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UX Operations

Energy efficiency in automotive production

Ing. Ciprian Ceauranu, Continental Automotive Timisoara

Content

Creating Sustainable Solutions

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Presentation target:

Sharing experience, provide a short overview about the sustainability/energy improvement measures and results using digitization and Industry 4.0 elements applied in Continental Automotive Timisoara Factory.

Content:

1. Continental Automotive Timisoara Factory short overview
2. Energy Efficiency – Industry 4.0
3. Factory Energy System analyze
4. Waste reduction
5. Efficiency increase & green energy
6. Connect everything
7. Sustainability
8. Big data & metadata
9. Expert system & AI
10. Conclusion

1.Continental Automotive Timisoara Factory short overview

On The Map

Automotive

1 Sibiu
Engineering Center & Electronic Manufacturing

2 Timisoara, former SV
Engineering Center & Electronic Manufacturing

3 Iasi, former SV
Engineering Center

Tires

4 Timisoara Division – Passenger and Light Truck Tires, Replacement and OE

5 Bucuresti - Tire Distribution Center

ContiTech

6 Timisoara
Mobile Fluid Systems Manufacturing & Engineering Center and Power Transmission Group Manufacturing

7 Carei
Mobile Fluid Systems Manufacturing

8 Nadab
Mobile Fluid Systems Manufacturing

Elektrobit

9 Brasov
Engineering Center

10 Timisoara
Engineering Center

Continental Lightning

11 Iasi
Osram - Continental

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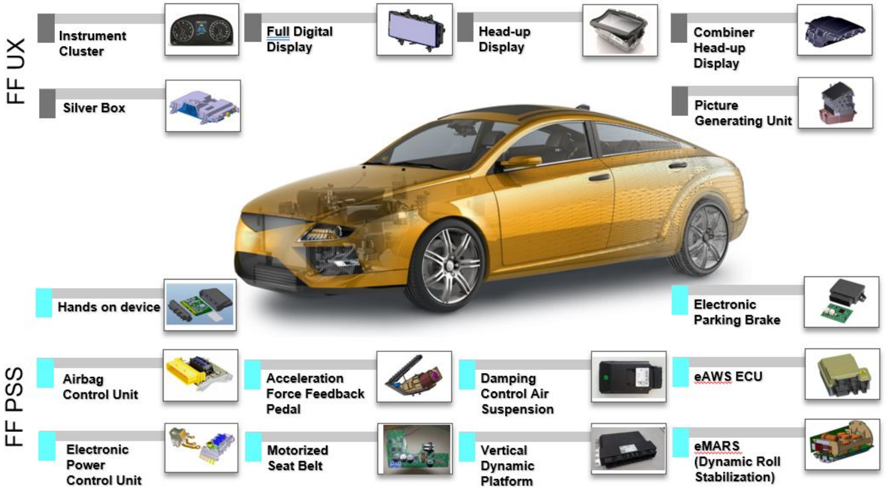
Ramp-up Highlights

- 2006, October – Opening ceremony of the plant
- 2007, January – Start serial deliveries for airbag control units
- 2008, May – Start serial deliveries for electronic parking brakes
- 2008, July – Start serial deliveries for clusters & displays
- 2012, August – 1st Plant extension
- 2017, January – 2nd Plant extension
- 2018, July – Lead Plant PSS worldwide
- 2019, January – Official opening sample production OSIS
- 2020, January – BU PSS Plant
- 2022, QII – 3rd Plant extension



Division and products

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2. Energy Efficiency – Industry 4.0

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Energy efficiency

1. TSR Factory Energy System analyze

- ❑ Energy map
- ❑ Potential energy saving

2 Waste reduction

- ❑ Electric
- ❑ Thermal
- ❑ Pneumatic

3. Efficiency increase & green energy

- ❑ CHP
- ❑ Solar panel

4. Connect everything

5. Sustainability

- ❑ Energy KPI
- ❑ Company commitment

6. Big data & metadata

- ❑ Process information
- ❑ Machine parameters

7. Expert system & AI

- ❑ Automatic learning
- ❑ Digital twin

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3. Factory - Energy System Evaluation

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Main actions for system level

1. Install online sensing devices:
- Sensors: temperature, humidity, pressure, water flow
- Counters for consumption monitoring: electrical, thermal, nitrogen, compress air
2. Correlate the production volume information with consumptions
3. Analyze the energy dependences with production and the potential improvement, define and follow KPI
4. Define details improvement plan

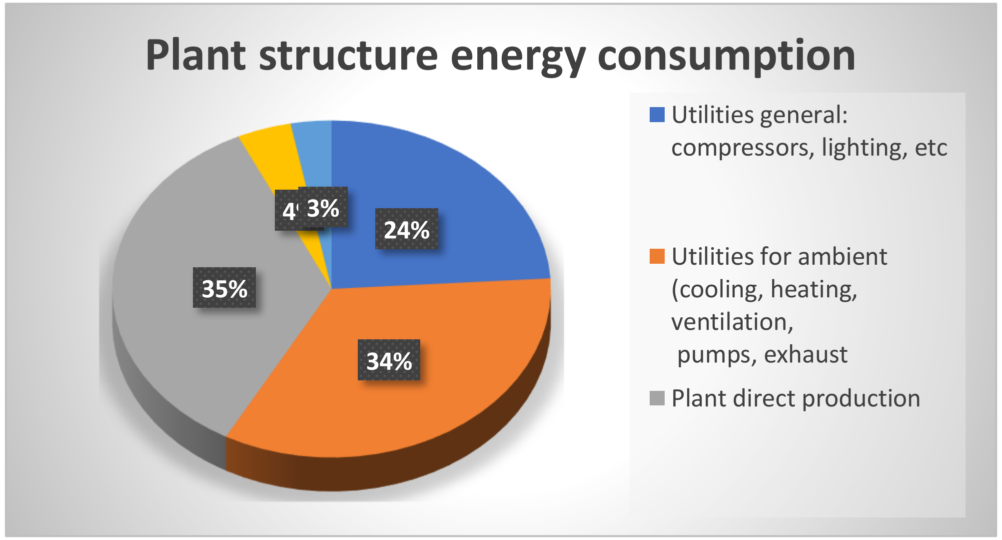

Fig. Example: Energy consumption, TSR factory

Actions based on analyze:

1. Work for energy reduction & cost (CHP, solar panel). Better energy balance
2. Utilities energy consumption reduction (electricity, compress air, lighting, nitrogen)
3. Reduce and optimize HVAC at the complete location
4. Reduce energy waster (FM and production)
5. Actions to increase energy efficiency

Results: More then expected energy consumption in infrastructure. Actions needed!

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3. Factory - Energy System Evaluation. Tools

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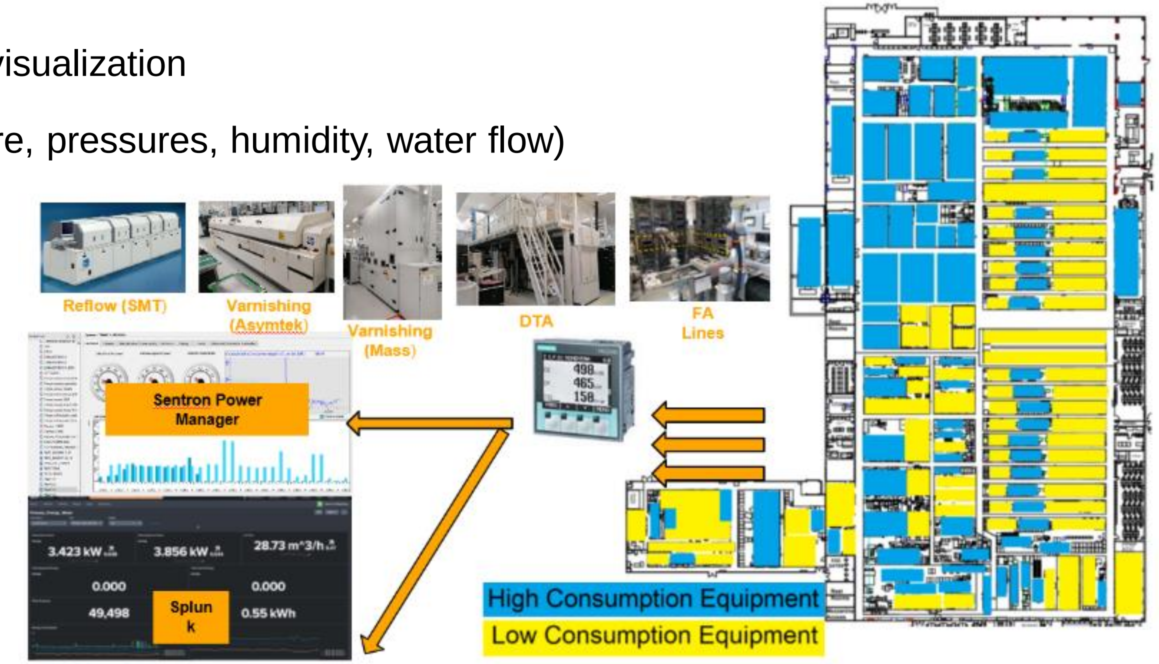
Highlights:

- The significant electricity consumers from SMT/ Preassembly / FA Area is covered with electricity meters
- Communication from electricity meters to Database is done via Ethernet(Sentron Power Manager, Node Red of other similar IE4.0/Cloud SW tool).
- Splunk Solution(DPLP) & Grafana SW implementation for data visualization
- Similar solution implemented for other meters (water, temperature, pressures, humidity, water flow)

Fig. Sensors & counters, Data to cloud



Results: Positive surprise regarding potential energy savings, more then expectation!

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4. Waste Reduction Examples

(no compress air/ nitrogen leakage)

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Main actions:

- Periodical check the air leakages using ultrasonic measurement device, mark and fix all the leakages
- Reduce the compress air pressure (7.5 ->7 bar, resulted ≈8% energy reduction). Avoid compress air pressure losses in pipes, implement additional big section pipe connection from technical area to production.
- Improve ventilation in compressor area, reduce working temperature conditions.

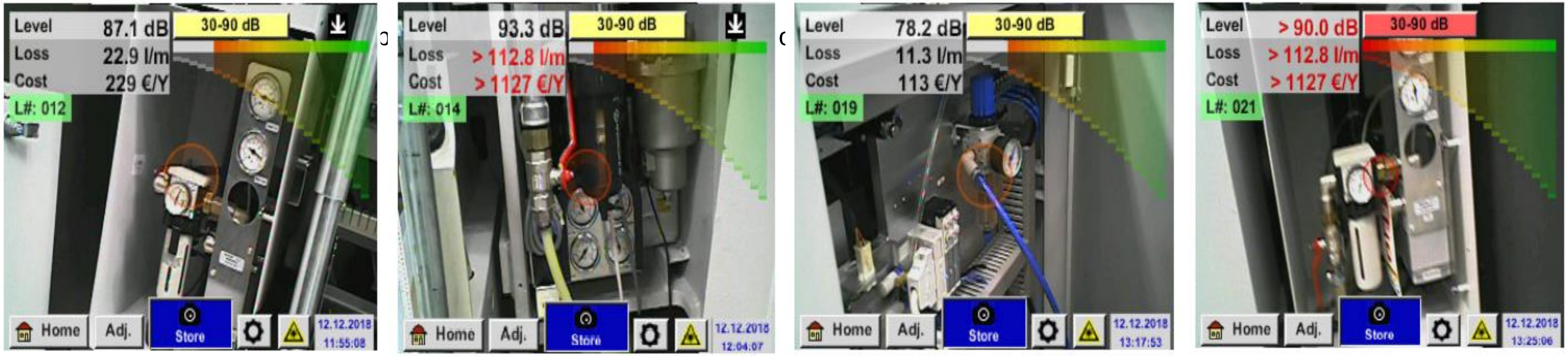

Fig. Compress air and nitrogen leakages identification

Results: Cost saving avoiding compress air leakage over 60Keuro/year

4. Waste Examples

(Extend air connection diameter, reduce compressors set pressure (7.5 bar ->7 bar)

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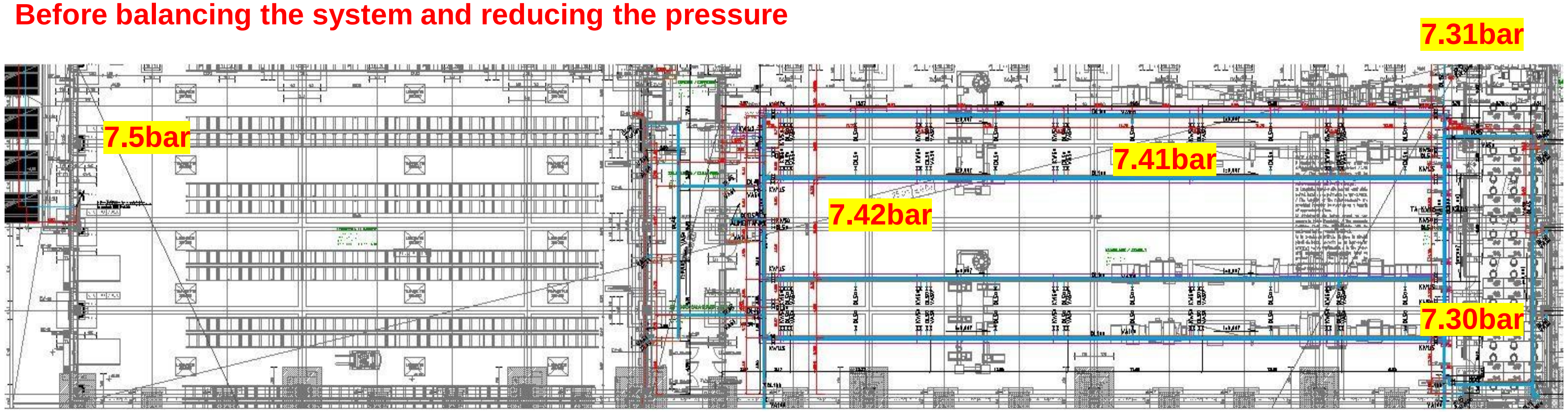
Production area view – compress air measurement (before and after improvement)

Before balancing the system and reducing the pressure



After balancing the system and reducing the pressure

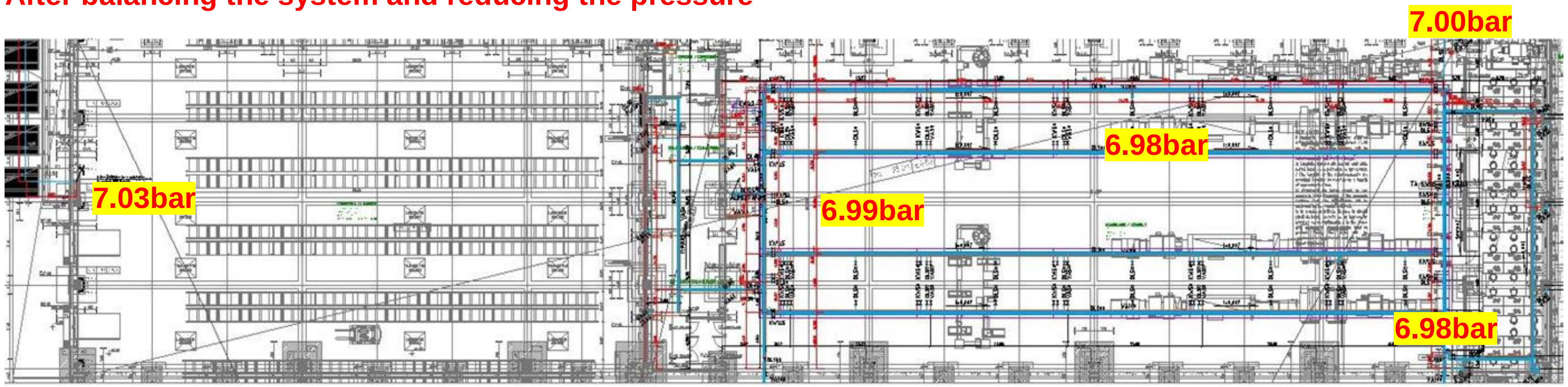


Fig. Compress air distribution – reduce the pressure loss on distribution, reduce the compressor pressure (energy consumption)

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4. Waste Examples

(Energy reduction based on air pressure reduction)

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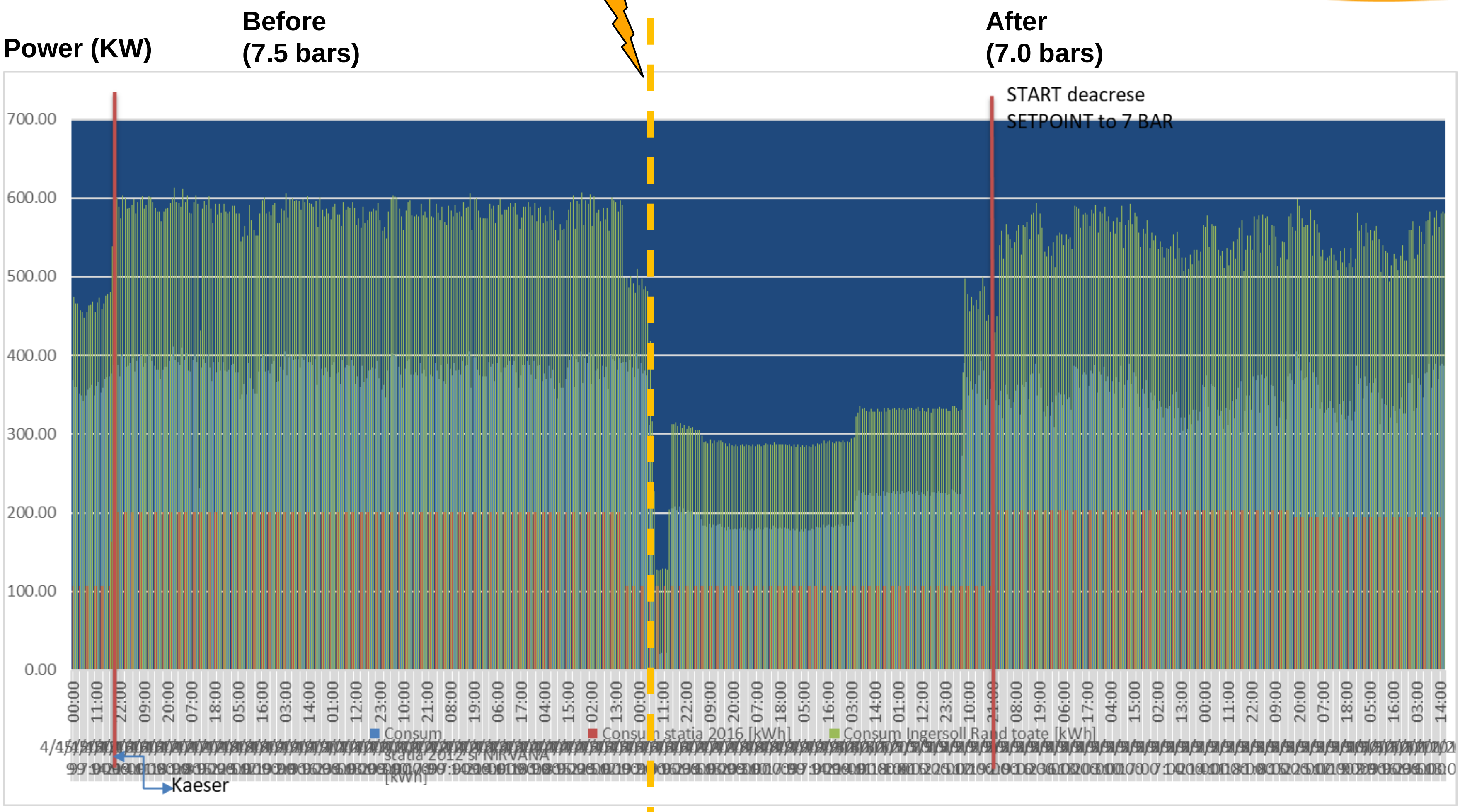

Fig. Compress air – compressors energy consumption reduction

Results: Reducing compress air pressure reduce proportionally the compressor electrical consumption! Direct saving 50Keuro/year

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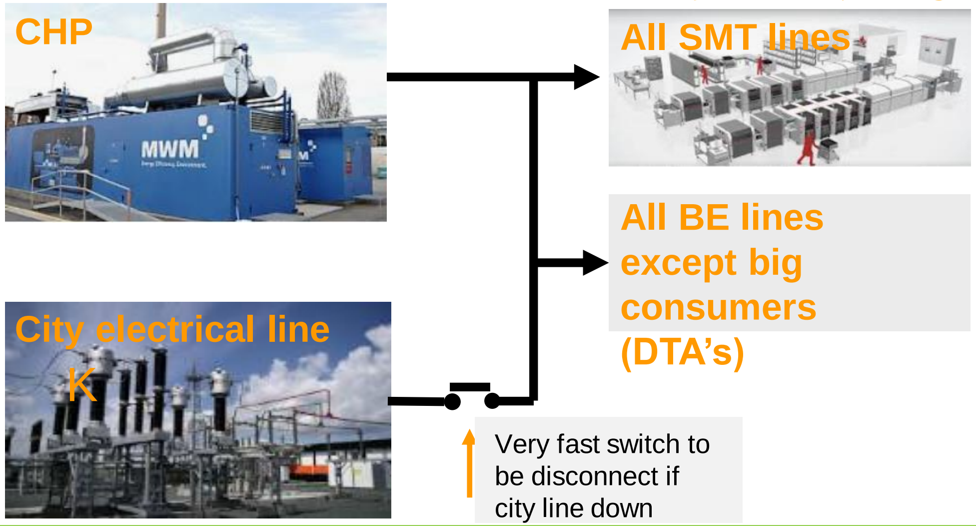
5. Efficiency increase & better solutions

(Trigeneration/ Combined Heat and Power Electrical Implementation)



CHP Needs:

1. Often voltage variation & interruption of the city electrical line create issues in production.
2. Because of high power consumption UPS solution is expensive regarding investment and fix cost.
3. Increase the location cooling capabilities

Implementation benefits:

1. CHP power all the production busbars and normally is connected in parallel with Enel network. The extra generator power is transfer to Conti electrical network using switch K;
2. If city network power down occur the switch is fast disconnected, and generator will power only the production area and some utilities. After grid power return automatic synchronization and K reconnected.
3. CHP function all the time at nominal power except the island mode period that is adapted to the demand. Over 90% of the gas energy is used (for energy, heat or cooling water)

Results: CHP have very good energy efficiency, over 90%. Typical classical electric power plant around 40%

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5. Efficiency increase & better solutions

(Trigeneration/ Combined Heat and Power Electrical Implementation – common rails)

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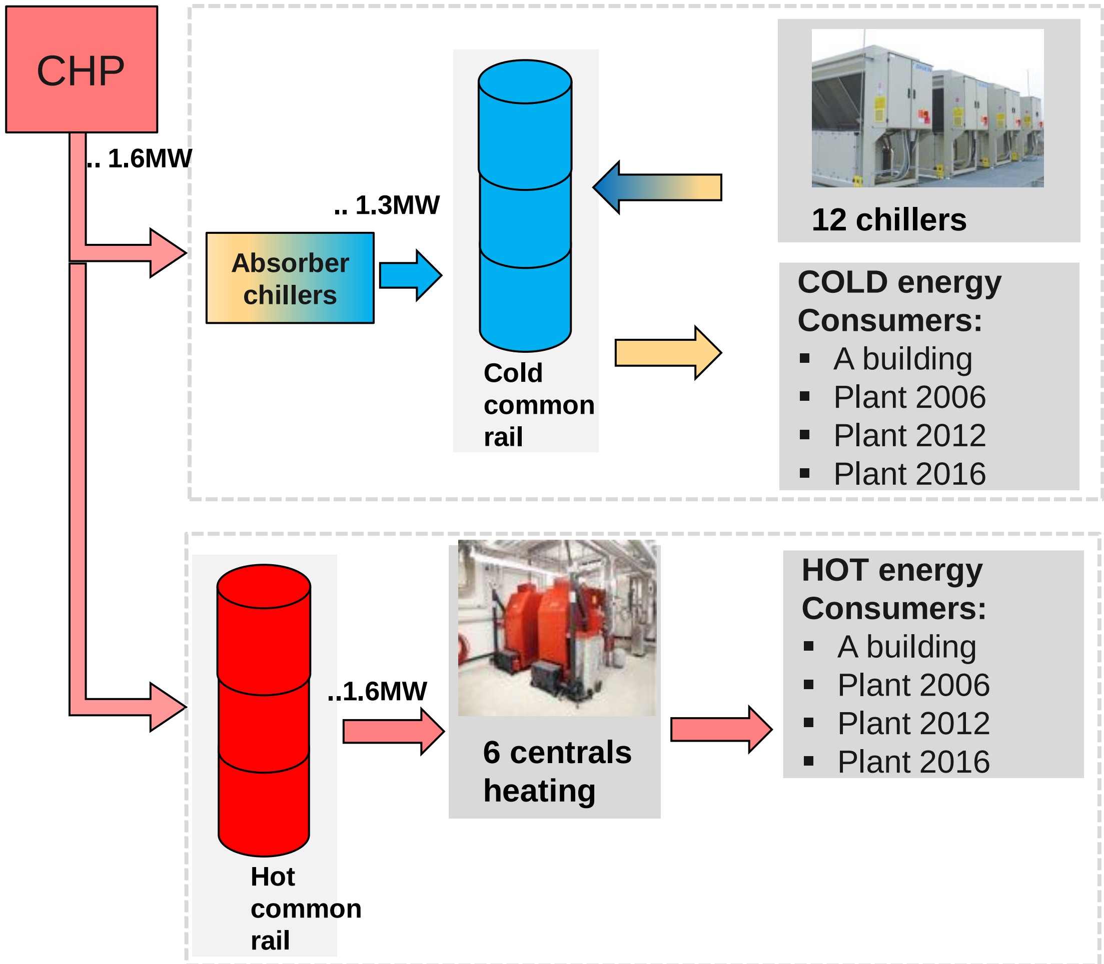

Cold water:

Production capacity:

CHP: 1.3MW
Chillers: 7.3MW
Free cooling (winter): 1,7MW

Consumption:

A building: 3,1 MW
Plant 2006 + B Building: 2,6MW
Plant 2012: 1MW
Plant 2016: 2,4MW

Hot Water:

Production capacity:

CHP:1,7 MW
With Burner :5,8MW

Consumption:

A building: 1,7 MW
Plant 2006-2012 + B Building: 2,8MW
Plant 2016: 1,3MW

Results: CHP & common rails implementation was a very good decision. Investment recovery under 2 years..

Benefits

1. **CHP generated energy (hot and cold) is used completely all time.**
2. **Common rails implementation increase the efficiency of cooling & heating system and assure backup solution**

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5. Efficiency increase & better solutions

(Intelligent power down mode for production machine)

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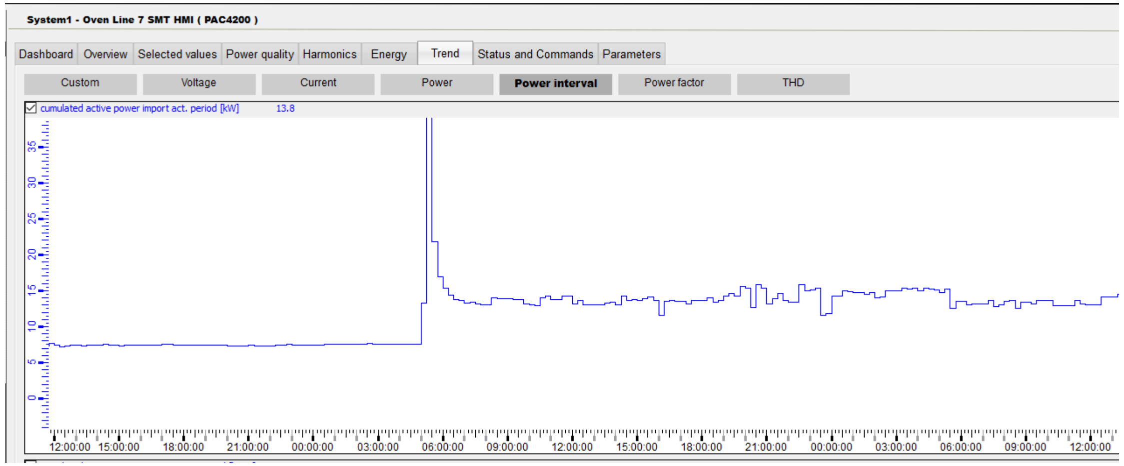
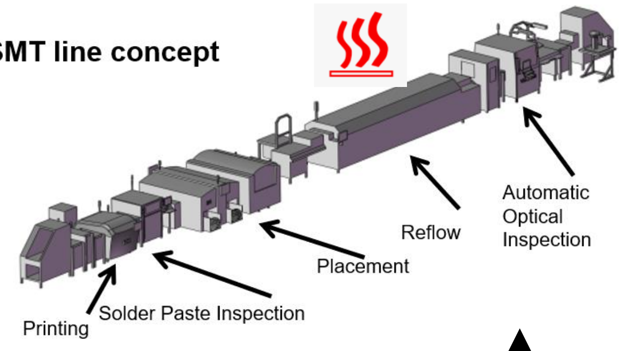
Highlights for PCB production

1. Around 75% of energy/PCB in SMT production is consume by reflow oven
2. Was created reflow programs with energy saving for suspended mode (reduce oven temperature, no nitrogen consumption, no ventilation)
3. Starting and stop of the standby is done automatically using the production traceability system



SMT line concept



SMT Consumption per Process	
Process	Consumption(%)
Transfer Conveyors	2.74%
Aspirator + Klima	3.79%
Laser	1.22%
Printing	2.08%
SPI	1.99%
Placement	5.42%
Reflow	80.40%
X-ray	2.71%
AOI	2.26%

Process	Average Electricity Consumption	Equipment Consumption per PCBA	Facility Consumption per PCBA	Cost/ PCBA
Reflow	14 kWh	0.06 kWh	0.04 kWh	0.009 EUR

Results: Automatic standby mode for SMT reflow reduce the waste energy with around 20%

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5. Efficiency increase & better solutions

(Intelligent power down mode for production machine)

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Highlights for Backend production

1. Main energy consumption in the backend area are because of ovens, varnishing and temperature functional test (DTA)
2. Recommend to avoid in the design phase the processes with big energy consumption
3. Where possible – shut down the equipment if no production is expected next yours;
4. Start automatic economic program for assemble line after a configured idle time(1 hour);

BE - Consumption pe Process	
Process	Consumption (%)
FT	1.50%
Depaneling	1.25%
ICT	1.25%
Screwing	0.75%
Press Fit	0.75%
DTA	65.91%
Varnishing	14.54%
Ersa Versaflow	14.04%

Back-End – DTA/ Varnish/ SWS(ERSA) Process

Process	Average Electricity Consumption	Equipment Consumption per PCBA	Facility Consumption per PCBA	Cost/ PCBA
1. DTA	70 kWh	0.25 kWh	0.15 kWh	0.036 EUR
2. ERSA	12 kWh	0.17 kWh	0.12 kWh	0.026 EUR
3. Varnishing	8 kWh	0.09 kWh	0.06 kWh	0.014 EUR

Results: Automatic standby mode for big assemble line consumers reduce the waste energy with around 15%

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5. Efficiency increase & better solutions

(Optimize air handling units)

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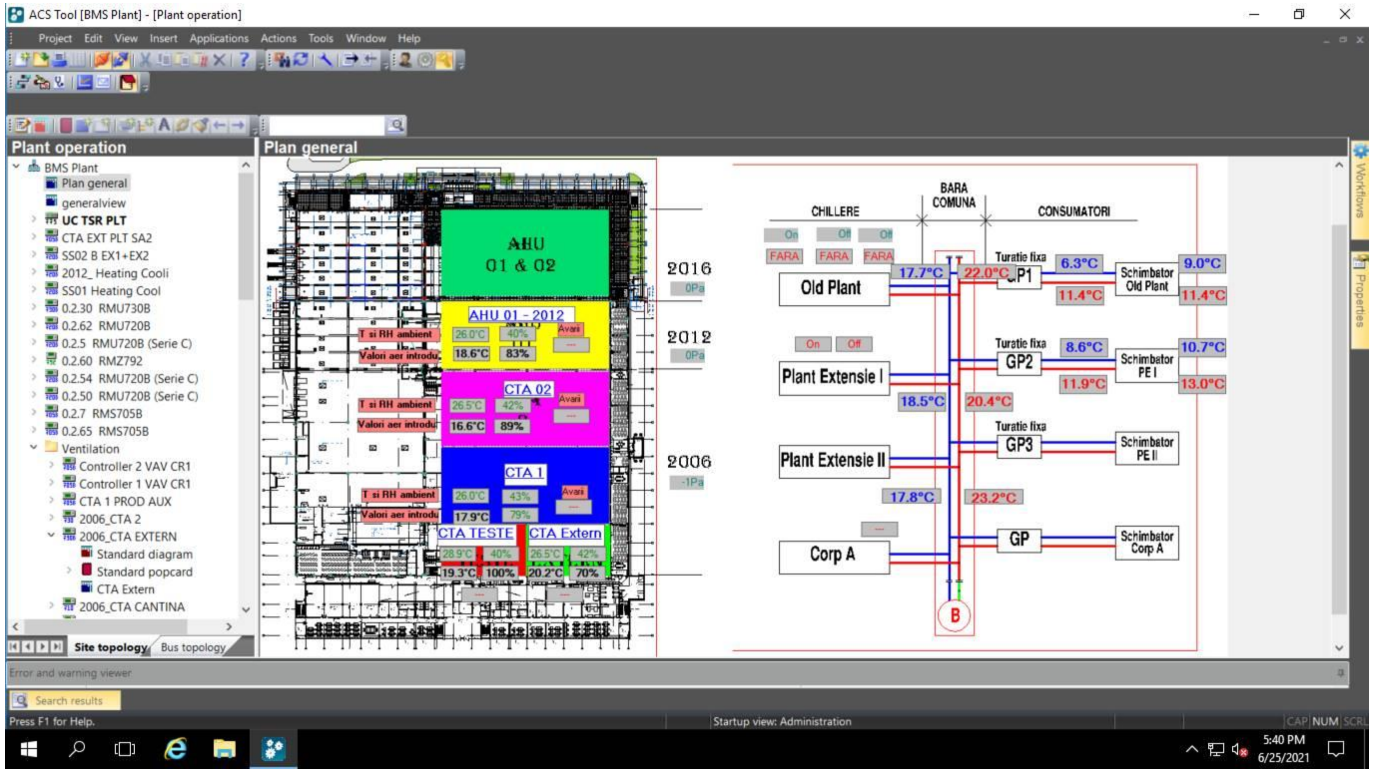
Improvements

- AHU use optimized set of parameters considering external conditions
- Replace the humidification units & increase the cooling capacity
- All set of parameters & alarm system remote accessible



Results: Clever adjustment of air handling unit assure the needed production environment at important lower energy/cost.

Fig. Air handling unit – remote interface

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5. Efficiency increase & better solutions

(Installation of photovoltaic solar panels)

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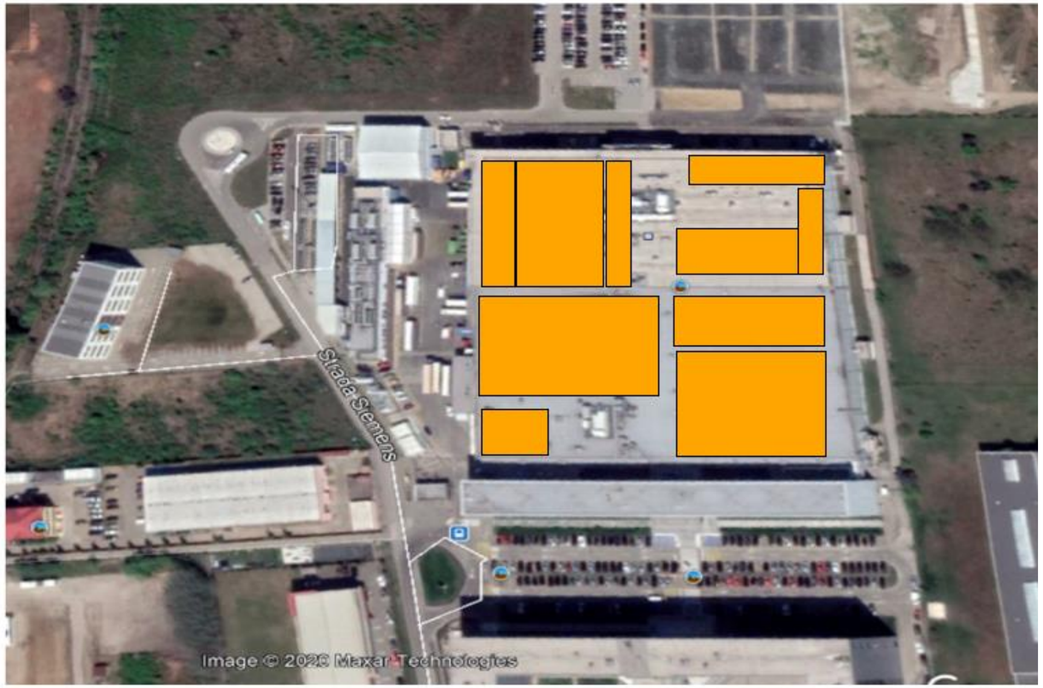
Highlights:

- Photovoltaic solar panels over the actual production & logistic & office and future over parking
- Advantage: assure ≈ 8-15% green energy for plant
- Solar energy will be delivered in internal low voltage network and consumed completely at location level



Results: Technology already proved, could be challenges to get some approvals (for example over the roof) ..

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6. Connect everything

(Remote information & monitoring)

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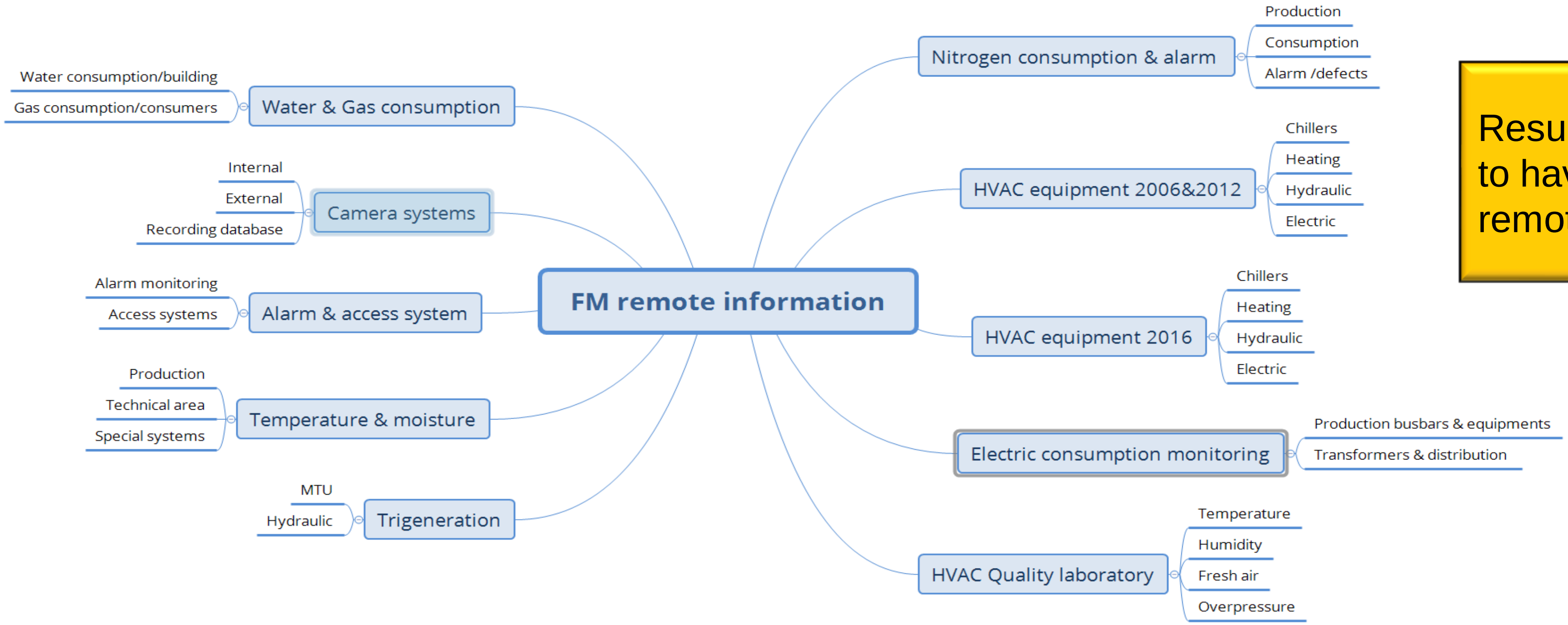
Status:

- All FM equipment were remote connected (monitor and control) on Continental network and accessible inside CONTI network or remotely via VPN
- Remote monitoring & intervention part of normal equipment support activities



Results: Very big advantage in usage to have all the equipment available remotely!

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7. Sustainability

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Highlights:

- Sustainability targets and KPI defined, part of corporate regulations
- Energy reduction & green level certificate part of actions and audits.

Our Key Ambitions

By 2050 at the latest, we and our value chain partners are striving for:

- **100%** **Carbon Neutrality** along our entire value chain
- **100%** **Emission-free mobility and industry**
- **100%** **Circular Economy**
- **100%** **Responsible Value Chain**

+ 8 Essentials

- Good working conditions
- Green and safe factories
- Innovations and digitalization
- Benchmark in quality
- Safe mobility
- Long-term value creation
- Sustainable management practices
- Corporate citizenship

Foster innovation and phase in new business

Transform or phase out non-viable business

Sustainable business practices

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8. Big Data

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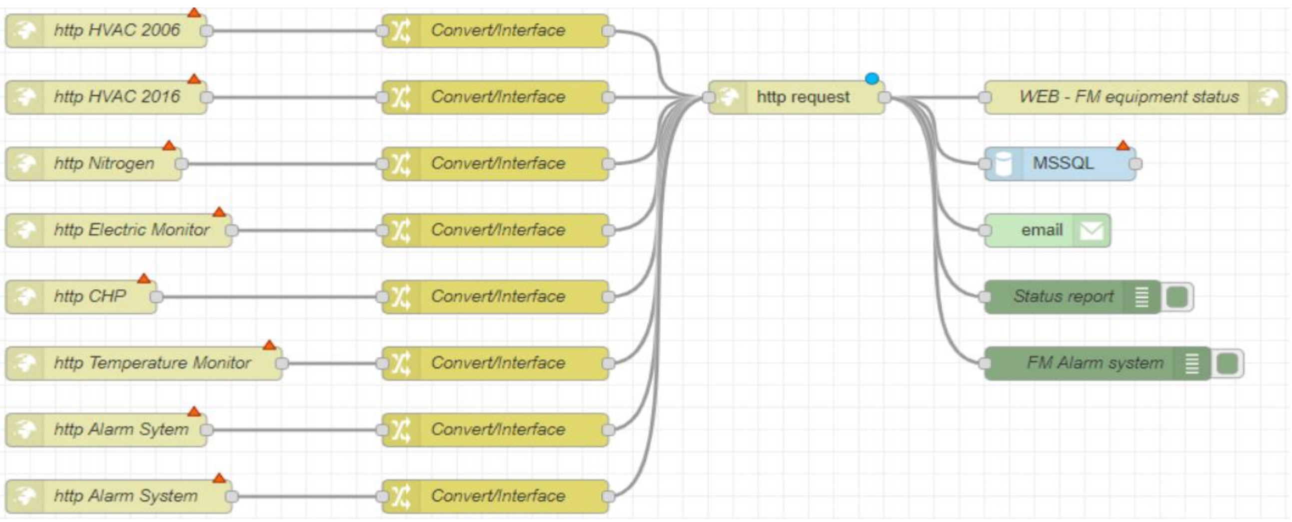
Main actions

- Migrate all the FM remote equipment connection to WEB, standardize the elements (over 100), over 1300 parameters collected
- Create interfaces to centralize the main information from different equipment, unitary approach
- Centralize monitoring/ alarm systems

Project: Researching Facility Management Industry 4.0/ IIoT Solutions Regarding Integrability/ Interoperability and Supervision. Grant with University Politehnica Timisoara



Results: New IT tool/cloud made the implementation faster and standardize.

Sensors → Interface → Database → Data usage

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8. Big Data – Example from utilities

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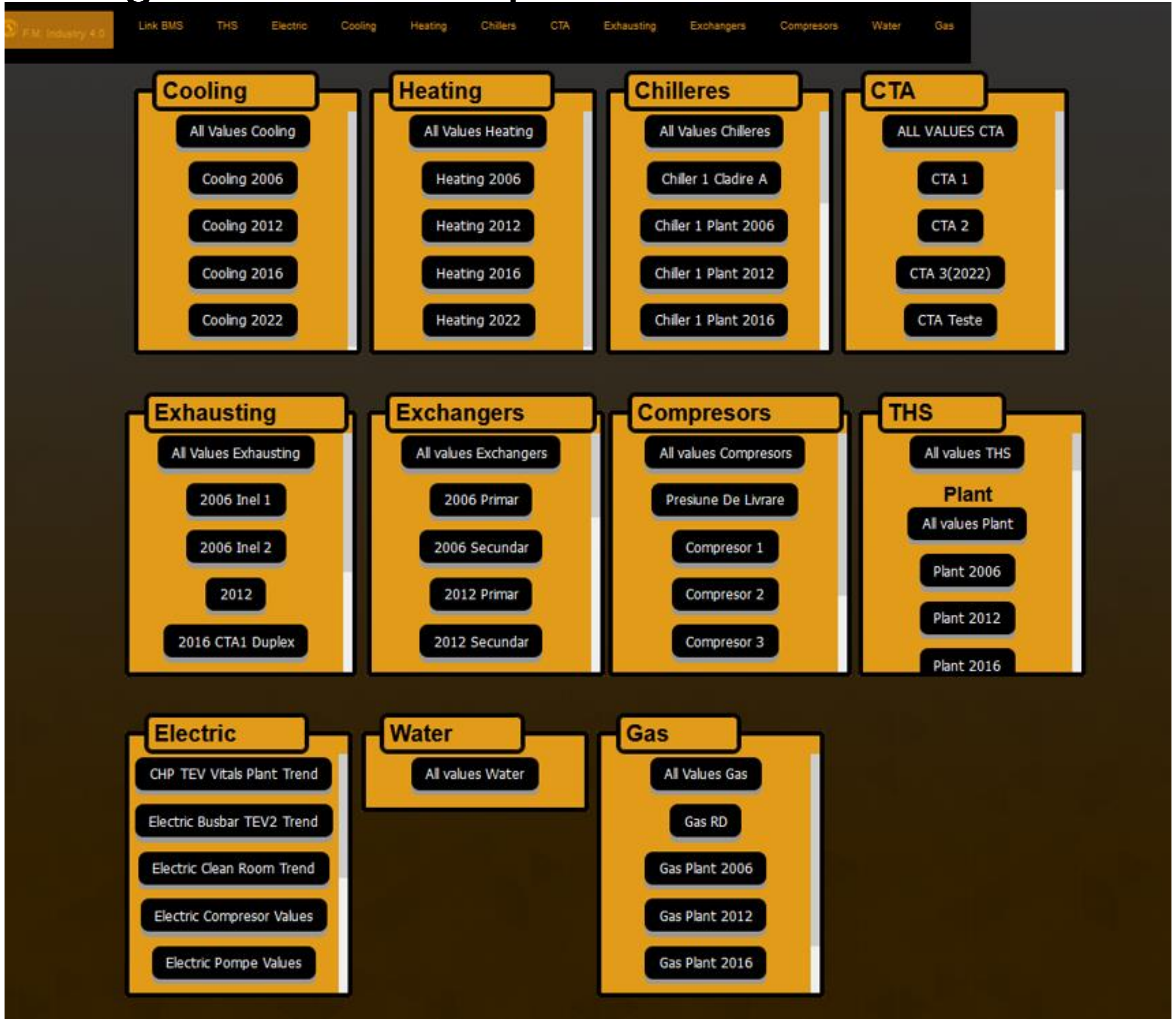

Highlight:

1. Multiple equipment generations connected to unitary interface
2. Clouds tools strongly simplified the development of data interface and user interfaces
3. User have all the details needed to be able focus on improvements

Fig. User interface for relevant factory utilities

Results: Easy to use interface, fast payback.

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8. Big Data – Example from utilities

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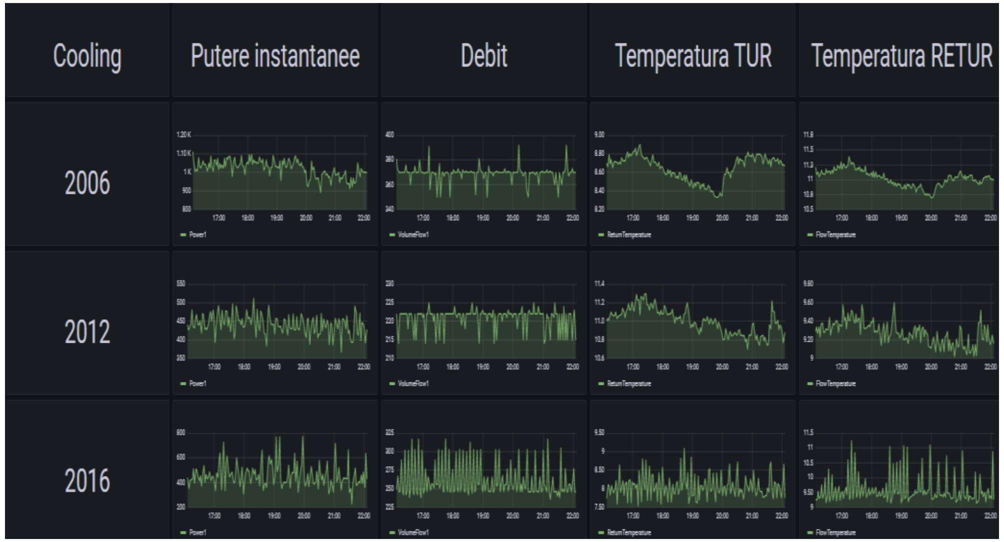
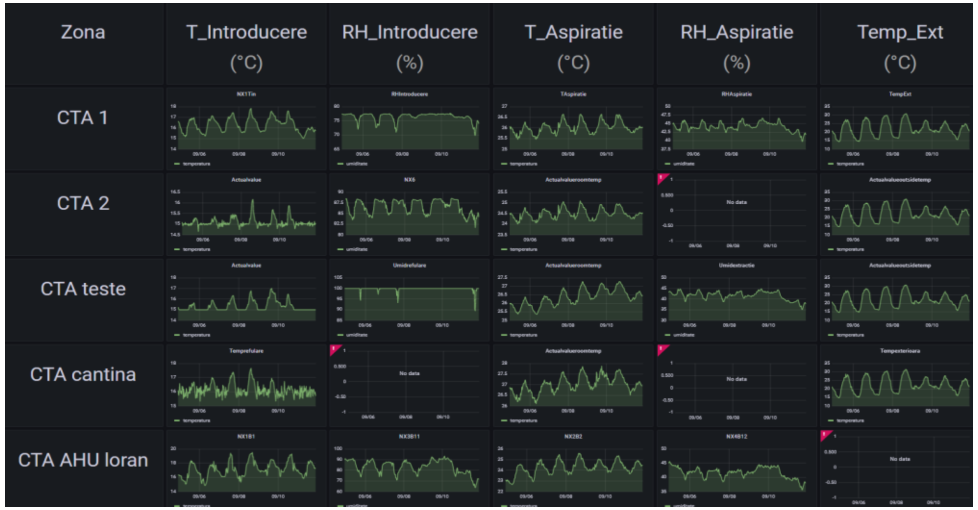
Plant	Temperature(°C	Humidity(%)	Anexa Tehnica	Temperature(°C	Humidity(%)
2006	23.6	45.2	Cazane Viessman 2006	34	26.9
2012	23.9	46.5	Cazane cladirile A&C-2016	27.5	39.9
2016	23.6	45.1	Statie de incendiu	30.4	34.6
JTECK	25.1	40.9	Schimbator racire 2006	31	33.2
STEP1	24.5	43.6	Statie pompe rece/cald 2012	30.3	35
M0.600	22	48.1	Pompe rece/cald 2016	29.5	36.5
TGD 2006	25	42.4	Statie compresoare Kaeser	42.7	17.5
TGD Trafo 5	0	33.9	TEV 1	36.2	25.3





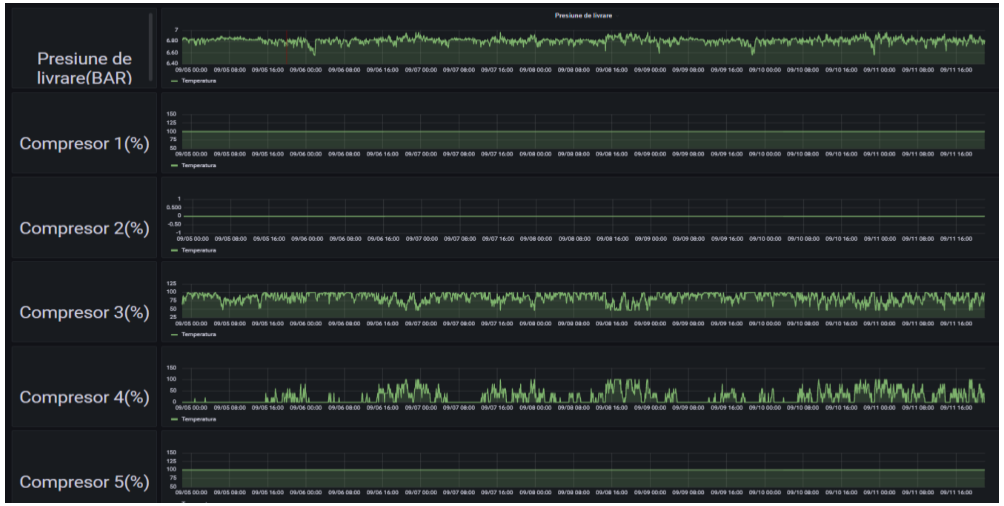


Fig. User interfaces for temperature, cooling common rail, air handling units and compressors

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9. Expert System

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Having all the data available, history data and the digital twin of the equipment next logic step is to use expert system to assure the best and the most economical functions.

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10.Conclusions

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1. Reduce the **waste energy** and actions to improve the **energy efficiency** provided very good results, more than expectation
2. **Industry 4.0 SW/tools** provided additional capabilities and implementation power for energy reduction and cleaver automatization
3. **Connectivity development** coming from IE 4.0 and new SW solution (example Node –Red) create the possibility to collect the data from different generation of equipment, to store it in Big Data and to use the data based on flexible new SW generation tools.

Save cost, increase efficiency and be environment friendly

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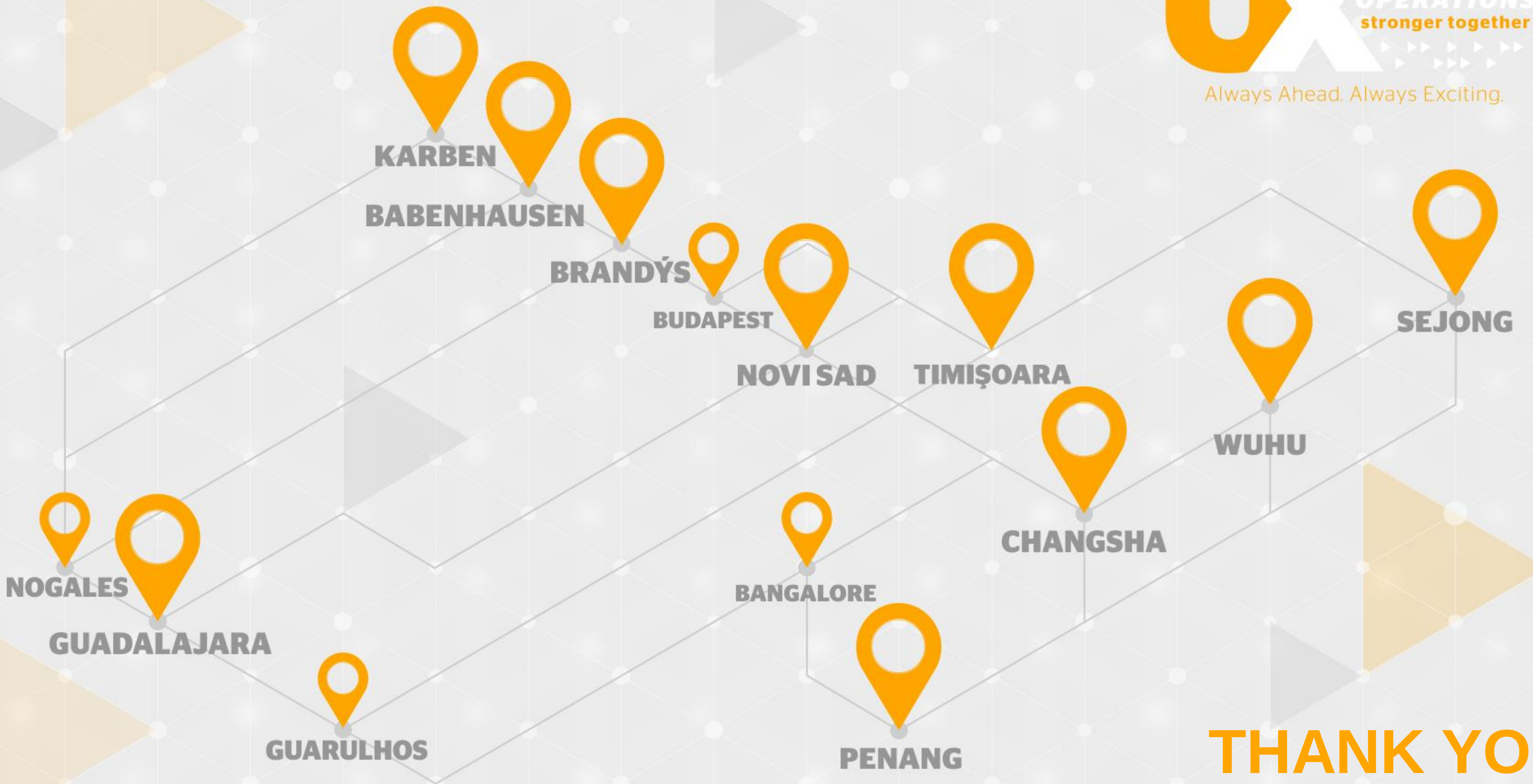

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