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LEADING Technology for the HOT-DIP Galvanizing Industry

Electrically-Heated Furnaces and their potential for Sustainablity

European General Galvanizers Association

Assembly 2023, Salzburg

EGGA
GALVANIZING EUROPE

C. H. Evensen Industriovner AS
Fredrikstad – Norway

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Key information – Our background

Name: **Nils Erik Faulhaber**
Work: Mechanical Engineer and Project Manager for CHE

CHE is based in **Norway**, Fredrikstad

Founded in 1937

- Over **85 years of experience** with innovative solutions in Heat Treatment Industry
- Over **60 years of experience** with electric heated HDG applications
- Over **30 years of experience** with gas heated HDG applications
- Over **25 years of experience** with hybrid solutions.

Part of **VOW ASA Group** with operations in Europe and the US. Vow is a world leading provider of technology and solutions that prevent pollution and greenhouse gas emissions (**www.vowasa.com**).

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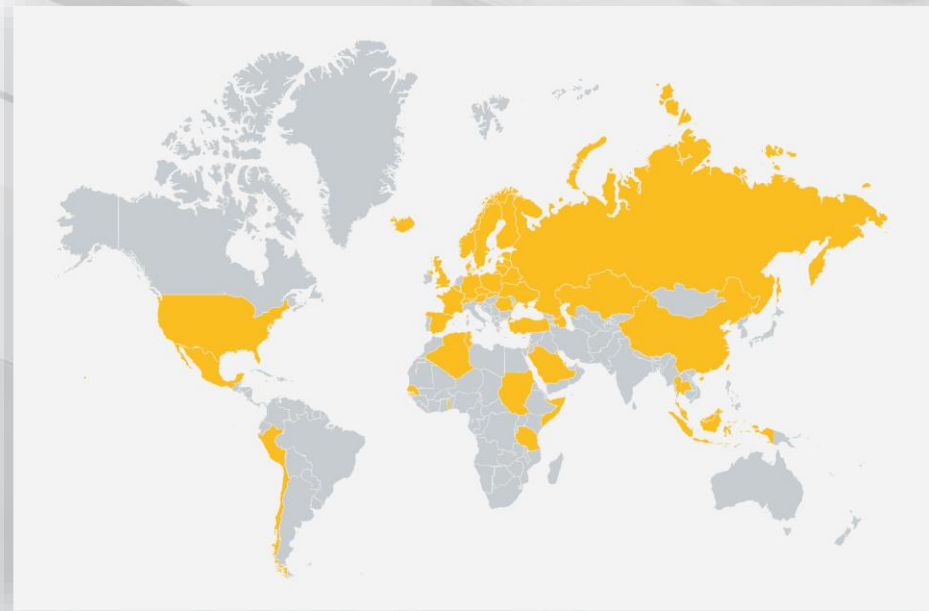
CHE Installations worldwide

Approx. **250 Hot Dip Galvanizing installations worldwide,** over 4.000 totally for Heat Treatment Solutions in **45 countries**



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Global situation

- More and more Hot Dip Galvanizers are focusing on their **energy consumption** – both economically, but also related to the source of the energy and sustainability.
- Subjects of **discussion**:
  - CO_2-foot print
  - Availability
  - Price
  - Future
  - Sustainability
- Possible Solution: **Electrically heated Systems**

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Why electricity ?

- Electric energy production is **not depending on a single energy source**.
- **Different Energy sources** can be transformed like:
  - Gas
  - Waterpower
  - Photovoltaic
  - Geothermal energy
  - Wind energy, etc.
- With the choice of the energy source the **CO_2-footprint** can be chosen as well.

Sustainable sources are **available**.

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Challenges

- **80%** or more of all galvanizing furnaces worldwide are **not electrically heated** (estimation).
- **Infrastructure/ Availability** of electricity on site.
- Gas optimized plants **require adjustments** for change of energy source.
- **Future perspectives**

Long term goal will be carbon-neutral production.

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Advantages

- **Even and homogenous heat distribution** on kettle walls (longer life span).
- **Lower nominal energy consumption** (No heat loss through chimney).
- Easy to fit two temperature **regulation zones** (less top dross).
- **Less maintenance.**
- **Long life span of heating elements**
- **Heating elements are easy to repair**
- **Less auxiliary equipment.**

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Limitations

- In general, there are **no size limitations** for electrifying the HDG furnace or other HDG equipment.

Requirements:

- **Availability** of enough electricity on site.
- **Stable grid** (can be compensated with safety measures).
- Energy load **kW/m²** same as for gas fired applications

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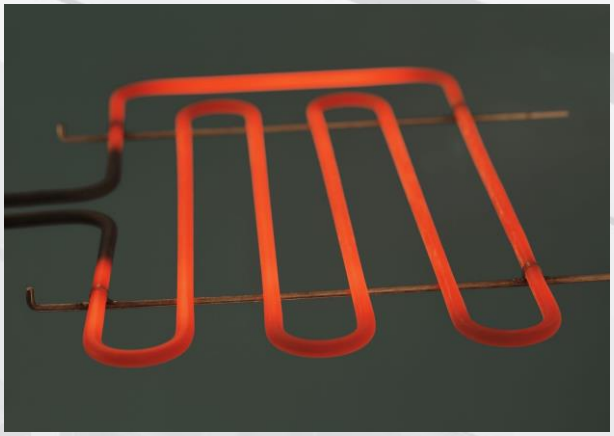
Standard electric heating methodes for galvanizing:

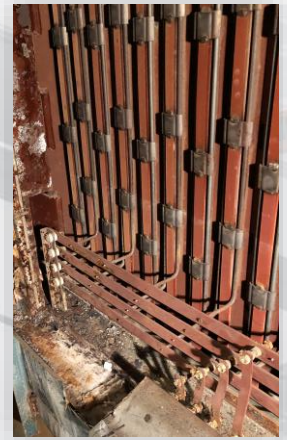
Electric Resistance heating

- Heating element wire emitting radiant heat



Induction

- Induction coils induce heat



- Complicated and expensive installation on kettle/ furnace
- **5% Energy loss** for cooling inductors

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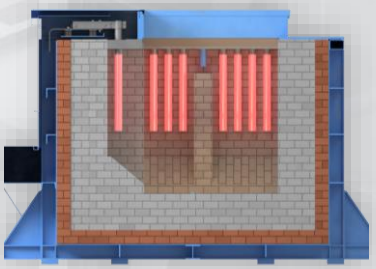
CHE Standard electric heating systems:

Immersion heating rods

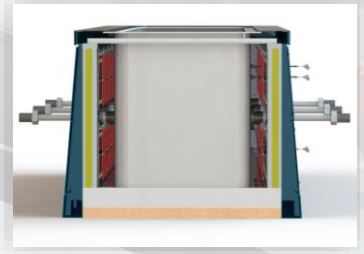
- Heating rods directly immerged in liquid zinc

- Most efficient heat distribution with direct heat transfer, less zinc

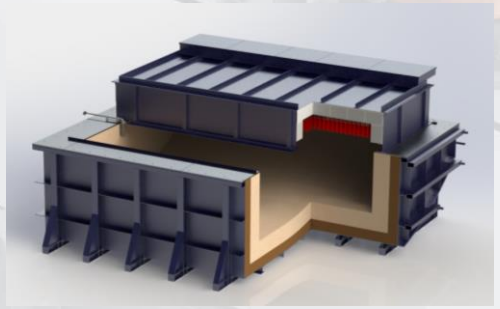


Radiant heat

- Heating elements around steel kettle wall



- Top heated systems (mostly ceramic kettle)



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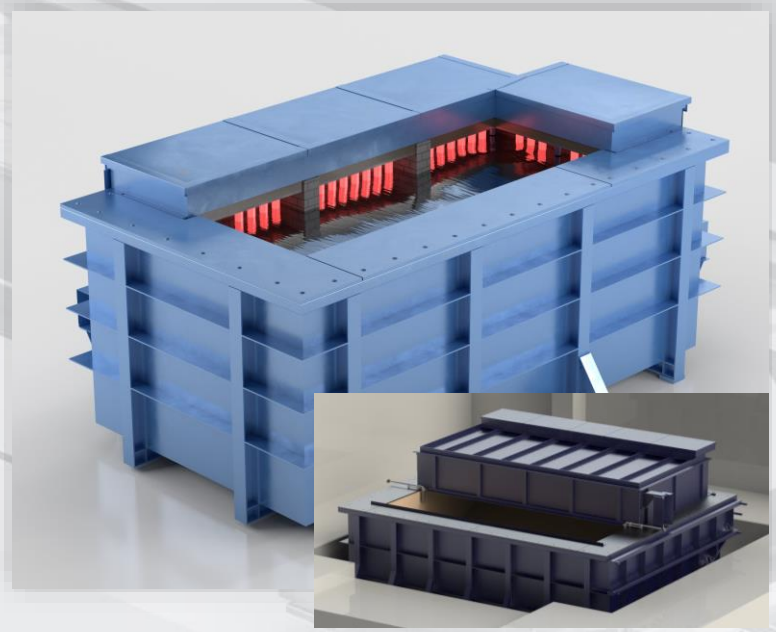
Fully electric heated HDG furnaces:

Electric heated HDG furnace with steel kettle

- Approx. 30% less nominal power required
- Independent of electricity generation min. 30% less CO_2-foot print

Electric heated ceramic bath



- Immersion heating rods – smaller bath dimensions, more effective heating
- Top fired, less nominal power

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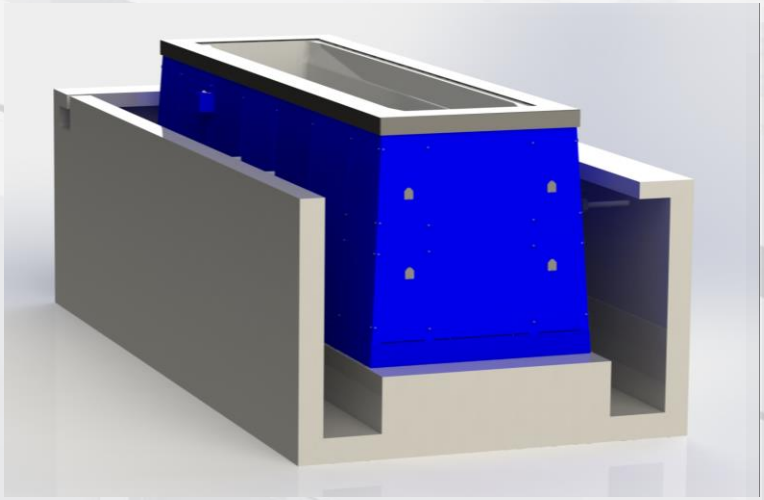
Example for electrically heated HDG furnace with steel kettle:

Energy calculation



- (L x W x D) 7,0 x 1,5 x 2,8 m
- Capacity: 5 t/h
- Electrically heated

Energy calculation

KETTLE SIZE AND CAPACITY:

Length	7,00	m
Width	1,50	m
Depth	2,80	m
Gross hourly capasity:	5,00	Tons/h
Zinc consumption:	7,0	%

ENERGY CONSUMPTION

Heat losses zinc surface:	136,5 kW
Heat losses furnace construction:	18,7 kW
Energy for production:	345,0 kW
Energy for zinc melting:	29,8 kW
Security:	26,5 kW

GAS HEATING			ELECTRIC HEATING	
Installed power:	856 kW		*Installed power:*	556 kW
Calorific value, gas:	10	kW/Nm³	*Energy loading, sides only:*	15 kW/m²
Mat. gas consumption:	86	Nm³/h	*Energy loading, sides and ends:*	13 kW/m²
No. of burners:	4			
Energy loading:	13	kW/m²		

ZINC CONTENT	WEIGHT OF KETTLE
(Incl. 70mm, Free-Board)	
198 Tons	25 Tons

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Example for electrically heated HDG furnace with steel kettle:

Annual consumption

Assumption:

- 2 shifts per day
- 5 working days a week
- 45 working week a year
- Annual production: approx. 12.000 t/year

ANNUAL ENERGY CONSUMPTION

Production related figures:

Annual hours total:	8 760	*h*	
Average hourly production capacity:	4,00	*tons/ h*	Average per hour
Production hours per week:	70	*h*	
Production weeks per year:	45	*Weeks*	
Annual production hours:	3 150	*h*	
Annual production	12 600	*tons*	
Zinc consumption	7	%	

Energy consumption:

Energy loss from zinc surface production:	429 975	*kWh*	
Energy loss from zinc surface covered:	117 810	*kWh*	
Energy loss from furnace construction:	163 593	*kWh*	
Energy for production:	869 400	*kWh*	
Energy for zinc melting:	74 970	*kWh*	
Total energy consumption, electric:	**1 655 748**	***kWh***	
Spesific energy consumption, electric:	**131**	***kWh/ton***	
Total energy consumption, gas (65%)	**2 547 305**	***kWh***	**254 730 Nm³**
Spesific energy consumption, gas:	**202**	***kWh/ton***	**20,22 Nm³/ton**

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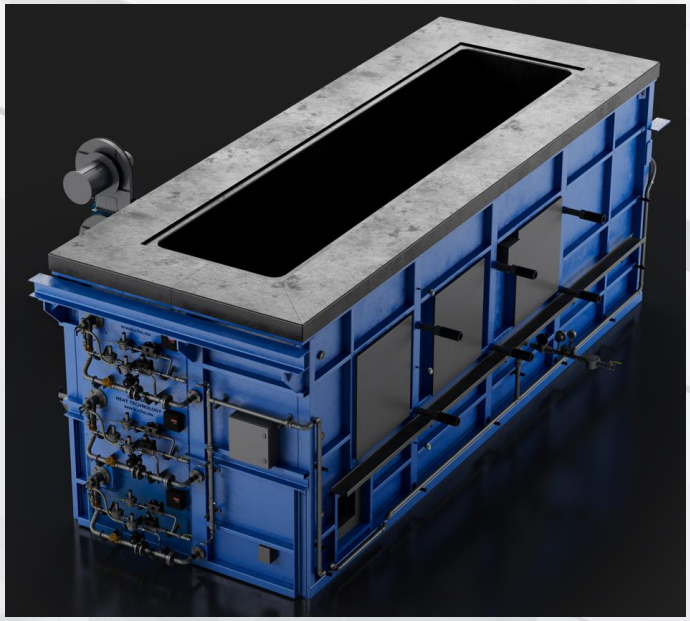
Hybrid HDG furnaces (gas/electric):

High velocity burners combined with electric heating element



- Main power supply is gas
- Additional electric heating can improve CO_2-balance drastically

Applicable electric sources

- Direct supply from local electricity supplier
- Surplus of own electricity production from
  - Photovoltaic
  - Wind energy
  - Fuel based emergency generator
  - Etc.

➡ **Extra production security!**

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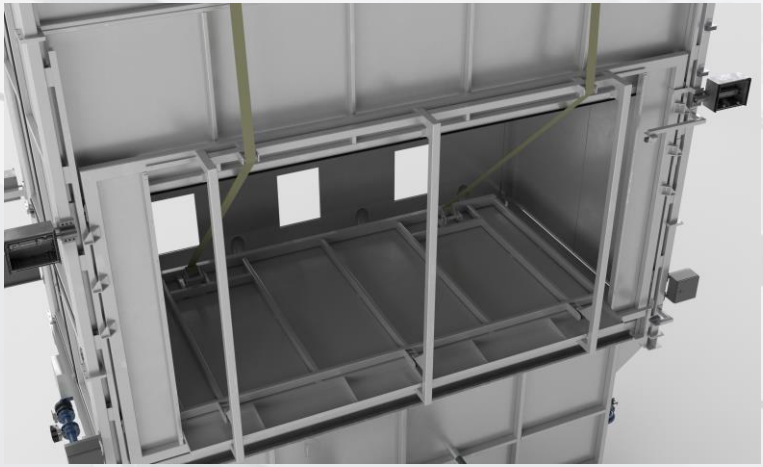
Auxiliary equipment:

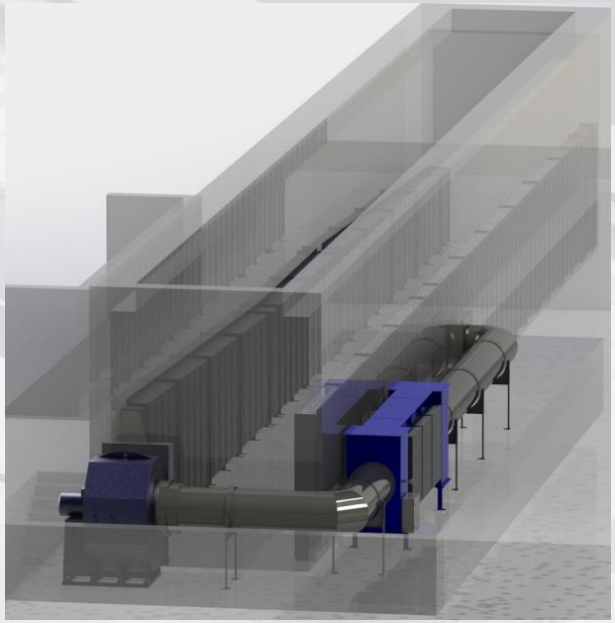
Fume enclosure with integrated cover lid



- Simple covering of HDG bath in non-production hours, lunch breaks etc.

➡ **approx. 70% less losses over bath surface**

Fully electrically heated HDG dryer



- For fully electric HDG line.

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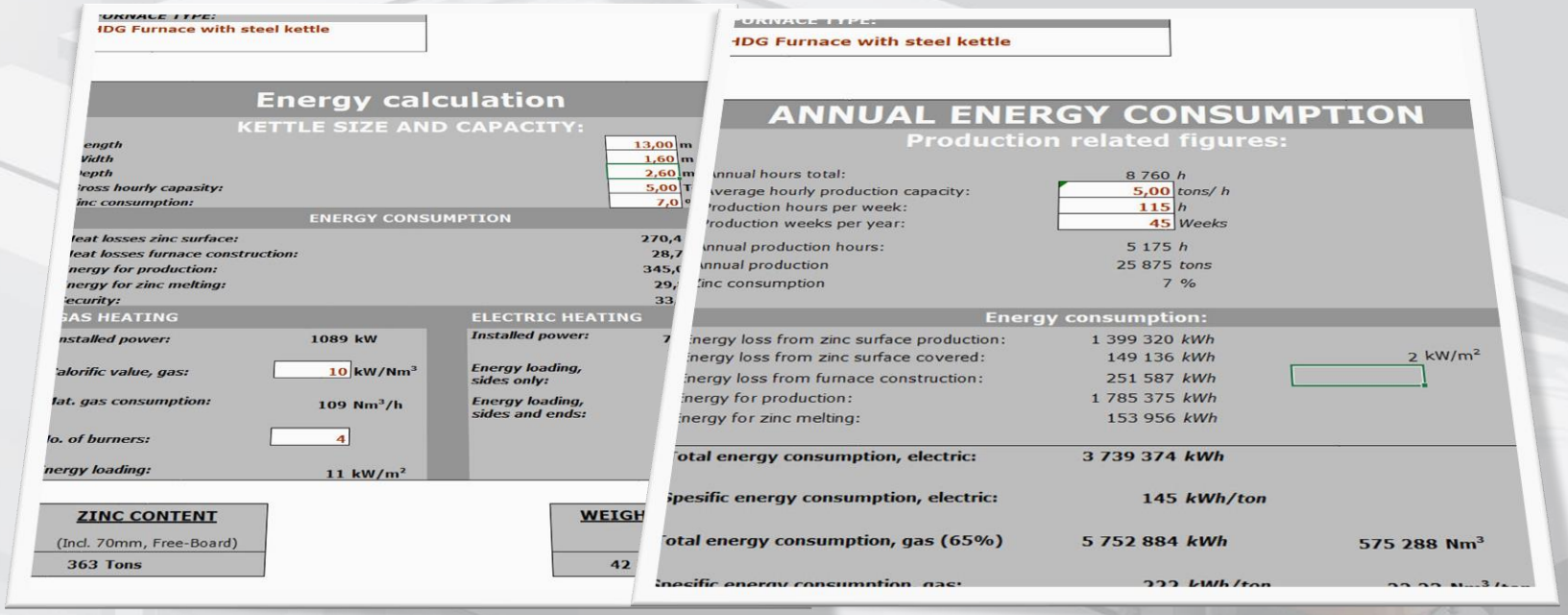
Energy calculation



- Calculation of **Energy load** on kettle wall
- Calculation of **annual energy consumption** based on customer input
- **Clear picture** of required energy and where energy consumption and CO_2-footprint can be minimized!

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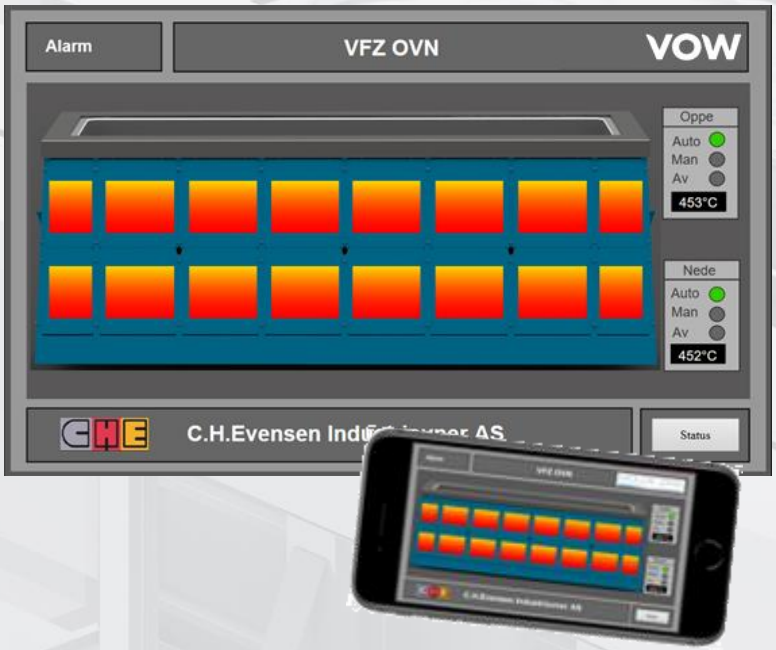
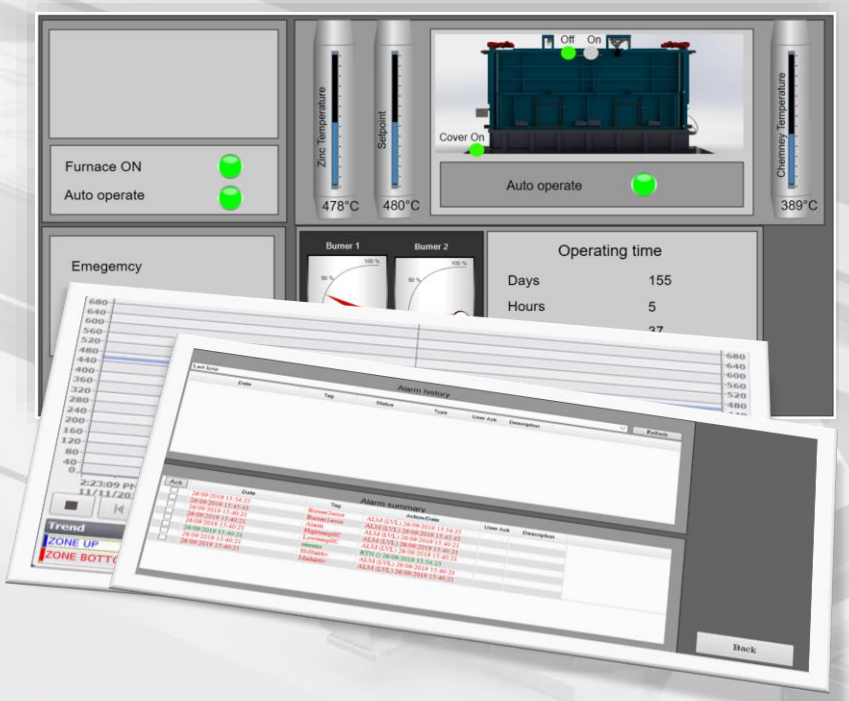
Programming and control:

Remote control and remote assistance



- Full remote control for customer and service assistance on PC and Pads
- Smart solutions possible

Data logging



- Data logging of desired production parameters and information

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Conclusion

- **In order to achieve a carbon-neutral industry, the transition to electric heated systems seems to be a potential solution and feasible**.
- Both short-term and long-term measures can be taken.
- The **future will be probably be fully electric**, but in a transition period there will be electric and hybrid solutions.
- **CHE** delivers **gas fired, electric and hybrid solutions**.
- **Let's make the Hot Dip Galvanizing Industry more sustainable together and get closer to a**

Carbon-neutral Industry!

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Thank you for your attention !