



# **Car Body Painting 2011**

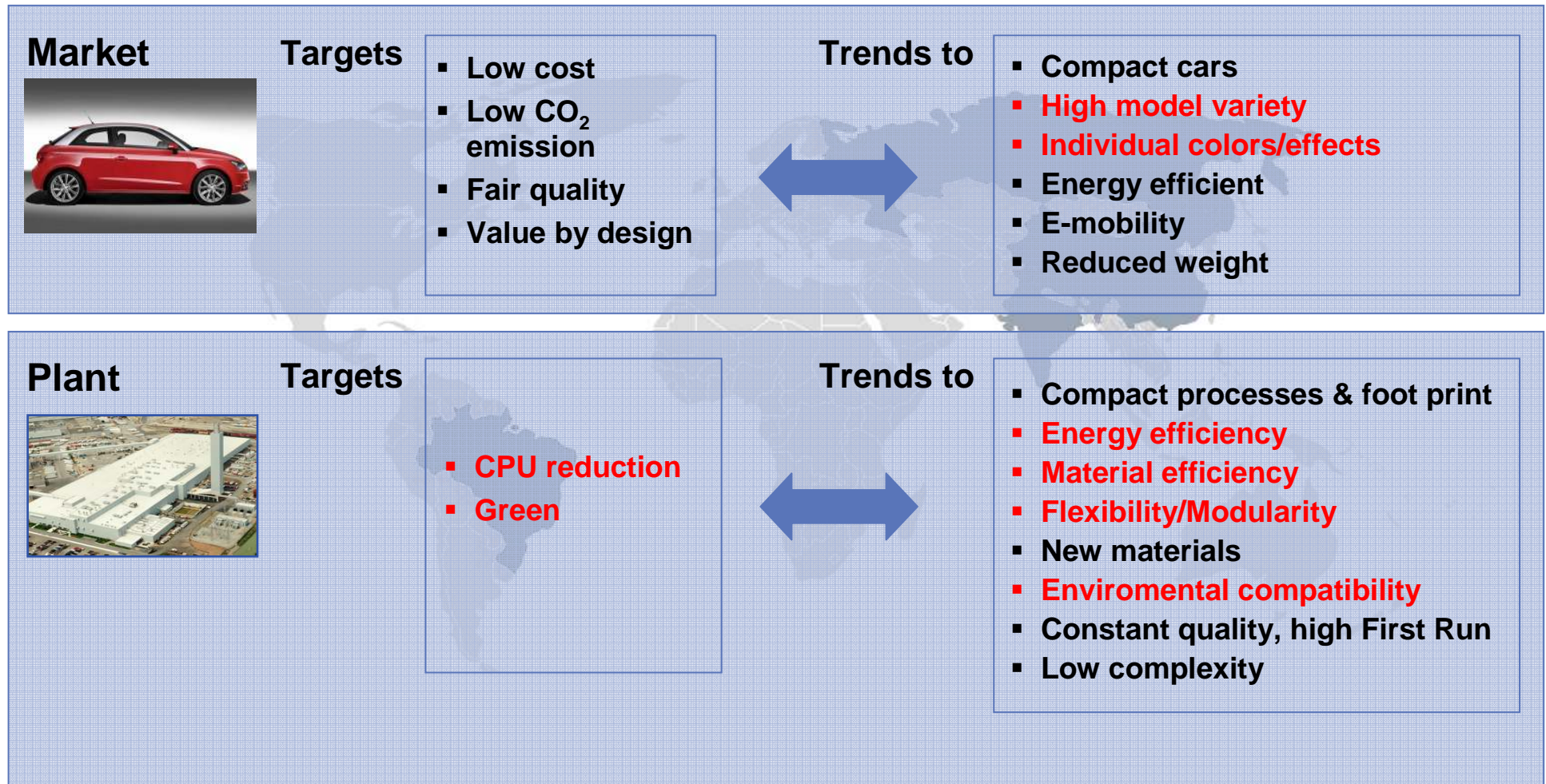
**Line vs. Box Concept in Automotive Painting  
- A Contribution for more Energy & Cost Efficiency -**

**Dr. Hans Schumacher, Dürr Systems GmbH**

**Bad Nauheim, 08.11.2011**

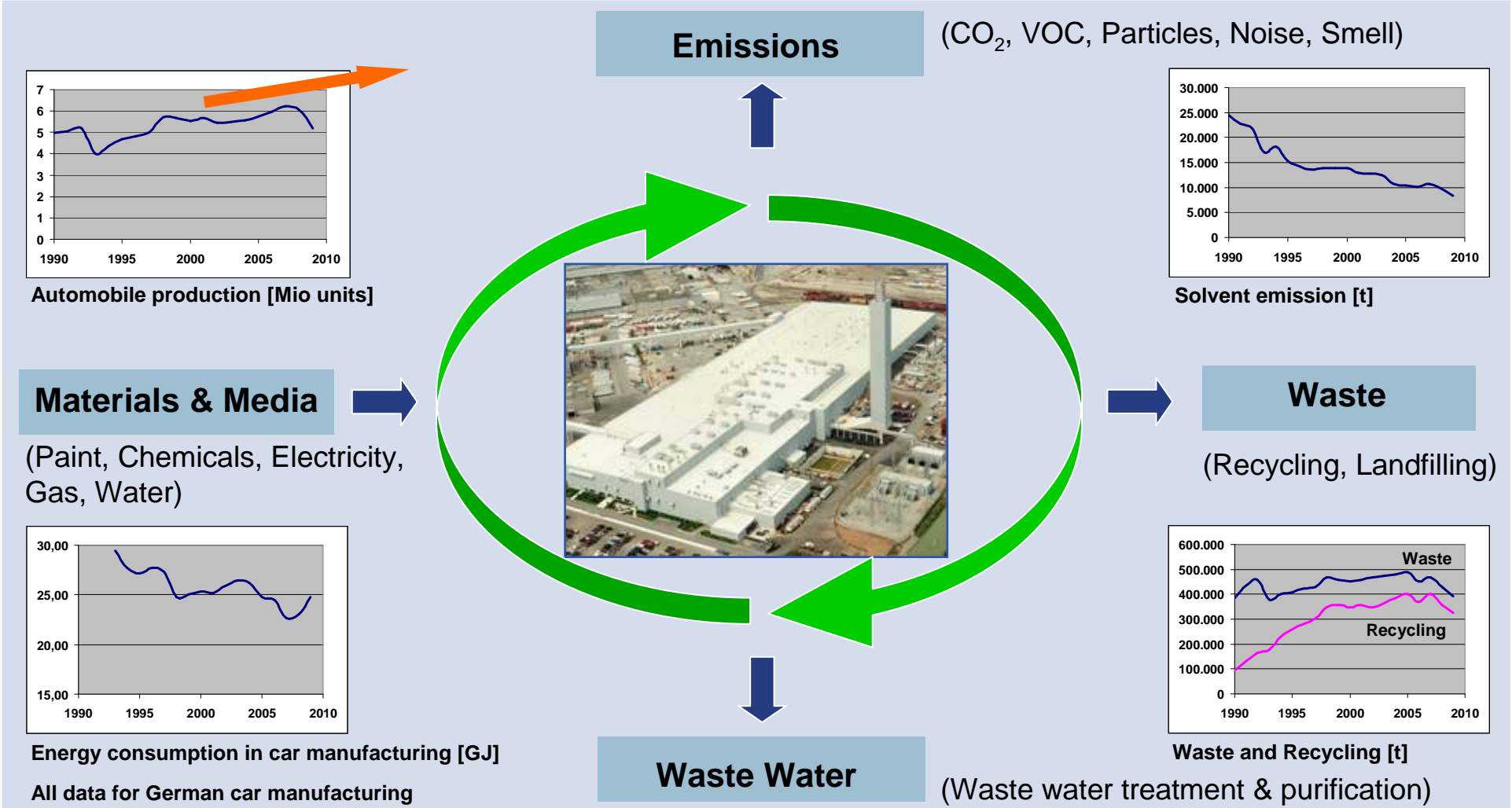
# Automotive Market and Car Manufacturing

## Global trends and targets



# Green Paintshop

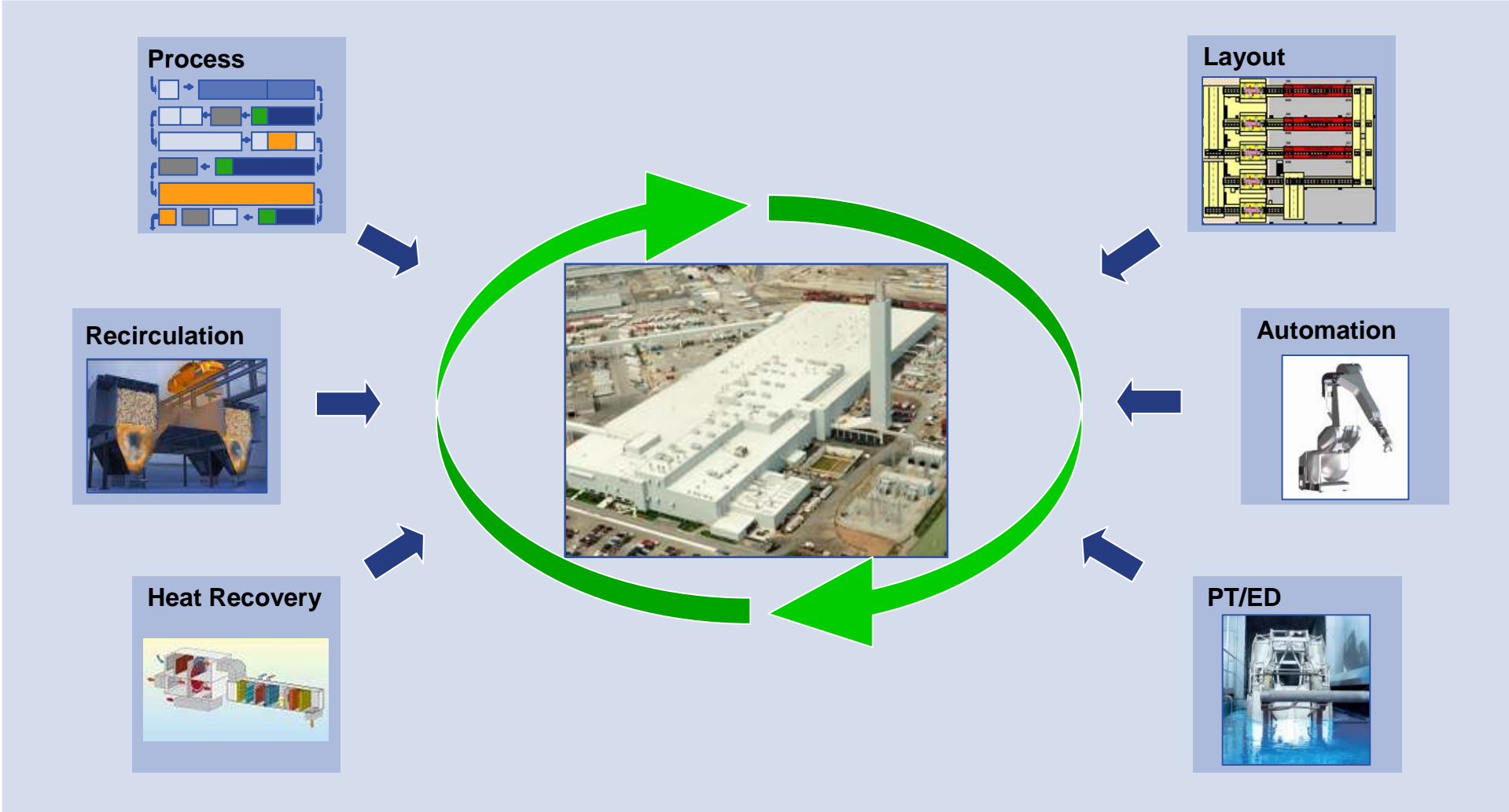
## Main factors of ecological and economical sustainability



Source: VDA, OICA (International Organization of Motor Vehicle Manufacturing)

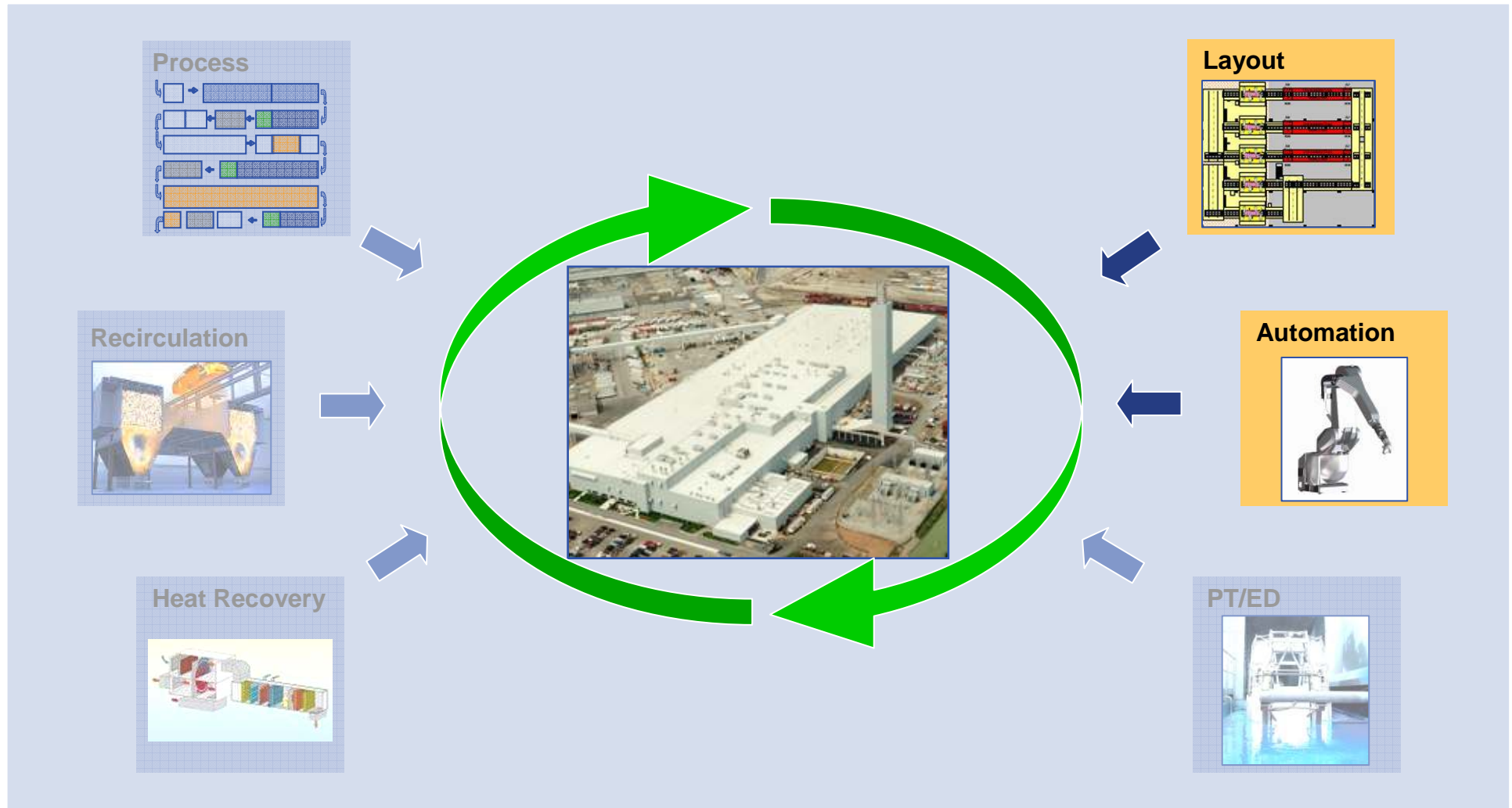
# Green Paintshop

## Energy and Material savings potentials



# Green Paintshop

## Energy and Material savings potentials



# Sequential Paint Lines vs. Modular Paint Boxes

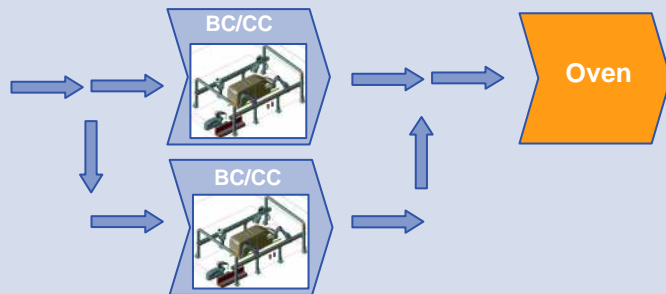
## Generic concept comparison

### Sequential Paint Line



- One sequential line of booths and ovens
- Body transfer by chain conveyor
- In each station and oven zone, only a part of the painting is processed
- Tracking or stop & go mode

### Modular Paint Boxes





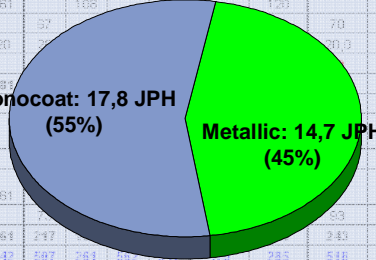
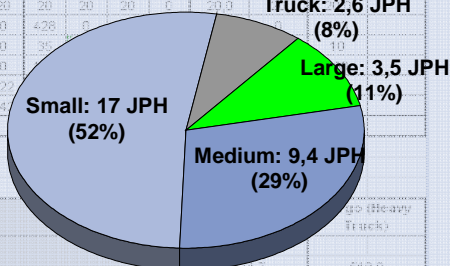


- Single stations (boxes) arranged in parallel
- Bodies fed in/out by adequate conveyors
- Painting task is maximized in each box
- Stop & go mode

# JMC Nanchang



## High variety of products to be processed

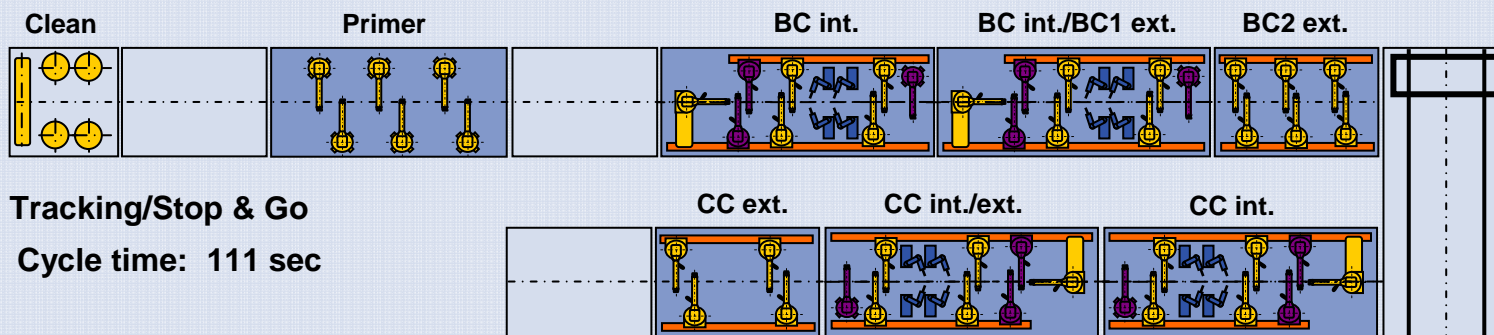
<h3>Passenger Car</h3> 		<ul style="list-style-type: none"> <li>Capacity: 26 JPH</li> <li>Process: 3wet High Solid (solvent borne)</li> <li>Types: 4 Passenger</li> <li>Body size: 15 m<sup>2</sup> exterior surface area</li> <li>Colors: 2 Primer, 2 Monocoat, 6 BC / 1 CC</li> <li>Application: Interior/Exterior</li> </ul>	
<h3>Van/Truck</h3>  		<ul style="list-style-type: none"> <li>Capacity: 32,5 JPH</li> <li>Process: 3wet High Solid (solvent borne)</li> <li>Types: 21 Van/Truck</li> <li>Body size min: 25 m<sup>2</sup> exterior surface area</li> <li>Body size max: 40 m<sup>2</sup> exterior surface area</li> <li>Colors: 2 Primer, 3 Monocoat, 5 BC / 1 CC</li> <li>Application: Cargo/Interior/Exterior</li> <li>SOP: 2.2013</li> </ul>	<h3>Color Mix</h3>  <h3>Body Mix</h3> 

# JMC Nanchang



## Approach of a modular paint box concept for van/truck

### Sequential Line Layout: 32,5 JPH

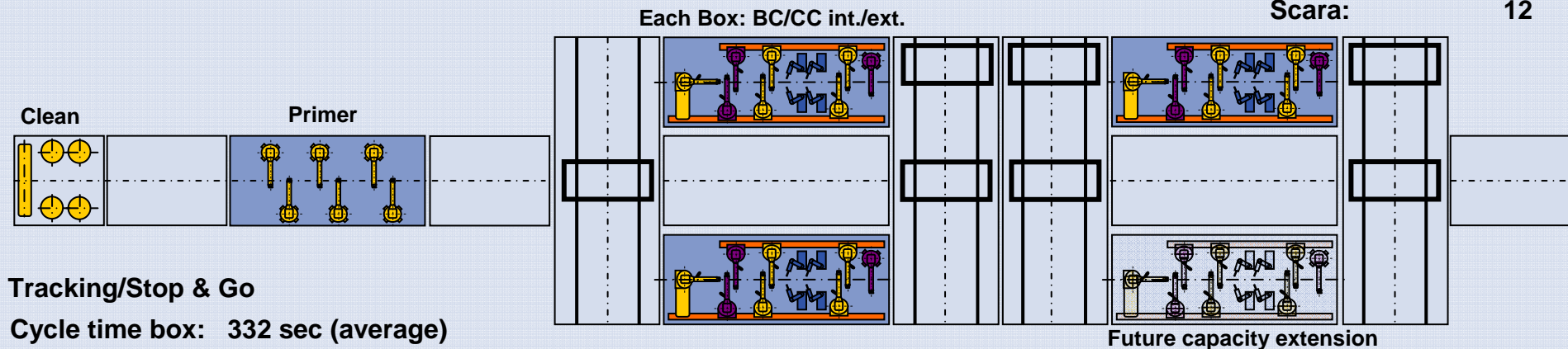


Scrubber length: 91 m  
 Robots: 36  
 Opener: 12  
 Scara: 16

Tracking/Stop & Go

Cycle time: 111 sec

### Modular Box Concept 1: 32,5 JPH



Scrubber length: 58 m  
 Robots: 21  
 Opener: 9  
 Scara: 12

Tracking/Stop & Go

Cycle time box: 332 sec (average)

Future capacity extension

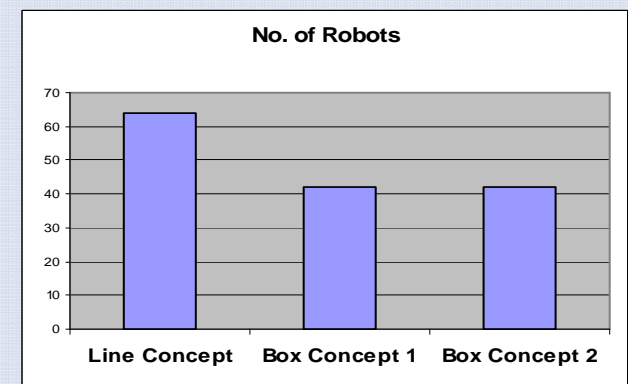
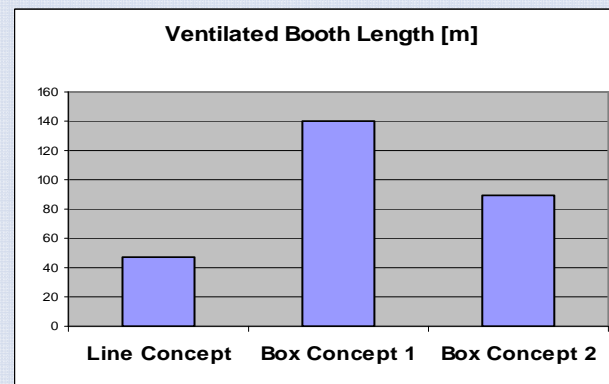
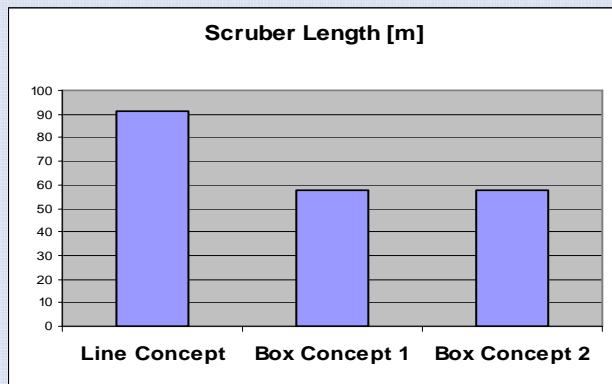
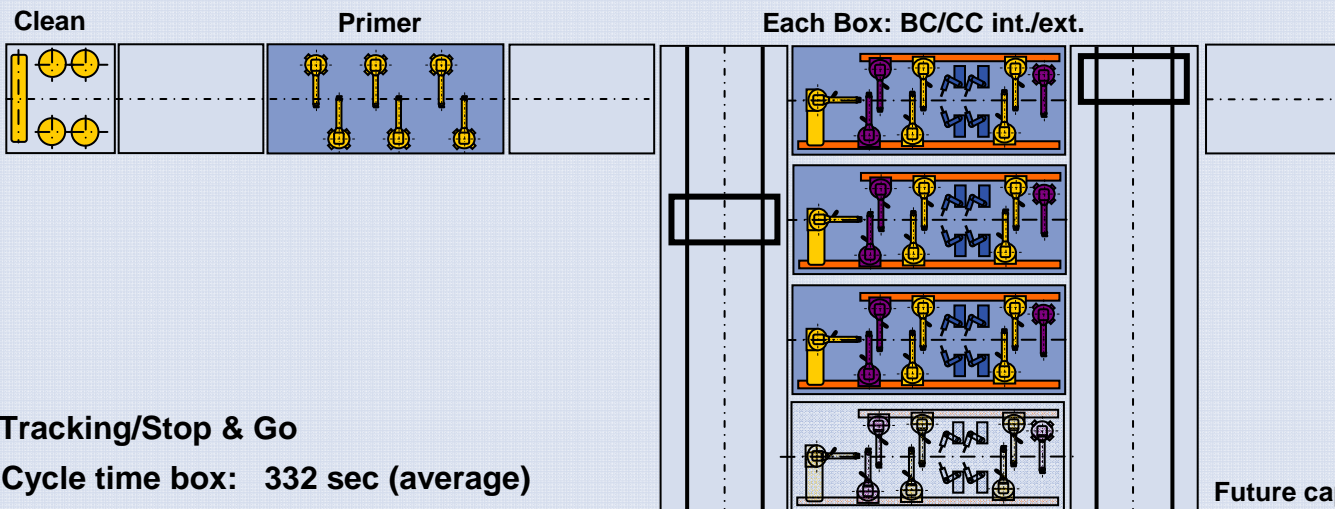
# JMC Nanchang



## Layout optimization

### Modular Box Concept 2: 32,5 JPH

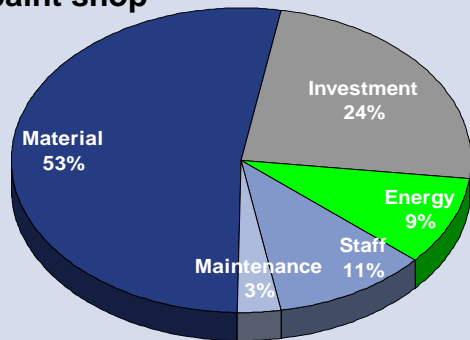
Scrubber length: 58 m  
 Robots: 21  
 Opener: 9  
 Scara: 12



# JMC Nanchang

## Saving evaluations box optimized layout vs. line

Cost per unit (CPU) in a typical paint shop



Calculation of No. of Boxes

$$T_{tot} = \sum \frac{F_{o,i}}{100} (T_{p,i})M_i ; T_c = \frac{3600}{C}$$

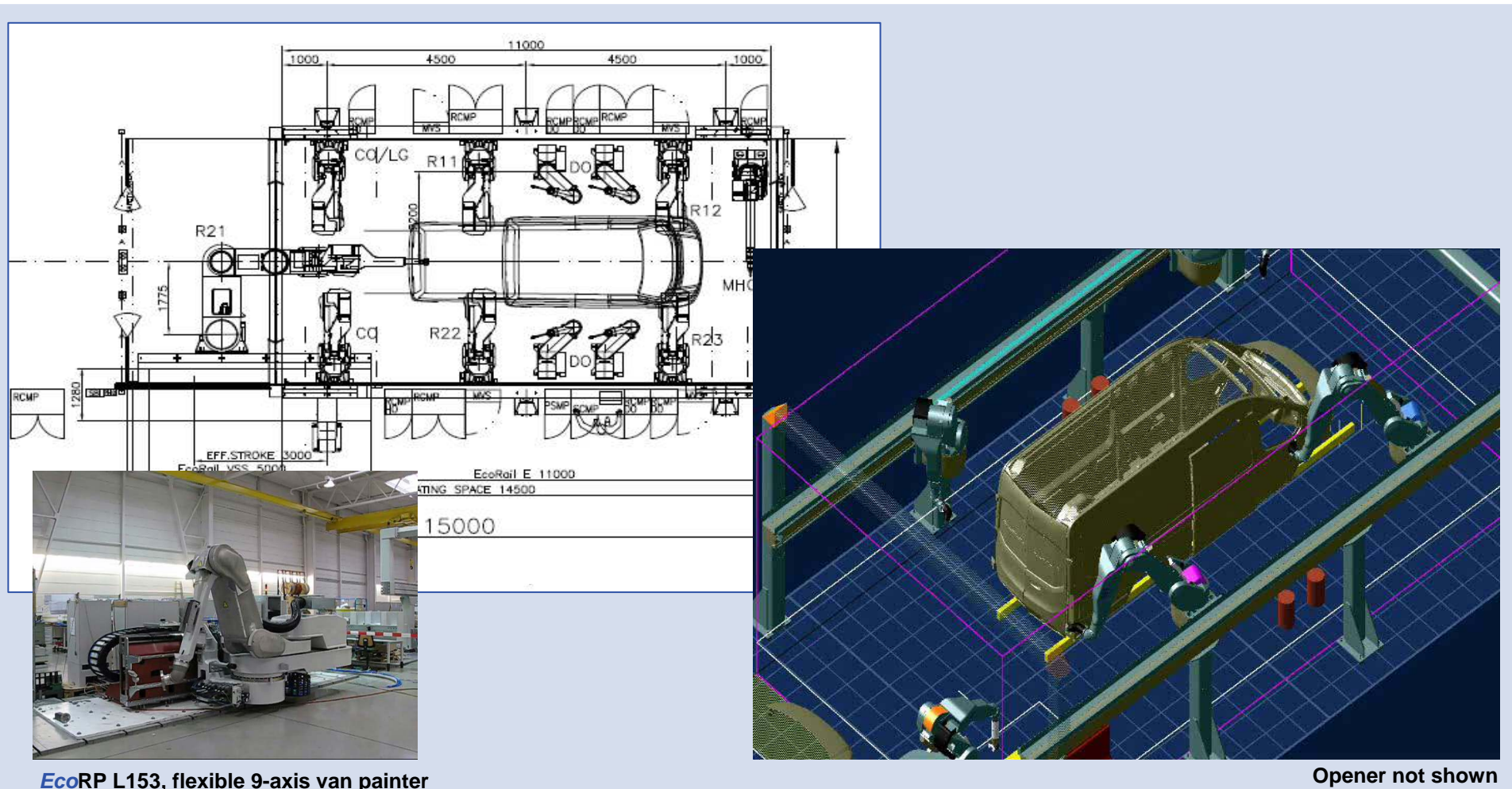
$$n_B = \frac{T_{tot}}{T_c}$$

- M<sub>i</sub>: Product Variety
- P<sub>i</sub>: Process Variety
- C: Plant Capacity
- T<sub>tot</sub>: Total Time [s]
- F<sub>o,i</sub>: Frequency of Occurrence [%]
- T<sub>p,i</sub>: Process Time [s]
- T<sub>c</sub>: Cycle Time [s]
- n<sub>B</sub>: No. of Boxes

	Line	Box Concept 1	Box Concept 2
<b>Energy: reduced booth ventilation</b>			
▪ Scrubber length	91m	58m	58m
➤ <b>Savings:</b>		<b>36%</b>	<b>36%</b>
<b>Investment: reduced amount of robots and booth length</b>			
▪ Number of robots:	64	42 ●	42 ●
▪ Scrubber length:	91m	58m ●	58m ●
▪ Ventilated booth length:	47m	140m ●	90m ●
▪ Conveyor length:	121m	118m ●	88m ●
▪ Cross conveyors:	1 cc	4 cc ●	2 cc ●
➤ <b>Savings:</b>		<b>31%</b>	<b>34%</b>

# JMC Nanchang – Modular Paint Box

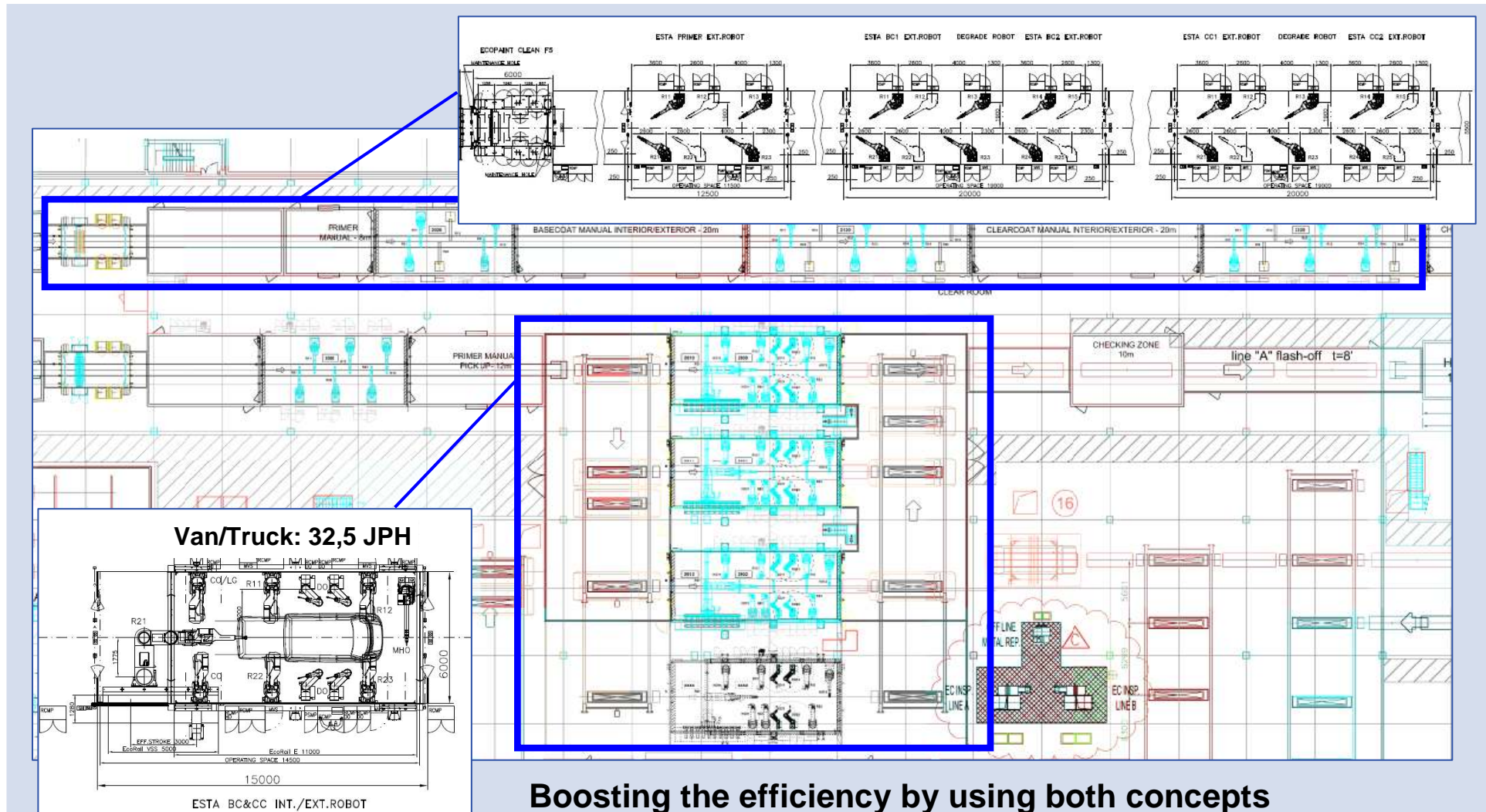
Interior and exterior application of BC and CC in the same box



EcoRP L153, flexible 9-axis van painter

Opener not shown

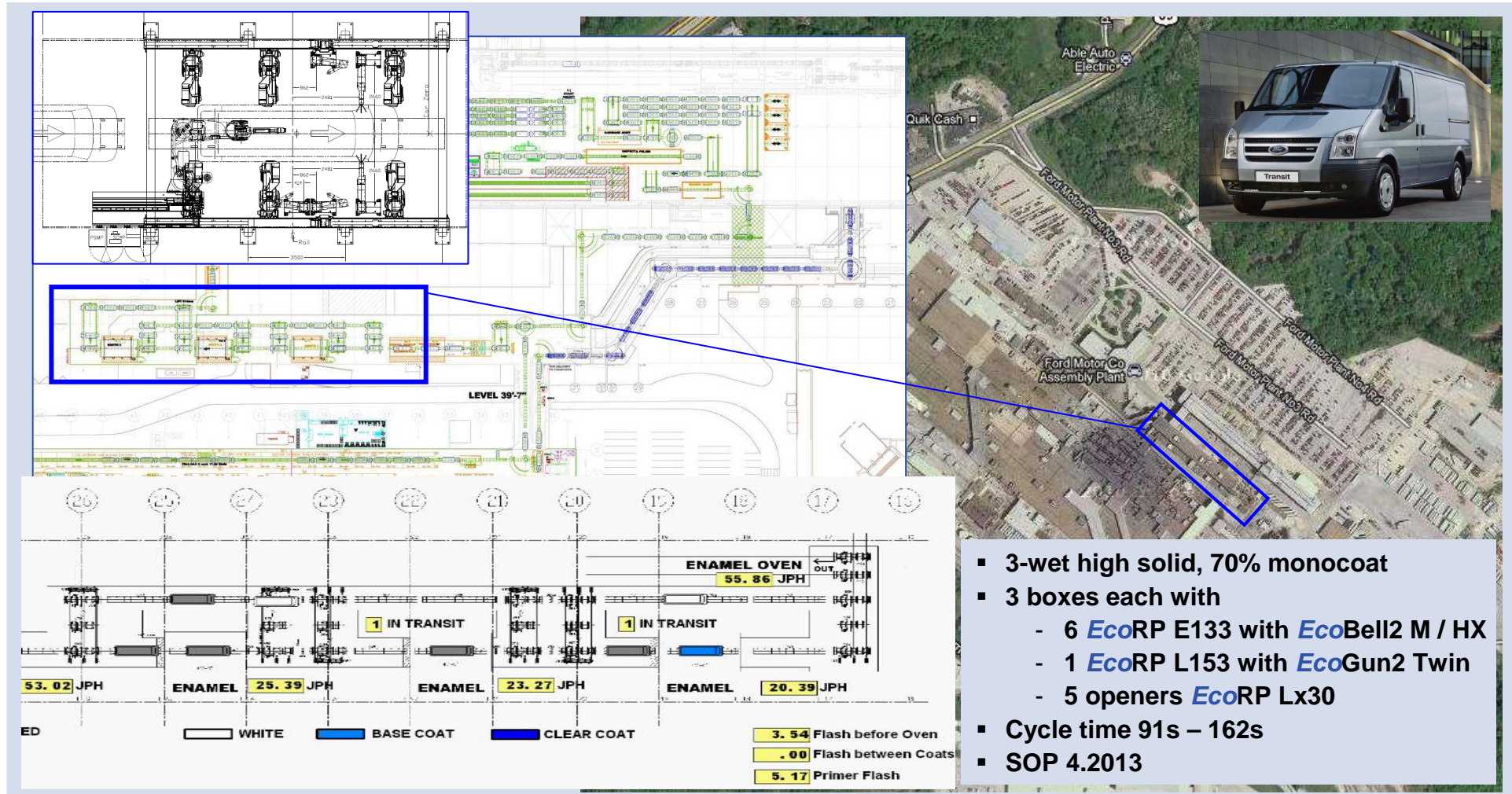
# JMC Nanchang – Overall Layout



**Boosting the efficiency by using both concepts**

# Ford Kansas City, Modular Box Concept

## New brownfield plant

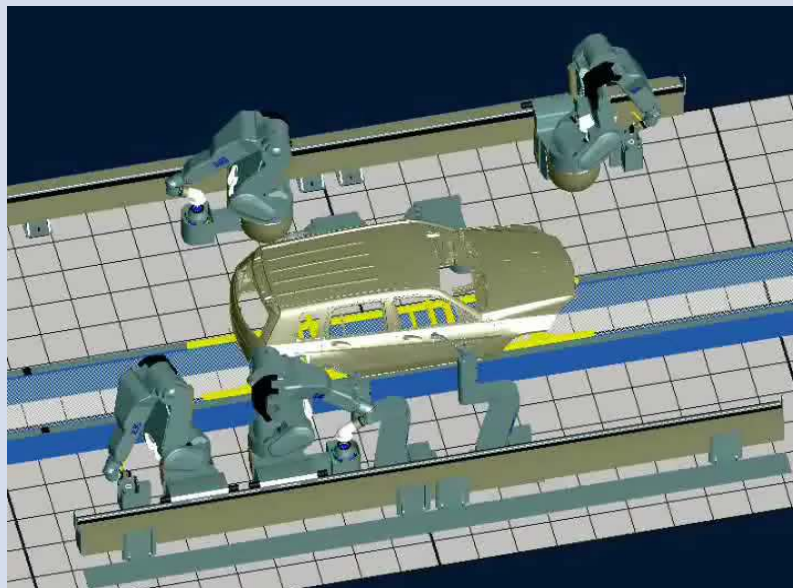
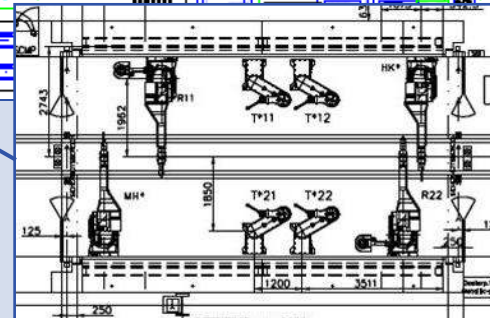
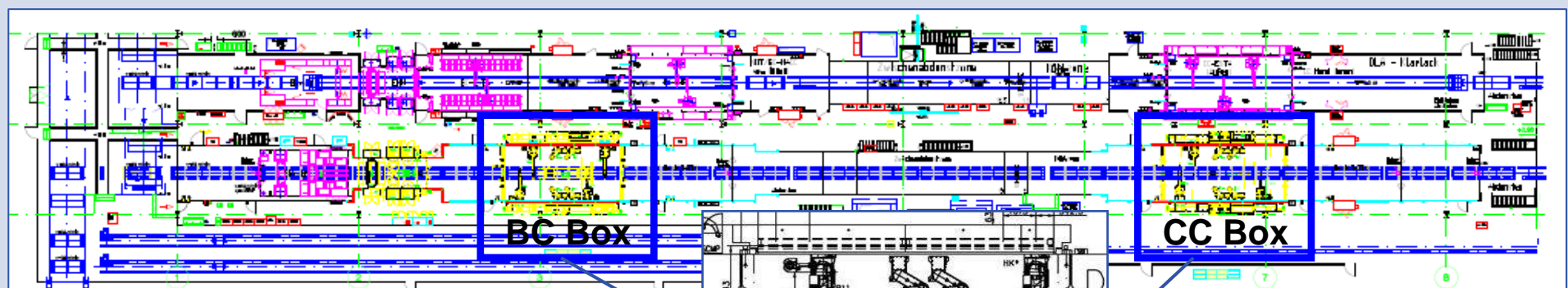


- 3-wet high solid, 70% monocoat
- 3 boxes each with
  - 6 EcoRP E133 with EcoBell2 M / HX
  - 1 EcoRP L153 with EcoGun2 Twin
  - 5 openers EcoRP Lx30
- Cycle time 91s – 162s
- SOP 4.2013

# Mercedes-Benz Bremen, Modular Box Concept



## Paint shop extension



- Waterborne basecoat, 2K solvent clear coat
- 2 boxes, 1 BC / 1 CC each with
  - 2 *EcoRP* L133 with *EcoBell3 C*
  - 6 openers *EcoRP* L13x
- Cycle time 5 to 9 min.
- SOP 1.2011



# FAW Changchun, Modular Box Concept

## Paint shop extension

**ESTA BC Int./Ext.**

**ESTA CC Int./Ext.**

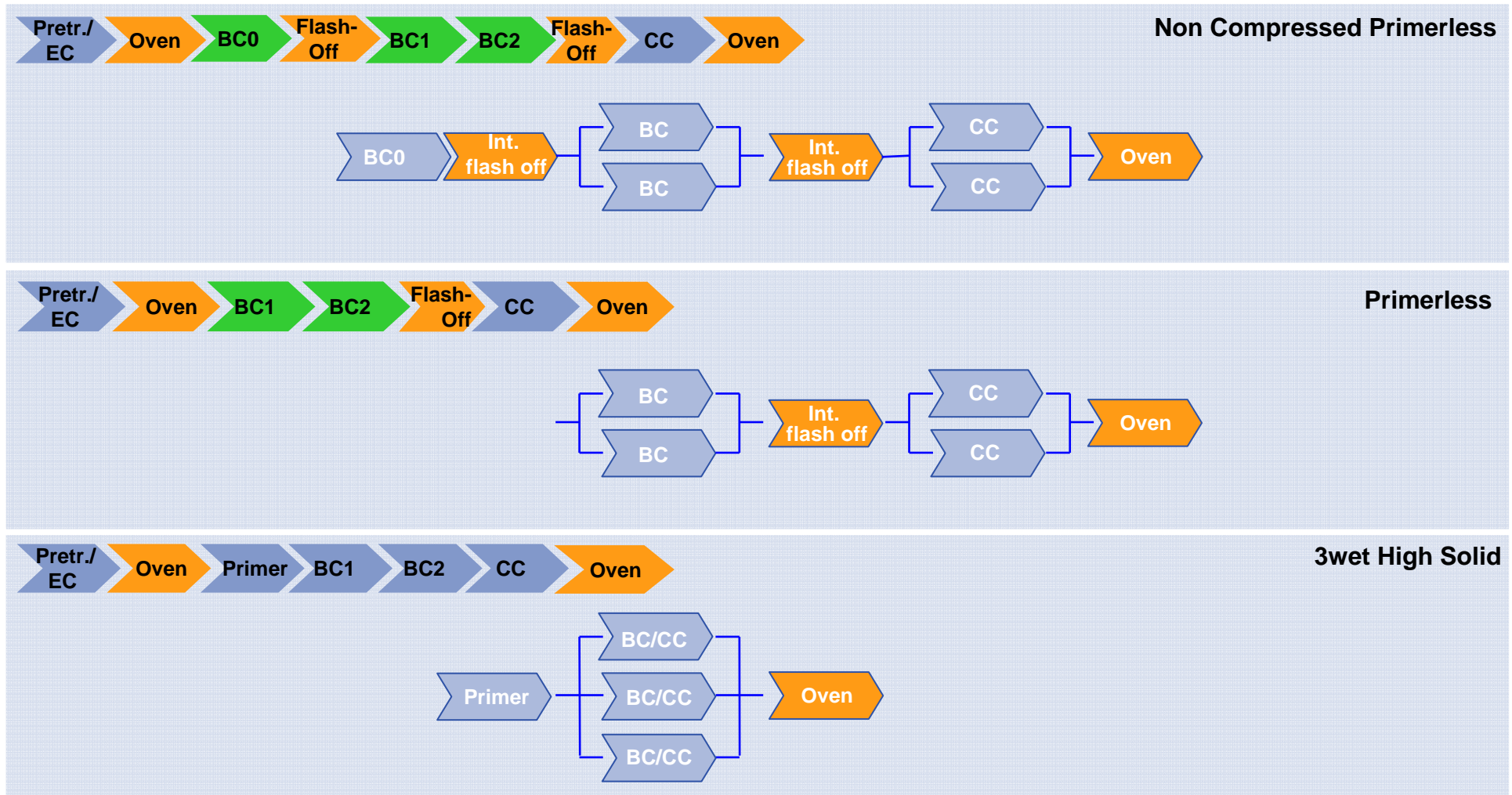
**Future expansion**

**Coating Production Line**

- solventborne paint
- 2 boxes, 1 BC / 1 CC each with
  - 3(2) *EcoRP L133* with *EcoBell3*
  - 6(5) openers *EcoRP L130* / *EcoRP L133*
- Cycle time 6 min.
- SOP 5.2012

# Compact Paint Processes: Evaluation

## Applicability for modular box concepts



# Key Enablers (1)

Flexible and simple application products for efficient box painting

**EcoBell3 C** (Compact electrodes)



**EcoBell3 C** for interior and exterior painting of waterborne material

**EcoBell2 HX** (High fleXibility)



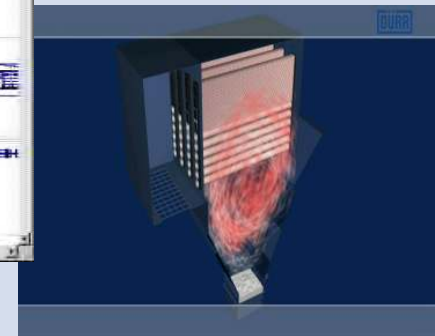
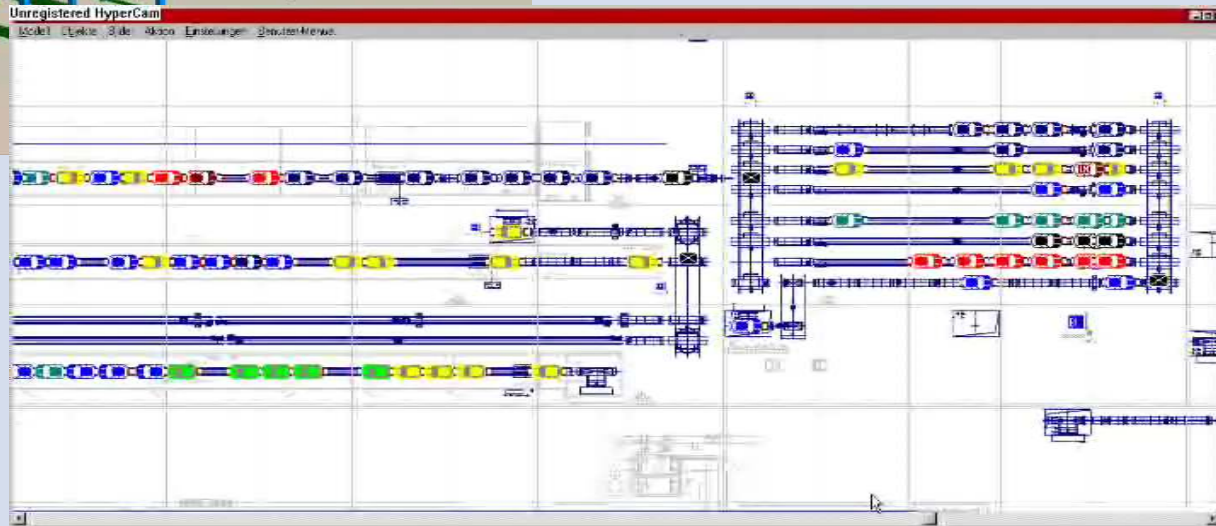
High spray pattern flexibility necessary for interior and exterior application

# Key Enablers (2)

## Know how and process technology for efficient box painting



Conveyor technology for flexible layout solutions  
and  
Simulation know how for more complex material flow



Significant energy reduction for booth ventilation

# Conclusion

- The box concept is a layout alternative to improve the efficiency in case of high production variety
- The box concept is a further step towards “Green Paintshop”