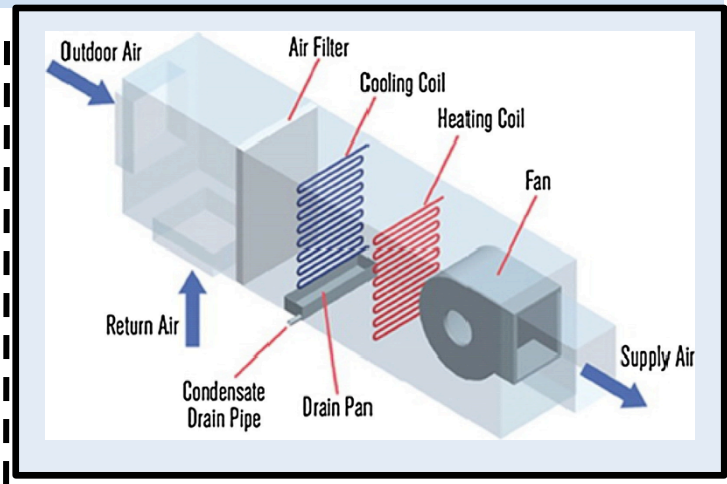
Water
HVAC Condensate Recovery
Water Saver

HVAC condensate recovery system uses the condensate from heating, ventilation and air-conditioning (HVAC) systems as a source of clean water. Condensate occurs in the cooling coil (evaporator section) of the HVAC unit, where evaporative cooling drives the heat exchange. The refrigerant is circulated through evaporator coils for the specific purpose of cooling the air forced over it. A condensate drainpipe is provided with a drain pan, which is fixed at the bottom of the cooling coil.



Potential Use in Hotel Industry

- On-sight application to air-conditioning system
- Provides an alternative water source for on-sight activities such as on-sight irrigation or toilet flushing
- Water sustainability
- Suitable for hotels in humid climates

Advantages	Disadvantages
Higher water saving percentage in hot, humid climates	Easier to implement at the building design stage
High quality of recovered water keeps treatment costs low	Condensate can be exposed to contamination during air transfer
Easy implementation of simple technology	May require additional storage facilities
Quick return on investment	

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Water
HVAC Condensate Recovery
Water Saver

Part 2 –Performance, Case studies

The city of San Antonio : US, Newly constructed commercial buildings installing air conditioning systems on and after January 1, 2006 shall have a single and independent condensate wastewater line to collect condensate for future utilization.

Case study 1 : Rivercenter Mall, Collection Potential = 12,000,000 Gallons/Year, End Use – Cooling Tower Make-Up Water, Total Cost - $32,058 • Financial Savings/Year - $49,500* • **Simple Payback Period – 8 Months**

Case study 2 : HEB Grocery Distribution Center, Condensate from air handlers and refrigeration systems • Annual Savings = 6,200,000 Gallons • Boiler Feed Make-up Water • Total Cost - $19,000 • Financial Savings/Year - $20,600 • **Simple Payback Period – 11 Months**

Case study 3 : San Antonio Public Library, 1,440 Gallons Day Potential, Surplus Storage Need = 8,835 Gallons (June, July & August) **26,000 Square Feet of Landscape Drip Irrigation** Ferro-Concrete Collection Tanks Total Cost = $21,500.00

Part 3 –Companies manufacturing/implementing the technology

Hyper-logic , https://hyper-logic.com/automated-reclaimed-condensate-system-arcs/

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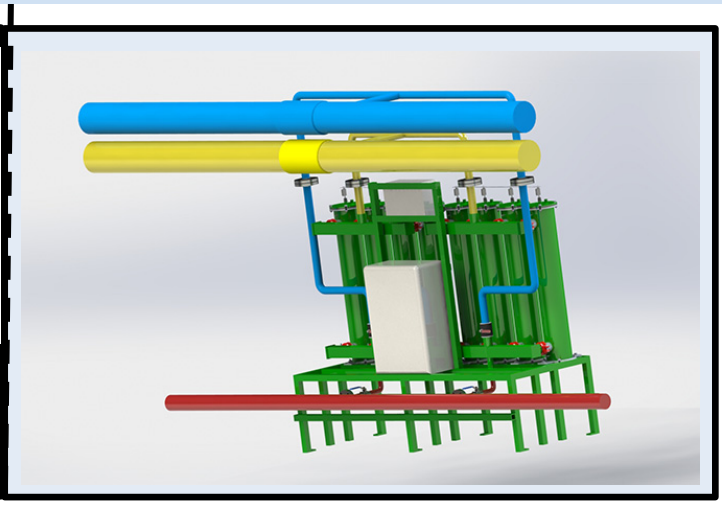
Water

Electro-chemical treatment of Cooling tower water and blowdown minimization

water savers

To use water efficiently in the cooling tower system, the cycles of concentration must be maximized. This is accomplished by minimizing the amount of the required blowdown that normally happens due to increase of salts concentrations. Treating the water reduces the make-up water demand. The degree to which the cycles can be maximized depends on the water chemistry within the cooling tower and the water chemistry of the make-up water supply. The treatment of the cooling tower water also helps the system in corrosion protection and microbiological growth and contamination.



Potential use in hotel industry

- Cooling tower blowdown minimization

Advantages	Disadvantages
Solves cooling tower problems stemming from algae, corrosion and scaling	Additional professional water treatment requirements
Reduces maintenance	

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Water

Electro-chemical treatment of Cooling tower water and blowdown minimization

water savers

Part 2 –Performance, Case studies

Table 6-1. Percent of Make-Up Water Saved by Maximizing Cycles of Concentration

Initial Concentration Ratio (Cri)	New Concentration Ratio (CRf)											
		2	2.5	3	3.5	4	5	6	7	8	9	10
	1.5	33%	44%	50%	53%	56%	58%	60%	61%	62%	63%	64%
	2.0	–	17%	25%	30%	33%	38%	40%	42%	43%	44%	45%
	2.5	–	–	10%	16%	20%	25%	28%	30%	31%	33%	34%
	3.0	–	–	–	7%	11%	17%	20%	22%	24%	25%	26%
	3.5	–	–	–	–	5%	11%	14%	17%	18%	20%	21%
	4.0	–	–	–	–	–	6%	10%	13%	14%	16%	17%
	5.0	–	–	–	–	–	–	4%	7%	9%	10%	11%
	6.0	–	–	–	–	–	–	–	3%	5%	6%	7%

CASE A : UET improved the efficiency of the air-conditioning system for the surgery building of a major Israeli hospital complex, which was using soft water and salt to tackle scale build-up in the water cooling system. This product is designed for pre-treatment of feed water to reverse-osmosis systems

And eliminated the problems of scale build-up, increased their water conductivity, and reduced their use of water softeners and salt.

Total Water Savings were about 45% and chemical were not added any more.

CASE B : Electrochemical Treatment Unit Installed in Central Ohio Chemical Processing Plant. The Elgressy Electrochemical Scale Treatment System (EST) was installed on one (1100 T.R) of the two cooling towers on site. Although a direct year to year comparison is difficult because of load changes, it is clear that the EST

system is saving water with the increase in cycles of concentration. It was estimated that the water savings was in excess of 2.2 million gallons if all operating conditions were the same

Part 3 –Companies manufacturing/implementing the technology

- Elgressy, https://www.elgressy.com/solutions/cooling-towers-treatment-est/
- UET, https://www.uet.co.il/product/cooling-tower-system/

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Hotel Water User/ Consumer

f. Gardening and landscaping

f. 1 Low Water Irrigation

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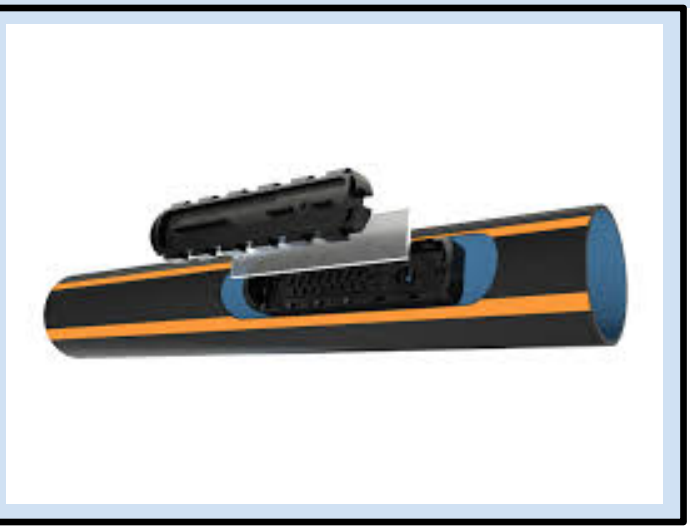
Water
Drip Irrigation
smart irrigation

Drip irrigation is a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants While water is dripping, evaporation is reduces.
Subsurface drip irrigation is a low-pressure, high efficiency irrigation system that uses buried drip tubes or drip tape to meet crop water needs.



Potential Use in Hotel Industry

- Hotel gardens and landscape irrigation systems

Advantages	Disadvantages
Decreased evaporation	Higher initial cost
In subsurface systems, invisible	More delicate : surrounding environment could affect tubes and drippers (bacteria, salination, clogging, wastage…)
No water aerosols	

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water
Drip Irrigation
smart irrigation

Part 2 –Performance, Case studies

In exploratory work of researchers from Spain and Chile, 10 of 12 of the hotels surveyed in Spain were engaged in various environmental practices related to water consumption savings, such as the use of dispensers, sprinklers, heating water taps, dual-flush water tanks and **drip irrigation**.
(Alonso-Almeida et al., 'Revisiting green practices in the hotel industry: A comparison between mature and emerging destinations', Journal of Cleaner ProductionVolume 140, Part 31 January 2017Pages 1415-1428)

Part 3 –Companies manufacturing/implementing the technology

Netafim- https://www.netafim.com/en/products-and-solutions

Naan-Dan-Jain - http://naandanjain.com/

N-Dirp, Gravity micro irrigation https://ndrip.com/

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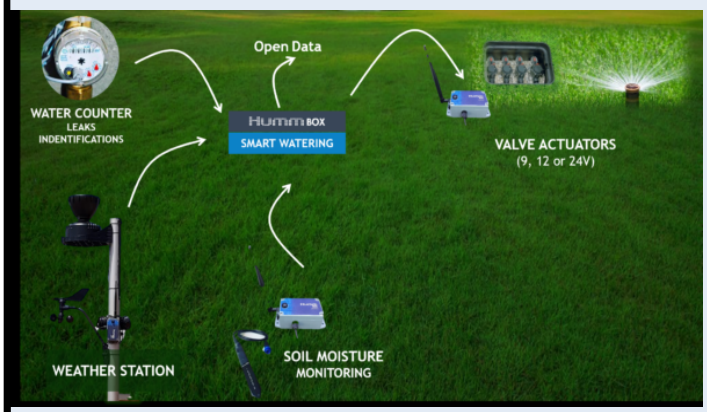
Water
Precise Irrigation
Water Saver

As much as 50% of water used for landscape irrigation is wasted due to overwatering caused by inefficiencies in traditional irrigation methods and systems. Smart irrigation systems tailor watering schedules and run times automatically to meet specific landscape needs. These controllers significantly improve outdoor water use efficiencies.
Unlike traditional irrigation controllers that operate on a preset programmed schedule and timers, smart irrigation controllers monitor weather, soil conditions, evaporation and plant water use to automatically adjust the watering schedule to actual conditions of the site. Within smart irrigation devices one can find : Soil Moisture Sensors, Rain Sensor, water counters, valve actuators and connected weather station,



Potential Use in Hotel Industry

- Hotel gardens and landscape irrigation systems

Advantages	Disadvantages
Decreased evaporation	Initial costs
In subsurface systems, invisible	

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Water
Precise Irrigation
Water Saver

Part 2 –Performance, Case studies

WATERSENSE LABELED CONTROLLERS IN ACTION: CURBING WATER WASTE
Location: Granite Park office complex landscape in Dallas, Texas
Landscape size: 372,000 square feet
Project overview: Following an irrigation audit, an irrigation professional certified by a WaterSense labeled program improved the office park's irrigation system's efficiency by installing a weather-based irrigation controller, rain sensor, and freeze sensor, as well as performing regular maintenance on the existing irrigation system.
Savings: 12.5 million gallons of water and $47,000 in 2009
Simple payback: Less than 1.5 years

According to the website Hillsboroughtcounty : When rain sensors are working correctly, they save lots of water - more than 2,500 gallons per 1,000 square feet annually, say Hillsborough County Extension experts. According to the same source, Soil moisture sensors are more expensive than rain sensors. However allows to save more water. Soil sensors measures moisture level of soils, so property owners are able to know when irrigation is needed.

Part 3 –Companies manufacturing/implementing the technology

- Soil Moisture Sensors, https://www.seeedstudio.com/Grove-Moisture-Sensor.html
- Rain Sensor, http://ww3.rainbird.com/homeowner/products/timers/RSDrainsensor.htm
- autonomous sensors, http://www.greencityzen.fr/solutions-en/page-solution-smart-watering/
- Watersense labeled controllers, https://www.epa.gov/sites/production/files/2017-01/documents/ws-products-large-landscape-irrigation-controllers.pdf
- Hydreon corporation, https://rainsensors.com/applications/irrigation-control/

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Water & Energy
Smart water solutions for irrigation
water & energy savers

Several new solutions are entering the market some of which are very simple ideas and products that enable “gain more from less”. Some systems use the humidity in the air to Irrigate Plants. Others improve the water use by plants and reduces the water required for the same size of plants.

Potential use in hotel industry

- Landscape irrigation
- Cut in supplied water use

Advantages	Disadvantages
simple	Limited saving quantities
Low maintenance	
Hardly any maintenance required	
Increased pants yield	

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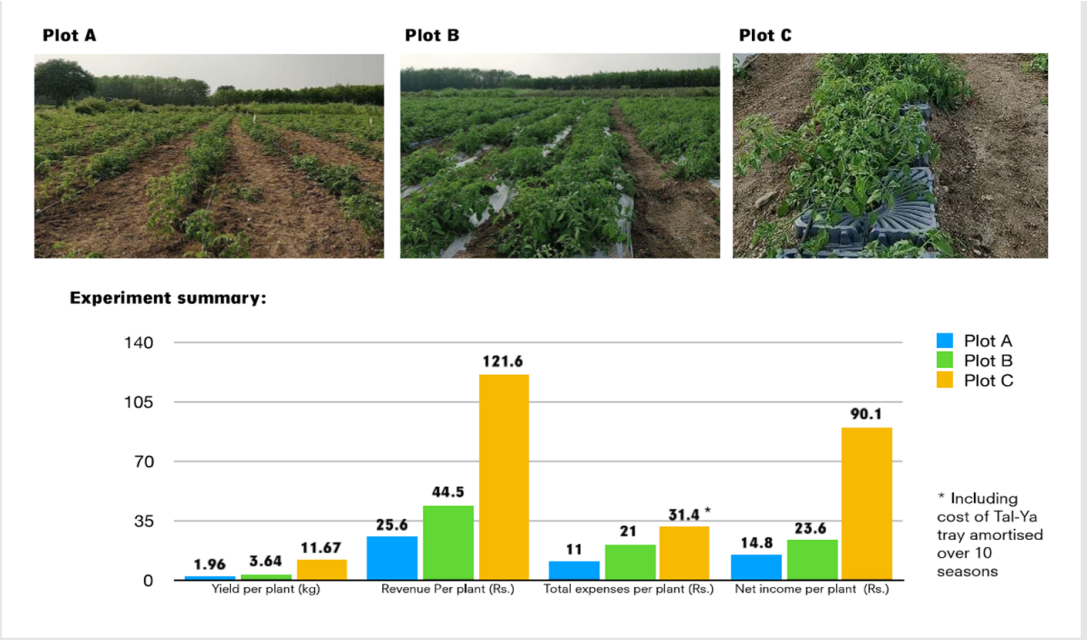
Water & Energy
Smart water solutions for irrigation

water & energy savers

Part 2 –Performance, Case studies

ED LINACRE'S AIRDROP is a simple device that literally sucks water out of thin air. Airdrop consists of a mast-like tube with a wind-powered turbine that sucks air down into a coiled metal pipe. The air descends under the earth and cools until it hits 100% humidity and the water starts to drip out.

Tal-Ya manufactures a unique, patented polypropylene tray that covers the plant's root system. Yield of pant is significantly increased while water consumption is decreasing.



Part 3 –Companies manufacturing/implementing the technology

Tal-Ya, http://www.tal-ya.com/

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Hotel Water User/ Consumer

f. Gardening and landscaping

f. 2 Smart plants selection

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Water
Smart plants selection
Water Saver

Most of hotels have gardens, and gardening in most regions require water for irrigation. The use of plants with minimal water consumption can save large quantities of water. The garden can be as nice as the one that require much more water to be maintained. One good example for saving water by correct plant selections is growing Low-Water Lawns That Stay Green Under Pressure.

Potential use in hotel industry

- Replacing high water consuming plants with low water consuming plants in the gardens
- Mostly important in dry countries with frequent droughts
- Low water lawns

Advantages	Disadvantages
Variety of plants available	Cost of plants may be higher
Lowering water bills	

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Water Saving Gardening Plants

Part 2 –Performance, Case studies

A University of California ranking shows the most drought tolerant grass for lawns are in the following order :

- hybrid Bermuda grass
- Zoysia grass
- Common Bermuda grass
- Seashore paspalum
- St. Augustine grass
- Kikuyu grass
- Tall and Red fescues
- Kentucky Bluegrass
- Ryegrass
- Several Bentgrass species
- Buffalo grass

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Hotel Water User/ Consumer

f. Gardening and landscaping

f. 3 Recycled Greywater Use

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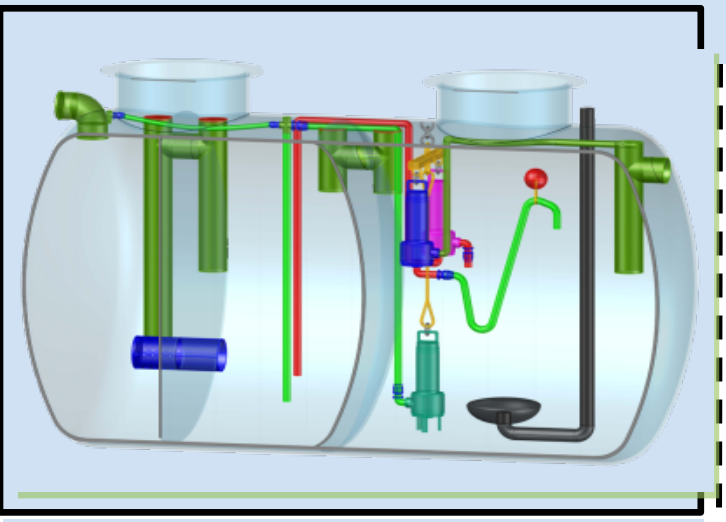
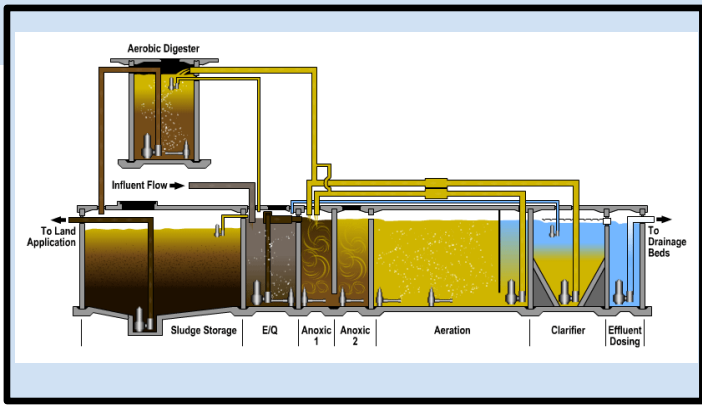
Water

SBR–Sequential Batch Reactor

wastewater reuse, grey water

SBR (Sequential Batch Reactors) is a biological treatment system with active sludge, where all stages of the purification process occur in **a single tank** without the need to use clarifiers. This process treats the wastewater in **batches**, and in each batch there are a series of stages to complete the treatment. This technology produces treated water with quality standards suitable for reuse





Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Reused water for gardening and landscaping

Advantages	Disadvantages
Flexibility in operation and control	Maintenance and control required
Low visual impact	Sludge removal is required
Investment savings by removing necessary elements in conventional systems	Potential odours in malfunction
Small area requirements	Energy costs
Decreased water and wastewater bills	Effluent need to be filtered and disinfected

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Water
SBR–Sequential Batch Reactor
wastewater reuse, grey water

Part 2 –Performance, Case studies

PARAMETER	INFLUENT (MG/L)	EFLUENT (MG/L)	PERFORMANCE (%)	LIMITS OF POURING
SST	243	9	96	60 mg/l (70%) for municipalities between 2.000 and 10.000 h-e
DQO	579	47	92	125 mg O2/l (75%)
DBO	316	11	96	25 mg O2/l (70-90%)
N-NH4	43,1	6,2	86	N/A
Ptotal	7,1	3,5	81	N/A
Power consumption (KW/ m3)	**0.96**			

- In A research in Iran, synthetic greywater were treated by SBR system. The concentrations of LAS, COD and BOD5 at the inlet were 6.8 mg/l, 385 mg/l and 170 mg/l, and in the outlet, 0.95 mg/l, 19.25 mg/l and 8.5 mg/l, in fact, in the 8-hour cycle, the removal efficiency were 86%, 93% and 95%, respectively.

Part 3 –Companies manufacturing/implementing the technology

Bioazul, https://www.bioazul.com/en/sbr-sequencial-batch-reactor/

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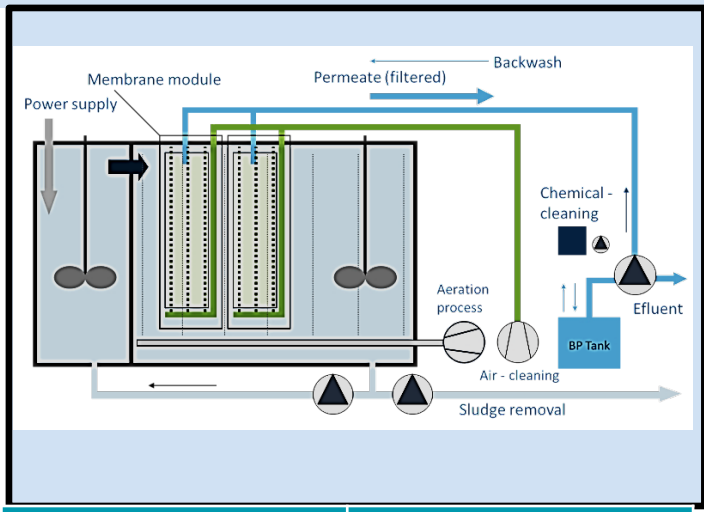
Water
MBR – Membrane Bioreactor
wastewater reuse, grey water

MBR(Membrane bioreactors) is a biological treatment system with active sludge, where sludge separation from the effluent is carried out via ultrafiltration or microfiltration membranes . The process achieves an advanced level of removal efficiency of suspended solids (organic and inorganic). In addition, these systems remove pathogens by 99.99%, achieving a high quality effluent for reuse (e.g. irrigation of gardens).



Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Water to be reused for laundry, irrigation and toilet flushing.

Advantages	Disadvantages
Small footprint	Maintenance and control required
High effluent quality	Sludge removal is required
Disinfected effluent	Fouling in membranes (periodic replacement)
no sludge sedimentation problems.	Chemicals requirements
	Energy consumption

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Water
MBR – Membrane Bioreactor
wastewater reuse, grey water

Part 2 –Performance, Case studies

• BOD5	<2.0 mg / L
• SST	<2.0 mg / L
• NH3-N	<1.0 mg / L (with nitrification)
• Total Phosphorus	<0.1 mg / L (including anaerobic zone)
• Total Nitrogen	<3-10 mg / L (including anaerobic zone)
• Turbidity	<0.5 NTU
Total Coliforms	<100 cfu / 100 mL
Fecal Coliforms	<10 cfu / 100 mL
Coliform Reduction	> 5-6 log elimination
Virus reduction	<4 log removal

- **Suez ,** https://www.suezwatertechnologies.com/products/biological/leapmbr-wastewater
- **Kubota**, https://www.kubota-mbr.com/en
- **Alfa-Laval,** https://www.alfalaval.co.il/products/separation/membranes/mbr-membranes/mbr-membranes/
- **Huber ,** https://www.huber.de/products/membrane-filtration-mbr.html
- **Yumpu,** https://www.yumpu.com/en/document/read/36369354/gep-watermanager-gwa-dehoust-gmbh

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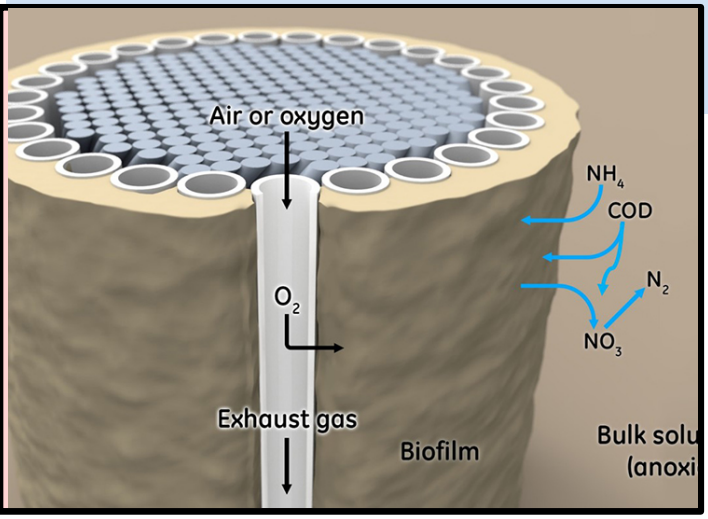
Water
MABR

wastewater reuse, grey water

MABR (Membrane aerated biofilm reactor **)** is a biological treatment system. The MABR process utilises gas permeable membranes to provide the oxygen required for aerobic biological treatment. A gas permeable membrane is used to deliver oxygen to a biofilm that is attached to the surface of the membrane where both nitrification and denitrification occur simultaneously with very high efficiencies of oxygen transfer which leads to low energy costs.



Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Reused water for gardening and landscaping

Advantages	Disadvantages
Modular units	Further treatment required downstream for several water uses
Very low energy consumption	Less experienced comparing to some others biological systems
Compact and low footprint	

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Water
MABR
wastewater reuse, grey water

Part 2 –Performance, Case studies

Decentralized Wastewater Treatment Bordeaux, USVI

Customer	VIWMA- Virgin Island Waste Management Authority
Project	The Bordeaux region of St. Thomas had a pressing need for a wastewater treatment plant that produces high effluent quality. Its existing plant was old and did not meet regulation nor industry standards. The Virgin Islands Waste Management Authority (VIWMA) was looking for a solution that could treat current and future sewage flow and produce high quality effluent, to be discharged into the environment in the Bordeaux area.
Design Parameters	• Flow: 95 m^3/D (25,000 GPD) • Wastewater characteristics: municipal wastewater • Wastewater minimum temperature: 24°C (75°F)
Raw waste water Influent	• $BOD_{5,t}$: 220 mg/l • TSS: 180 mg/l • TN: 45 mg/l • Phosphorous: 14 mg/l
Effluent Requirements	• $BOD_{5,t}$: 10 mg/l • TSS: 10 mg/l • Average NH4-N: 10 mg/l • Phosphorous: 1 mg/l
Solution	• **Pretreatment:** fine screens and FOG separator • **Secondary treatment: MABR** and a secondary clarifier • **Tertiary treatment:** media filter and disinfection
Results	• Secondary treatment 0.26kWh/m^3 (0.98 kWh/kgal) • Exc. feed pump – 0.21 kWh/m^3 (0.79 kWh/kgal)

fluence

Part 3 –Companies manufacturing/implementing the technology

- **Oxymem, by DuPont,** https://www.oxymem.com/
- **Fluence ,** https://www.fluencecorp.com/
- **Suez ,** https://www.suezwatertechnologies.com/products/biological/zeelung

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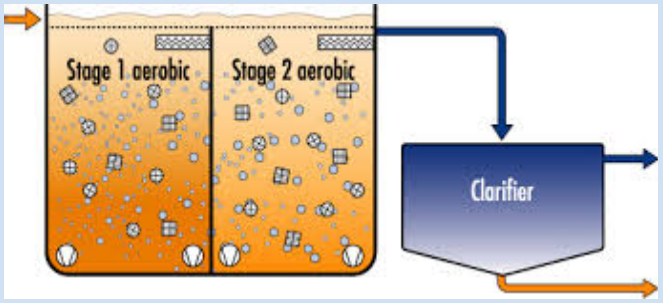
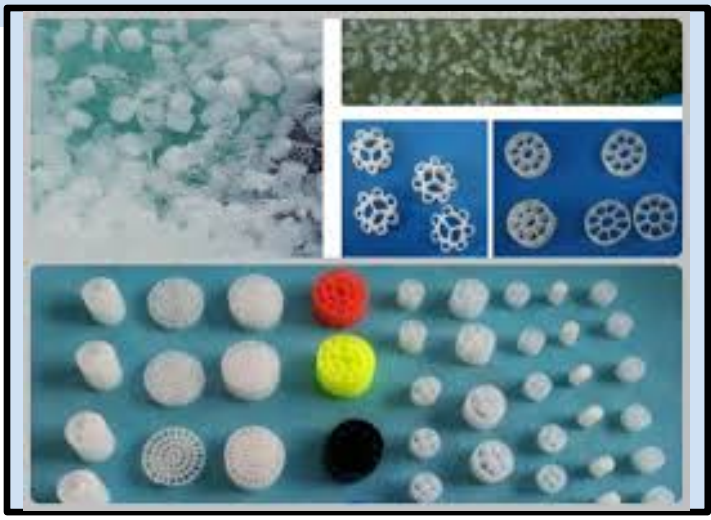
Water
MBBR

wastewater reuse, grey water

MBBR (Moving bed biological reactor) is a biological treatment system consists of an aeration tank with special synthetic carriers that provide a surface where a biofilm can grow. The carriers are made of a material with a density close to the density of water (1 g/cm^3). The carriers are mixed in the tank by the aeration system enabling good contact between the wastewater pollutants and the biomass on the carriers To prevent the plastic carriers from escaping the aeration it is necessary to have a sieve on the outlet of the tank.





Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Reused water for gardening and landscaping

Advantages	Disadvantages
Small footprint	Energy consumption
Short retention time	Further treatment required downstream for several water uses
Stable organic compounds and nitrogen removal	

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Water
MBBR

wastewater reuse, grey water

Part 2 –Performance, Case studies

A pilot system implemented in a building at University of Sao Paulo allowed to segregate greywater collection and characterization. To evaluate the greywater production water flow meters were installed in the water inlet of each greywater source.

The treatment system included a moving bed biofilm reactor and a settling tank at pilot scale. The evaluation of greywater treatment was conducted based on the monitoring of physicochemical and microbiological water quality parameters during the operation of the experimental system.

Based on the results. The removal efficiencies of BOD and COD were 59% and 70% respectively. The phosphorus removal during the experimental period was low. Nevertheless the water quality produced is viable to be applied for outdoor purposes - landscape and garden irrigation in household, commercial and institutional buildings and the results were satisfactory according to Brazilian standard. The treatment showed stability and reliability ensuring the potential for a safe reuse if appropriate operation and monitoring of the treatment system is performed.

Part 3 –Companies manufacturing/implementing the technology

- Lenntech, https://www.lenntech.fr/procedes/moving-bed-biofilm-reactor.htm
- Suez, https://www.suezwaterhandbook.com/degremont-R-technologies/wastewater-treatment/biological-processes/mbbr-Moving-Bed-Biofilm-Reactor-Meteor-MBBR
- Aqwise , http://www.aqwise.com/mbbr/
- PT. REKA INDONESIA SERVICES, https://rekain.com/service/moving-bed-biofilm-reactor/
- Wateq-Canada, https://www.wateqcanada.com/municipal-wastewater/packaged-plants/moving-bed-biofilm-reactor-mbbr/
- Veolia, https://www.veoliawatertechnologies.com/en/products/anoxkaldnes-mbbr

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Water
RBC

wastewater reuse, grey water

RBC(Rotating biological contactor) is a fixed-bed biological treatment system used in the treatment of greywater. The RBC process involves allowing the wastewater to come in contact with a biological medium in order to remove pollutants in the wastewater before settling of the excess biomass. The RBC consists of a series of closely spaced, parallel discs mounted on a rotating shaft which is supported just above the surface of the liquid. Microorganisms grow on the surface of the discs where biological degradation of the pollutants takes place.

Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Reused water for gardening and landscaping

Advantages	Disadvantages
Small footprint	Effluents needs further treatment for many uses
Small amounts of excess sludge	
Low power consumption	
Easy to install and operate	

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Water
RBC
wastewater reuse, grey water

Part 2 –Performance, Case studies

A study combining a model calculation and actual treatment results showed that, the treatment efficiency of the RBC system based on BOD removal was ranged between about 93.0% and 96.0%, and based on TSS removal was ranged between about 84.0% and 95.0 % for all concentrations of influent grey water.
Also, the proposed model results indicated that grey water can be properly treated by RBC
system and can be reused for many purposes after disinfection and sand filtration.
(Abdel-Kader AM, Studying the efficiency of grey water treatment by
using rotating biological contactors system,Progress in Agricultural Engineering Sciences 25(2) · July 2013)

Part 3 –Companies manufacturing/implementing the technology

- Evoqua, https://www.evoqua.com/en/brands/Envirex/Pages/rotating-biological-contractor-systems.aspx
- Mecana, http://www.mecana.ch/de/produkte
- Biodisk corporation, http://www.biodisk.ca/system.php
- Miranda, http://www.miranda-tr.com/en/referanslar/
- EPC Ltd, https://www.epc-tec.com/?lang=en

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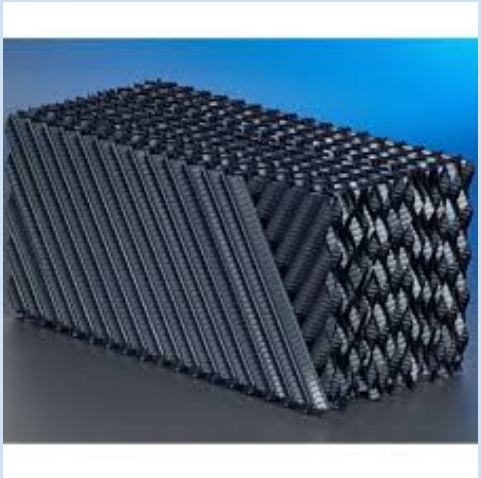
Water
Trickling Filter

wastewater reuse, grey water

TF(Trickling filter) is a fixed-bed biological treatment system. Also called called biological filter and biological trickling filter a biological reactor that operates under (mostly) aerobic conditions. Pre-settled wastewater is continuously 'trickled' or sprayed over the filter and as the water migrates through the pores of the filter, organics are aerobically degraded by the biofilm covering the filter material. Commonly used nowadays is a plastic packing material with high porosity and large surface area.



Potential use in the Hotel Industry

- **Grey water treatment**
- **Wastewater treatment**
- **Effluents for toilet flushing**
- **Reused water for gardening and landscaping**

Advantages	Disadvantages
Very Small footprint	Effluents needs further treatment for many uses
Small amounts of excess sludge	High initial costs
Low power consumption	Possible flies and snails problems
Easy to install and operate	

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Water
Trickling Filter
wastewater reuse, grey water

Part 2 –Performance, Case studies

Part 3 –Companies manufacturing/implementing the technology

- Brentwood, https://www.brentwoodindustries.com/water-wastewater-products/trickling-filter/
- Hewitech, https://www.hewitech.de/en/products/water-purification/tricklingfilter/
- Trickling filters Australia, https://tricklingfilters.com.au/products/trickling-filters/
- AES, http://www.aesarabia.com/trickling-filters/

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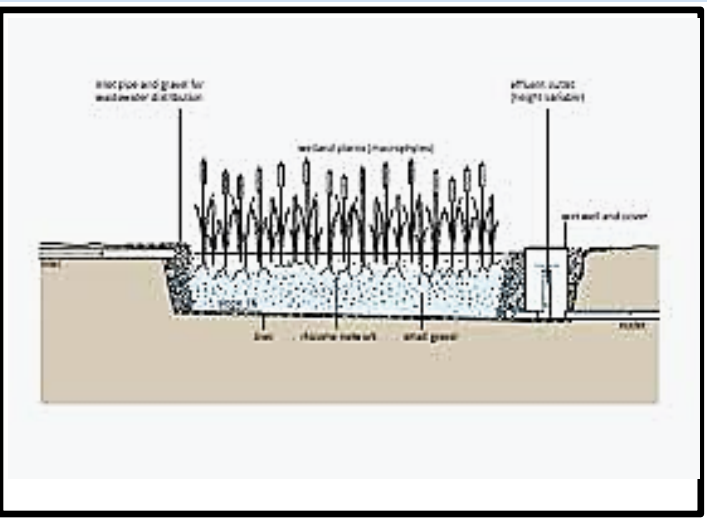
Water
Constructed Wetland

wastewater reuse, grey water

Constructed wetlands (CW) are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality. There are two main types of constructed wetlands: subsurface flow and surface flow constructed wetlands. The filter bed, consisting usually of sand and gravel. Subsurface flow constructed wetlands are designed to have either horizontal flow or vertical flow of water through the gravel and sand bed. In recent years other configuration and intensification of the CW are presented.



Potential use in the Hotel Industry

- Grey water treatment
- Wastewater treatment
- Effluents for toilet flushing
- Reused water for gardening and landscaping

Advantages	Disadvantages
Low energy consumption	Relatively large area requirements
High effluent quality	
Low maintenance requirements	
Low nuisance potential	

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Water
Constructed Wetland
wastewater reuse, grey water

Part 2 –Performance, Case studies

The experimental pilot plant is located in a Euro-Mediterranean hotel in Lloret de Mar. A horizontal flow wetland (HF) was integrated, in a cascading vertical set-up (vertECO), for decentralized treatment of real low load greywater streams.
The removal efficiency for standard parameters was very high, on average more than 90% for many parameters (COD, BOD5, TSS, VSS and turbidity) and more than 80% for TOC. The effluents consistently met the standards for various reuse applications, at all three HRTs implemented (HRTs: 1.9, 1.4 and 1.0 days), according to Spanish Legislation (Zraunig et at. “Long term decentralized greywater treatment for water reuse purposes in a tourist facility by vertical ecosystem”, Ecological Engineering, Volume 138,November 2019Pages 138-147)

Parameter	AV influent	AV effluent
COD ($mgO_2\ L^{-1}$)	158 ± 112	6 ± 12
BOD ($mgO_2\ L^{-1}$)	116 ± 67	3 ± 3
TOC ($mgC\ L^{-1}$)	39.0 ± 25.6	5.5 ± 2.3
TSS ($mg\ L^{-1}$)	63 ± 114	3 ± 6
VSS ($mg\ L^{-1}$)	53 ± 82	2 ± 3
Turbidity (NTU)	68.4 ± 39.8	1.8 ± 1.5
EC ($\mu S\ cm^{-1}$)	767 ± 108	783 ± 52
pH	7.08 ± 0.31	7.36 ± 0.29
TN ($mg\ L^{-1}$)	10.4 ± 9.3	4.6 ± 2.6
TKN ($mg\ L^{-1}$)	10.3 ± 9.0	2.4 ± 2.3
NO_2^--N ($mg\ L^{-1}$)	0.06 ± 0.39	0.10 ± 0.43
NO_3^--N ($mg\ L^{-1}$)	0.02 ± 0.04	2.31 ± 1.80
NH_4^+-N ($mg\ L^{-1}$)	4.88 ± 2.92	1.55 ± 1.37
PO_4^--P ($mg\ L^{-1}$)	0.34 ± 0.76	0.54 ± 1.80

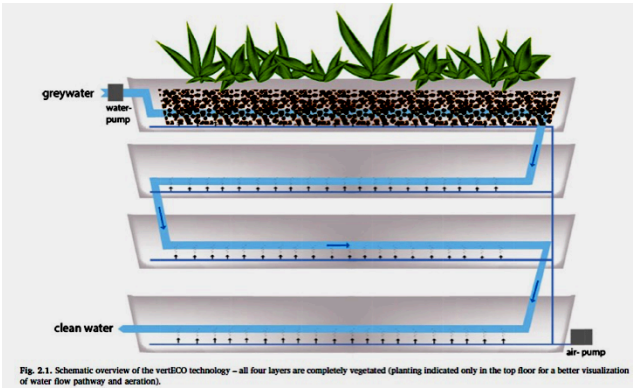

Fig. 2.1. Schematic overview of the vertECO technology – all four layers are completely vegetated (planting indicated only in the top floor for a better visualization of water flow pathway and aeration).

Part 3 –Companies manufacturing/implementing the technology

- TripleT, https://triple-treatment.com
- Hydrik, http://www.hydrik.com/

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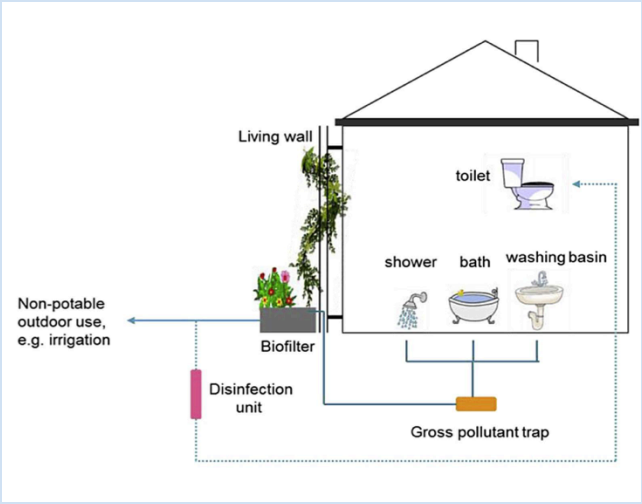
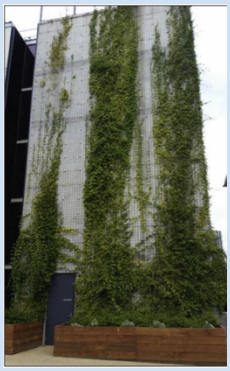
Water & Energy

Greywater treatment by living wall and green roof systems

Wastewater reuse, energy saver

Integrated Grey Water Treatment (GWT) using green building vegetated structures provides buildings water recycling and urban cooling to conserve water and reduce energy requirements. Vegetation in living walls and green roofs are passive methods for energy savings in buildings. Integration with the GWT system fulfills the vegetation's water requirements that water scarce arid regions generally lack, while offering simultaneous water treatment.





Potential Use in Hotel Industry

- Grey Water Treatment
- Passive cooling
- Improved air quality

Advantages	Disadvantages
Cost-savings from energy and water conservation	Knowledgeable personnel required for site-specific installation
Aesthetically appealing	Specific light requirements
Long lifespan and low maintenance	May require additional ventilation
Minimal component replacement	
Improves air quality	
Increases property value	

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Hotel Water User/ Consumer

f. Gardening and landscaping

f. 4 Harvested Rain water Use

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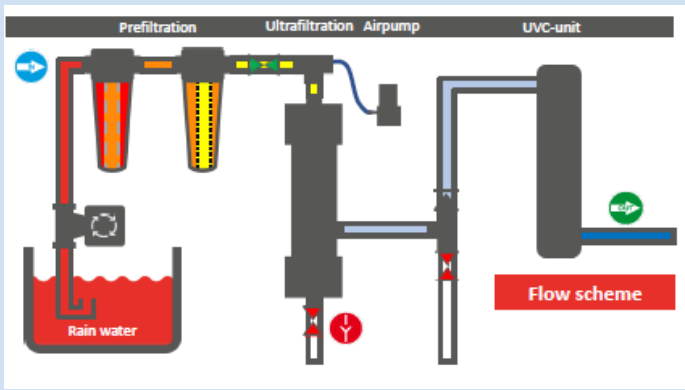
Water & Energy
Rain water harvesting
water savers

Rainwater harvesting is an alternative water supply approach . Rainwater harvesting captures, diverts, and stores rainwater for later use. Rainwater from a properly designed rainwater pre-filtration and storage system can be used without further treatment for landscape irrigation, garden ponds, and most exterior applications. Rainwater can also be used for fire protection and in-door uses like toilet flushing and up to drinking water (depending on treatment and regulator approval). When rainwater is used within buildings, supplemental treatment is essential. . A rainwater harvesting system can range in size and complexity. All systems have basics components, which include a catchment surface, conveyance system, storage, distribution, and treatment.



Potential use in hotel industry

- Laundries
- Effluents for toilet flushing
- Reused water for gardening and landscaping
- Swimming pool Top up

Advantages	Disadvantages
reduces demand on existing water supply	Weather depending
reduces run-off, erosion	Not maintenance free
Low to none energy requirements	
For some uses hardly needs any treatment	

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water
Rain water harvesting
water savers

Part 2 –Performance, Case studies

Hotel Penaga is an adaptive reuse hotel in Georgetown , the capital of Penang, Malaysia. Penaga Hotel applied rain water harvesting method.The type of water that has been collected at Penaga Hotel is non-potable water and it is not suitable for cooking and drinking.)

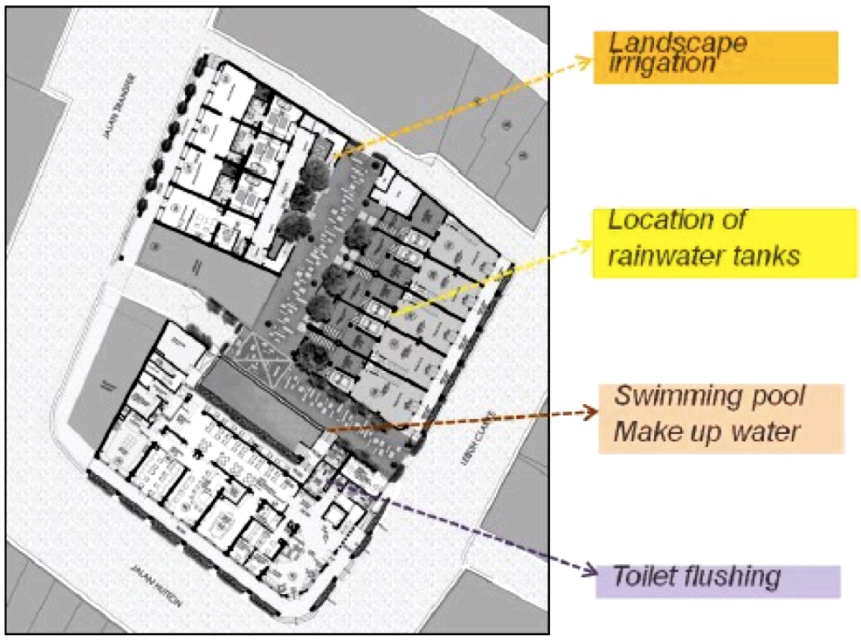

Fig 10.Rainwater harvesting system

At Penaga Hotel the non-potable water was used to irrigate the plant and to flush toilet. Other than that, after some treatments the water is also used for the swimming pool. The water efficiency fittings used also reduce the water usage, for example the 50% reduction of annual potable water consumption. (Dewiyana E et al. , 'The Green Aspects of Adaptive Reuse of Hotel Penaga', Procedia - Social and Behavioral Sciences Volume 22223 June 2016,Pages 631-643

Part 3 –Companies manufacturing/implementing the technology

- Conservation technology, http://www.conservationtechnology.com/
- Stormsaver, https://www.stormsaver.com/commercial-rainwater-harvesting/how-it-works
- D2D Water Solutions B.V., https://www.d2dwatersolutions.com/yourproducts/drop2drink-unit
- Rainwater recovery on EPDM roof, https://www.epdm-distribution.fr/actualites/recuperation-deau-de-pluie-toiture-epdm-2

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Hotel Water User/ Consumer

g. In house water use

g. 1 Gray water recycling for various uses

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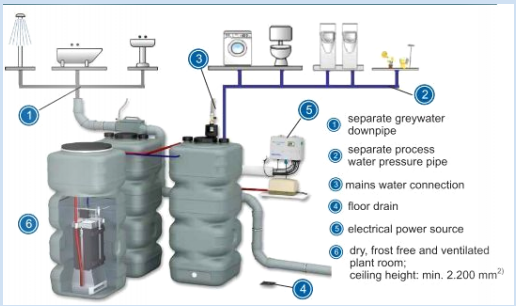
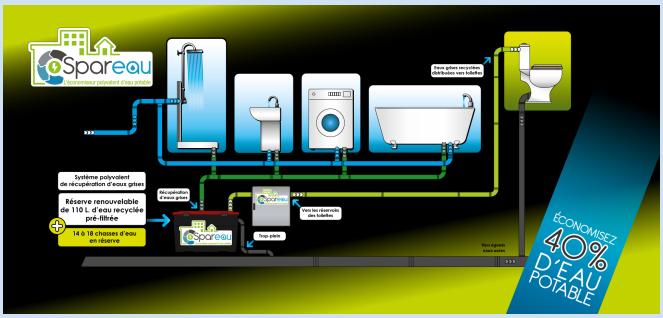
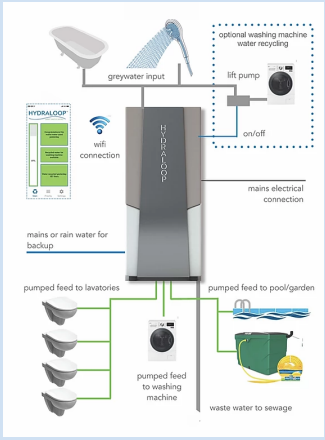
Water
In house Grey water recycling – Complete Systems
water savers

Compact in-house water recycle system can drastically reduce water usage were developed and considered to have low maintenance requirements.
The basic idea of some processes is to reuse water from the bathroom and washing machine without the use of filters and membranes that tend to clog but rather combine water treatment technologies to remove dirt, soap and other particles from the water . Others do use some kind of membrane separation or even a small MBR as part of the process







Advantages	Disadvantages
reduces demand on existing water supply	Price ?
Low maintenance requirements for some of the systems	Small capacity units

Potential use in hotel industry

- Laundries
- Effluents for toilet flushing
- Reused water for gardening and landscaping
- Swimming pool Top up

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Water
In house Grey water recycling – Complete Systems
water savers

Part 2 –Performance, Case studies

By installing a Multi-units set-up in the main building of a hotel, centrally collected water from hand basins, baths and showers can be collected and reused for toilet flushing, garden irrigation and pool top up. A maximum water recycling capacity of 6000 liters (1.585 gallons) a day Can be offered.

Part 3 –Companies manufacturing/implementing the technology

- Hydraloop : treatment system combines five technologies; Sedimentation, Flotation, Dissolved Air Flotation, Foam fractionation and an Aerobic Bioreactor. The sixth technology, which is the final treatment, is disinfection using UV light., https://www.hydraloop.com/products
- Aquapure – international , http://aquapure-international.com/en/aquapure-systems-2/
- Eautenticwater, Spareau system, https://eautenticwater.com/spareau/

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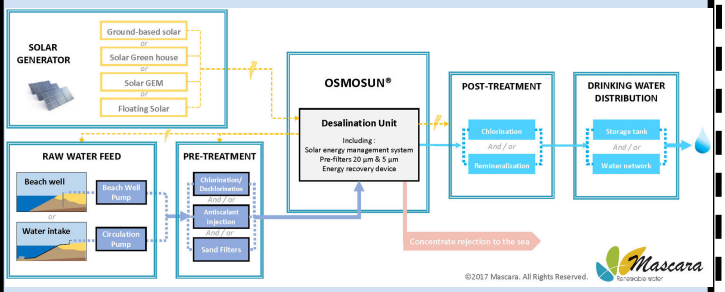
Water
Seawater Desalination
water savers

In some hotels and resorts, especially by the sea, seawater desalination may be an alternative for water of poorer quality supplied by the city or village network.
Current solution for easy built units are available also to be supplied and a BOT project with the technology supplier .
Most of modern desalination plants include some pretreatment, Reverse Osmosis (RO) membranes and post-treatment units.



RO powered by solar energy

Packaged RO units

Potential use in hotel industry

- Building supply
- Water for gardening and landscaping
- Swimming pool water

Advantages	Disadvantages
reduces demand on existing water supply	Price
High water quality	Small capacity units
Reliable water supply	Energy demands besides the solar powered units
	Brine to be discharged

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Water
Seawater Desalination
water savers

Part 2 –Performance, Case studies

Seawater Desalination for Hotel Resort resort in Costa Rica

Water source	Sea water
Technology	Ultrafiltration, Seawater Reverse Osmosis desalination, ERD (energy recovery), Remineralization post treatment
Capacity	1,500 m^3/day (0.39 MGD)
Application	Potable water – Drinking water & irrigation for golf course and landscape
A to Z time	8 Months
Highlights	• Reserva Conchal is located in Guanacaste, a province that has suffered droughts since 2014 • The water shortage posed a serious threat to the resort • Needed an immediate potable water solution that would not hurt the environment or burden the water grid

Part 3 –Companies manufacturing/implementing the technology

- Fluence, https://www.fluencecorp.com/desalination/
- GES, https://ges.co.il/wp-content/uploads/2019/10/GES-Full-project-reference-list-151019.pdf
- Aquapure-international, http://aquapure-international.com/en/our-products/
- Osmosun, **reverse osmosis desalination solution using only solar energy**, https://www.osmosunwater.solutions/en/applications/#osmosun-sw
- Elementalwatermakers, , **reverse osmosis desalination solution using only solar energy** https://www.elementalwatermakers.com/projects/

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CONTENT

2. ENERGY TECHNOLOGIES

a. Energy systems equipment
b. Kitchen equipment
c. Envelope

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Hotel Energy User/ Consumer

Energy systems equipment

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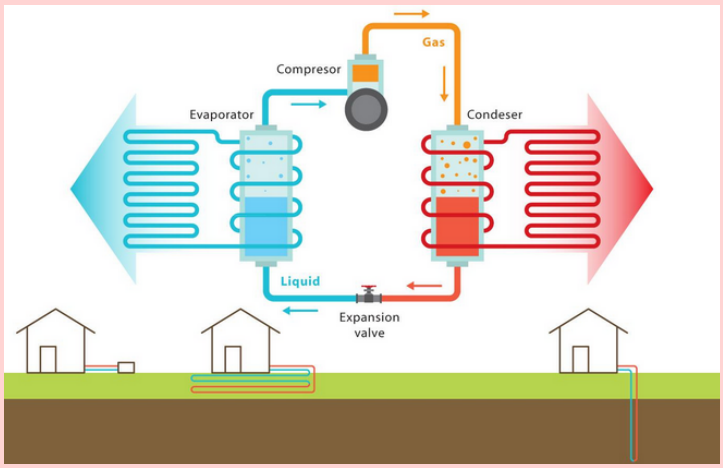
Energy
Heat pump
HVAC systems

Heat pumps unit can provide space heating, cooling (if they are reversible) and can also provide domestic hot water. A ventilation system ensures that new, fresh air gets into the building while regulating the heat via a heat exchanger. The heat is transfered from a cold space to a warmer one. A heat pump system is composed of a condenser, an expansion valve, an evaporator and a compressor. Heat pumps are more efficient than resistance heaters because the thermal energy is taken from the ambient environment and not completely produced by electricity.



https://www.vecteezy.com/free-vector/heat">Heat Vectors by Vecteezy

- **Potential use in hotel industry**

Heat pump systems should be considered for heating and cooling needs of hotel buildings (new constructions or refurbishment) because of the thermal comfort provided and consequent energy savings.

Advantages	Disadvantages
Considerable energy savings for heating and cooling needs.	The installation cost is higher than that of a resistance heater.
Heat pumps are at least 3 times more performant than resistance heater.	The efficiency can decrease with very low external temperature (below 7°C)
Possibility to use heat pumps for domestic hot water production	Some maintenance is to be provided, but less than combustion heating systems.
Emission free operation on-site	Noise caused by external fan unit

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Energy
Heat pump
HVAC systems

Part 2 –Performance, Case studies

The coefficient of performance (COP) for heat pumps, defined as the ratio of useful heating or cooling provided to work required, ranges typically between 3 and 5, depending on operating conditions.

After six months of operation in Scandic Hell Hotel in Trondheim, Norway (established in 1987), an all-in-one CO_2 heat pump has saved 59-69% of energy compared to an electric boiler (previous heating system).

The Piccolo Hotel in Moneglia (Italy) is heated and cooled by two geothermal heat pumps of 60 kW, COP about 3,5. Domestic hot water is also produced. Heating and cooling is distributed by radiant floor. The seasonal space heating efficiency is 138%.

Part 3 –Companies manufacturing/implementing the technology

Eurevia	http://www.eurevia.com/
LG	www.lg.com
Mitsubishi	https://fr.mitsubishielectric.com/fr/
Nibe	https://www.nibe.eu/
Vaillant	https://www.vaillant-group.com/
Daikin	www.daikin.com
Stiebel Eltron GmbH & Co. KG	https://www.stiebel-eltron.com/en/home.html
Systemair GmbH	https://www.systemair.com/
tecalor GmbH	https://www.tecalor.de/de/home.html
Vivreco	https://www.vivreco.fr/
Watinyoo	https://www.watinyoo.com/
Danfoss	www.danfoss.com
Panasonic	www.panasonic.com
Samsung	www.samsung.com
De Dietrich	https://www.dedietrich-thermique.fr/
Frisquet	www.frisquet.com
SDEEC	www.sdeec.fr
Nextherm	http://nextherm.fr/
Atlantic	www.atlantic.fr
Sanden	http://www.sanden-europe.fr/

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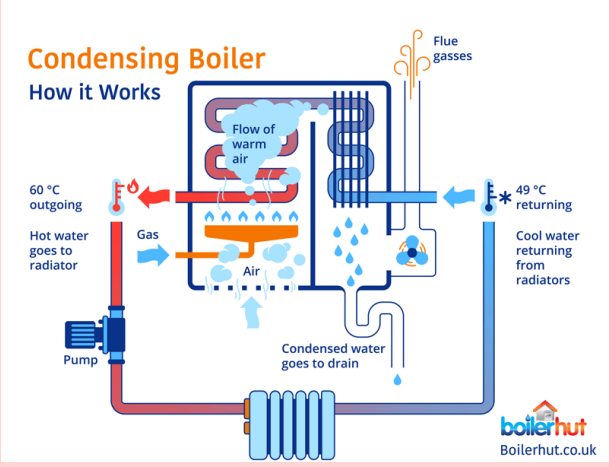
Energy
Condensing boiler
HVAC and Domestic Hot Water production

Condensing boilers are energy efficient boilers that can recover waste heat (latent heat of evaporation) produced during the combustion of the fuel (gas or oil). This additional waste heat is used to heat the water and increase the energy efficiency of the boiler compared to conventional boilers. They can be used to power central heating systems and also domestic hot water. A drain has to be installed to get rid of the acid condense and some manufacturers propose an inline neutraliser to neutralise the pH of the condense



- **Potential use in hotel industry**

The installation of condensing boilers should be considered when retrofitting existing boilers. Because of higher energy efficiency, energy cost for space heating and domestic hot water will decrease as well as fuel consumption and GHG emissions.

Advantages	Disadvantages
High efficiency condensing boilers can convert more than 88% of the fuel used into heat, compared with around 80% for conventional types.	Higher installation cost than conventional boilers
Lower gas consumption (up to 30%) for the same heating performance compared to conventional boilers	Corrosion issues can arise from acid condense, but neutraliser can stabilise the pH

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Energy
Condensing boiler
HVAC and Domestic Hot Water production

Part 2 –Performance, Case studies

Performances in energy efficiency can be higher than 90%.

The Tiziano Hotel in Milan (Italy) retrofitted its heating system and installed a condensing boiler, with a total thermal power of 342,9 kW and 98% energy efficiency to power space heating and domestic hot water production. The hotel improved by 30% the energy efficiency for heating needs.

Part 3 –Companies manufacturing/implementing the technology

Vaillant	https://www.vaillant-group.com/
Baxi	https://www.baxi.co.uk/
Bosch	https://www.bosch.com/
Viessmann	https://www.viessmann.com/com/en.html
Frisquet	https://www.frisquet.com/
Atlantic	www.atlantic.fr
Vergne	http://www.vergne-innovation.eu/
Ferroli	https://www.ferroli.com/int
Riello	https://www.riello.com/corporate/it
Unical	https://www.unical.fr/
Saunier Duval	https://www.saunierduval.fr/particulier/
Ariston	https://www.ariston.com/

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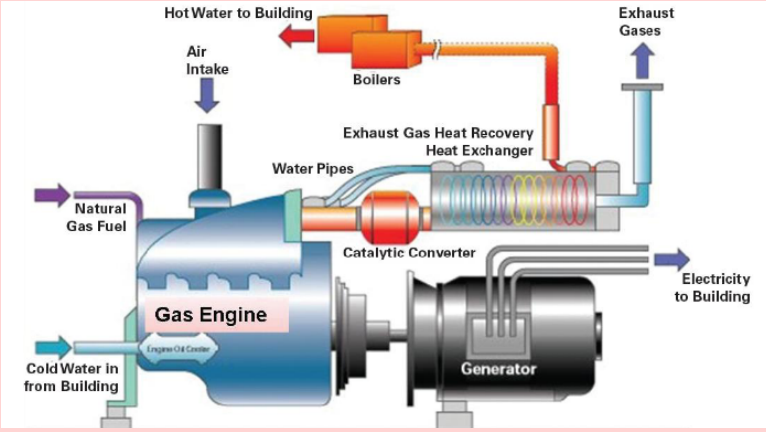
Energy
Combined heat and power
Heat and power generation

Combined heat and power (CHP) generation or co-generation is on–site electricity and heat simoultaneous production. When cooling is provided, then the process is known as CCHP (combined cooling, heating and power) or trigeneration. Unlike conventional electricity generation systems, CHP technology can recover otherwise wasted thermal energy and use it for space heating or domestic hot water production. The thermal energy comes from a



Source : https://www.gasnetworks.ie/business/gas-benefits/case-studies/Ormonde_Hotel_Case_Study.pdf

- **Potential use in hotel industry**

A technical feasibility study need to be carried out to determine the thermal and electrical loads of the hotel. When the two loads match on a daily and seasonal basis, the efficiency of CHP system will be higher.

Advantages	Disadvantages
Heating is recovered and put to useful purposes	A room is needed for the CHP installation
Savings on total energy costs for the user	Costs should be considered for insulating the piping system
Reduced emissions	If other fuels than biogas are used, not really environmental friendly
Indipendence and security of power and heat supply	Not suitable for low heating loads

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Energy
Combined heat and power
Heat and power generation

Part 2 –Performance, Case studies

Because of the utilisation of the heat, combined heat and power can achieve up to 90% efficiency, and energy savings can span from 15 to 40% compared to conventional power and heating systems.

In 2016 the Kilkenny Ormonde Hotel in Ireland (118 guest bedrooms, with leisure centre facilities, swimming pool, meeting rooms and conference venue) upgraded its CHP unit to more precisely reflect the heating and electrical requirements of the hotel and leisure centre.

- The CHP unit satisfies: 65% of the total heat demands, 40% of the total electrical demands.
- Payback on investment in less than 3 years.
- Annual energy saving of circa € 47,000

Part 3 –Companies manufacturing/implementing the technology

Dalkia	https://www.dalkia.fr/fr
Siemens	https://new.siemens.com/global/en.html
GE	https://www.ge.com/
Viessmann	https://www.viessmann.com/com/en.html

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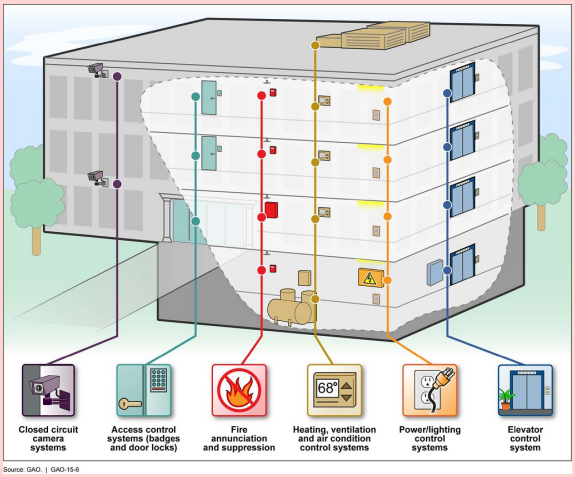
Energy
Building Energy Management System
Energy Monitoring and Management

Monitoring and controlling of energy-related building equipments can be provided by Building Energy Management Systems (BEMS). These systems integrates equipments such as ventilation and air conditioning, lighting, lifts, sensors (smoke detection, movement). Remote monitoring of equipments allows energy savings by optimising operation modes, set points, hours of operation. They can also trigger alarms (e.g. for equipment maintenance), track records of consumptions and provide reports.



- **Potential use in hotel industry**

BEMS can be particularly useful in the hotel industry to check and manage energy consumption in the building, plan maintenance and make considerable energy savings on each energy-related equipment.

Advantages	Disadvantages
Energy savings	Cost of installation
Monitoring of equipment for maintenance	Maintenance needed (e.g. replace batteries in sensor)
Record of historical consumption data	The systems require knowledgeable people to manage them
Centralised monitoring and management of equipment via intranet or WiFi	

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Energy
Building Energy Management System
Energy Monitoring and Management

Part 2 –Performance, Case studies

Energy savings can range from 10 to 40%.

The Evolution Lisboa Hotel in Portugal has integrated a BEMS solution that also enables guests to control their room. The hotel saves an estimated 40% on energy costs, about 35 k€ on the energy bill.

Part 3 –Companies manufacturing/implementing the technology

Courtois Energie Conseil	https://www.courtoisenergies.fr/
Beebryte	https://www.beebryte.com/
Comwatt	https://www.comwatt.com/
EcoCO2	https://www.ecoco2.com/
Ecotec	https://www.eauxdemarseille.fr/Le-Groupe/Les-societes-du-groupe/Energie-electricite
Gridpocket	https://www.gridpocket.com/en/
SENR	https://www.senr.fr/
TEC Lab	http://my-orchestra.com/fr/
Inovadea	https://www.inovadea.com/
Unigrid Solutions	http://www.unigridsolutions.com/
WIT	https://www.wit.fr/
Schneider Electric	https://www.se.com/ww/en/
Entelec	https://www.entelec.eu/fr/
Siemens	https://new.siemens.com/global/en.html
GE	https://www.ge.com/

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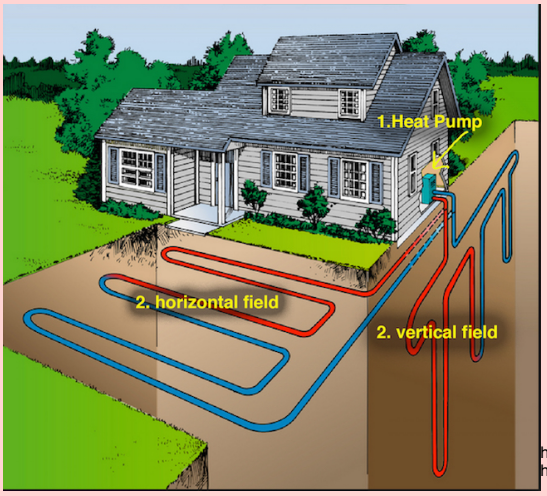
Energy
Geothermal heating/cooling
HVAC technologies

Geothermal heating and cooling systems take advantage of of the sun's thermal energy which is absorbed and stored by the earth. During winter, the ground temperature is higher than the outside air, therefore heat can be transfered inside a buiding through an underground pipe system powered by a heat pump. During summer, the ground is cooler than the outside air and the pipe system can transfer cool air (heat sink). The pipe sytems can be vertical or horizontal.



https://www.renewableenergyworld.com/2016/02/24/the-hidden-genius-of-geothermal-hvac-systems/#gref

- **Potential use in hotel industry**

Geothermal heating and cooling technologies can be used by hotels to cover space heating and cooling demand and guarantee a comfortable indoor temperature.

Advantages	Disadvantages
Low heating and cooling operating costs	More expensive to install than conventional electric or gas fired sytems
Electricity savings compared to conventional systems and stable prices	The installation is site-specific (some ground types can be unsuitable)
Permanent and local heating / cooling ressource	

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Energy
Geothermal heating/cooling
HVAC technologies

Part 2 –Performance, Case studies

The coefficient of performance (COP) ranges between 3 and 5.

The Alma Verde holiday villas in Portugal measured cooling-energy savings of over 95% for a ground cooling tube system compared with use of conventional air conditioning units.

Part 3 –Companies manufacturing/implementing the technology

Watinyoo	https://www.watinyoo.com/
Hocosto (storage)	https://www.hocosto.com/applications/
Atlantic	www.atlantic.fr
Nextherm	http://nextherm.fr/
Etao	https://www.etao.fr/
enOware GmbH	https://www.enoware.de/
Viessmann	https://www.viessmann.com/com/en.html
Daikin	www.daikin.com

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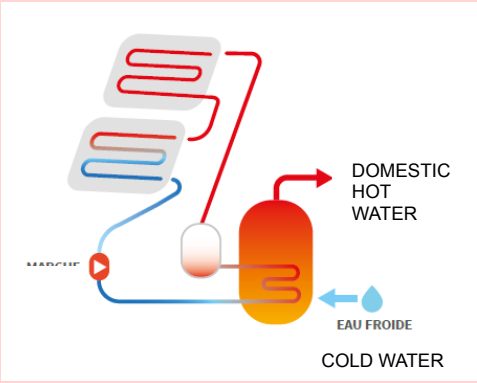
Energy
Solar Domestic Hot Water
Domestic Hot Water production

Solar Domestic Hot Water systems can convert solar energy into heat for domestic hot water production. A working fluid flowing through a sun-facing collector transfers solar heat to water in a tank. They include a supplementary heater or a pre-heater (electric or gas powered) to ensure domestic hot water production during cloudy days. Thermosiphons and Forced-Circulation are the two main systems. The difference between them is due to the way that the water circulates between the collector and the water tank.



Source : https://www.ademe.fr/production-deau-chaude-sanitaire-etablissements-tourisme-loisirs

- **Potential use in hotel industry**

Solar thermal is adapted to the hotel industry: the summer attendance of these establishments is correlated with the maximum productivity period of solar collectors, allowing a good adequacy of the domestic hot water demand with its production.

Advantages	Disadvantages
Domestic hot water need could be covered from 40% to 80% over the year	Purchasing, operation and maintenance costs
Indipendence from energy prices	Stagnation and over heating during summer in not self-draining systems
Value a local, abundant resource	The system requires sufficient roof space
Higher attractiveness for responsible tourism	

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Energy
Solar Domestic Hot Water
Domestic Hot Water production

Part 2 –Performance, Case studies

The performance of Solar Domestic Hot Water systems can reach 100% during summer, and vary from 40% to 85% during the year.
The Global Grange Ltd in London equipped their 5 stars hotel with solar thermal system. This system heats around 7200 litres of water each day for showering, washing hands and cleaning.

System Size	140 m²
Carbon Saved	19 Tonnes per year

Part 3 –Companies manufacturing/implementing the technology

Eco Power Europe	https://www.ecopowereurope.com/
Paw GmbH & Co. KG	https://www.paw.eu/
Giordano Industries	www.giordano.fr
KYRIAZIS SA	https://e-kyriazis.gr/

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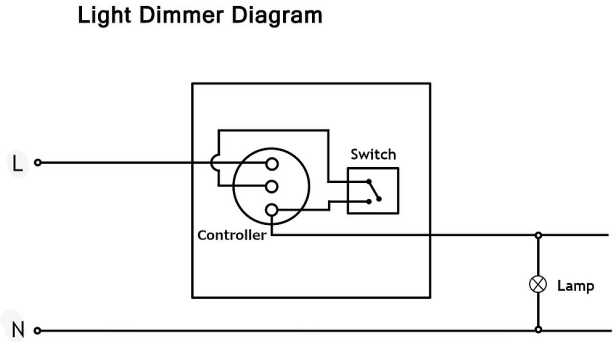
Energy
Low Energy Lighting
Lighting

Lighting should be properly controlled to decrease energy consumption. Different low energy technologies are available : recent T5 tubes (compact fluorescent tubes) or LED lights. Intelligent lighting zone control can also optimize energy consumption for example using motion detectors in corridors, timers and light dimmers. At the conception stage, building design can be optimized to optimise the use of natural light and the impact of glazed surface on heating and cooling needs.



https://commons.wikimedia.org/wiki/File:Light_dimmer_diagram.jpg

- **Potential use in hotel industry**

Lighting represents approximately 12% of energy consumption in hotels. Installing low energy controlled lighting is a great opportunity for energy savings. Inefficient lighting causes important heat losses which can add to building cooling demand in summer.

Advantages	Disadvantages
T5 tubes need lower maintenance than old T12 tubes	Purchase of new equipments : motion detectors, light dimmers
Artificial lighting dimmed when daylight is available	LED lighting is not always dimmer compatible
Reduced replacement costs: LED lights last significantly longer than traditional bulbs (up to 40 000 hours).	Progresses need to be made on recycling of LED lighting

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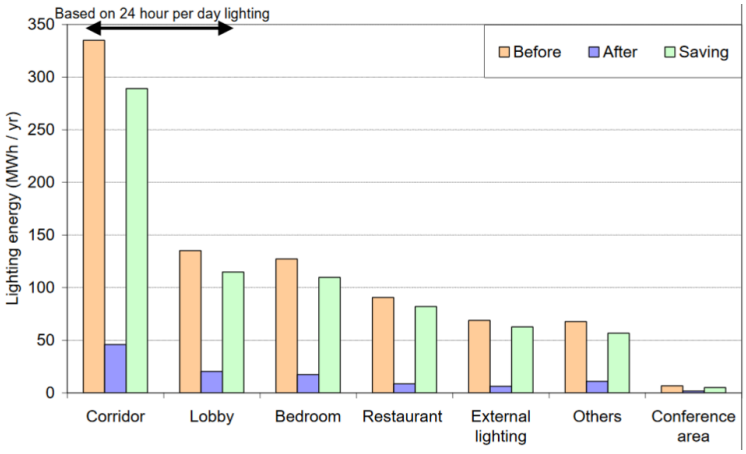
Energy
Low Energy Lighting
Lighting

Part 2 –Performance, Case studies

One 65-room luxury hotel can save over 700 MWh per year through an efficient lighting system almost entirely comprised of LED and compact fluorescent lamps, compared with traditional lighting (electricity reductions visible on the diagram at the right)



https://ec.europa.eu/environment/emas/takeagreenstep/pdf/BEMP-7-FINAL.pdf

Part 3 –Companies manufacturing/implementing the technology

Augier	https://augier.com/
Lacroix group	https://fr.lacroix-group.com/
RAGNI SA	https://www.ragni.com/
Vinci Energies	https://www.vinci-energies.com/
StarLED	https://www.starled.fr/
Philips	https://www.philips.com/global
Celux	https://www.celuxiluminacion.es/
Arditi	http://www.arditi.com/en/
Lumi'in	http://www.lumi-in.fr/

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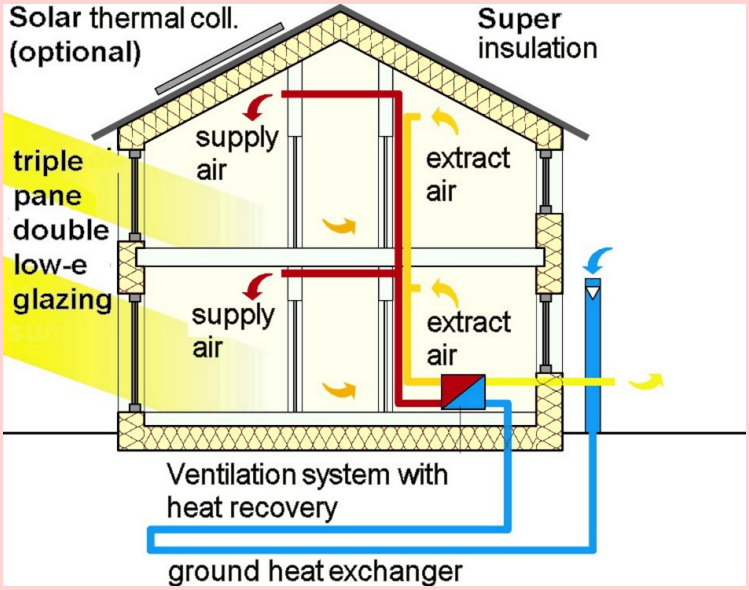
Energy
Heat recovery ventilation
HVAC products

To maintain a good quality indoor air, ventilation is essential to extract exhaust air and replace it with new fresh air. Heat recovery ventilation (HRV) allows to do this while recovering residual heat in the exhaust air to pre-heat the fresh air to be introduced in the room. During the hot season, the same ventilation system can use the cooler exhaust air to pre-cool the fresh air and reduce energy consumption for air conditioning.



Source : www.passiv.de

- **Potential use in hotel industry**

Each room of a hotel needs to be adequately ventilated to keep good thermal and acoustic quality. Heat recovery ventilation provide good indoor air quality while considerably saving energy.

Advantages	Disadvantages
Heat recovery can reach 95% in the HRV systems	The systems are initially expensive to install
Continuous clean fresh air : pollutants are filtered and odours are removed	A good regulation is necessary to avoid ventilation noise
HVR systems can regulate the moisture condensation and avoid mould growth	Maintenance costs : filters should be changed every six months

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Energy
Heat recovery ventilation
HVAC products

Part 2 –Performance, Case studies

Heat recovery rates con reach up to 95%, but rates can be a bit lower for big volumes (> 600 m3/h).

Many case studies can be found on the Passive House Database (https://passivehouse-database.org/index.php).
This B&B in the south of the French Alps (St Michel de Chaillol) installed a HRV system with an efficiency of 84%.

Part 3 –Companies manufacturing/implementing the technology

Daikin	www.daikin.com
Zehnder	https://www.zehnder.fr/
Aldes	https://www.aldes.fr/
Swegon	https://www.swegon.com/

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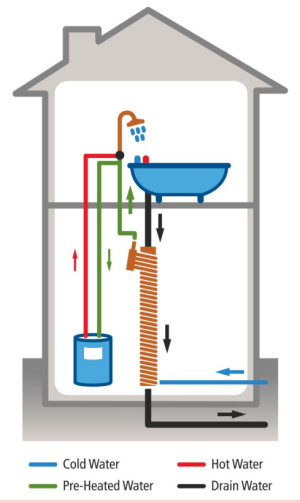
Energy
Wastewater heat recovery
Domestic Hot Water production and consumption

The majority of the heat used for domestic hot water is exploited for a short time and then lost in the sewage system. Wastewater heat recovery systems allow to recover a part of the heat to pre-heat incoming water for domestic hot water preparation, and therefore decrease the building energy consumption. Different technologies are available : shower/bathtub heat recovery, horizontal or vertical heat exchanger to be installed to the sewage system.



https://commons.wikimedia.org/wiki/File:Waste_Water_Heat_Recovery_in_the_most_efficient_%27equal_flow%27_configuration.png

https://en.wikipedia.org/wiki/File:SHARC_wastewater_heat_recovery_system.jpg

- **Potential use in hotel industry**

Domestic hot water preparation is the second end-use energy consumption in hotels. Wastewater heat recovery is particularly adapted to easily make energy savings and improve the environmental impact of the building.

Advantages	Disadvantages
Passive heat recovery systems require no external energy source	Additional equipment to be installed
30 to 70% energy savings for domestic hot water preparation	Capital and maintenance costs to be considered
Easy installation by plumbers	

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Energy
Wastewater heat recovery
Domestic Hot Water production and consumption

Part 2 –Performance, Case studies

The redevelopment of Camden Town Hall Annexe in London has installed Waste Water Heat Recovery systems for Showers to the majority of its' rooms. The technology can recover up to 67% of the heat energy that would normally be wasted down the drain. Each unit is connected to 2 individual showers via back-to-back bathroom units, in an effort to maximise ROI.

Part 3 –Companies manufacturing/implementing the technology

Zypho	https://www.zypho.pt/
Recoup	https://recoupwwhrs.co.uk/
EHTech	https://www.ehtech.fr/
Gaïa Green	http://www.gaiagreen.net/
Wagner Solar GmbH	https://www.wagner-solar.com/de/
Cerian Shower S.L.	https://passiveshower.com/en/home/
Q-Blue B.V.	https://www.q-blue.nl/en/home

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Energy
Hybrid solar panels

Energy Saving

A single panel combining two technologies exploiting sun's energy: photovoltaics for electricity generation and solar thermal for hot water production. The upper surface of the panel is covered with photovoltaic cells and the lower part can collect heat through a solar thermal collector. The photovoltaic cell are then cooled and can be more performant. Installation of such hybrid panels reduces rooftop space by installing one panel instead of two and allows to meet different energy needs of buildings such as domestic hot water or pool heating. Hot water production can also be used to improve the performance of heat pump for heating application.

- **Potential use in hotel industry**

- Water and pool heating
- Production of cheap and clean power
- Energy and cost savings

Advantages	Disadvantages
The solution is cost saving when it comes to both electricity and thermal energy prices	Performance depends on solar radiation. No energy produced at night.
Competitive price and compatibility with different systems	

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Energy
Hybrid solar panels

Energy Saving

Part 2 –Performance, Case studies

It has been claimed that hybrid panels can have an efficiency as high as 85% and generate four times the energy produced from the same surface area for only a 25% increase in cost.

Iberostar Hotel in Tenerife installed 102 hybrid solar panels, the ROI is 5 years, and 86 tons CO2 per year are avoided

https://abora-solar.com/en/sectors/hybrid-panel-in-hotels/

Part 3 –Companies manufacturing/implementing the technology

DualSun	www.dualsun.com
Abora	https://abora-solar.com/
DanSolar	http://dansolar.dk/en/international/
FotoTherm	http://www.fototherm.com/
SoLink	https://www.solink.it/

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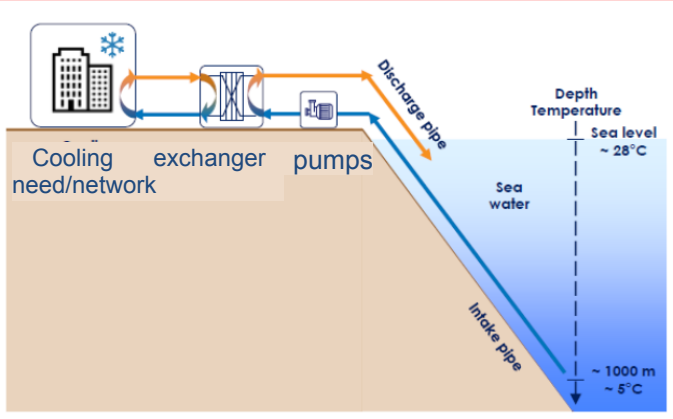
Energy

Sea Water Air Conditioning (SWAC)

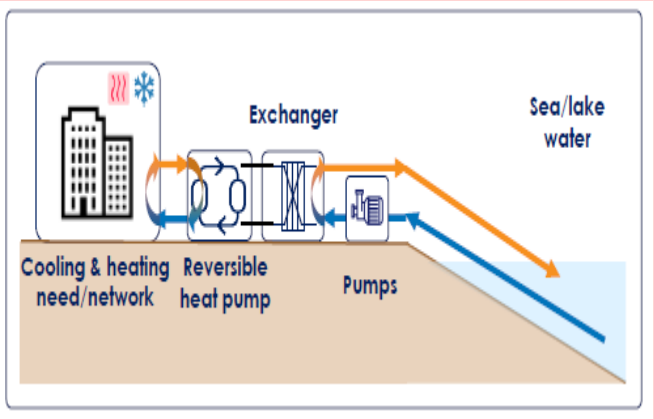
Energy Saving

SWAC systems allow to use seawater as a cold source (in "free-cooling") to meet air conditioning needs of some buildings up to an entire district. Whilst conventional cold groups have an electrical consumption mainly related to the operation of the compressors, SWAC have a much lower power consumption, mainly related to seawater pumps. This principle of free-cooling is also applicable on fresh water (lakes). SWAC systems can also be combined with thermodynamic machines (Chiller, Heat Pump) to take advantage of constant cold (or hot) water temperature to improve their performances. Such systems can provide heating or cooling (thalassothermy).

Opened-loop free-cooling



Thalassothermy



- **Potential use in hotel industry**
- Air conditioning
- Heating & cooling
- Energy savings

Advantages	Disadvantages
SWAC has a much lower power consumption than conventional cold groups. Cost savings	Amortization of installation costs is done over a relatively long period, it is therefore essential to have a constant cold demand in order to maximize the use of SWAC system and reduce the ROI period
Ideal for badly connected areas (shorter RoI)	Installation of the system (especially pipes) can have a significant impact on the flora and fauna.

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Energy

Sea Water Air Conditioning (SWAC)

Energy Saving

Part 2 –Performance, Case studies

SWAC systems are much more efficient than conventional air conditioning sytems: the energy efficiency ratio is about 4 times higher. Consumption of electricity is about 4 times lower.

The Thassalia project in Marseille (France) provide heat and cooling to a certain number of buildings (500 000 m²) via a 3 km district heating/cooling system. The results are 70% less greenhouse gases emissions.
The Intercontinental Hotel in Bora Bora has also implemented a SWAC system, which allows 90% savings in air conditioning and 85% total energy savings.

Part 3 –Companies manufacturing/implementing the technology

DeProfundis	https://www.deprofundis.com/
Engie	https://pro.engie.fr/
Dalkia	https://www.dalkia.fr/fr
Bardot Ocean	fr.bardotgroup.com
Naval Energies	https://www.naval-energies.com/fr
Bernoulli System AB	http://www.bernoulli.se/
Bluerise	http://www.bluerise.nl/

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Energy
Biomass
Energy production

Biomass is all organic matter that can be used for energy: forest and agricultural residues, pruning residues, residues from agroforestry industries, etc. Internationally, biomass pellets are a standardized fuel. The calorific value of the pellet reaches 4,200 kcal / kg and its specific weight is 600/700 kg / m3. Pellet boilers are best suited for automatic heating and hot water systems. They require a container for the pellets and a transport system (worm gear) to take them to the boiler.

Pellets (wood)

Compact boiler with a power up to 256 kW in cascade

https://www.oekofen.com/es-es/pellematic-maxi/

- **Potential use in hotel industry**

The use of biomass to heat a whole hotel could reduce the total annual cost by up to 50%. It can also be used to heat outdoor pools in compliance with regulations.
In Spain more than 470 hotels use biomass.

Advantages	Disadvantages
Substantial energy savings	Fuel needs a lot of storage space
Clean energy	Poorly developed distribution channels
Short payback (few years)	Initial costs can be high

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Energy
Biomass
Energy production

Part 2 –Performance, Case studies

Hotel Cal Petit in Oliana (Lleida). KWB 100 kW biomass boiler. The hotel has an area of 2,000 m2 and the boiler meets the demand for heating and DHW. An 18-ton metal silo adapted to pneumatic loading is used, which is the feeding system used by the boiler. The investment pays for itself in about 4.5 years, with savings of around € 8,000 and 43 Tn of avoided CO2 emissions. The estimated annual energy production is 145,000kWh.

Part 3 –Companies manufacturing/implementing the technology

Oekofen	https://www.oekofen.com/
Hargassner	https://www.hargassner.es/
KWB	https://www.calderaskwb.com
Inmecal	http://calderasinmecal.com/
Tubocas	https://www.tubocas.net/

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Energy
Microeolic
Energy production

Wind power generation for use in individual installations can be considered to have an installed power of less than 100 kW, although there is no well defined limit. The generators can be horizontal or vertical axis. Its application can be off grid, in case of isolated areas or not connected to the network, which need accumulation systems (batteries). Or it can be grid connected, being able to use the energy produced for self-consumption. It is usually used in combination with other renewable

Wind turbine
BORNAY - 3 kW

By https://www.bornay.com/es/productos/kits-energias-renovables/autoconsumo

- **Potential use in hotel industry**

It can be used in isolated areas as a complement to other energy sources. It can permanently power small household appliances, lighting, pumping equipment, etc.

Advantages	Disadvantages
Substantial energy savings	Landscape impact
May be independent of electrical network	It cannot be installed in any geographical area
Quick payback	Initial costs can be high

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Energy
Microeolic
Energy production

Part 2 –Performance, Case studies

Rural Hotel Casa Calixto. Villarrobledo (Albacete)
Installation carried out to run a rural complex of 3 houses with a maximum capacity of 16 - 18 people. Generator located at 21.5 m high. The wind turbine's energy production is above 70% of its nominal value during more than 8 hours of wind per day in the area.

Part 3 –Companies manufacturing/implementing the technology

Bornay	https://www.bornay.com/es
Enair	https://www.enair.es/
Aeolos	https://www.windturbinesta
Smarttwister	http://www.smarttwister.org
Polux Hispania	http://poluxminieolica.com/

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Hotel Energy User/ Consumer

Kitchen equipment

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Energy
Steam-heat-recovery kitchen equipment
Cooking technologies

Ventilation of professional kitchens accounts for a large part of the total energy consumption, because of the electricity consumed to extract air at high volumic rates and because of the induced need of heating/cooling associated to the air change. Furthermore, the high steam content in the indoor air is a source of discomfort for the staff. Steam-heat-recovery solutions recover the heat contained in the condensing air in professional ovens and dishwashers, generally in specific condensation hoods. This increases the energy efficiency of cooking and dish washing, and reduces the energy consumption associated to ventilation.

Combi oven with condensing hood
Source: https://www.retigo.com/products/vision-combi-ovens/vent/vv-2011-detail

- **Potential use in hotel industry**

This solution is valid for hotels that offer a restoration service. In addition to energy savings, it can offer better working conditions to the hotel staff.

Advantages	Disadvantages
Heat recovery increases equipment efficiency	Additional investment with respect to conventional kitchen equipment
Enables to lower or even suppress entirely need for an exhaust ventilation system	Maintenance costs
Energy savings	Not always compatible with gas unit

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Energy
Steam-heat-recovery kitchen equipment
Cooking technologies

Part 2 –Performance, Case studies

Steam-heat-recovery combi ovens are 20% more efficient than conventional combi ovens.

Some of the kitchens of the Lasaretti Hotel in Finland were redesigned with efficient condensation hoods.
https://jeven.fi/en/referenssi/renovated-kitchen-ventilation-in-hotel-lasaretti/

Part 3 –Companies manufacturing/implementing the technology

Retigo	https://www.retigo.com/
Jeven	https://jeven.fi/en/
France Air	https://www.france-air.com/

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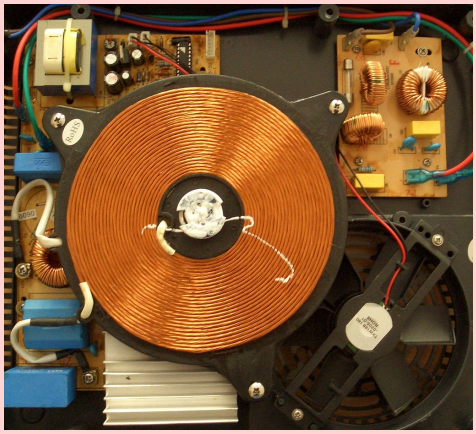
Energy
Induction cooking
Kitchen technologies

Induction cooking provide rapid, controllable and precise heat and at the same time it can save energy. An induction hob has a glass surface on which cooking vessels are placed. Under the glass surface, a coil of copper wire and alternating current passes through it, causing a magnetic field. This magnetic field induces an electrical current in the pan, which is then heated by a resistive heating coming from the induced electrical concentrated current.

Source: Adventys



By Wdwd - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=3753862

- **Potential use in hotel industry**

Induction cooking can be used in hotel industry because it allows precise professional cooking while being energy efficient.

Advantages	Disadvantages
Fast and easily controllable cooking	Cooking vessels must be compatible with induction
Efficient cooking, less heat is wasted in the kitchen	Induction hobs are usually more expensive than conventional electrical or gas stoves
The cooktops don't get very hot, safety is therefore increased	

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Energy
Induction cooking
Kitchen technologies

Part 2 –Performance, Case studies

Heating performance of induction cooking is comparable to gas cooking, up to 90% of the heat generated is used.

The Den Hoorn restaurant in Kapelle-op-den-Bos in Belgium changed from cooking gas to induction, resulting in 25% energy reduction and less maintenance and cleaning.

Part 3 –Companies manufacturing/implementing the technology

Adventys	http://plaque-induction.com/
Copreci	https://www.copreci.com/en/
Electrolux	https://www.electroluxgroup.com/en/
Charvet	https://www.charvet.fr/vdoc/easysite/site-institutionnel/fr
Falcon	http://www.falconworld.com/fr/
Menu System	https://www.menu-system.com/en/

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Hotel Energy User/ Consumer

Envelope

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Energy
Photovoltaic glass

Energy production – Building Integrated Photovoltaics

Transparent photovoltaic (PV) glass can be used as a material for windows as well as an electricity producing solution for self consumption. Daylight is converted to electricity by transparent semiconductor-based photovoltaic cells. The PV glass panes could be installed to replace conventional glass on the building windows with a good sun exposure. The PV glass is also suitable for façades, curtain walls, canopies and terrace floors. The building can reduce its dependence from the grid and reduce its carbon footprint.

- **Potential use in hotel industry**

Photovoltaic glass could be used in new hotel buildings or in refurbishment of the buildings envelope instead of conventional glass. The hotels could then become electricity producers and take advantage of new aesthetic components.

Advantages	Disadvantages
Same thermal and sound insulation as conventional glass	Extra operation and maintenance costs compared to a conventional window
Local electricity production: energy savings	Higher investment than conventional glass
Natural light can go through the glass	
Filtering of UV harmful radiation and IR radiation	
Possibility to get public subsidies	

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Energy
Photovoltaic glass
Energy production – Building Integrated Photovoltaics

Part 2 –Performance, Case studies

Case study in Imperial Beach, California : Pier South Mariott Hotel
Total area : 283 m²
Electricity generated in 35 years : 1 700 MWh
CO2 emissions avoided in 35 years : 1139 tons CO2
85% reduction in HVAC energy demands

Part 3 –Companies manufacturing/implementing the technology

Onyx Solar	https://www.onyxsolar.com/
Via Solis	http://www.viasolis.eu/
PhotoWatt	http://www.photowatt.com/
Megasol	https://megasol.ch/
Britesolar	https://www.britesolar.com/
Polysolar	https://www.polysolar.co.uk/

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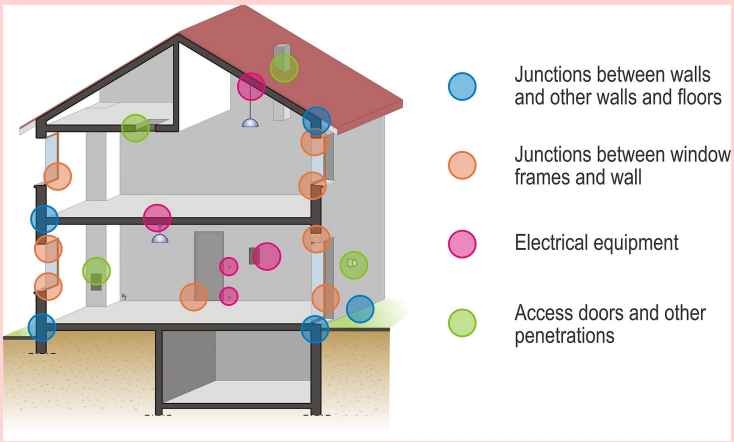
Energy
Building envelope air tightness
Energy efficiency envelope solutions

The building envelope air tightness can be defined as the capacity of the envelope to resist to air infiltrations or exfiltrations. Air leakage in a building should be avoided : in summer, infiltration can bring humid and hot air inside the building. In winter, exfiltration air can condense and damage the envelope. In both cases, a bad air tightness can lead to an increased energy consumption for space cooling or heating. A good air tightness level should be combined to an appropriate ventilation system (to guarantee indoor air quality) and ensures an efficient envelope insulation.

Common air leakage points in a building envelope



By CEREMA – Pôle QERA - http://tightvent.eu/faqs/what-are-the-most-common-air-leakageinfiltration-paths, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=31442687

Building technique
A continuous seal of the hot side of the building envelope guarantees the air tightness.

- **Potential use in hotel industry**

Thermal comfort is very important for hotel buildings : that's why air tightness improvement should be included with high quality standards in refurbishment programs and in new buildings.

Advantages	Disadvantages
Substantial energy savings	Heating and cooling systems could be too powerful after a refurbishment to increase air tightness
Building envelope is more protected and last longer	Moisture and condensation issues could appear if thermal bridges are not treated
Increased thermal comfort	Envelope refurbishment is needed to improve air tightness
Better performing ventilation system	Poor ventilation and high air tightness can affect air quality

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Energy
Building envelope air tightness

Energy efficiency envelope solutions

Part 2 –Performance, Case studies

Building air tightness can be expressed in terms of airflow through the envelope at a reference pressure (usually 50 Pascal). Several countries recommend or require minimum air tightness levels. Good performances range between 0,6 and 2 /h at 50 Pa.

La Casa del Castell in Mora d'Ebre (Cataluña, Spain) is a small hotel designed and built to the Passivhaus standard. The air tightness value is n_{50} = 1.03/h

Part 3 –Companies manufacturing/implementing the technology

proClima MOLL bauökologische Produkte GmbH	https://proclima.com/
Hevadex bvba	www.hevadex.com
Rotho Blaas SRL	https://www.rothoblaas.it/
Finsa – Financiera Maderera S.A.	www.finsa.com
SIGA	www.siga.swiss

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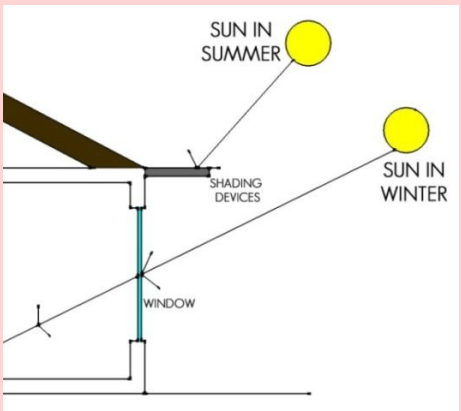
Energy
Sun shading devices
Energy efficiency envelope solutions

In sunny, hot climates, sunlight can lead to a peak consumption of cooling energy during the cooling season. The amount of sunlight admitted into abuilding can be controlled by different devices. Shading can be provided by external window devices, to prevent unwanted sunlight to get into a conditioned space. Awnings, overhangs, trellises, solar screens, textiles can be used. Some devices can also be oriented to regulate sunlight into the building, manually or automatically. If natural landscape is available, trees with deciduous foliage can be planted : they will shade the building in summer and let sunlight warm the building in winter. The position of the sun in the sky during cooling season needs to be studied to effectively design the shading



Investigation of Usage of Passive Solar Energy in Salamis Road's Buildings, Famagusta - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Overhang-of-a-building-or-simple-shading-devices_fig5_271301009 [accessed 30 Apr, 2020]

https://www.contemporist.com/facade-screened-with-redwood-for-sun-shading/

- **Potential use in hotel industry**

Sun shading devices should be applied to any building in warm climates. In hotels, they guarantee clients and hotel employees thermal and visual comfort and working conditions.

Advantages	Disadvantages
Sun shading devices can improve user visual comfort	Durability and maintenance of the devices to be considered
Energy savings in cooling needs and smaller HVAC installation	Thermal bridges can increase in case of bad installation
Shading devices can be the opportunity of differentiating the building façade	Difficulties can arise to choose devices in historical buildings

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Energy
Sun shading devices

Energy efficiency envelope solutions

Part 2 –Performance, Case studies

External solar shading devices can halve the annual cooling demand and peak load while internal shades only reduces it by one third. The solar heat gain of the windows can be reduced even 80-90% with outdoor sun shading devices. This can also affect the design ofthe HVAC-system, leading to smaller installations. Some shading device can integrate photovoltaics panels and can be used to produce electricity.

For a 1,000 m2hotel with an annual electricity consumption of 37.5 kWh/m2for space cooling, and if the French emission factors are applied, a 20% energy saving on space cooling represents:0.63 teq CO2 avoided each year. French emission factor for electricity: 84.3 gCO2 / kWh. French emission factor for gas: 231 gCO2 / kWh (Source: ADEME)

A Port Frioul restaurant in Marseille (France) installed a bioclimatic pergola that regulates automatically the inclination of the brise soleil depending on sun and wind conditions for an increasead thermal comfort.

Part 3 –Companies manufacturing/implementing the technology

Somfy	www.somfy.fr
Colt international	https://www.coltinfo.co.uk/
Tryba	www.tryba.com
Bubendorff	https://www.bubendorff.com/
Roto Franck	https://www.roto-frank.com/fr/
Paralu	https://www.paralu.fr/

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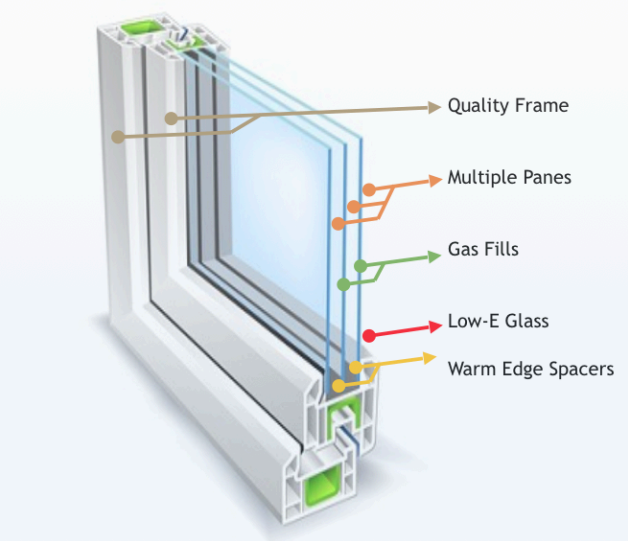
Energy
Energy Efficient windows
Energy efficiency envelope solutions

Poor quality windows can lead to heating and cooling losses and therefore to an increased energy cost for the building. Energy efficient windows can be made of different materials (wood, PVC, aluminium), have multiple low emissivity glass panes (2 or 3), spaced by a spacer and filled with a gas (argon or krypton). When choosing a window, it's important to take into consideration the U value, that measures insulation properties, and the solar factor that defines the amount of solar energy that can pass through the window. A higher solar factor can lower heating needs during winter but increase cooling needs in summer. A thermal study can help choosing the best option with regard to the climate.



https://wildenlivinglab.com/2017/11/09/energy-efficient-windows/

- **Potential use in hotel industry**

Energy performant windows can assure good thermal comfort in each room and can be the opportunity to choose good acoustic performance too.

Advantages	Disadvantages
Comfortable room temperature	Costs for replacement
Replacement of windows can improve acoustic comfort	Bad installation can affect insulation properties
Energy savings	

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Energy
Energy Efficient windows

Energy efficiency envelope solutions

Part 2 –Performance, Case studies

Windows insulation properties (glazing and frame) can be measured by the U value (Uw). The lower the Uw, the best performances. Good performances are typically lower than 1.3 W/m²K. Triple glazed windows can go as low as 0.7 W/m²K.

The Hipotels Bahia Cala Millor Hotels (Mallorca) refurbished the building envelope and replaced windows. This lead to a decrease of 35% in thermal losses.

Part 3 –Companies manufacturing/implementing the technology

Optiwin	http://www.optiwin.net/
Aluplast GmbH	https://www.aluplast.net/fr/index.php
Menuiserie Bader	https://www.bader-bois.fr/
SIP productos industriales S.A.	https://www.salamander-windows.com/en
Carpintría Industrial Binéfar, S.A.	https://www.carinbisa.com/
Torinco S.L.	https://www.torrero-torinco.com/
Joint Dual	https://www.joint-dual.com/
Finstral AG	https://www.finstral.com/fr/home/1-0.html
Minco S.A.	https://www.minco.fr/
Millet	https://groupe-millet.com/
Kawneer	https://www.kawneer.com/kawneer/france/fr/info_page/home.asp
Riche S.A.	https://www.chassisriche.be/
Aluminios Cortizo S.A.U.	https://www.cortizo.com/
SCHÜCO International KG	https://www.schueco.com/web2/com

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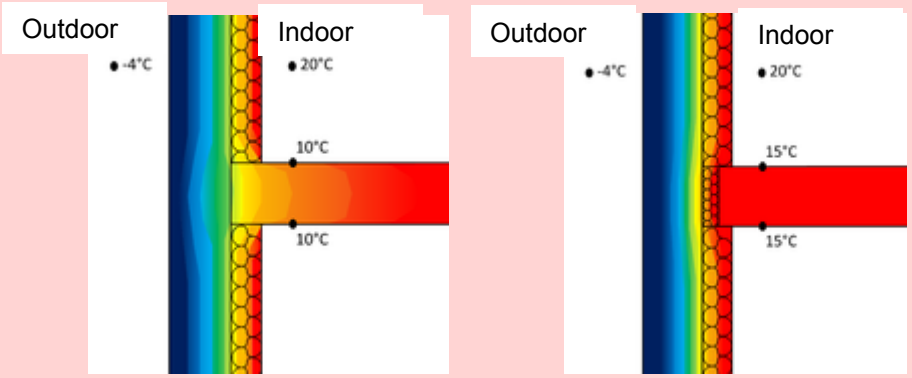
Energy
Thermal bridge breakers

Energy efficiency envelope solutions

When a part or a component of a building envelope has a higher conductivity than the surrounding materials, heat can easily flow from inside to outside of the building (thermal resistance is reduced). This can happen when isolation of the building is not continuous : for example when a balcony spans from the building (linear thermal bridge) or when an element breaks the isolation. A thermal bridge breaker is an element that prevents discontinuity in isolation. A linear breaker is composed of an isolating element and a metal framework.



Temperature difference without and with a thermal bridge breaker

Source : https://fr.wikipedia.org/wiki/Pont_thermique

- **Potential use in hotel industry**

The first energy end-use in hotel industry is space heating and cooling. The thermal bridges breakers can assure comfortable indoor temperature.

Advantages	Disadvantages
Comfort improving, as the temperature is more constant	Installation costs during construction
Healthier environment: no thermal bridges means less condensation and prevention of mold and fungus growth	Construction workers should be trained for good installation
Protection of the envelope, longer-lasting building	
Energy savings on heating/cooling expenses	

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Energy
Thermal bridge breakers

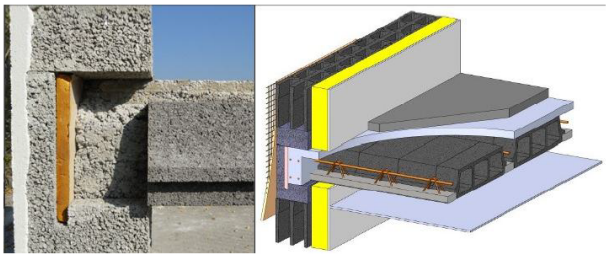
Energy efficiency envelope solutions

Part 2 –Performance, Case studies

Thermal bridge breakers almost eliminate thermal bridges, e.g. the additional U value associated to the breaker is lower than 0.010 W / m²K

Many different products are commercially available and should be carefully chosen after calculation of thermal bridges.

Source : Batiproduits



Part 3 –Companies manufacturing/implementing the technology

Schöck Rutherma	https://www.schoeck.fr/fr/home
Knauf	https://www.knauf.fr/
Rector	http://www.rectortechnical.com/
Plaka Group	https://www.plakagroup.com/fr-FR/PLAKA-France/
Farrat	https://www.farrat.com/

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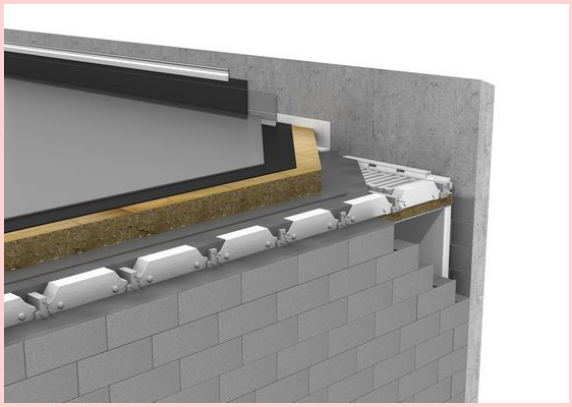
Energy
Rooftop insulation
Energy efficiency envelope solutions

More and more hotels want to make the best use of their rooftop and propose restaurants, bars or pools on the terrace roof. Planning these new services could be the occasion for a thermal renovation. Thermal insulation helps shield the building's space by preventing heat gains or losses through the building envelope and keep a comfortable indoor temperature. The materials used for insulation have a low thermal conductivity (the smaller the value, the greater the material's insulating power). Different insulation techniques are available for flat and pitched roofs and should be carefully chosen, after a thermal study of the building envelope, to avoid

Flat rooftop insulation solution



Building techniques

- Ceiling or roof can be insulated
- Use of rigid insulation boards
- Use of wool insulation panels (rmineral or natural components)
- Spray foam insulation between attic rafters or cellolose on attic floor
- A proper air tightness insulation is necessary to guarantee thermal insulation

https://www.batiproduits.com/fiche/produits/systeme-prefabrique-pour-isolation-de-toit-terr-p114817985.html

- **Potential use in hotel industry**

The first energy end-use in hotel industry is space heating and cooling. Roof insulation is a cost-effective way of saving energy and reducing heating and cooling bills.

Advantages	Disadvantages
Comfort improving, as the temperature is more constant	High costs for refurbishment
Healthier environment: no thermal bridges means less condensation and prevention of mold and fungus growth	Loss of insulation power in case of poor work quality and humidity infiltration
Protection of the envelope, longer-lasting building	
Energy savings on heating/cooling expenses	

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Energy
Rooftop insulation

Energy efficiency envelope solutions

Part 2 –Performance, Case studies

For low consumption buildings, the thermal transmittance (U value) for the roof should be lower than 0,24 W/m²K. For passive buildings, the U value should be lower than 0,15 W/m²K.

When combined with external walls insulation, roof insulation measure can result in up to 50% savings on space heating.

The Ibero hotel (close to Pamplona, Spain) was renovated in 2016. The roof was insulated with 32 cm of wood fiber, reaching a U value of 0.223 W/m²K.

Part 3 –Companies manufacturing/implementing the technology

Corstyrène	https://www.corstyrene.fr/
Parexlanko	https://www.parexlanko.com/fr
Le Relais – Isolant Metisse	http://www.isolantmetisse.com/
Saint Gobain ISOVER	https://www.isover.fr/
Eco homes	https://www.ecohome-insulation.com/
Construcciones Juan Zorzano Blanco S. L.	https://www.zorzano.com/
Jackon	https://www.jackon-insulation.fr/
ROCKWOOL	https://www.rockwool.fr/

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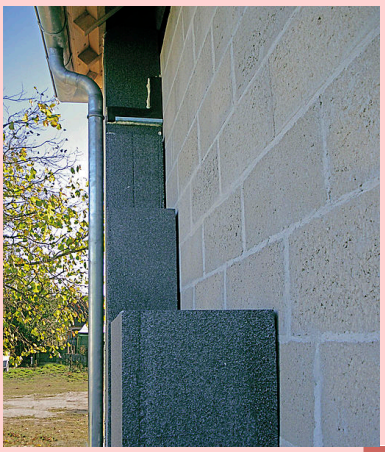
Energy
Walls insulation

Energy efficiency envelope solutions

Thermal insulation is an important solution to reduce energy consumption in buildings by preventing heat gains or losses through the building envelope and keep a comfortable indoor temperature. The materials used for insulation have a low thermal conductivity (the smaller the value, the greater the material's insulating power). Many materials are available: slag wool, cellulose, mineral wool, fiber glass, polystyrene, polyurethane foam, etc. Insulation is best placed on the exterior of the walls, but when the building characteristics don't allow it, for example because of architectural/historical value, an interior insulation can be envisaged.



https://fr.m.wikipedia.org/wiki/Fichier:PSE_graphit%C3%A9_maison_passive.jpg

Building techniques

- Self-supporting sandwich panel with laminated gypsum board cladding and rock wool or EPS filling
- Polyurethane projected on the exterior facade
- Insulation filling in the front chamber (if there is a chamber)
- Ventilated exterior facade
- A proper air tightness insulation is necessary to guarantee thermal insulation

- **Potential use in hotel industry**

The first energy end-use in hotel industry is space heating and cooling. Walls insulation is the most cost-effective way of saving energy and reducing heating and cooling bills. Walls insulation should be coupled to roof and basement insulation to reduce thermal bridges.

Advantages	Disadvantages
Comfort improving, as the temperature is more constant	Time to install interior insulation to be considered, clearing of rooms
Healthier environment: no thermal bridges means less condensation and prevention of mold and fungus growth	Need of space outside the wall for exterior insulation, slight reduction of living space for interior insulation
Protection of the envelope, longer-lasting building	Loss of insulation power in case of poor work quality and humidity infiltration
Energy savings on heating/cooling expenses	

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Energy
Walls insulation

Energy efficiency envelope solutions

Part 2 –Performance, Case studies

For low consumption buildings, the thermal transmittance (U value) for the walls should be lower than 0,24 W/m²K. For passive buildings, the U value should be lower than 0,15 W/m²K.

The envelope of the Hiphotel Bahia Cala Millor Hotel (Mallorca) has been insulated on the exterior walls. This lead to a decrease of 25% in heat losses by transmission of the exterior façades.

Part 3 –Companies manufacturing/implementing the technology

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