Technikgruppe successfully presented its combustion optimisation system for waste-to-energy and biomass plants.

6th MatER Meeting and 7th International Conference on Final Sinks

June 2023, Piacenza / ITALY

Technology of fire

technikgruppe®

www.technikgruppe.com/technology-of-fire

STAND PRESENTAZIONE DISCUSSIONE

At the wonderfully organised event held from 5 to 7 June in Piacenza, northern Italy, TECHNIKGRUPPE presented its unique system for optimising the incineration process in waste-to-energy and biomass-to-energy plants. This marked the company's third participation in an Italian event since the pandemic.

www.technikgruppe.com/technology-of-fire

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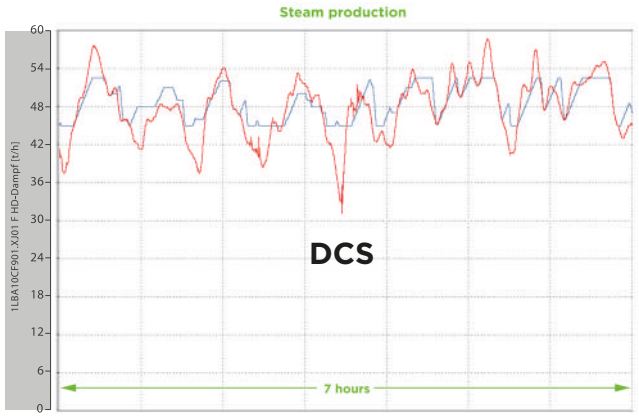
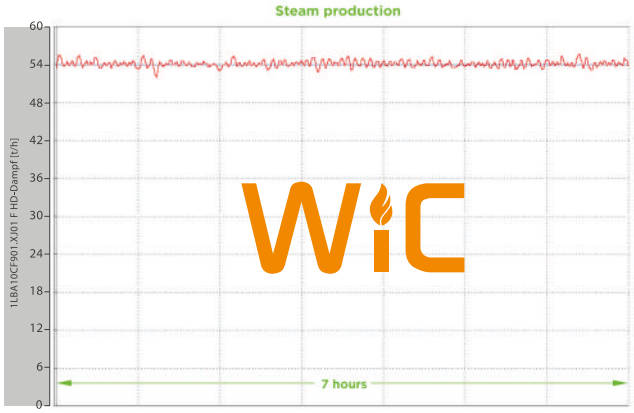
Don't hesitate to contact us!

The WiC Combustion manager...

- **stabilises and improves steam production**



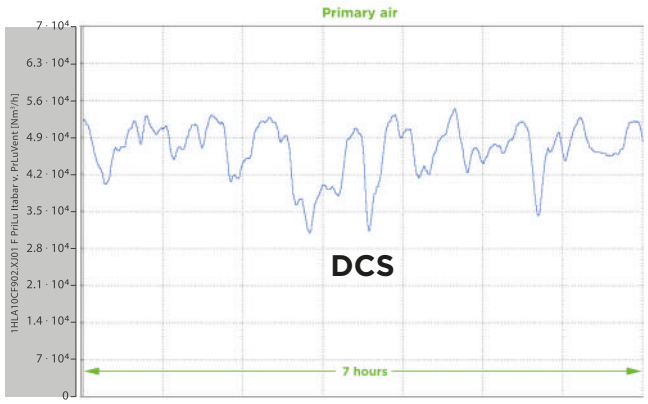
Steam production controlled by DCS



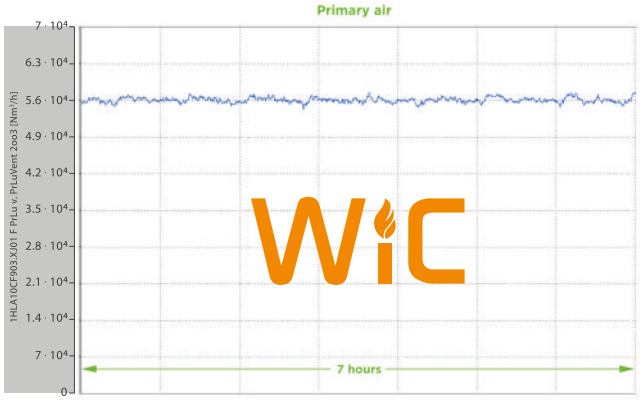
Steam production controlled by WiC (same line)

N.B.! In most cases, boilers are designed with large reserves due to lack of precise combustion control. This allows the combustion capacity to be increased by optimising the combustion control.

- **Stabilises the combustion (primary) airflow**



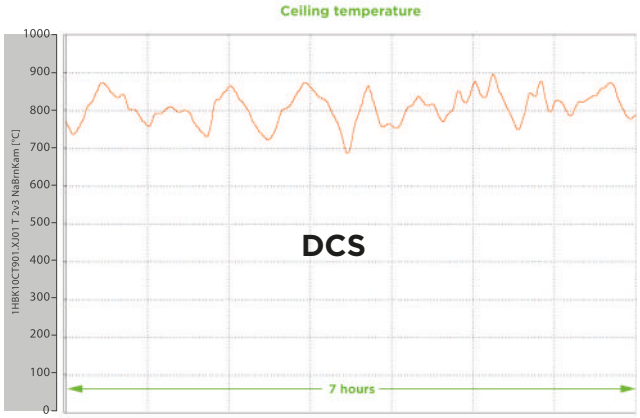
Primary air controlled by DCS



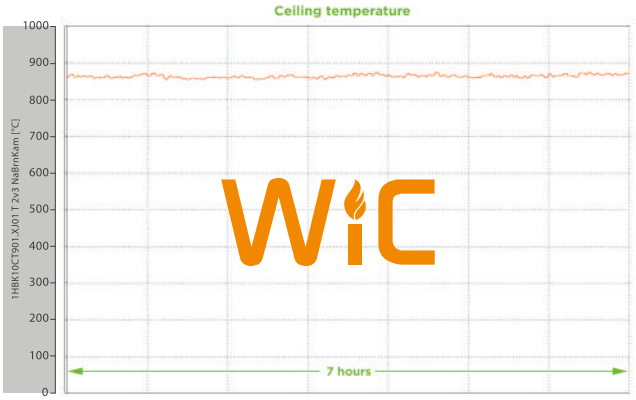
Primary air flow controlled by WiC (same line)

Please NOTE! The higher amount of primary air is related to an increase of waste throughput/steam production

- **Stabilises the flue gas (ceiling) temperature**



Ceiling temperature with DCS

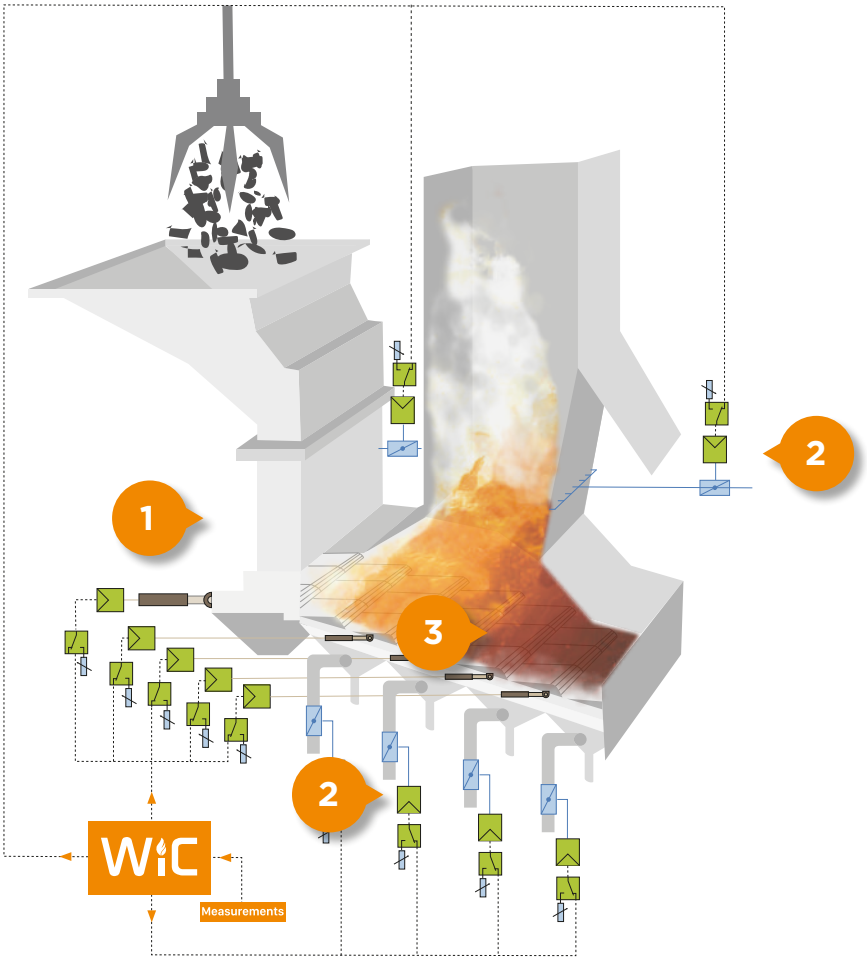


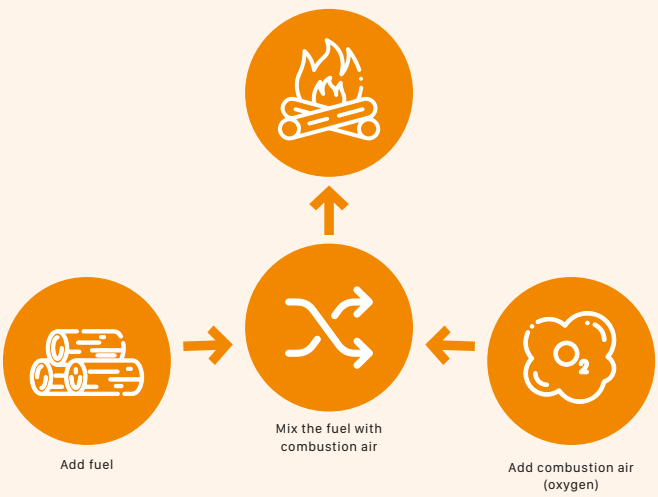
Ceiling temperature with WiC (same line)

Please NOTE! The average temperature is, of course, higher because of enhancement of waste throughput/steam production

Technology of fire

Application of WiC can significantly improve the profitability, reliability and uptime of Waste-to-Energy and Biomass-to-Energy plants. Each combustion line is a unique system. TG's WiC Combustion Manager is based on over 25 years of experience in optimisation. Our technical experts can support your technical team through personal visits or video conferences.





The combustion process in Energy from Waste and Biomass plants is very complex, and the demands on control systems in those plants are very sophisticated. There are many theories about the best techniques to recover the energy from waste, and there are equally many different approaches to find the right solutions.

In most conventional combustion systems there are numerous implemented control algorithms and many disagreements on how to compare different methods.

Put simply, there are three main actions which have an influence on the combustion process.

1. Adding fuel into the burning chamber
2. Blowing oxygen into the fire
3. Mixing the fuel with combustion air

With more than 25 years of experience in combustion optimisation behind us, we can say that forward-moving reciprocating grates are ideally suited to the application of the three basic principles for combustion control.

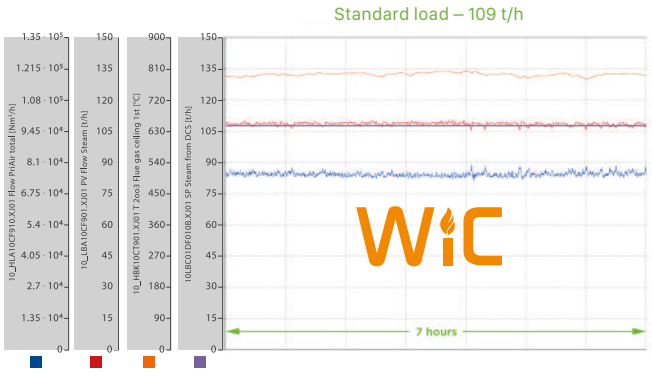
These three main actions involve around 30 actuators. But these actuators offer many possible combinations for fine tuning.

1	actuator provides	10 combinations // 0-1-2-3-4-5-6-7-8-9-
2	actuators provide	100 combinations // 00-01-02-03-04- ……..96-97-98-99
3	actuators provide	1000 combinations // 000-001-002-003-004-005-006-007 ……..997-998-999
20	actuators provide	100 000 000 000 000 000 000 possible combinations for fine adjustment
		// 00 000 000 000 000 000 000 ……. 99 999 999 999 999 999 999

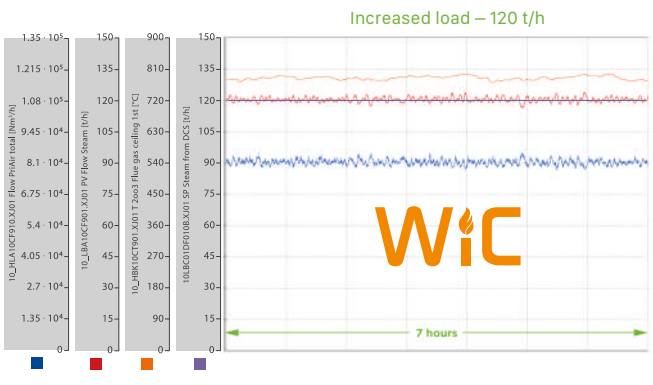
The status of the combustion process changes every few seconds! This means that every few seconds we need to fine tune the actuators. It is clear that defining the appropriate combination every few seconds is a very complex task.

Whereas checking the combustion quality itself is very simple → see some diagrams of KPIs from a combustion process.

Increased combustion capacity without mechanical modifications



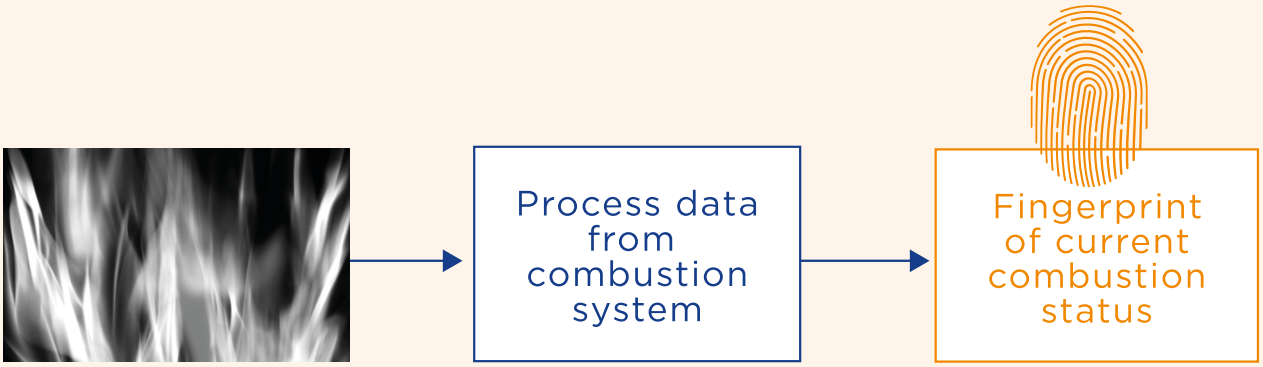
After stabilising steam production, it was possible to determine the actual capacity of the system



This led to a 10 % load increase from the original design limit (MCR).

It is important to note that, even after increasing steam production from 109 t/h to 120 t/h, steam production still remained stable.

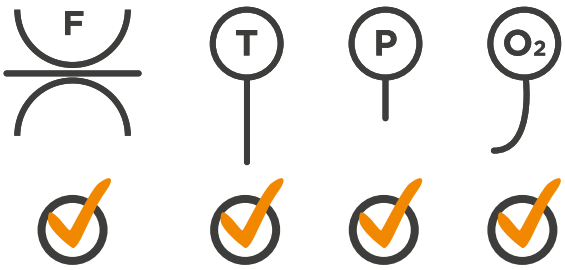
How to assess the combustion status?



Modern automation systems provide various signals from the combustion process. These signals are the fingerprint of the current combustion status.

With appropriate algorithms it is possible to calculate the appropriate combination (1 out of billions) for the actuator positions. Standard industrial process controls cannot be used for this purpose! It is necessary to use particularly powerful controllers.

No thermal camera or pyrometers are needed.

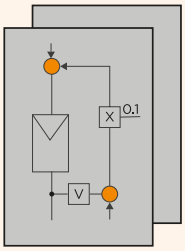


WiC only needs standard process measurements as data inputs.

This considerably reduces equipment and maintenance costs.

What is the difference between conventional controllers and WiC ?

Traditional systems

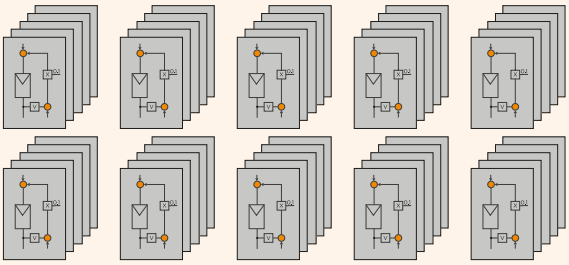


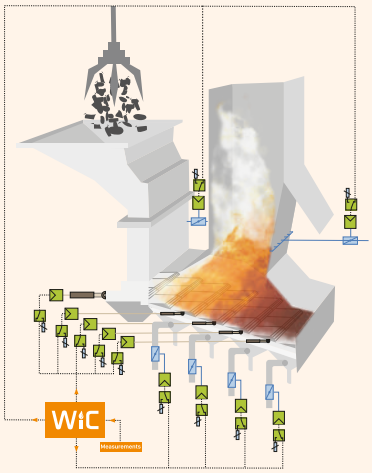
50

Conventional controllers have about 50 functional diagrams

WiC system

6500





100.000.000.000.000.000.000 possible positions for fine tuning.

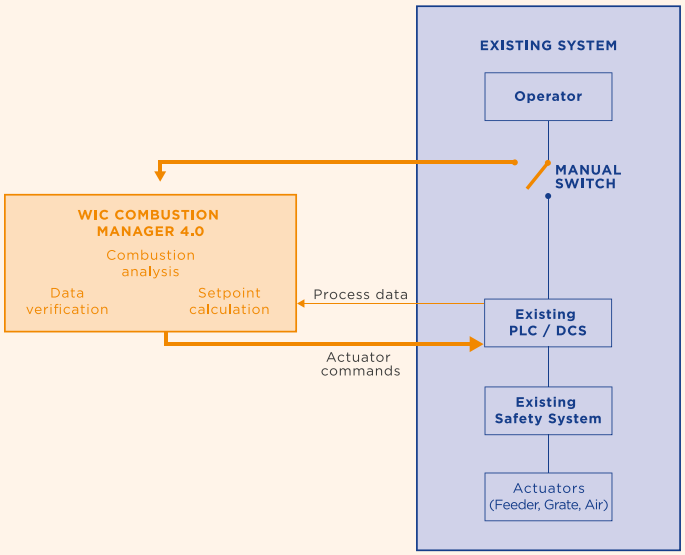
For this complex task, the technical experts at TECHNIKGRUPPE have developed a very sophisticated software package with about 6,500 functional diagrams.

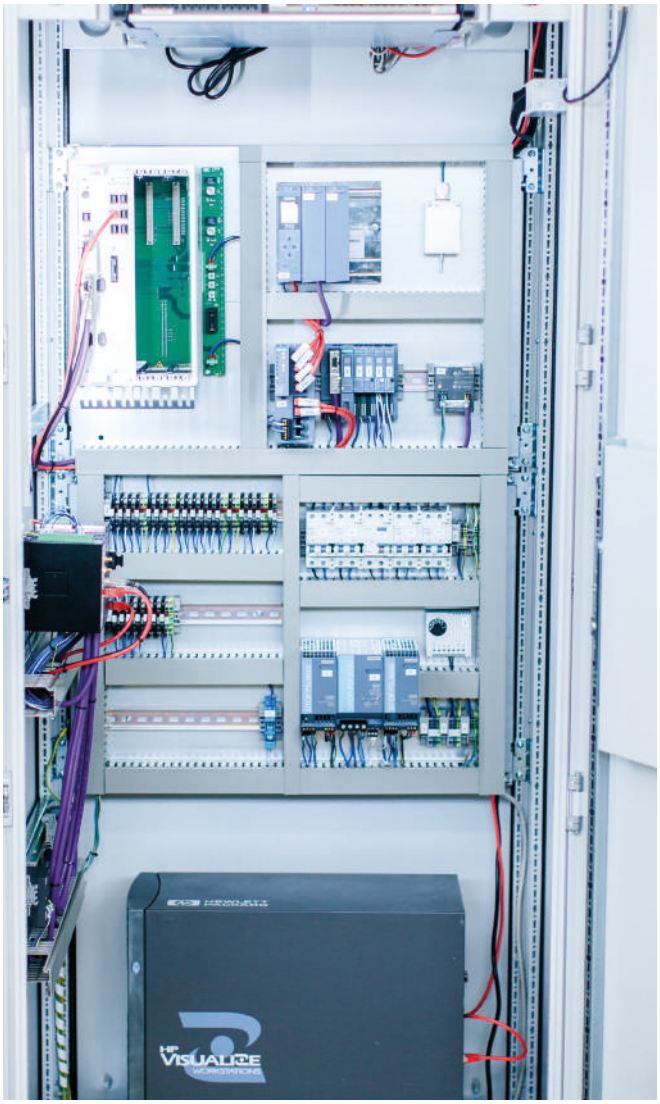
WiC uses real-time data processing, far more data than traditional systems. WiC processes some 6500 functional diagrams instead of typically 50.

Each plant is unique, and for every particular plant the control calculations must be performed thoroughly. In the combustion control process, it is necessary to calculate many equations simultaneously in real time.

With its 6500 functional diagrams, WiC provides a level of quality and accuracy which it is not possible to achieve with traditional controllers and control strategies.

How is WiC connected to existing automation systems?





In most applications, WiC is a bypass or an "add-on" system to the existing combustion control system. It may also be integrated from project start up. The WiC usually comes in a 600 mm (D) x 800 mm (W) x 2000 mm (H) (24" (D) x 31" (W) x 79" (H)) cabinet, and is installed in the DCS room.

The basic working principle of the WiC is to "listen" to the process signals from the DCS, calculate appropriate set-points for the combustion parameters, and send them back to the DCS to control the actuators of the combustion system (air dampers, feeder and grate hydraulics).

Note:

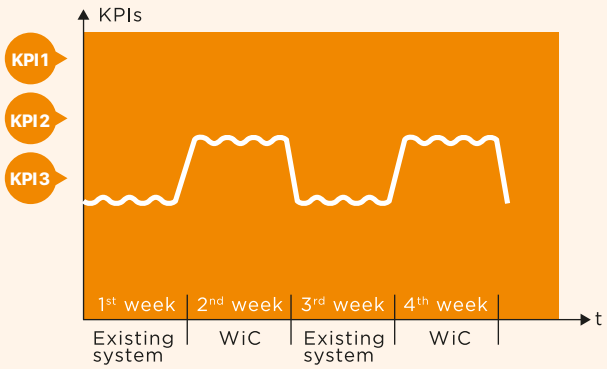
- WiC does not replace the existing system
- WiC is a bypass/add-on system for exact process set point calculations
- WiC does not interfere with the existing safety system
- With a single switch (software and/or hardware), the operator can define the source of the setpoints, using WiC set-points or DCS setpoints. This is essential for the operators to gain confidence in a "new combustion philosophy". The operators can, at any time, switch back to their familiar existing system, which they can therefore directly compare with the new WiC Combustion Manager.

The installation of WiC takes about four weeks. WiC does not interfere with ongoing operation; there will be no disturbances or downtime in plant operation.

WiC commissioning is completed within ten minutes. Roughly 30 minutes after commissioning, it will be possible to see the first benefits of the WiC-system.

N.B.:
WiC can also work as an add-on for any third party combustion optimisation system the customer may have previously implemented.

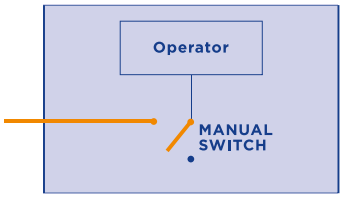
Measuring WiC benefits



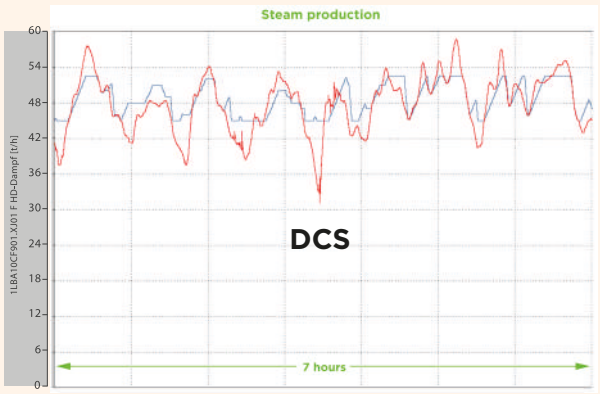
After WiC installation, one important question comes up: "What are the benefits of the WiC Combustion Manager?" To answer this question, the following procedures will work as simple and reliable testing methods.

Waste of roughly the same quality must be used, and the KPIs checked under WiC and under DCS combustion control.

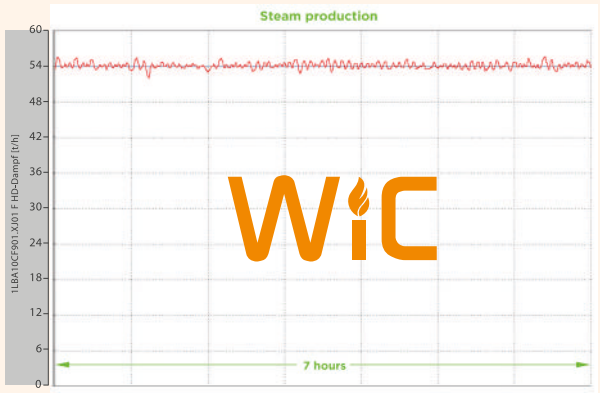
Plant operators can switch between the existing system and WiC.



Stabilisation and enhancement of steam production



Steam production controlled by DCS



Steam production controlled by WiC (same line)

The periods under comparison may be selected using similar waste conditions.

Commercially, the most important criteria are:

- Stability of steam production
- Amount of steam production
- Waste throughput
- Amount of additive consumption
- Stability of flue gas temperature
- Stability of primary and secondary air
- O2 concentration
- Amount of operator interventions

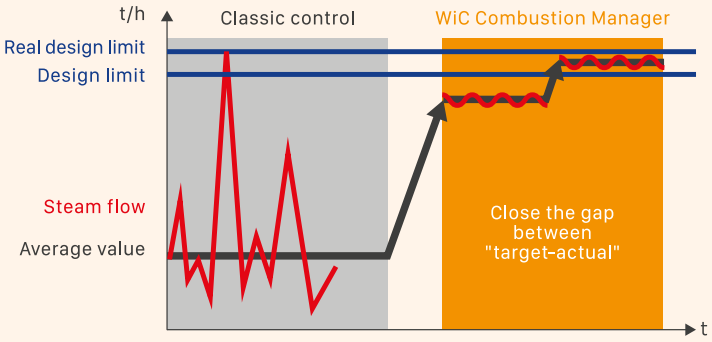
Some criteria are short term, being relevant for a fast initial assessment of the WiC benefits. Long-term benefits can be assessed on the basis of process signals over a period of several months after WiC installation.

WiC is a fully automated system and provides operation without permanent observation (OWPO). Besides this, WiC is also a great help for operators in the event of anomalies.

Note:
There is no need for mechanical modifications of the existing combustion system for WiC implementation. WiC is an add-on system utilising the existing equipment.

Enhancement of steam production towards real design limit

Steam Flow Optimisation

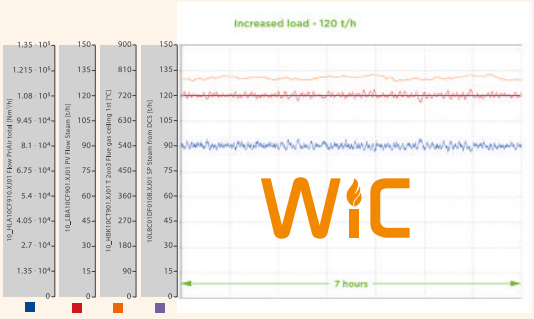


With implementation of traditional control systems, significant overshoots in steam production is possible; this is the main reason why the setpoint (average steam production) is kept below the design limit.

Traditional controls are very likely to produce dangerous overshoots above design limits! Therefore, in most cases, the design limit (MCR) is set **below the real design limit**.

That means, that in most cases the boilers are built with reserves to cover overshooting due to lack of combustion control quality. These reserves may be utilised by implementing a more reliable and stable combustion control system. → WiC

After stabilisation of steam production, the actual plant capacity can be determined.



This led us to a load increase of 10 % from original MCR.

It is important to note that even after increasing steam production from 109 t/h to 120 t/h the steam production is still stable.

Because of the large oscillations in steam production (usually caused by poor quality of combustion control or inadequate type of grate) most boilers are oversized to overcome the fluctuations in steam production and to mitigate the risk of poor performance of the steam circuits. This means that real design limit for steam production, in some cases, is much greater than typically expected. Therefore, by reducing the oscillation in steam production, greater steam output may be achieved.

Depending on the individual design and installation of the plant, and after a detailed engineering evaluation and the necessary approvals, it may be possible to enhance steam production and incineration capacity without any hardware changes. This means that good control of the combustion process can improve the output of the existing boiler.

After implementing WiC and removing the large fluctuations in steam production, Technikgruppe experts monitored steam production over a long period of time to prove the process was indeed extremely stable. Technikgruppe then carried out a detailed design evaluation on the boiler and steam circuit and with approval from the approval body we were able to increase steam production and thus increased the combustion throughput by approximately 10%.

This was all accomplished by using WiC to reduce steam fluctuations, thus creating a very stable process without any mechanical changes. Of course, this result (10%) cannot be guaranteed for all plants, but the design study will quickly show what is possible.

Combustion of low calorific waste

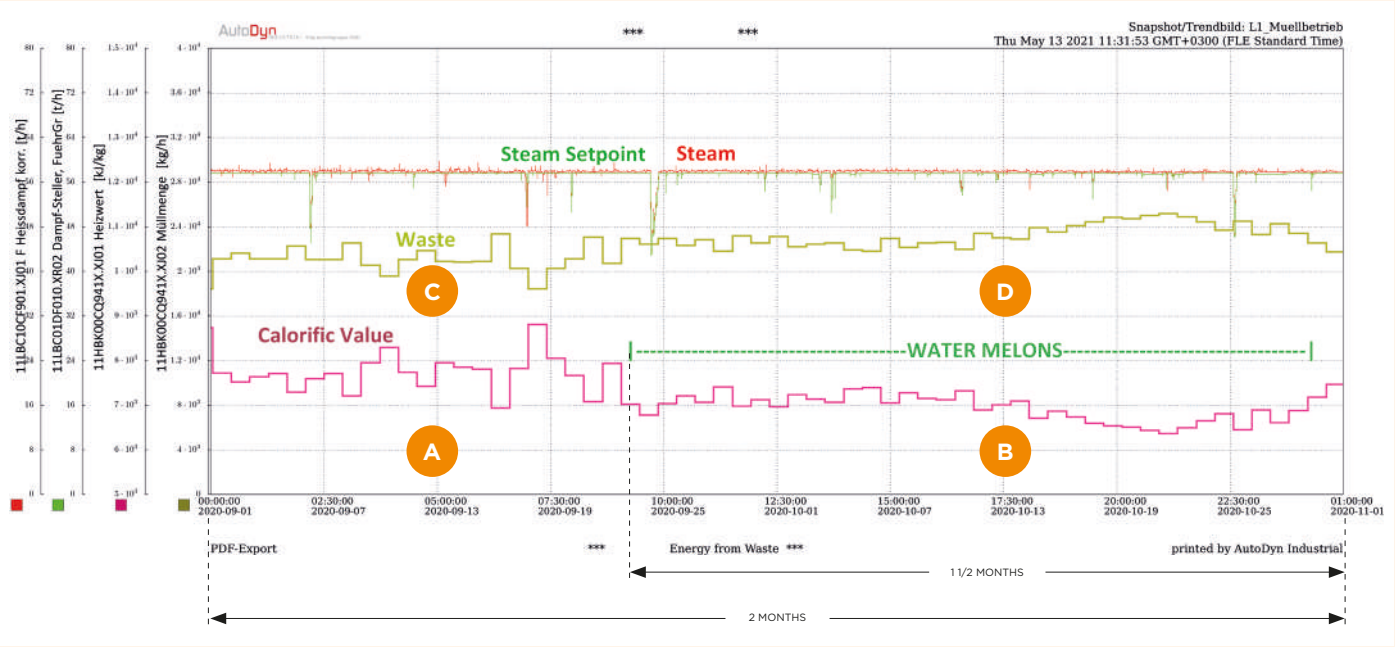
The incineration of waste with low calorific value is generally a very complex process.

Due to the great experience and expertise in the field of combustion technology, very complex calculations and very powerful processors, the WIC-Combustion Manager can optimally incinerate low calorific waste.

The following is an example of trends for an optimised incineration of low calorific waste.

C waste throughput with normal waste average 21 t/h

D waste throughput with watermelons average 24 t/h



A Calorific value normal waste average 7,5 MJ/kg

B Calorific value with watermelons average 6,5 MJ/kg

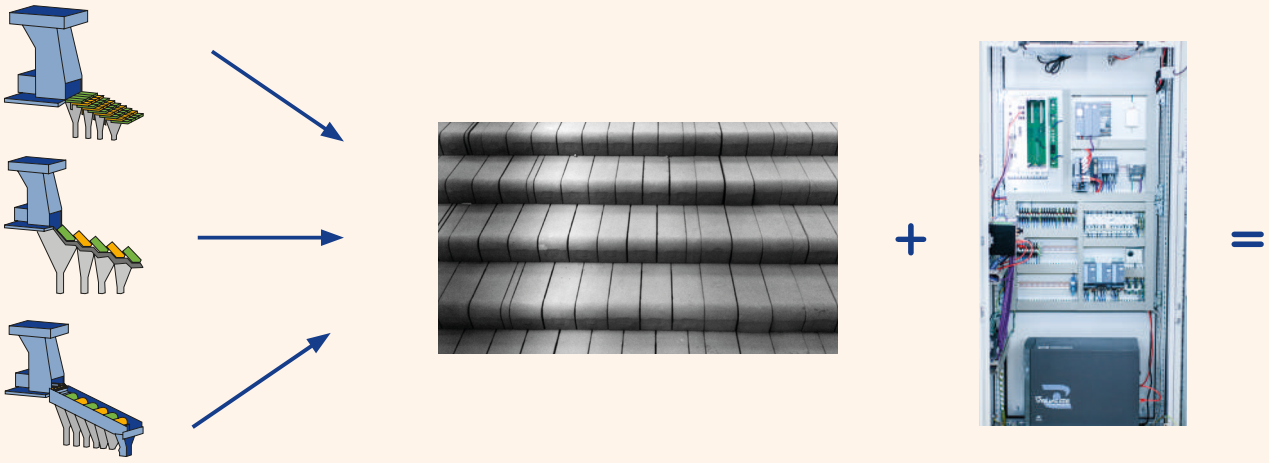
In this particular case, you can see a very successful incineration of waste with a high water content, which was seasonal due to watermelons in the waste.

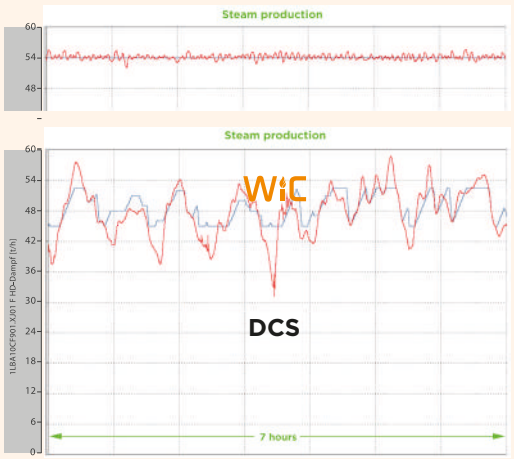
During the incineration of waste of normal quality, the calorific value of the waste averaged 7.5 MJ/kg, see A. The waste throughput for the incineration of regular waste averaged 21 t/h, see C. A high content of watermelons in the waste caused the average calorific value to drop to 6.5 MJ/kg, see B.

Nevertheless, the WIC Combustion Manager ensured stable and unchanged steam generation thanks to the appropriate combustion control!

Because of the lower calorific value of the waste, it is necessary to increase the waste throughput to 24 t/h, see D. This means that WIC guarantees stable steam generation even in difficult situations, and with increased waste throughput – which means higher profit (money from the gate fee).

Each combustion line is unique and each line must be analysed in detail. If you have problems with the incineration of low calorific waste, please contact TECHNIKGRUPPE and our experts will analyse your specific case.

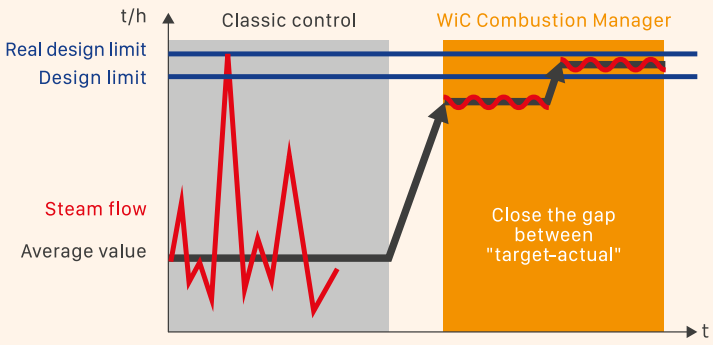




Fewer fluctuations (less cyclical) = more steam

More waste burnt

Steam Flow Optimisation



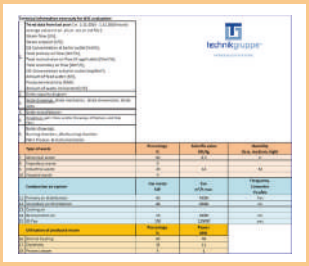
After years of operation, waste characteristics change and this can cause problems which, due to limitations in the grate characteristics, cannot be solved. However, it may still be extremely financially viable to retrofit another type of grate along with WiC and benefit from the longer-term savings, which will include:

- Increased incineration capacity
- Improved burn-out quality
- Extremely stable steam production – increased boiler steam capacity, reduces plant trips and operator interventions

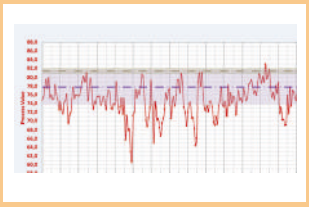
Changing the grate may seem expensive, but it can have a very fast return on investment. In such cases, TECHNIKGRUPPE's technical experts can provide independent advice.

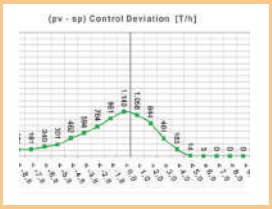
A typical project schedule would be as follows:

1. Obtain measurement data, drawings ...
   (may be done remotely/via email)



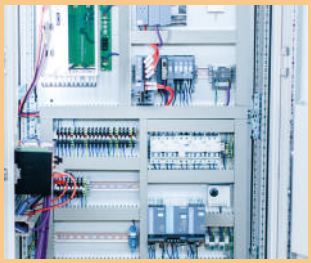
2. Carry out data analysis and feasibility study





3. Site survey – interview site team
   engineering/operations/maintenance

4. Install WiC – fine tune combustion



5. Train the operators and staff

WiC installation can significantly improve the profitability, reliability and uptime of Waste-to-Energy and Biomass-to-Energy plants. If TECHNIKGRUPPE's feasibility study determines that WiC will deliver the best technical and financial results compared to other systems, TG offers free trial installation including operator training on a contingent fee basis.

Payment is made in monthly rates, which are in any case less than the increase in profit through WiC.

What about the financing model for WiC?

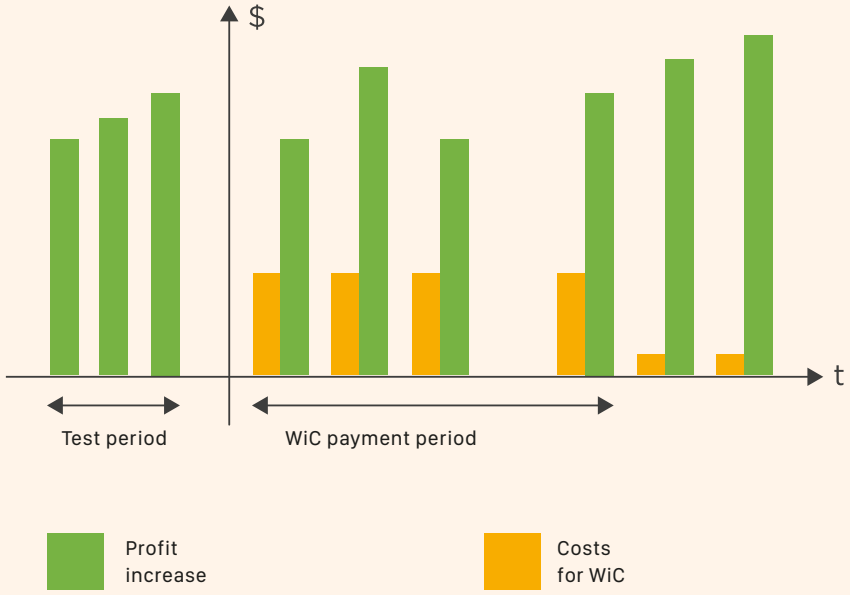
Besides the benefits mentioned above, the WiC provides a considerable additional advantage:

- **Profits as soon as installation commences – WiC offers more than all other systems on the market, also in terms of financing.**

After TG's feasibility study, TG can assess the potential and benefits offered by WiC for your particular plant. If the outcome of the feasibility study is positive, TG is able to offer installation and commissioning free of charge:

- **no upfront investment**
- **test installation and commissioning free of charge**
- **no technical risk, no commercial risk for you**

WiC generates additional profits from the beginning of installation



TG has great experience in reliably assessing the advantages of the WiC system on your particular plant.

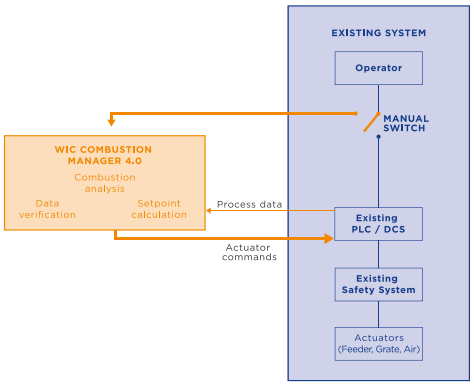
After commissioning, the customer can immediately measure the short-term benefits of the WiC (financial benefits). At that point the customer can decide freely, without any obligations, whether to go ahead with a contract for WiC. The entire risk is borne by TG. The customer can terminate the contract month-by-month for any reason, without any further obligations.

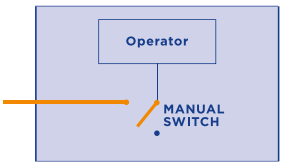
If a leasing model with monthly fees is chosen, the fees are in most cases less than the short-term profit enhancement. After a certain time, the customer becomes the owner of the WiC and pays only for the software licence and optional maintenance contract.

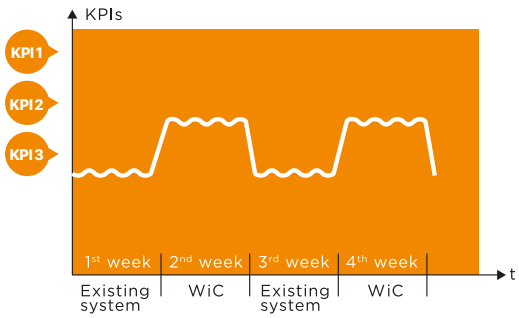
Commercial benefits of the WiC Combustion Manager

Every plant and every incineration line is a unique system. Good results on one line in a particular plant does not automatically mean good results on others. TG's basic purchase model provides a Combustion Management System without any commercial and technical risks. The implementation of the WiC is totally financed by TG. Our tested and proven methods provide simple and reliable comparison between before and after WiC installation. **Finally, only a test run and evaluation will provide a real picture of the system quality.**

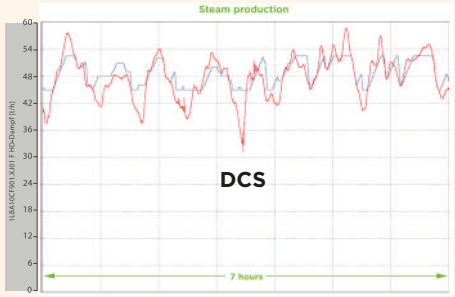
How to measure the financial and technical benefits from WiC?



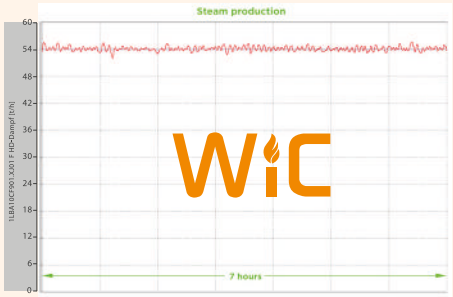




(1) Stabilisation and enhancement of steam production



Steam production controlled by DCS

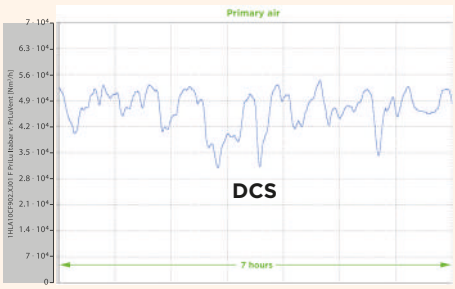


Steam production controlled by WiC (same line)

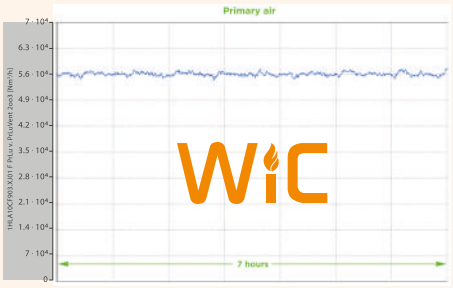
Stabilisation of steam flow brings:

- increased steam production
- increased waste throughput
- increased electricity production
- better burn out quality

(2) Stabilisation of combustion air flow



Primary air controlled by DCS



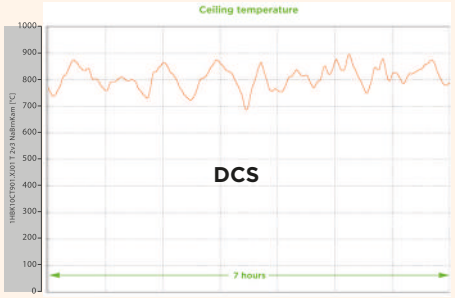
Primary air flow controlled by WiC (same line)

Please NOTE! The higher amount of primary air is related to an increase of waste throughput/steam production

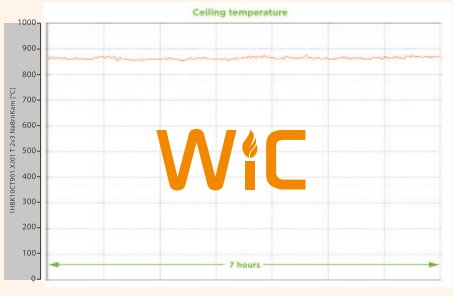
Stabilisation of combustion air brings:

- less additives in flue gas cleaning
- less energy and mechanical forces on fans
- less slagging and fouling

(3) Stabilisation of flue gas temperature (ceiling temperature)



Ceiling temperature with DCS



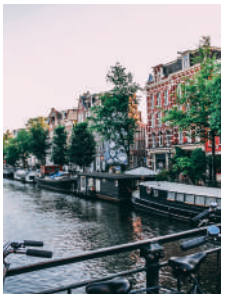
Ceiling temperature with WiC (same line)

Please NOTE! The average temperature is, of course, higher because of enhancement of waste throughput/steam production

Stabilisation of flue gas temperature brings:

- less slagging and fouling
- less wear on refractory
- less corrosion
- less cleaning effort
- lower ceiling temperature
- better heat transfer

TECHNIKGRUPPE HAS PARTICIPATED IN THE FOLLOWING



STAND
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DISCUSSIONE

2023

8-10 MAY
WtE and Biomass Plant Optimisation Workshop,
Amsterdam / Netherlands

INFO

2023

15-16 MARCH
EfW Conference,
London / UK

STAND

2022

8-11 NOV
Key Energy Expo,
Rimini / Italy

2023

5-7 JUNE
International Conference,
Piacenza / Italy

STAND
PRESENTATIONE
DISCUSSIONE

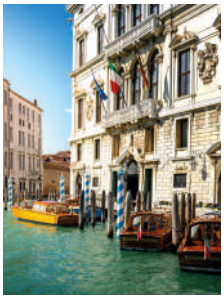
STAND
PRESENTATIONE
DISCUSSIONE
WORKSHOP

2023

19-20 APRIL
Conference Aston,
Birmingham / UK

2022

21-22 NOV
Venice 2022 / Italy



STAND
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DISCUSSIONE

2022

12-14 OCT
WTERT Conference
New York / USA

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Follow-Up-16-Piacenza_EN_01