CASE STUDY

Assessment of Operating Costs Due to Energy and Water Use During Terminal Sterilization With STERRAD™ Systems Compared to a Steam Sterilizer

This article was prepared by Advanced Sterilization Products, and has not undergone any scientific peer review.

INTRODUCTION

Many factors are considered in the selection of a method for terminal sterilization of medical devices and surgical instruments. However, **the differential costs of energy consumption and water use**—and environmental impact—**associated with these different methods are poorly understood**.

For example, the **lack of chemical sterilant** may lead to the **misconception that the day-to-day operation of a steam sterilizer is essentially cost-free**. But in fact, the energy and water use associated with these units actually shows them to be **quite costly to operate**.

Advanced Sterilization Products (ASP) commissioned Underwriters Laboratories (UL), an independent third-party research firm based in the US, to **analyze the environmental and economic impact of four sterilizer systems**.

Of these, three were models from the STERRAD™ Systems family of low-temperature gas plasma sterilizers, and one was a traditional steam-based clinical, in-use unit. The methodology, results, and conclusions of that study are presented here.[1]

METHODS AND MATERIALS

PARAMETERS

This study sought to **analyze energy consumption and water usage** for all units in the comparison, during active cycles as well as during idle time. Based on the results of the energy and water usage calculations, a further ad hoc analysis was performed to estimate the potential differences in operating costs based on current per-unit utility rates for electricity and municipal water services.

A "**reference daily workload**" was defined as the quantity of stainless steel surgical instruments requiring 8,4 m^2 of shelf space per day to sterilize. All systems were capable of handling this workload with a single operating unit running multiple cycles per day.

A **24-hour day** was used in all calculations in order to account for consumption of energy and water during both active and idle phases of operation.

For example, a steam sterilizer in idle mode must keep water at a temperature high enough to create steam whenever needed. In addition to the energy required to continuously keep the water hot, incidental evaporation means that there is ongoing water use even while the steam system is in idle mode.

Finally, **testing was limited to sterilization of stainless steel surgical instruments**, as these instruments are compatible across the systems being evaluated.

BASIS FOR COMPARATIVE ANALYSIS

Three of the systems were chosen for their similar total shelf space in order to make balanced assessments, and the fourth (the STERRAD NX™ System) was a compact model with approximately one-third less shelf space than the others. Because of this difference, as well as the overall disparity in cycle times and different proportions of time spent in active mode versus idle mode across all four systems, a method of statistical equalization was employed in order to facilitate direct comparisons.

System brand/model	STERRAD™ 100NX System	STERRAD™ 100S System	STERRAD NX™ System	40 cm x 66 cm steam system
Sterilization method	low-temperature H_2O_2 gas plasma technology			steam
Sterilization cycle time, min	47	55	28	13,5
Total shelf space, m^2	0,563	0,559	0,375	0,537

Table1: Specifications of the four sterilization systems included in the analysis

MEASUREMENTS AND CALCULATIONS

Electric power consumption by sterilization units in active and idle modes was measured **every 10 seconds over a 24-hour period** using a power analyzer (Fluke model 435). **Water consumption by the steam system included sterilizer feed water as well as steam generator feed water**. Calculations for this unit were made based on the unit specification sheet published by the manufacturer. **None of the three STERRAD™ Systems consumes water**.

Within each sterilization cycle, energy consumption varies significantly across a number of distinct stages. Thus, the total energy use for one cycle in active mode was calculated by adding together the different amounts of energy used within each stage. That sum was then multiplied by the number of cycles per day, resulting in total daily active mode consumption.

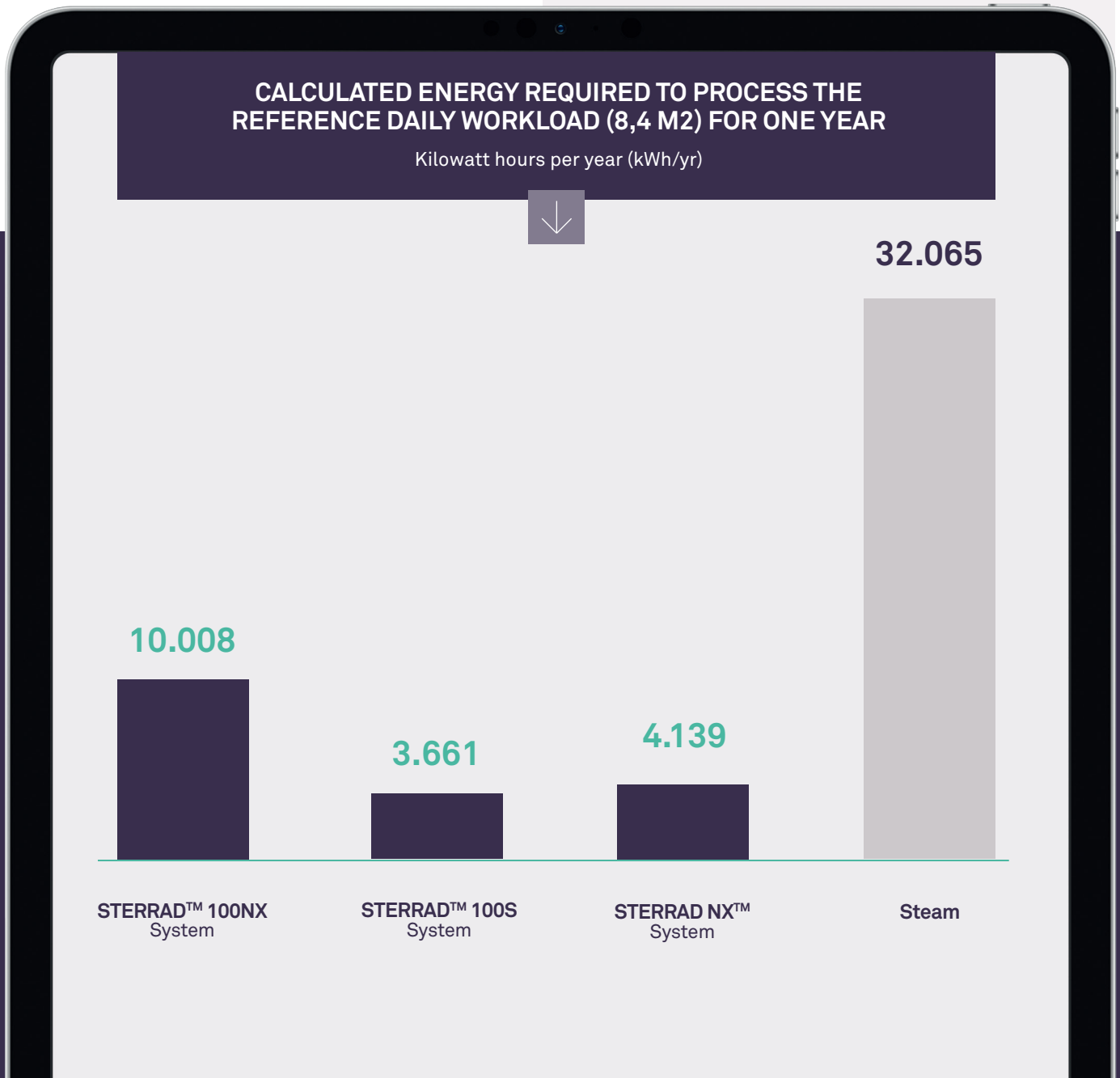
Energy use is relatively consistent during idle mode, so it was calculated simply as the amount of power required multiplied by the number of hours per day spent in idle. Total daily energy consumption, then, was the sum of all energy use in both active and idle modes.

RESULTS

ENERGY USE [1]

The results of the present analysis indicate that the STERRAD™ 100NX System, STERRAD™ 100S System, and the STERRAD NX™ System all consumed less energy than the steam sterilizer. Specifically, the STERRAD™ 100NX System used approximately 68% less energy than the steam unit, and the STERRAD™ 100S System and STERRAD NX™ System used approximately 87% less energy than the steam unit.

compared to steam sterilizers, the STERRAD™ 100NX system used **~68% less energy** to operate, while the STERRAD™ 100S system and STERRAD NX™ system used **~87% less energy**.



WATER USE [1]

Use of the STERRAD™ 100NX System, STERRAD™ 100S System, or STERRAD NX™ System may save 180.000 liters of water per year compared with steam sterilization.

The water consumption of a steam sterilizer is **180.000 liters per year** whereas STERRAD™ Systems **use no water at all**

RESULTS

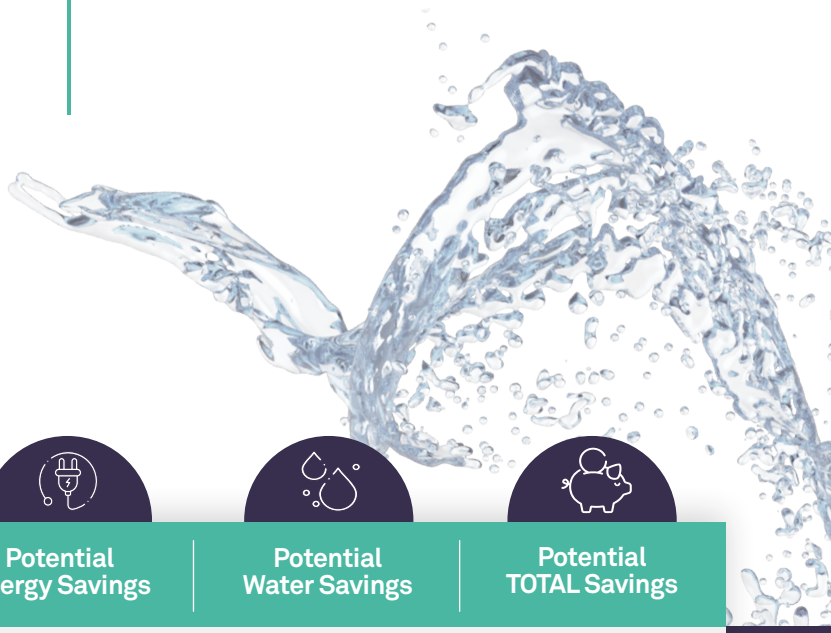
ECONOMIC IMPACT

Recent surveys of utility rates across Europe (Germany, Italy, Portugal, and Spain) were consulted in order to assess the costs associated with energy consumption and water usage for different sterilizer technologies.

Based on commercial utility rates, the lowest rate for electricity among the countries surveyed is EUR 0,09 per kWh (Spain) and the highest rate is EUR 0,29 per kWh (Germany). **These rates were used to calculate the potential energy cost savings in Table 2.**

Among the countries surveyed, the lowest rate for water use is EUR 1,09 per cubic meter (Spain). The highest rate is EUR 3,92 per cubic meter (Germany). **These rates were used to calculate the potential water cost savings in Table 2.**

STERRAD™ systems can save as much as **eur 8.800 per year** due to reduced energy and water consumption



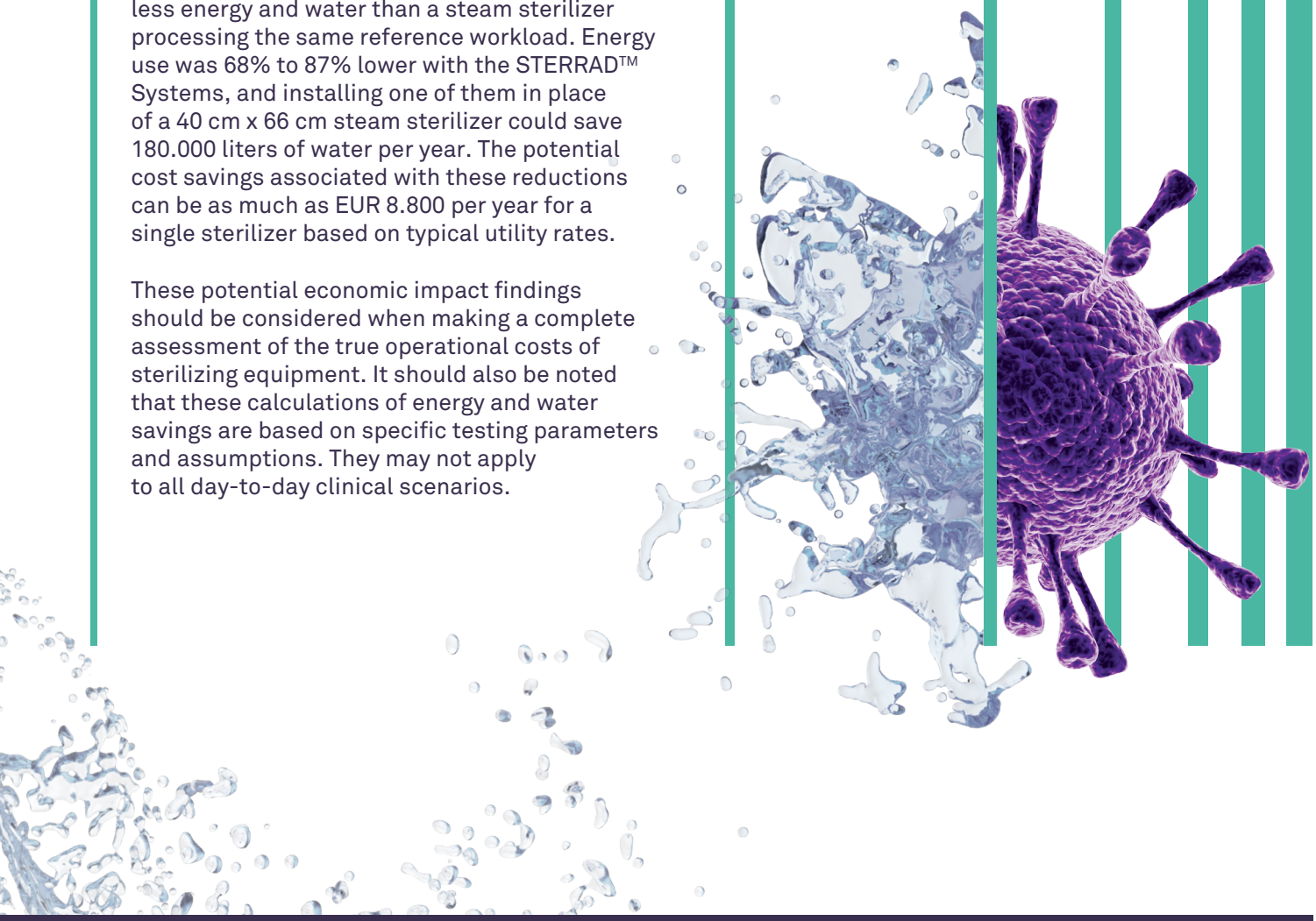
STERRAD™ System	Comparator System	Potential Energy Savings	Potential Water Savings	Potential TOTAL Savings
STERRAD™ 100NX System	**steam**	EUR **2.029-6.330**	EUR **196,89-708,07**	EUR **2.226-7.038**
STERRAD™ 100S System	**steam**	EUR **2.613-8.152**	EUR **196,89-708,07**	EUR **2.810-8.860**
STERRAD NX™ System	**steam**	EUR **2.569-8.015**	EUR **196,89-708,07**	EUR **2.766-8.723**

Table 2: Potential annual savings1-9 with STERRAD™ Systems based on reference daily workload (8,4 m2)

CONCLUSIONS

Testing of three low-temperature gas plasma sterilizers, the STERRAD™ 100NX System, the STERRAD™ 100S System, and the STERRAD NX™ System demonstrated that they all used much less energy and water than a steam sterilizer processing the same reference workload. Energy use was 68% to 87% lower with the STERRAD™ Systems, and installing one of them in place of a 40 cm x 66 cm steam sterilizer could save 180.000 liters of water per year. The potential cost savings associated with these reductions can be as much as EUR 8.800 per year for a single sterilizer based on typical utility rates.

These potential economic impact findings should be considered when making a complete assessment of the true operational costs of sterilizing equipment. It should also be noted that these calculations of energy and water savings are based on specific testing parameters and assumptions. They may not apply to all day-to-day clinical scenarios.



asp.com

ASP Advanced Sterilization Products

ASP International GmbH Zug Branch
Bahnhofstrasse 2, Zug 6300, Switzerland

CE 0123

ADVANCED STERILIZATION PRODUCTS, INC.
33 Technology Drive, Irvine CA 92618, USA

EC REP ASP, The Netherlands BV
BIC 1, 5657 BX Eindhoven, The Netherlands

Please read and follow the Instruction for Use (IFU) prior to using for important information, including contraindications, warnings, and proper directions.

REFERENCES

1. UL Final Assessment Report. Data on File, Advanced Sterilization Products (ASP). 2. Autorità per l'energia elettrica il gas e il sistema idrico. Available at http://www.autorita.energia.it/allegati/dati_documenti/ prezzi//elettricita-non-domestici.xls. Accessed May 20, 2016. 3. Strompreise in Deutschland im Vergleich. Available at https://www.strompreise.de/strompreis-kwh/. Accessed May 20, 2016. 4. Government of Spain; Ministry of Industry, Energy and Tourism. Available at http://www.minetur.gob.es/es-ES/IndicadoresyEstadisticas/DatosEstadisticos/IV.%20Energ%C3%ADa%20y%20emisiones/IV_12.pdf. Accessed May 20, 2016. 5. ERSE; Entidade Reguladora dos Serviços Energéticos. Available at http://www.erse.pt/pt/electricidade/tarifaseprecos/2016/ Documents/PrecosTVCF%20PTCont_2016.pdf. Accessed May 20, 2016. 6. Cittadinanzattiva. Available at http://www.cittadinanzattiva.it/files/libri_e_pubblicazioni/consumatori/Dossieracqua2016/ Dossier_acqua_2016.pdf. Accessed May 20, 2016. 7. Hamburg Wasser. Available at http://www.hamburgwasser.de/tarife-und-gebuehren.html. Accessed May 20, 2016. 8. Instituto Nacional de Estadística. Available at http://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176834&menu=ultiDatos&idp=1254735976602. Accessed May 20, 2016. 9. ERSAR. Available at http://www.ersar.pt/website/ViewContent.aspx. Accessed May 20, 2016.

DISCLOSURES AND ACKNOWLEDGMENTS

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For more information, please contact your local ASP representative or visit asp.com

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