INDUSTRIAL SOLAR
thermal solutions

DÜRR

LEADING IN PRODUCTION EFFICIENCY

DÜRR SYSTEMS GMBH

SOLAR PROCESS HEAT FOR SUSTAINABLE AUTOMOBILE MANUFACTURING - SYNERGIES OF A STRONG COOPERATION

Oliver Iglauer, Dürr Systems GmbH

Brussels, March 15, 2013

1. SUSTAINABILITY

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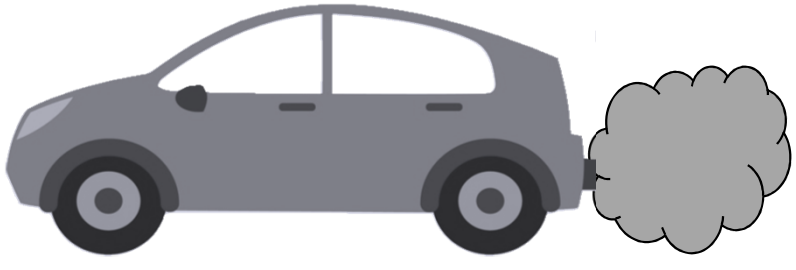
1. SUSTAINABILITY

Sustainable production processes

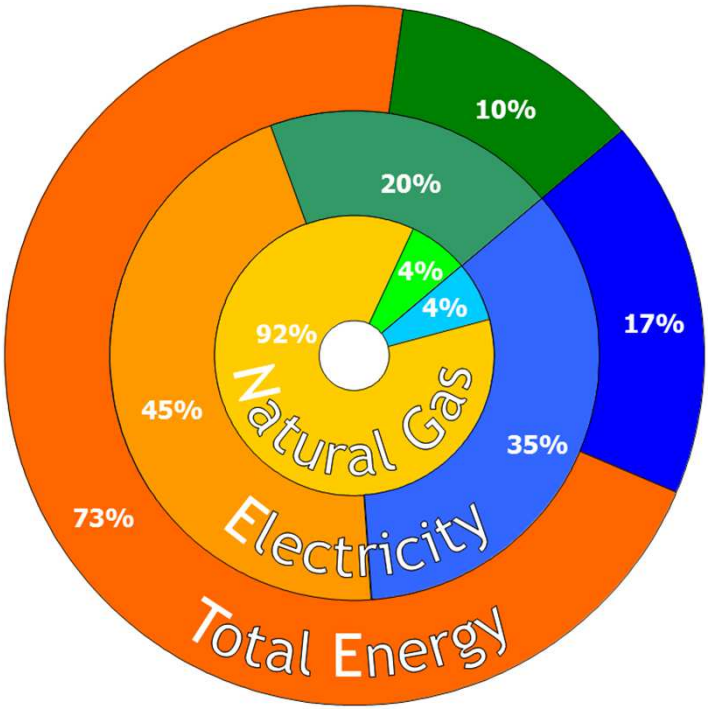
- Automotive industry is under high pressure to make cars more environmentally friendly



- Not only the cars themselves, but the whole process of value creation!

1. SUSTAINABILITY

Automotive car body production



- Paint shop is the No.1 energy consumer in automotive car body production
- A common paint shop has an average energy consumption of 700-900 kWh per car body (→ yearly consumption of about 150 GWh)

→ Solar process heat - e.g. for car body curing - can significantly reduce the carbon footprint in the paint process

Body
Paint
Assembly

2. COOPERATION PARTNERS

Strong cooperation since 2011

Dürr AG

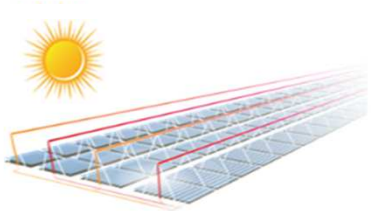
Eco⊕Paintshop

- Headquarter: Bietigheim-Bissingen (Germany)
- Sales revenues (FY 2012): € 2.4 billion
- Employees (2012): 7.700 in 23 countries

- Global supplier of complete paint and final assembly shops in the automotive industry

Industrial Solar GmbH

Fresnel Collector



- Office: Freiburg (Germany)
- Sales revenues (FY 2012): € 1.1 million
- Employees (2012): 15

- Leading manufacturer of Fresnel process heat collectors

  Turnkey provider of solar process heat and solar cooling systems

  7 years operating experience

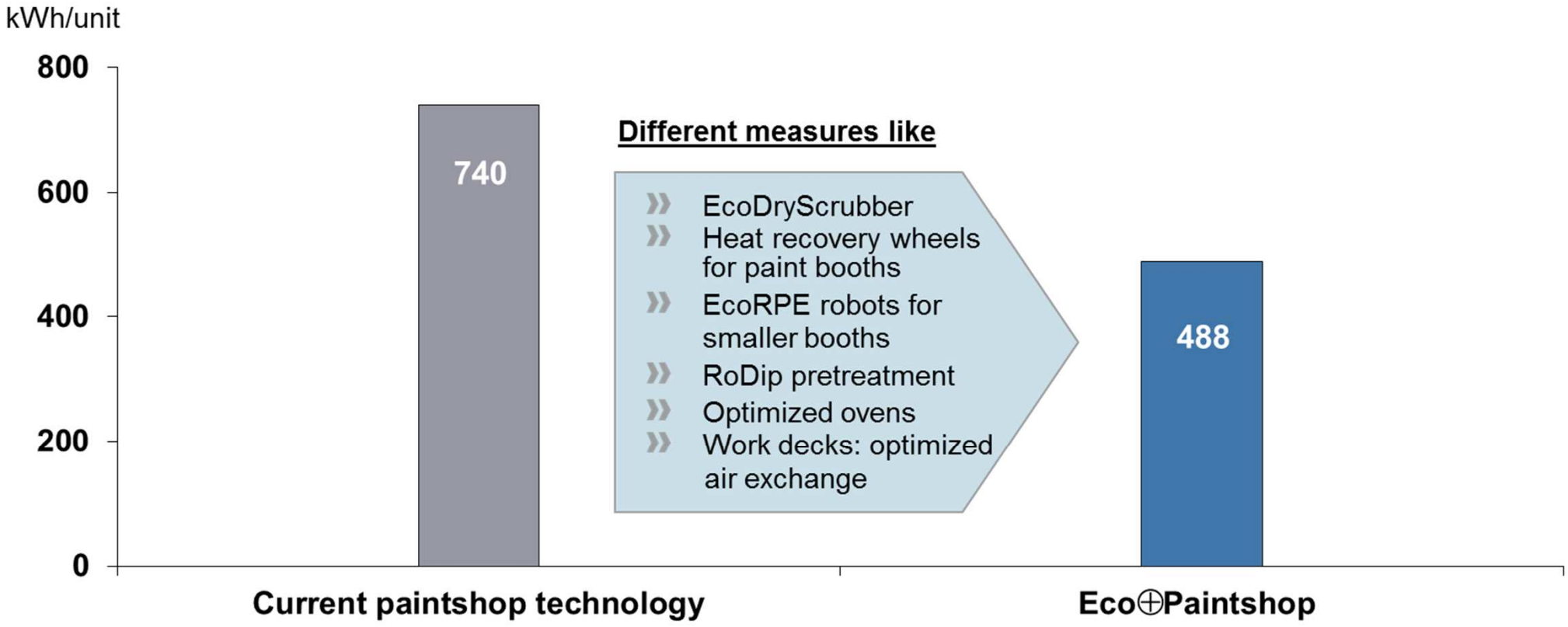
2. COOPERATION PARTNERS

Dürr - Eco⊕Paintshop

- … is a paint shop for the automotive industry
- … stands for less
  - energy
  - material
  - and water consumption
  - as well as less emissions

2. COOPERATION PARTNERS

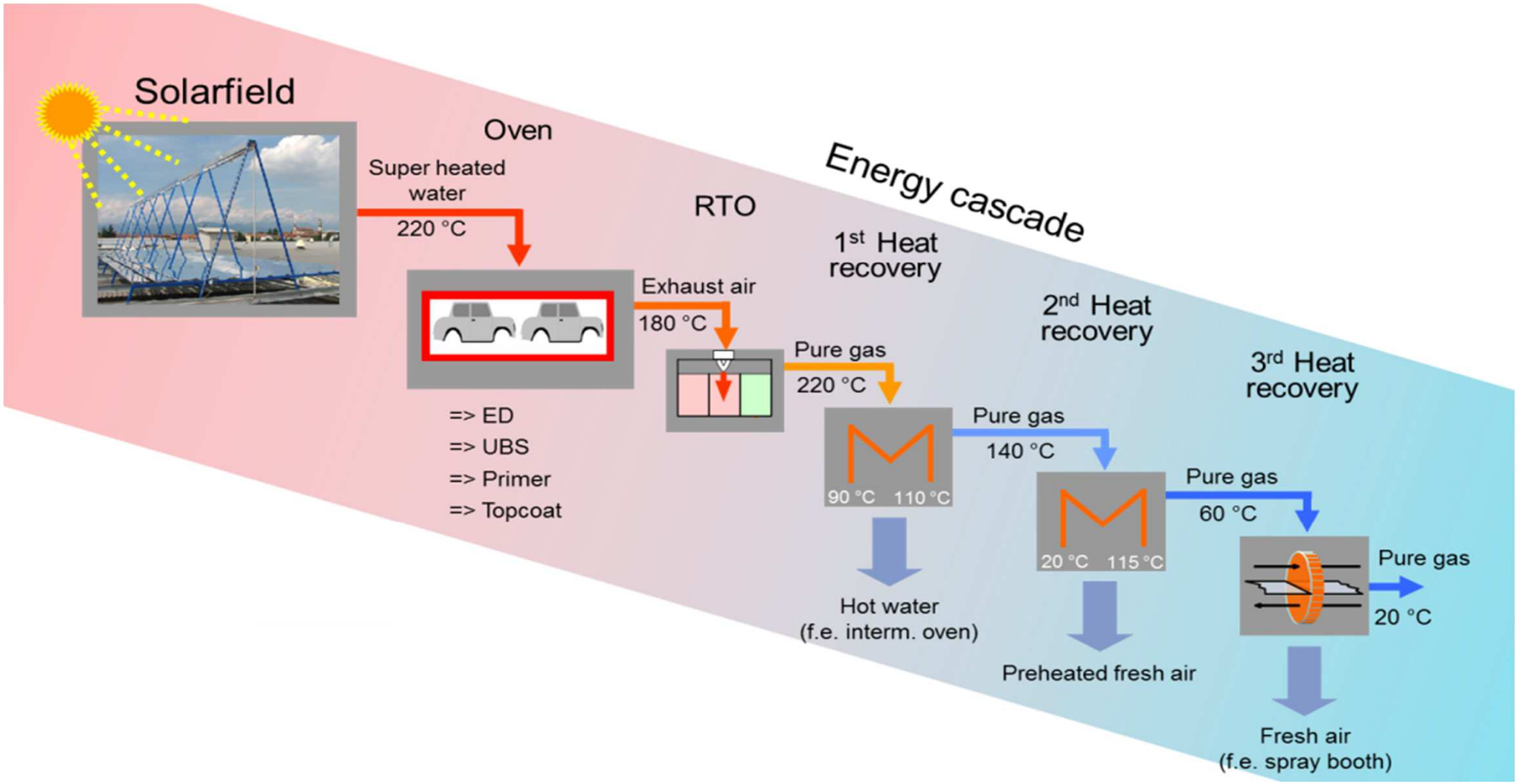
Dürr - Eco⊕Paintshop / Comparison



➡ Further reductions are possible through the use of decentralized / sustainable energies

3. ECO⊕PAINTSHOP & SOLAR PROCESS HEAT

Solar philosophy – Concentrating solar collectors



3. ECO⊕PAINTSHOP & SOLAR PROCESS HEAT

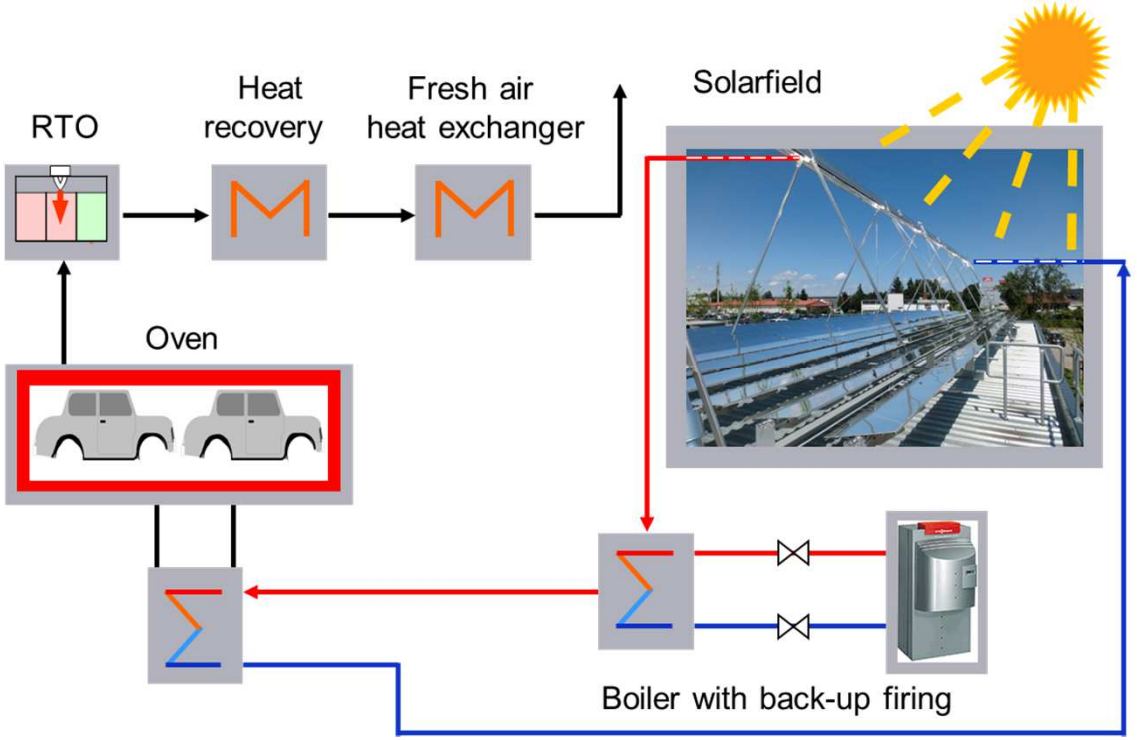
Industrial Solar - Fresnel collector / Five advantages

- Process heat (up to 400 °C)
- Best suited for rooftop installation
- Less space requirement compared to conventional parabolic trough collector
- No north-south alignment necessary
- Reduced heat-up of the building

3. ECO⊕PAINTSHOP & SOLAR PROCESS HEAT

Integration of solar process heat - Initial concept

Oven heating	Initial Concept
Basic principle (solar heat supply)	- decentralized - several water/air heat exchangers
Heat transfer medium	- pressurized water (220 °C; 35 bar)
Back-up system	- hot water boiler
Air purification	- air purification (downstream)



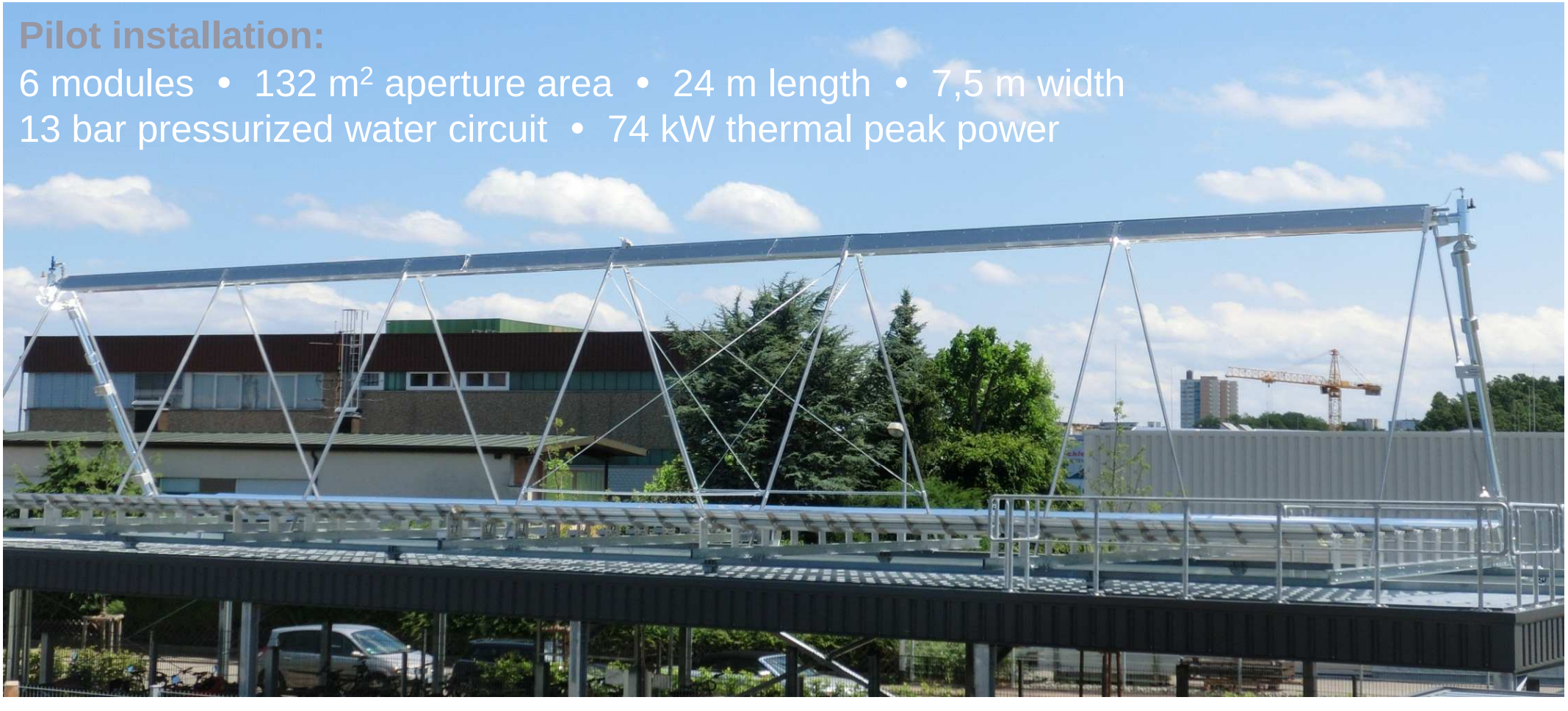
3. ECO⊕PAINTSHOP & SOLAR PROCESS HEAT

Integration of solar process heat - Initial concept

Pilot installation:

6 modules • 132 m^2 aperture area • 24 m length • 7,5 m width

13 bar pressurized water circuit • 74 kW thermal peak power



3. ECO⊕PAINTSHOP & SOLAR PROCESS HEAT

Integration of solar process heat - Initial concept

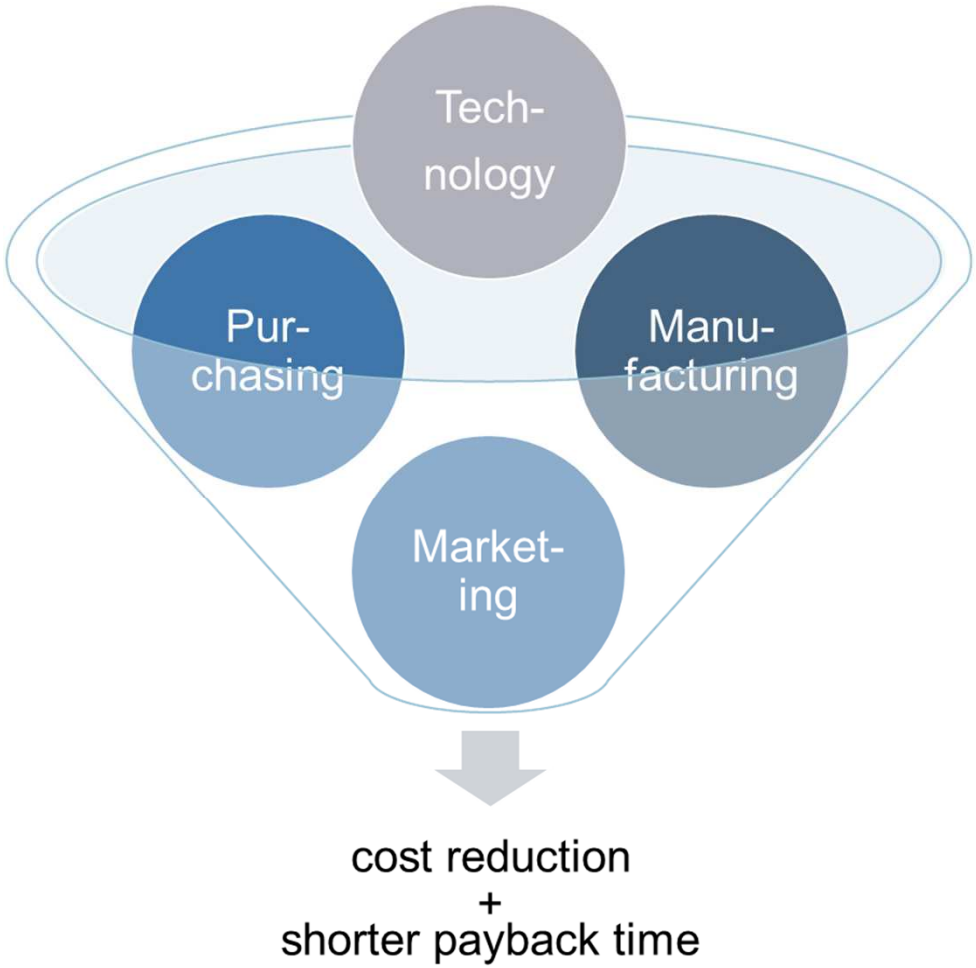
STUDY: PAINT SHOP WITH SOLAR HEATED OVENS
LOCATION: TANGER, MOROCCO

Paint shop capacity	30	units/hour
Operating hours (2x8h-2h breaks)	2	shifts
Operating days	250	d/a
Max. thermal demand	4.5	MW
Max. process temperature	200	°C
Available rooftop area	12,000	m^2
Collector aperture area	8,000	m^2
Collector thermal peak power	4.5	MW
Mean yearly efficiency	37.7	%
Yearly sum of DNI	1,926	kWh/(m^2a)
Yearly energy consumption	**15.75**	**GWh**
Yearly GHP of collector field	**5.81**	**GWh**
Useable GHP of collector field (without storage)	**3.98**	**GWh**

4. SYNERGIES OF THE COOPERATION

Efforts to enhance economical attractiveness

- Positive feedback from automotive companies
- Objectives for the future:
  - reduced costs
  - shorter payback time
- Key levers:
  - technical concepts
  - manufacturing concepts
  - purchasing concepts
  - marketing concepts
- Specific flanking measures



4. SYNERGIES OF THE COOPERATION

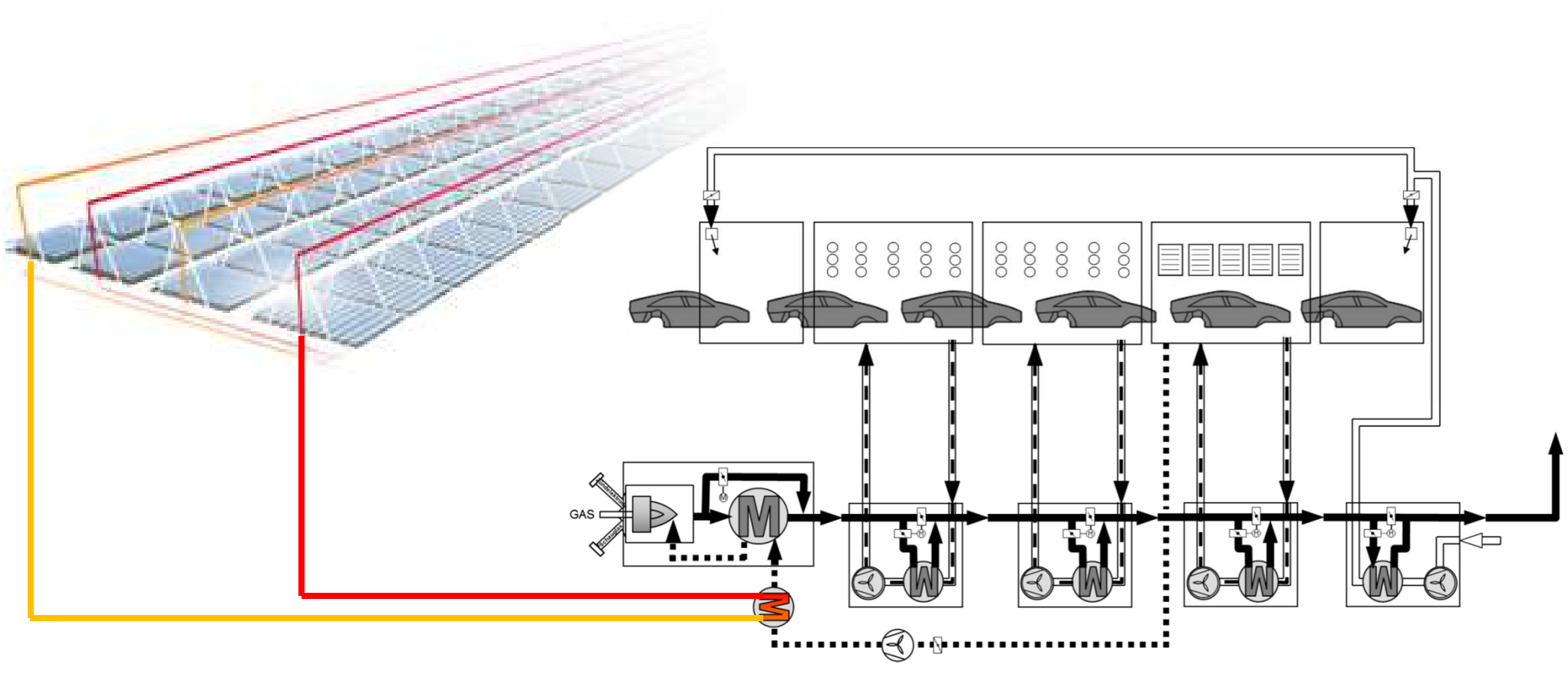
Technical concept (→ Integration of solar thermal energy)

Oven heating	Initial Concept	New Concept
Basic principle (solar heat supply)	- decentralized - several water/air heat exchangers	- centralized - only one thermal oil/air heat exchanger - preheating of the Exhaust-Air-Incinerator
Heat transfer medium	- pressurized water (220 °C; 35 bar)	- thermal oil (340 °C; basically pressure-less)
Back-up system	- add. hot water boiler	
Air purification	- add. air purification (downstream)	- Exhaust-Air-Incinerator (+ process heating system)
Complexity	- high	- less complex - based on proven technology (incinerator)

➡ Reduced costs and shorter payback time!

4. SYNERGIES OF THE COOPERATION

Technical concept (→ Integration of solar thermal energy)



4. SYNERGIES OF THE COOPERATION

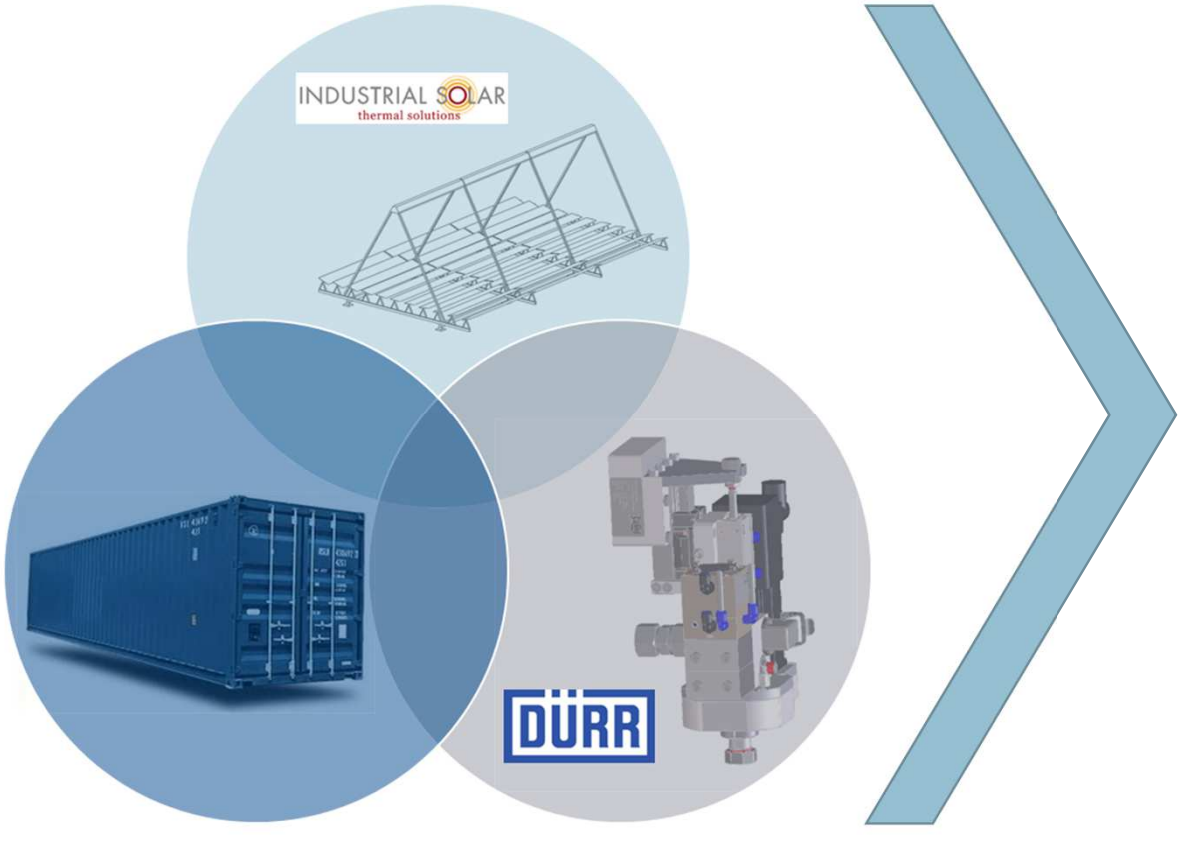
Manufacturing concept (→ Mirror assembly)

	Current Concept	New Concept
Place of production	- workshop in Germany	- mobile production in customized sea container on site
Mirror assembly	- largely manual gluing process	- semi-automatic gluing process
Gluing technology		- Dürr → comprehensive process knowledge → high-quality products
Transport	- expensive packing and transport	- space-saving transport
Flexibility	- limited	- high (scalable and flexible concept)

➡ Reduced costs and shorter payback time!

4. SYNERGIES OF THE COOPERATION

Manufacturing concept (→ Mirror assembly)



4. SYNERGIES OF THE COOPERATION

Purchasing and marketing concept

Purchasing	- Savings through volume bundling - Production on Dürr's own factories
Marketing	- Both companies complement each other → Dürr: - global presence - represented in 23 countries → Industrial Solar: - strategic partnerships in various countries - represented in numerous national and international associations, working groups and committees

➡ Reduced costs and shorter payback time + increased awareness of the product

SUMMARY

- **Solar process** heat can significantly reduce the carbon footprint in the paint process (e. g. for car body curing)
- Due to waste heat recovery systems providing thermal power at approx. 100 °C, it is essential to integrate **concentrating solar thermal collectors** (up to 400 °C).
- It is currently a **big challenge** to bring together
  - the required product profitability from customer side
  - and the realizable payback time of a concentrating solar thermal installation
- **Dürr and Industrial Solar** are ready to face this challenge - “Synergies of a Strong Cooperation”.
- It would be advantageous to have **specific flanking measures** to enhance the economical attractiveness of solar process heat.

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