Green and Clean

Laser Cleaning and the Environment

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Surface Cleaning Today

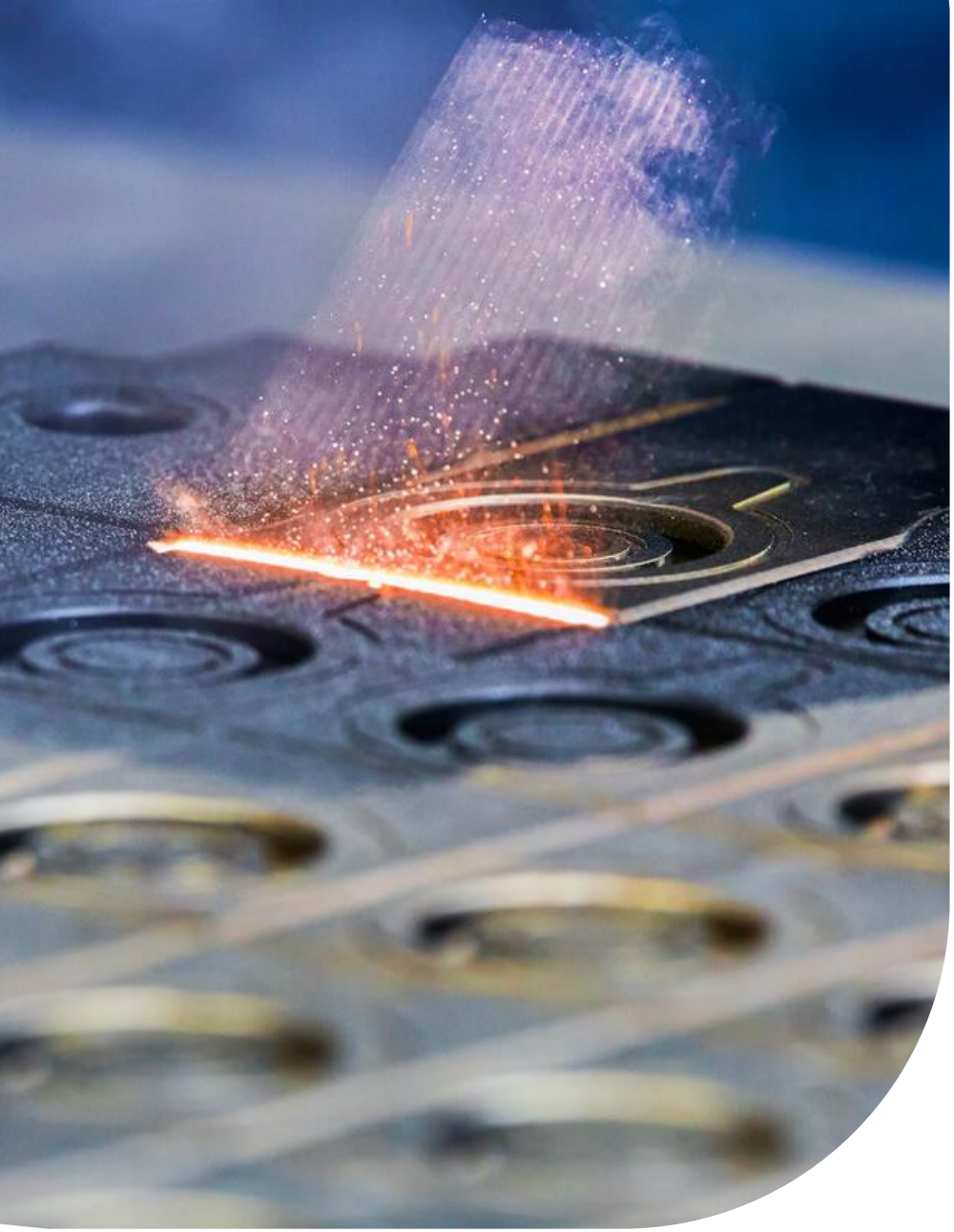
Surface Cleaning Today

Industrial surface cleaning methods today cover a vast amount of applications and include a wide variety of processes. Key applications in industrial manufacturing and maintenance of infrastructure include:

- removal of grease, oil and lubricants
- removal of oxide layers and rust
- paint stripping
- dust and particle removal

Overview of Industrial Cleaning and Surface Preparation Technologies:

- Laser Cleaning
- Media Blast Cleaning
- Wet Cleaning
  - Solvent Based
  - Water Based
  - Ultrasonic
- CO_2-Dry Ice Blast Cleaning
- Plasma Cleaning
- Burn-Off / Pyrolisis Ovens
- Mechancial Grinding, Brushing



Making a Smart and Clean Choice

Key evaluation factors when choosing the „right“ technology for cleaning include the obvious and not-so obvious:

- Performance – can the process reach the desired quality in the desired time?
- Total process cost – including all direct and indirect cost of equipment purchase, service, consumables, waste disposal and recycling
- Safety – for workers and consumers along the entire process chain
- Sustainability and emissions – energy and related CO_2 usage, use of environmentally hazardous chemicals, noise emissions

Let´s look at last things first in this whitepaper and compare the ecological footprint of laser versus other cleaning technologies!

02

Cleaning Technologies

A Comparison

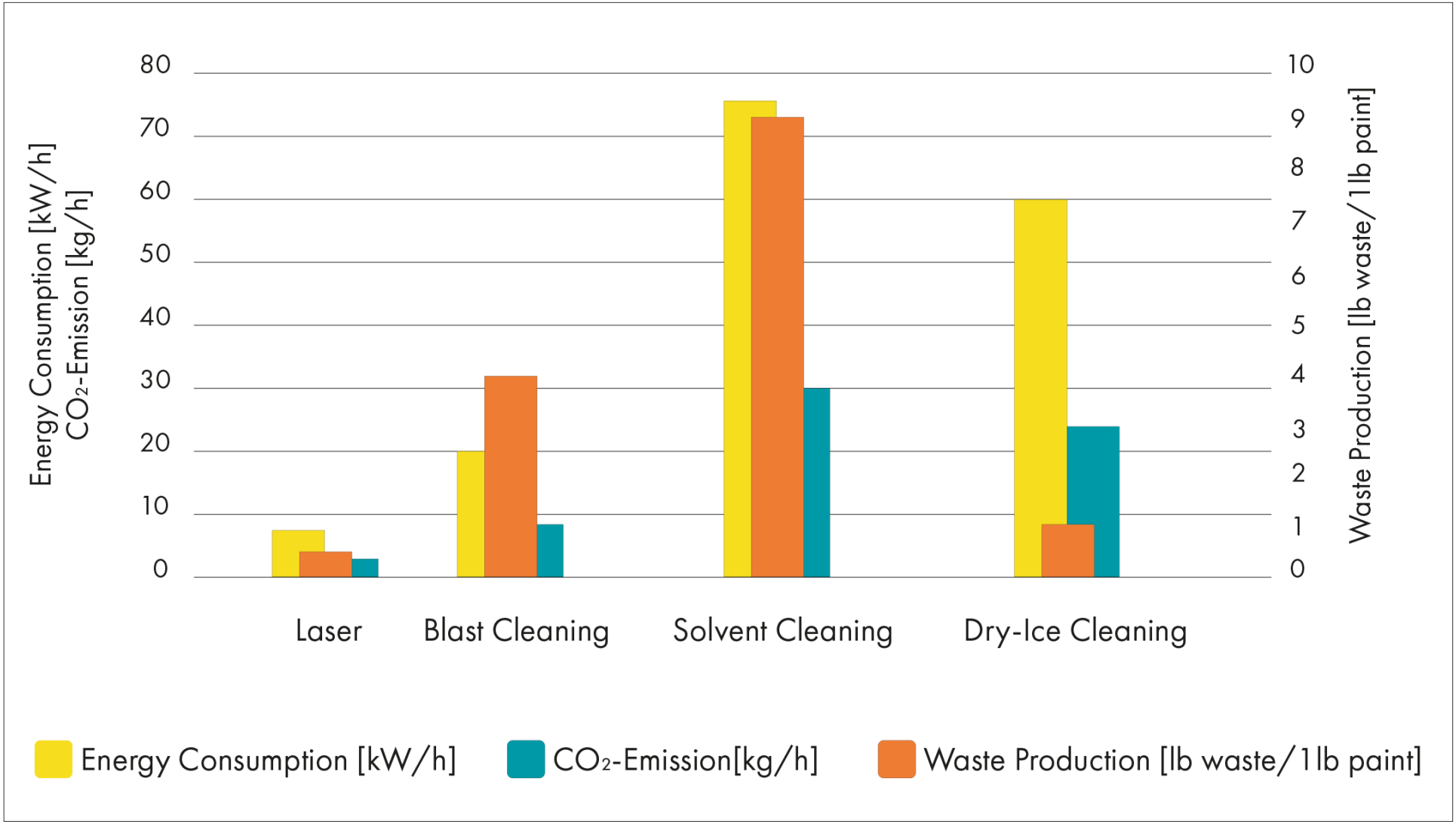
Laser Cleaning – It does not come Greener

Laser cleaning today is mostly used for removal of oxide layers, lubricants, paint or organic residue e.g. on metal toolings. Such cleaning tasks can also be carried out with the incumbent technologies that have been used in many industries since long: mechanical blast cleaning, solvent based cleaning and – with some limitations in application scope – dry-ice cleaning.

Let´s compare the working principle and associated environmental impact on a high-level, here based on a paint stripping application:

	Laser	Blast Cleaning	Solvent Cleaning	Dry-Ice Cleaning
Principle	Pulsed laser ablation creates sublimation of material	Blasting particles (plastic pellets or similar) are applied with high pressure and remove coating	Parts are dipped in a chemical bath dissolving the coating	CO_2-pellets are applied with high pressure and remove coating
Remainder of cleaning media post-process	Removed coating dust (locally evacuated during process)	Blast dust mixed with removed coating (to be disposed)	Solvent bath mixed with removed coating (to be disposed)	Removed coating (typically displaced during process)
Resulting waste stream after removal of 1 lbs of paint	0,5 lbs solid waste	4,1 lbs solid waste	9,1 lbs. Solid waste and 160 lbs. Liquid waste	1 lbs solid waste
Hazardous Chemicals	None	None	Yes	None
Energy required per operating hour	1 hour of operation @ 7 kW/h JETLASER M-500	1 hour of operation @ 20 kW/h	1 hour of operation @ 75 kW/h	1 hour of operation @ 60 kW/h
Total CO_2 emissions per operating hour	1 hour of operation @ 2,8 kg/h	1 hour of operation @ 8 kg/h	1 hour of operation @ 30 kg/h	1 hour of operation @ 24 kg/h

Environmental Impact of Cleaning Technologies Compared



Laser Cleaning –
It does not come Greener

→ So while each application deserves a specific analysis of their environmental impact, it is fair to conclude that conventional cleaning technologies each have one or more of the following disadvantages compared with laser cleaning:

- Use of Media – They are based on toxic chemicals or solvents that are harmful in their production, storage, use and disposal or they are based on removing one solid material with another
- Waste Volume – They produce significantly larger waste volumes than just the removed coating by mixing it up with the cleaning media (blasting dust, solvent baths)
- Energy – They require a lot of electrical energy to produce, apply (pressurized air), dry (after wet cleaning) and recycle the cleaning media
- Lack of Selectivity – They are based on blanket or dip cleaning and lack the capability to only clean areas that require a clean surface (e.g. for attaching a new coating, exposing a bond pad or similar)

Environment and Economics – No Longer a Conflict

The dramatically lower energy consumption, CO_2 emissions and reduced waste streams of laser cleaning are not only beneficial to meeting the obligations of having sustainable operations, but they also deliver a financial benefit. Uncovering „hidden cost of cleaning“ such as usage of pressurized air, factory space, disposal of cleaning residue often yield surprising saving potentials. Legislation mandating financial offsetting of CO_2 emissions or subsidies for implementing energy efficient technologies, can provide strong additional cases to invest in sustainable and green laser cleaning.

03

Laser cleaning

Basics

But how does "cleaning with light" work?

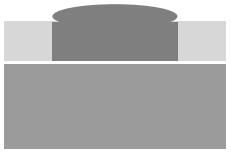
Our cleaning lasers work with a wavelength of about 1µm. Light of this wavelength is well absorbed by many typical layers of contamination, which means the energy of the laser beam can be absorbed in the layer.

Unlike laser cutting, for example, our lasers do not emit their energy continuously, but in the form of tens of thousands of short light pulses per second, each with a duration of only a few nanoseconds (1 nanosecond = 1 billionth of a second). Each pulse typically illuminates an area of a few millimeters on the surface.

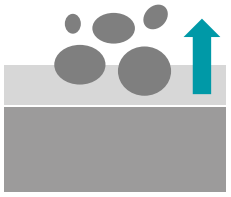
In the illuminated area, the energy introduced causes the layer to abruptly heat up locally and evaporate (so-called sublimation) or flake off - the coating is transformed into vapor and dust and can be extracted.

1 Laser beam contacts the coated surface

2 The laser activates with the material / coating, but not the part itself



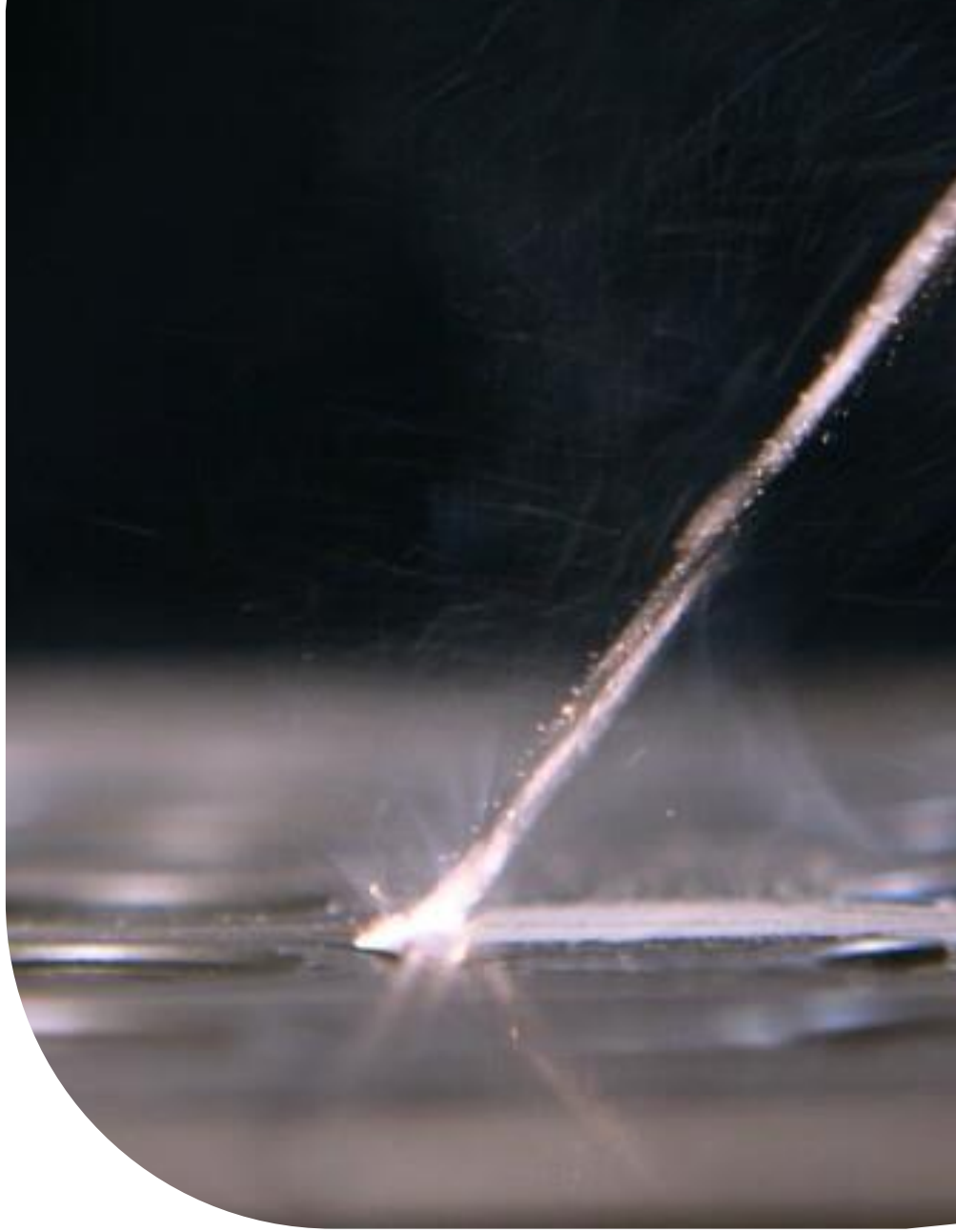
3 The surface is cleaned due to vaporization or sublimation



Yes, we scan!

The individual light pulses are positioned overlapping by a so-called “scanner” on the part to be cleaned. Depending on the system, we use a 1D scanner (which creates an oscillating cleaning line) or a 2D scanner (which deflects the beam in two directions on the surface).

The scanner strings together the individual light pulses, resulting in a two-dimensional ablation that looks to the human eye like a continuous laser line several centimeters long. This line is guided by the operator over the surface to be cleaned and allows the cleaning of large areas at speeds of up to several m² per hour.



Laser parameters at a glance

The higher the energy per light pulse and the more pulses per time a device emits, the higher the average power. We offer laser systems between 100 watts and 2,000 watts average power. As a rule of thumb, the higher the average power used, the faster a system can clean.

However, the actual speed is determined not only by the power used, but also by the accessability of the parts surface, the absorption behavior of the layer to be removed and its thickness. For typical processing tasks, the area rates are about

Application	Area rate per hr with 500 W
Mold cleaning Release agent residues	3 - 6 m²
Oil removal	15 - 20 m²
Removal of light oxide layers (rust)	5 - 10 m²
Paint removal	3 - 10 m²

Key advantages of the process :

Material-friendly

Due to the extremely short pulse duration only a small amount of heat is transferred to the underlying substrate, which is why even sensitive materials can be easily cleaned without melting or cracking.

Mobile

Our systems are compact and can be moved with a trolley. Laser cleaning thus allows in many cases the cleaning of fixtures and tools in installed condition without dismantling.

Low maintenance

Lasers deliver consistent results over thousands of hours of operation and require little maintenance or repair.

Dry

Lasers operate without solvents, abrasives, or water, reducing resource consumption and making them easy to use in a manufacturing operation.

Energy-saving

Laser cleaning systems have a power consumption of a few kW/h and are therefore much more sustainable and cheaper to operate than wet-chemical or pressure-driven cleaning technologies.

Compact design

Our systems are the size of a refrigerator and are thus significantly smaller than conventional cleaning machines.

04

Laser cleaning

Products

Click to see in action

Our JETLASER series includes several models that differ in cleaning speed due to their laser power, but are built according to the same operating principle:

- A mobile base unit houses the laser source, the cooling unit and the control system.
- The laser light and the control signals are guided through a hose package via a flexible light guide cable.
- The handpiece allows the laser light to be guided over the surface to be cleaned. This handpiece contains a so-called optical collimator, a lens and the scanner with which the laser light is "brushed" over the surface.
- For the respective data on dimensions, weights and other technical data of the different models, please refer to the respective valid data sheet.

Interested? Please contact us!

We help you to choose the right laser system

How much laser power is required?

A simple rule of thumb: the more average laser power, the faster the system works and the higher the initial investment.

The JETLASER series includes systems for every application: from the compact entry-level model with 100 watts of power, to the workhorse with 500 watts, to high-performance systems in the kW power range for continuous cleaning of large areas.

Depending on the model, the investment costs range from EUR 50,000 to EUR 300,000.

Our mobile JETLASER is ideal for applications:

- For which dry ice cleaning, sandblasting or chemical baths are used today
- For surfaces that are "visible" to the laser beam (i.e. do not have complex undercuts or channels)
- For a high variety of different component geometries
- If several different cleaning tasks are involved (for example, in industrial services)
- Where mobile use is required (as in the cleaning of built-in tools or the processing of facades)
- When little space is available

Your way to the right decision

1. Arrange a trial cleaning of your parts with us or one of our partners
2. Discuss the results and recommended specification with our consultants
3. Arrange a test purchase, or rent a system for trial use at your facility

By the way:
We also offer contract machining of components in our Laser Jobshop as a Service.
Inform yourself!

If you need to clean more and faster – Automatic laser cleaning

For high volumes of repetitive cleaning tasks, such as processing large series of components in multi-shift operation, automatic laser systems like 4JET's SCANYWHERE cells are best suited.

- Modular systems with 200 W to 4,000 W laser power
- 1 or 2 robots for optics or part positioning
- Loading by conveyor belt, turntable or lift gate
- Intuitive program generation

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