



Budapest University of Technology and Economics

Federation of European Heating, Ventilation and
Air-conditioning Associations

European commissioning practices today

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IEA Annex 40, IEA Annex 47

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Presentation Outline

- Needs to commissioning
- Commissioning process
- Commissioning in the design phase
- Commissioning in the operational phase
- iSERV EU project

FACT: Buildings are not operating well



Lack on information on how to
operate buildings

Have equipment problems unknown
to the operator

Are operated using conventional
sequence that are far from optimal



The result: Poor comfort

Energy waste of 10 to 50%



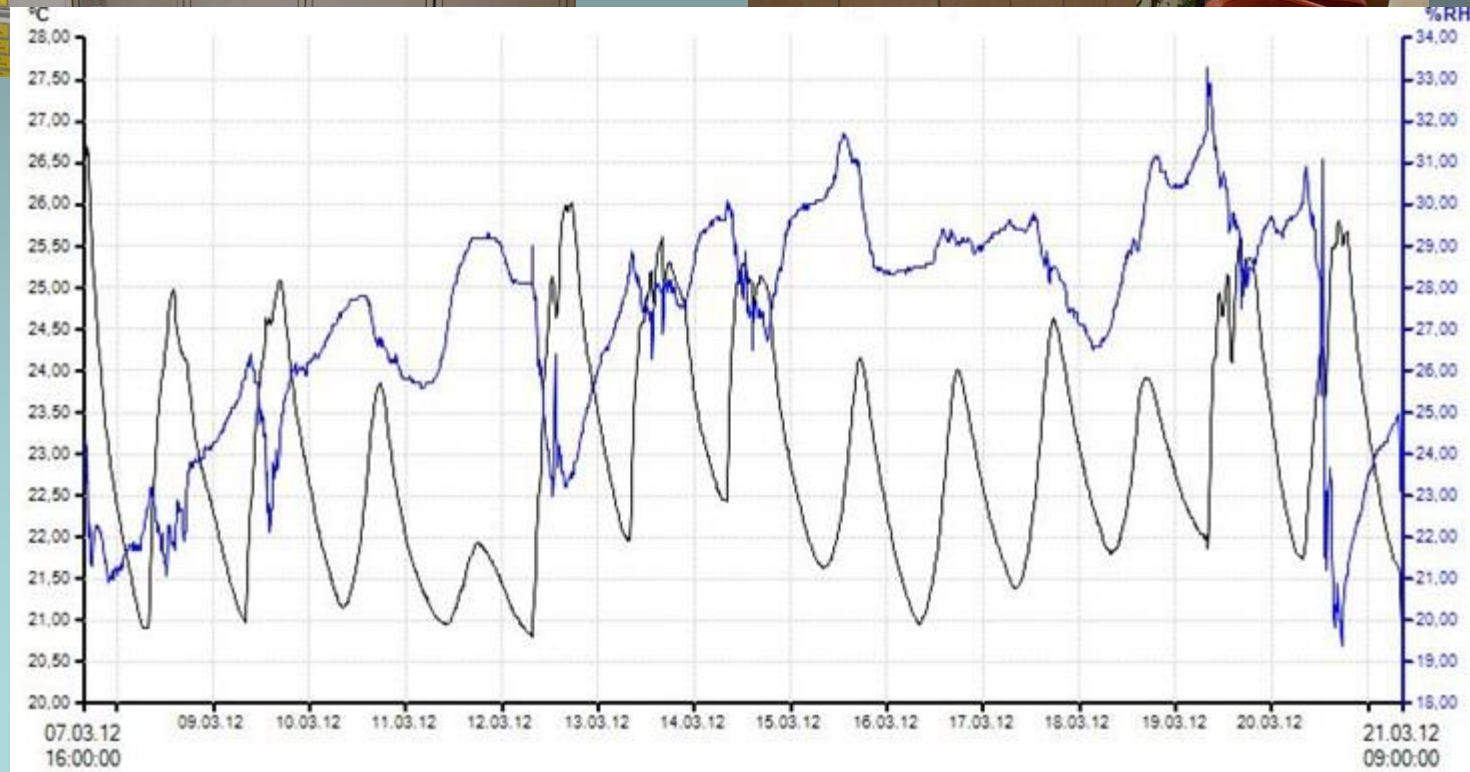
Needs to commissioning

Commissioning process

Commissioning in the design phase

Commissioning in the operation phase

iSERV project



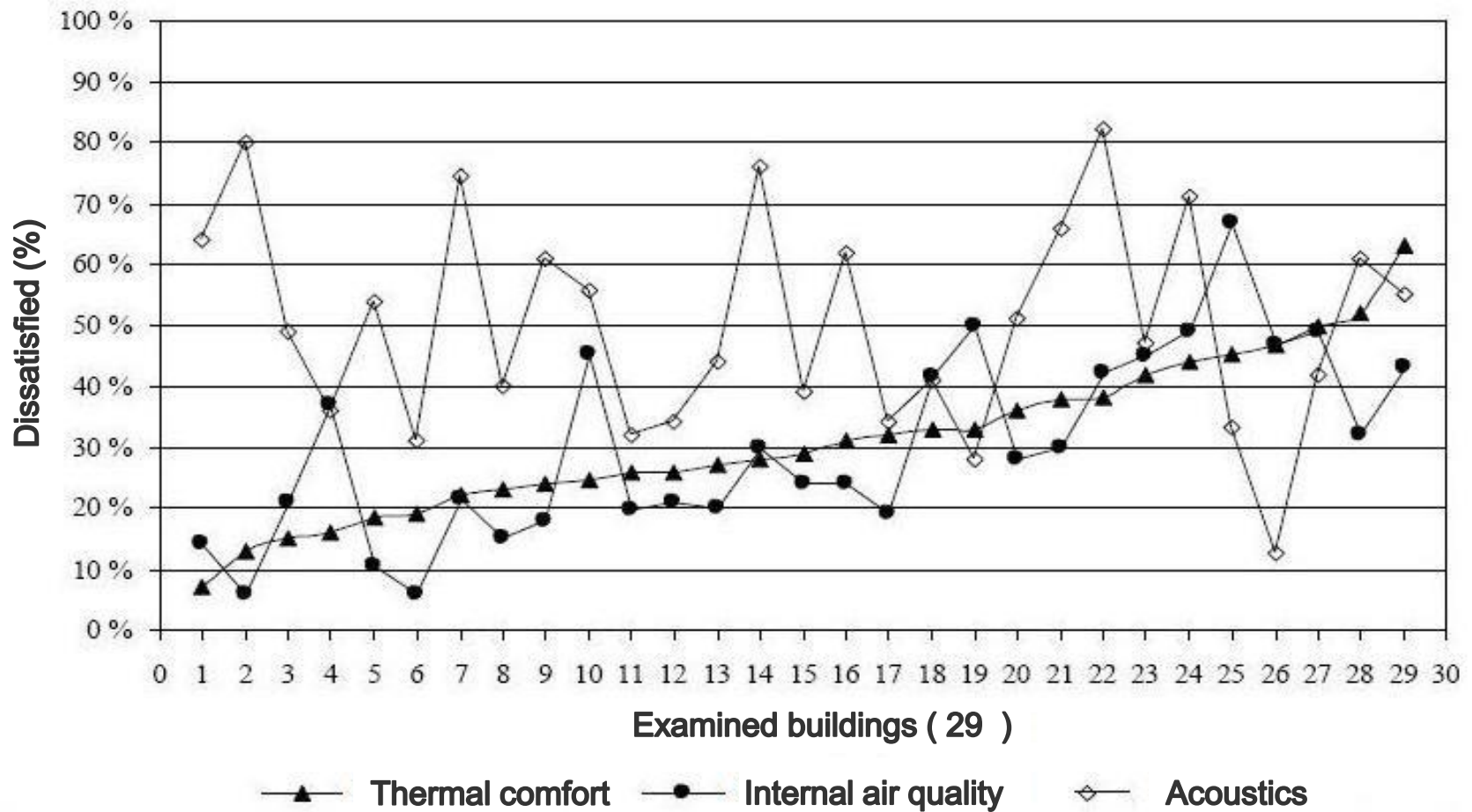
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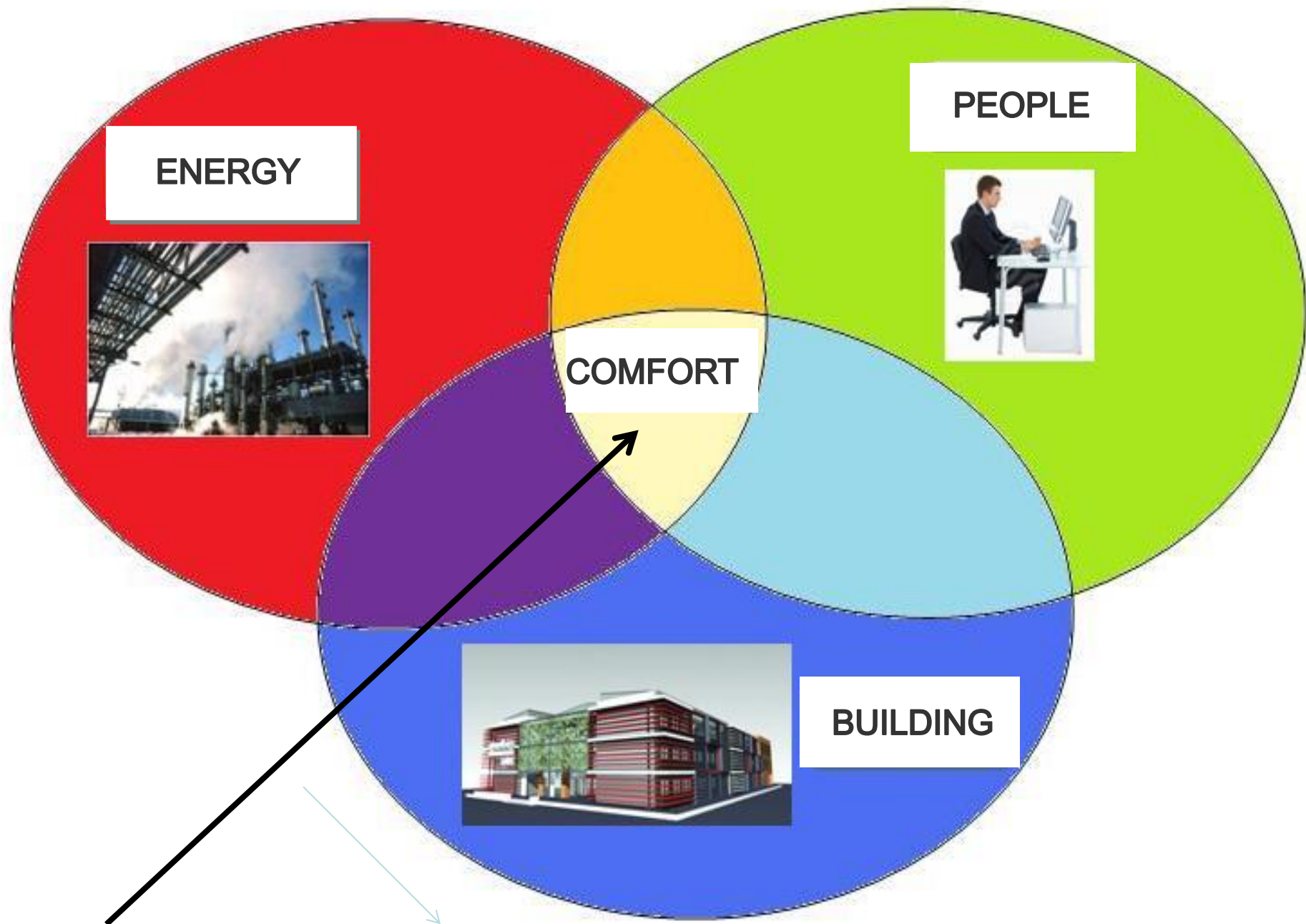
Commissioning in the design phase

Commissioning in the operation phase

iSERV project



(Olli Seppanen)



WE NEED THE COMMISSIONING !

Architectural Concept

Structural Concept

Integrated Building Concepts

Energy and Environmental Concept

ACREX 2014
Curtain Raiser



IDES-EDU
MASTER AND POST GRADUATE EDUCATION
AND TRAINING IN MULTIDISCIPLINARY TEAMS



INTELLIGENT ENERGY
EUROPE



EU Directives

- Energy Performance of Building Directive
EPBD 2002/91/EC
- Ecodesign of Energy Using Products Directive
2009/125/EC
- Energy Labelling Directive 2010/30/EU
- EPBD „recast” 2010/31/EU
- Energy Efficiency Directive EED 2012/27/EC

Better indoor climate with less energy

EN 15251

Temperature

Criteria for indoor environment

BUILDING	Category	Heating range, °C	Cooling range, °C
OFFICE	I	21 – 23	23,5 – 25,5
	II	20 – 24	23 – 26
	III	19 – 25	22 – 27
SHOPPING CENTER	I	17,5 – 20,5	22 – 24
	II	16 – 22	21 – 25
	III	15 – 23	20 – 26

Better indoor climate with less energy

EN 15251

Category	PPD	Air volume/person l/s/person
I	15	10
II	20	7
III	30	4
IV	>30	<4

Category	Allowed CO ₂ Concentration [ppm]
I	350
II	500
III	800
IV	>800

Category	Very Low Polluted Building l/s/m ²	Low Polluted Building l/s/m ²	Polluted Building l/s/m ²
I	0,5	1,0	2,0
II	0,4	0,7	1,4
III	0,3	0,4	0,8

Context: Potential Energy Saving

Potential for savings
through:

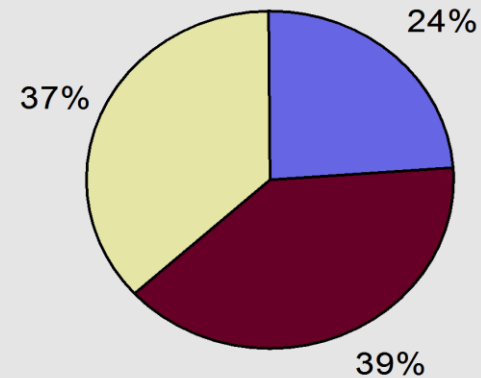
Load reduction (24%)

Improved efficiency (39%)

Better operation (37%)

Source: HarmonAC project results. <http://www.harmonac.info/>

Cooling Savings potential



■ Fabric and equipment ■ Plant ■ O+M

The energy use of the buildings in EU is 9500 PJ, which is 40 - 42 % of the total energy consumption.

Needs to
commissioning

**Commissioning
process**

Commissioning in
the design phase

Commissioning in
the operation phase

iSERV project

Commissioning (Glossary, Annex 40)

Clarifying Owner's Project Requirements (OPR) from viewpoints of environment, energy and facility usage, and auditing and verifying different judgments, actions and documentations in the Commissioning Process (CxP) in order to realize a performance of building system requested in the OPR through the life of the building



5 phases of commissioning

1. Pre-Design Phase

- o **Program Step** : occupancy requirements, functional use, quality of construction, energy management goals and requirements, indoor environment
- o **Planing Step**

2. Design Phase: specification for the HVAC system, simulation. commissioning plan



3. Elaboration Phase: software, equipment, fill out the records

4. Construction Phase

o **Construction Step**

- HVAC equipment is checked
- balancing water and air system
- achievement of design indoor environment
- performance of building management controls and energy consumption
- report

o **Acceptance Step**

- verify the accuracy of the balancing report
- verify the HVAC system complies, control system

5. Construction & Operation Phase

o **Post-Acceptance Step**

- periodic check-up

o **Ordinary Operation Step**

- optimisation and modification of the HVAC system
- periodic updates of as-built drawings



Costs and benefits of commissioning

- cost is between 0,3 % and 0,7 % of the total development cost
- energy cost saving between 5 % and 15 %
- increased staff productivity
- lower maintenance costs
- environmental protection



Needs to
commissioning

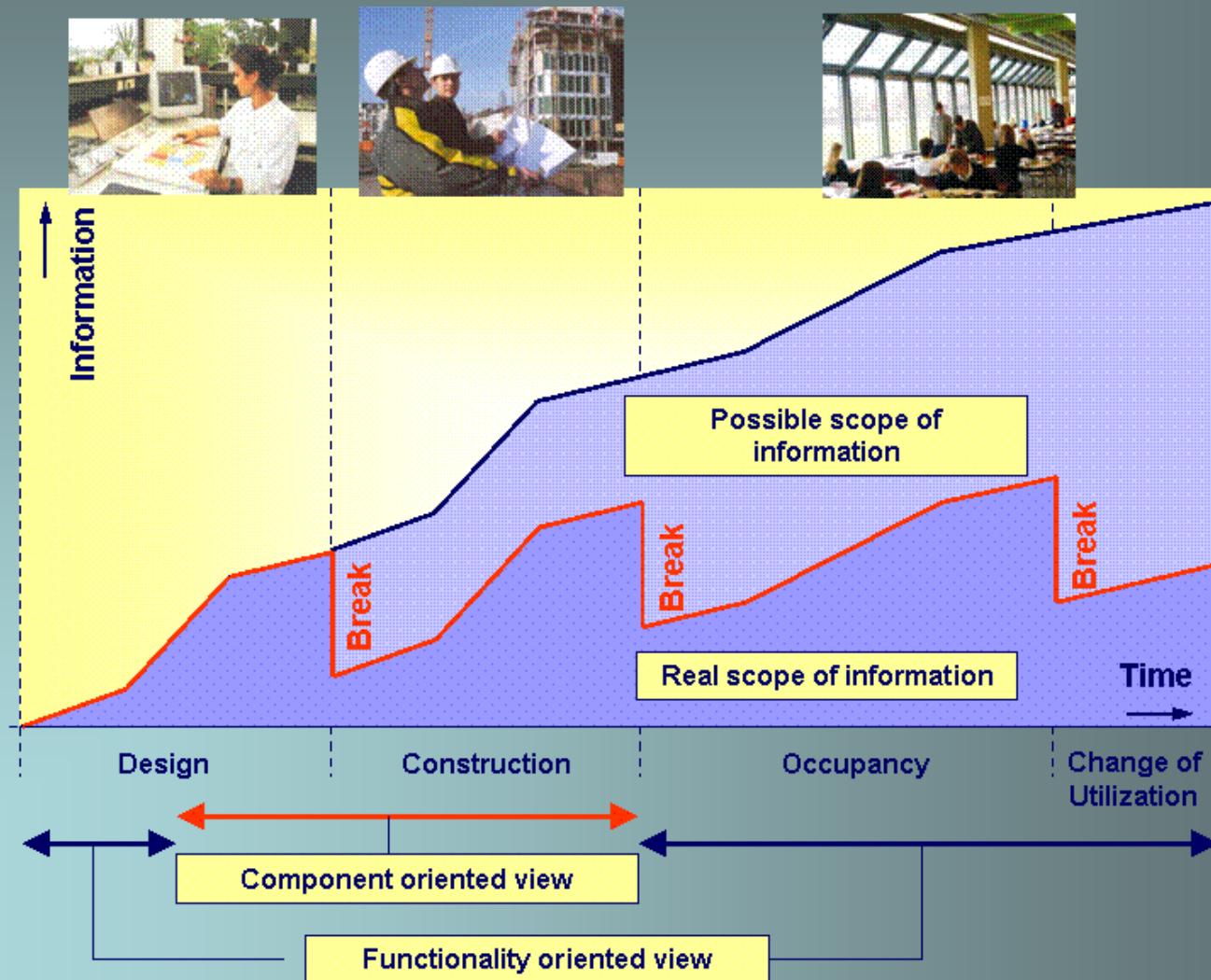
**Commissioning
process**

Commissioning in
the design phase

Commissioning in
the operation phase

iSERV project

Information through the Life-Cycle of Buildings



Needs to
commissioning

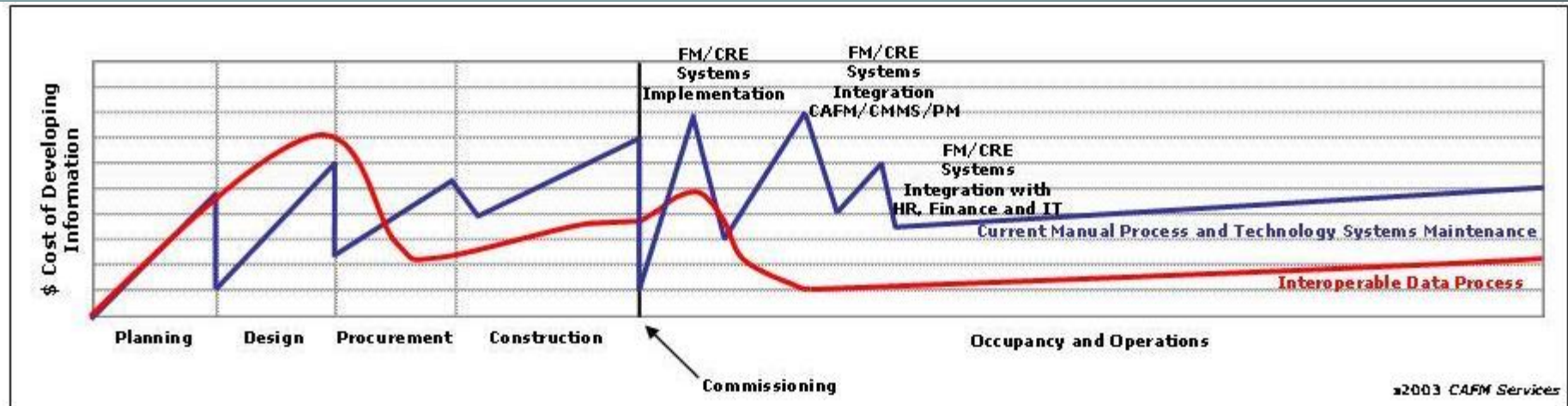
**Commissioning
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Commissioning in
the design phase

Commissioning in
the operation phase iSERV project

Information through the Life-Cycle of Buildings

Pay Now or Pay Later



DESIGN - CONSTRUCTION PHASE
(1 - 5 YEARS)

LIFECYCLE OPERATIONS PHASE
(30 - 100 YEARS)

Owner Pays AEC Team More \$ During
Design Phase To Develop BIM and
Standardized Electronic Data Exchange

Owner Saves \$\$\$\$\$ Over Operational Life of Asset Ownership
by Being Able to Quickly Bulk Load Technology Systems, Have
Critical Data In Electronic Format, Enabling Accurate Metrics
Reporting, Benchmarking and Transparency

Needs to
commissioning

Commissioning
process

**Commissioning in
the design phase**

Commissioning in
the operation phase iSERV project

Palace of Arts (PA), Budapest, Hungary

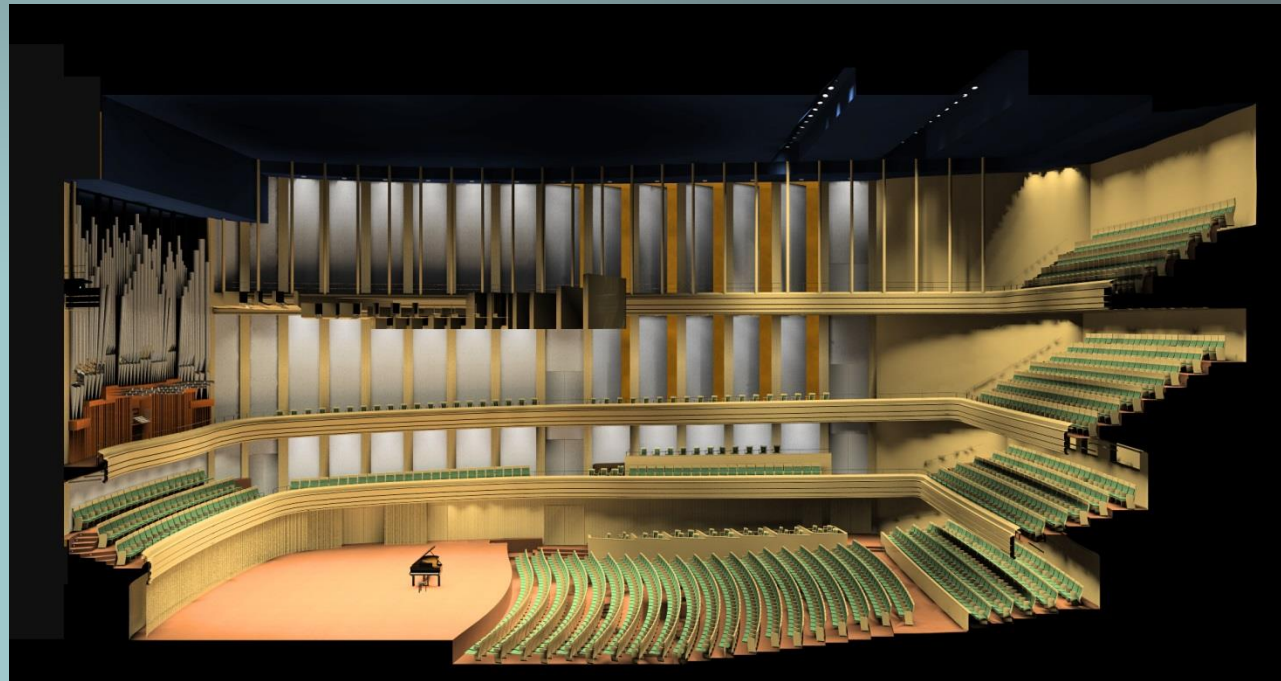
Best practice



The Palace of Arts embodies three separately functioning building's sections:

- Ludwig Museum of Contemporary Art
- National Philharmonic – Concert Hall
- Festive Theatre – Theatre Hall

The whole indoor space is 64,000m², if we would fill with guests, 4500 people would fit in.



Pre-design Phase

Technik für Mensch und Umwelt

Modellraum M 1:5

SMALL MODEL SIMULATION

Imtech

Rud. Otto Meyer & Rheinelektra Technik



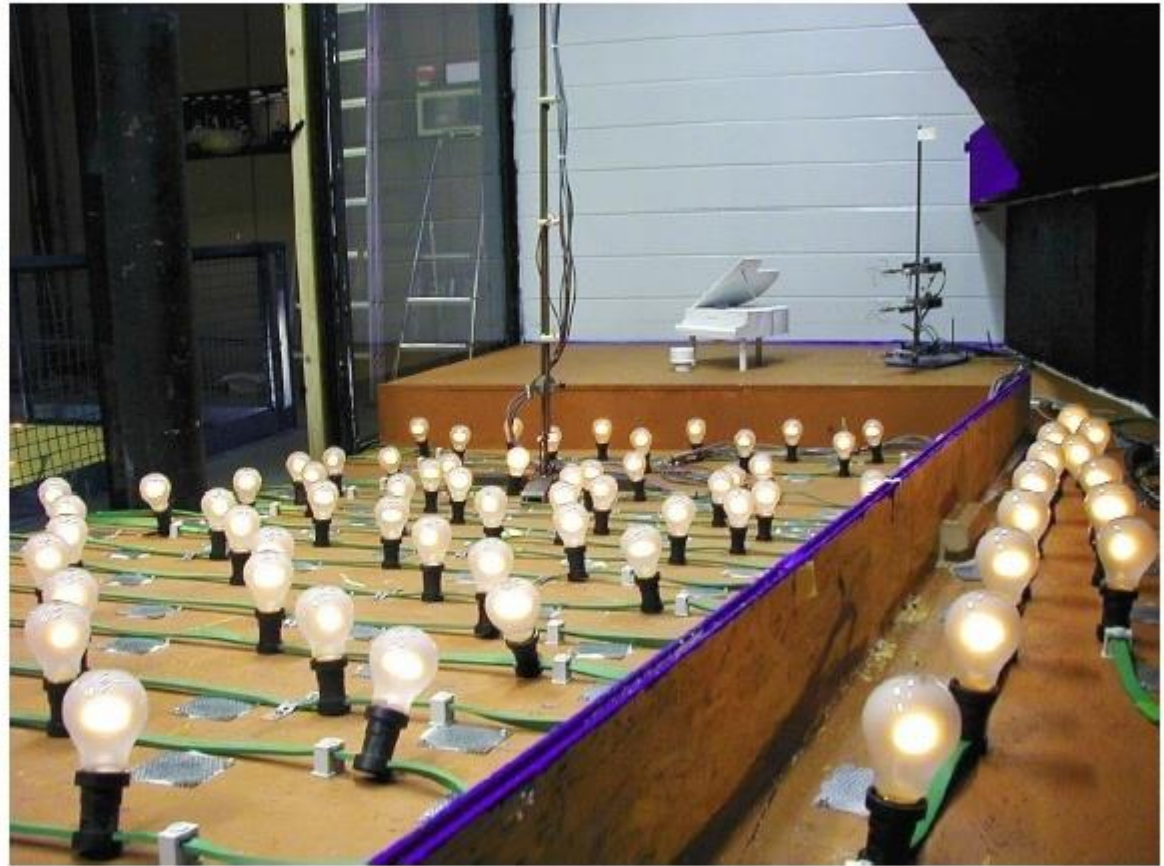
Technik für Mensch und Umwelt

Modellraum M 1:5

SMALL MODEL SIMULATION

Imtech

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Technik für Mensch und Umwelt

Ausschnittsmodell M 1:1

Imtech

Rud. Otto Meyer & Rheinelektra Technik



Technik für Mensch und Umwelt

Variante B: Ausströmverhältnisse Ausschnittsmodell

Imtech

Rud. Otto Meyer & Rheinelektra Technik



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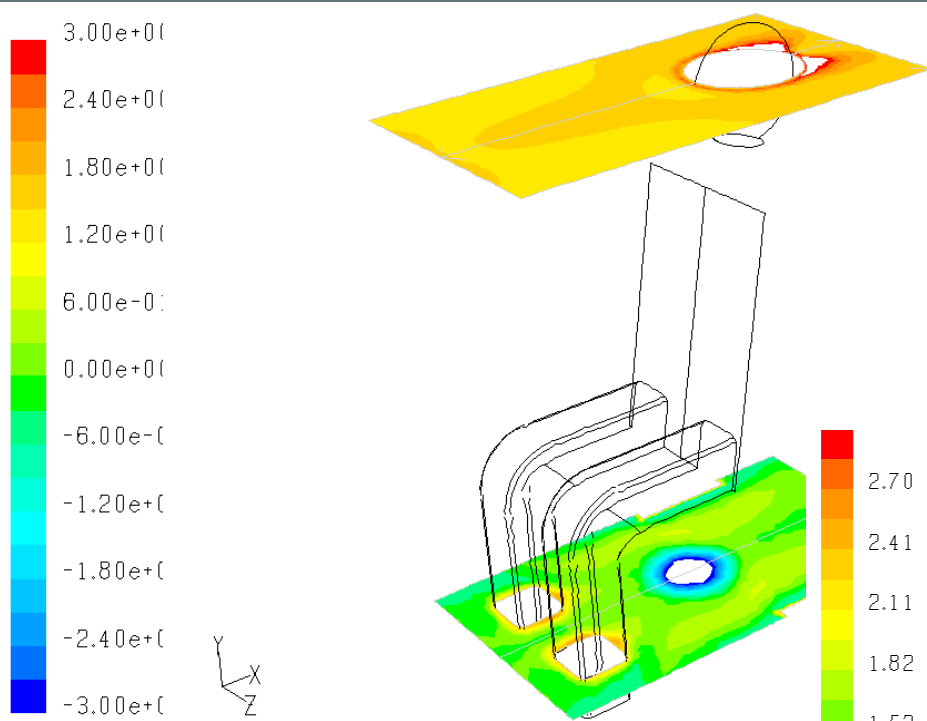
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commissioning

Commissioning
process

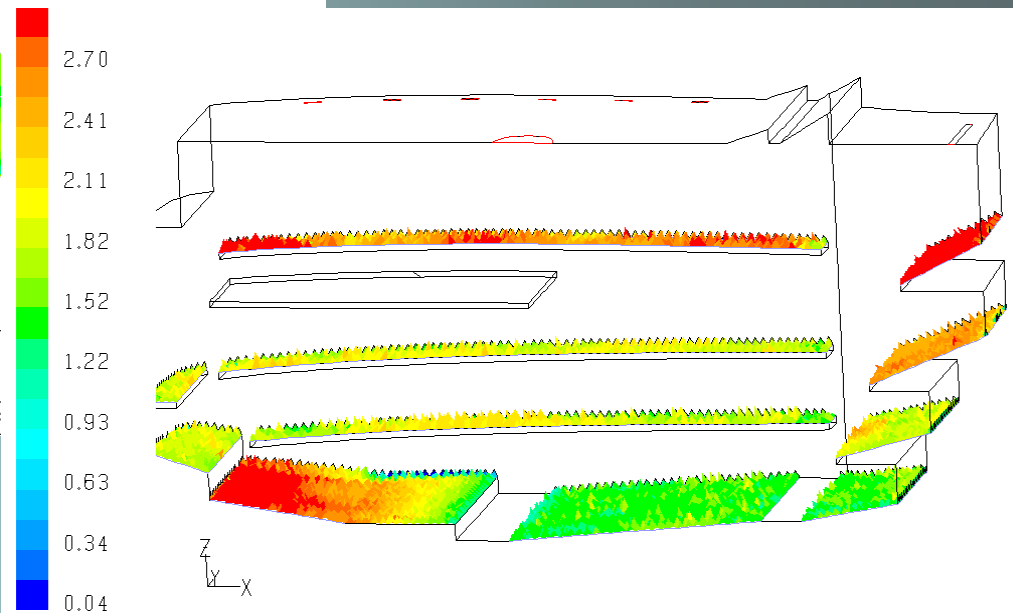
**Commissioning in
the design phase**

Commissioning in
the operation phase iSERV project

Computer simulation



Contours of pmv (Time=3.2200e+01)
FLUENT 6.0 (3d, segregated)



Contours of pmv (Time=3.3400e+02)
FLUENT 6.0 (3d, segregated, rngke, unsteady)

Aug 06, 2002

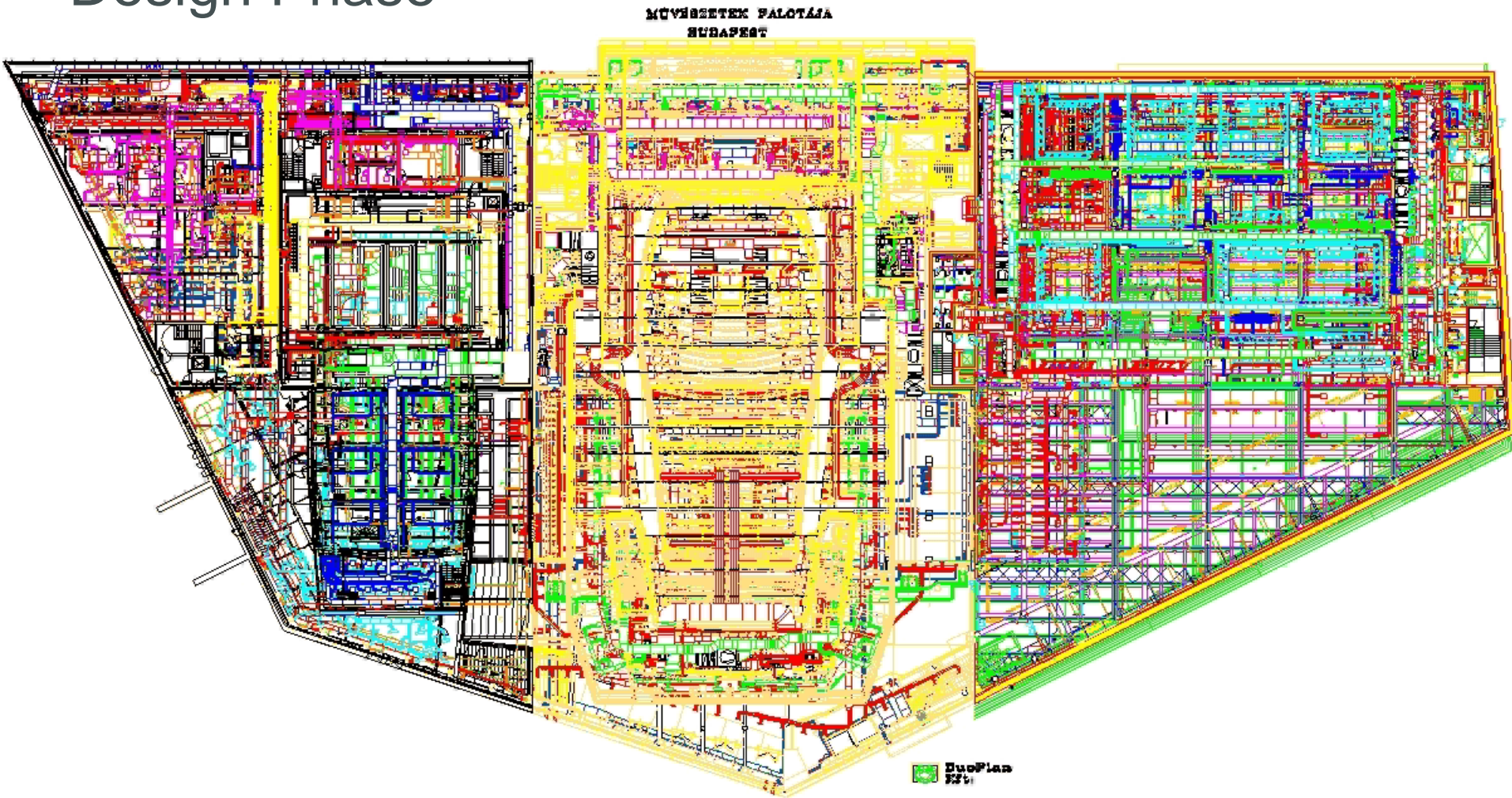
Needs to
commissioning

Commissioning
process

**Commissioning in
the design phase**

Commissioning in
the operation phase iSERV project

Design Phase



Needs to
commissioning

Commissioning
process

**Commissioning in
the design phase**

Commissioning in
the operation phase iSERV project

Construction Phase



The hands-on commissioning was done.



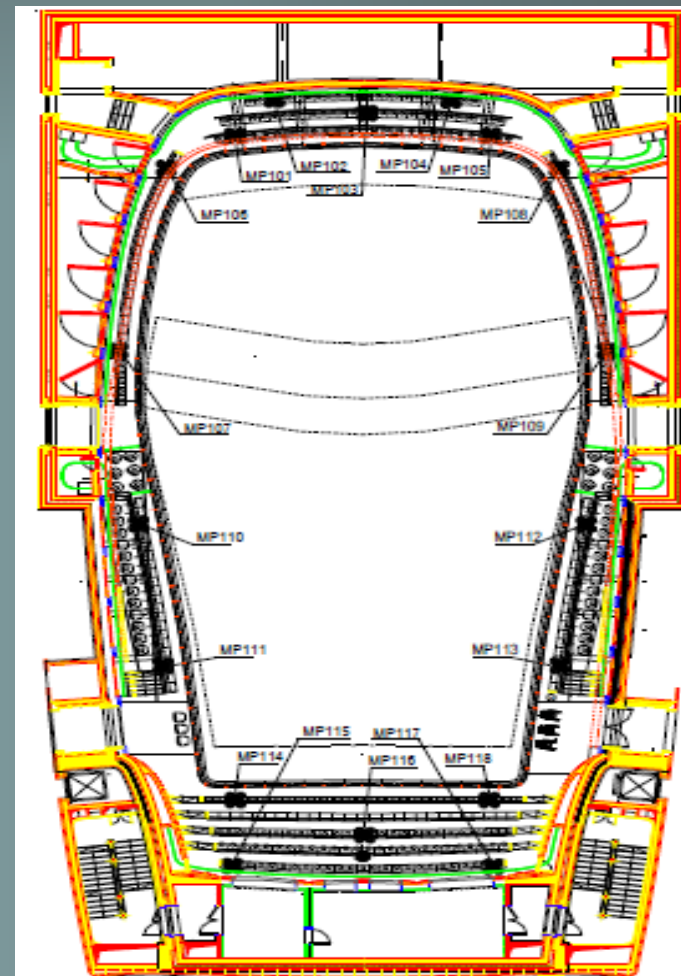
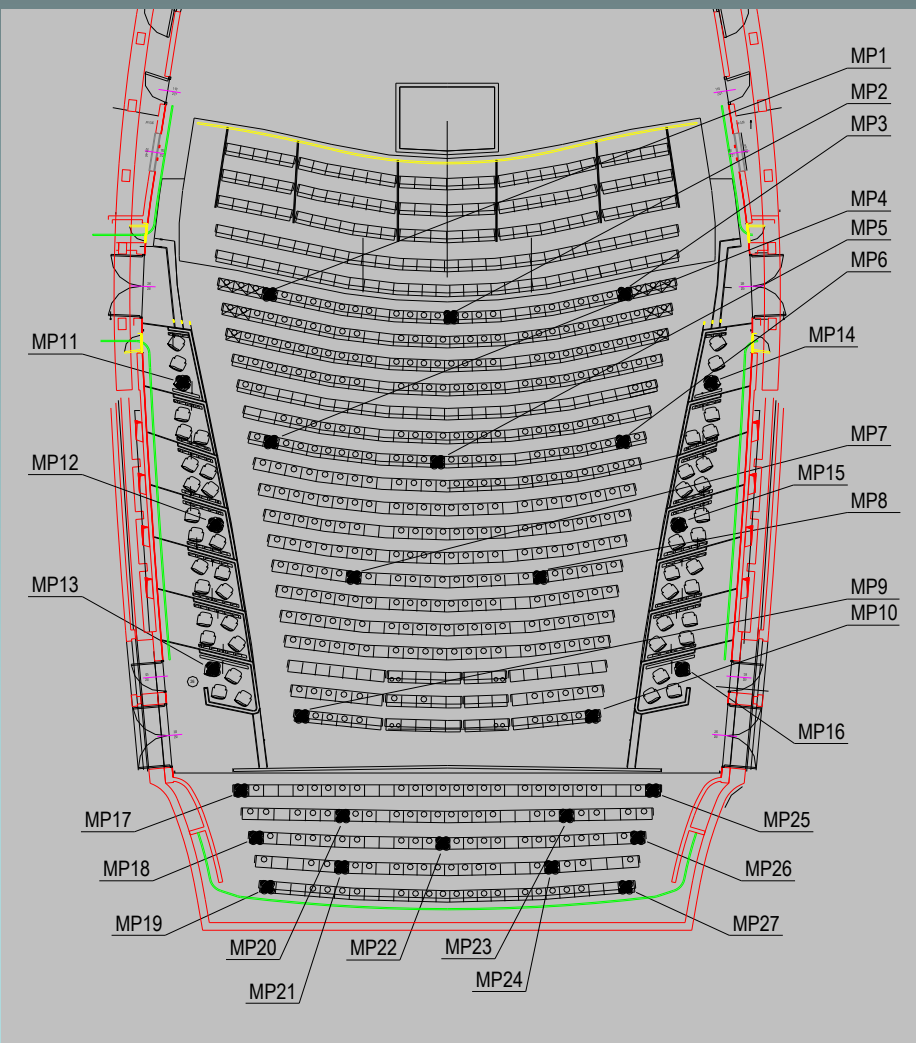
Needs to
commissioning

Commissioning
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**Commissioning in
the design phase**

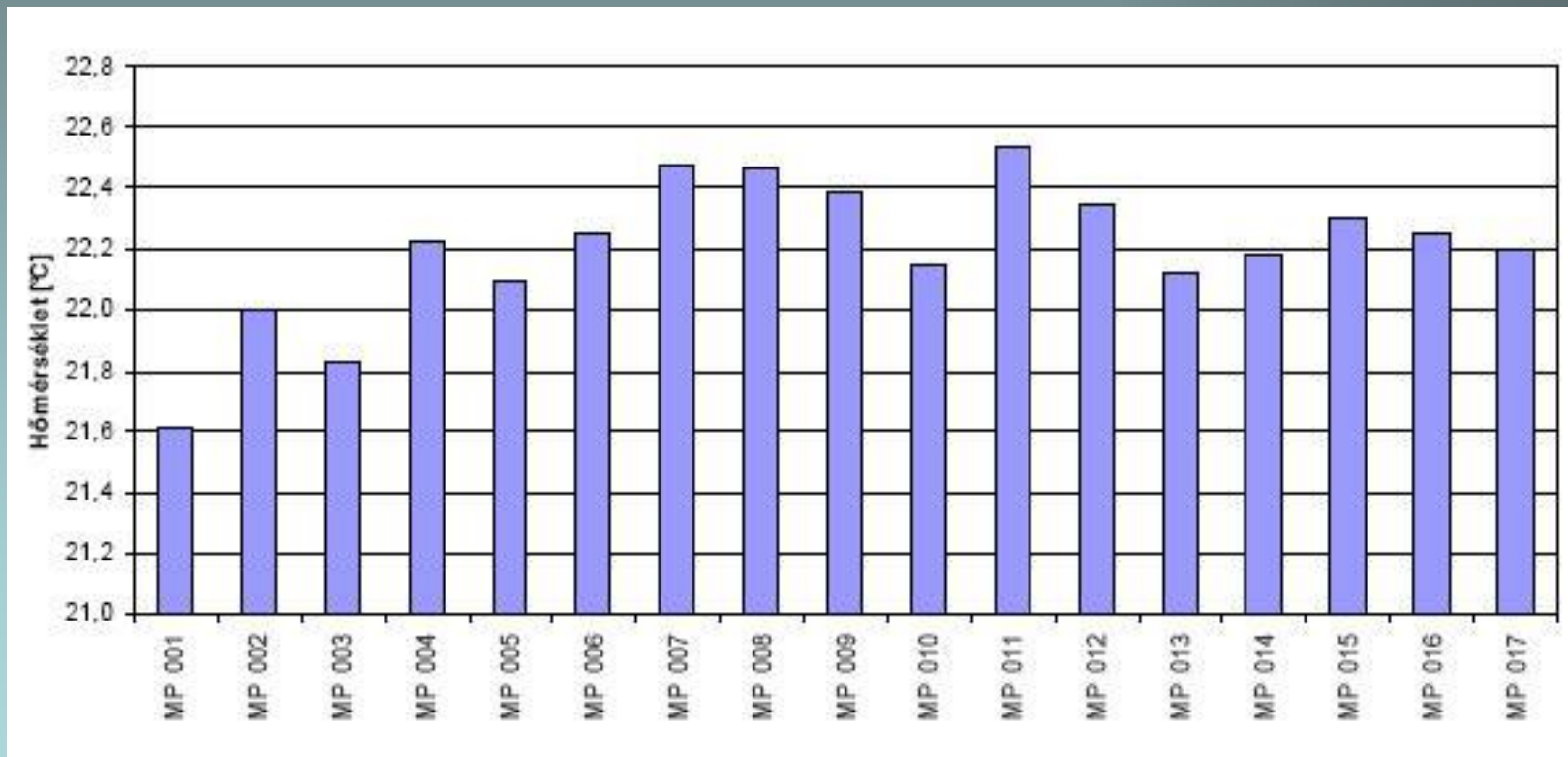
Commissioning in
the operation phase iSERV project

Data loggers at the Concert Hall ground and first floor ,
we measured the temperature and humidity



1. karzatra kihelyezett adatgyűjtők pozíciója

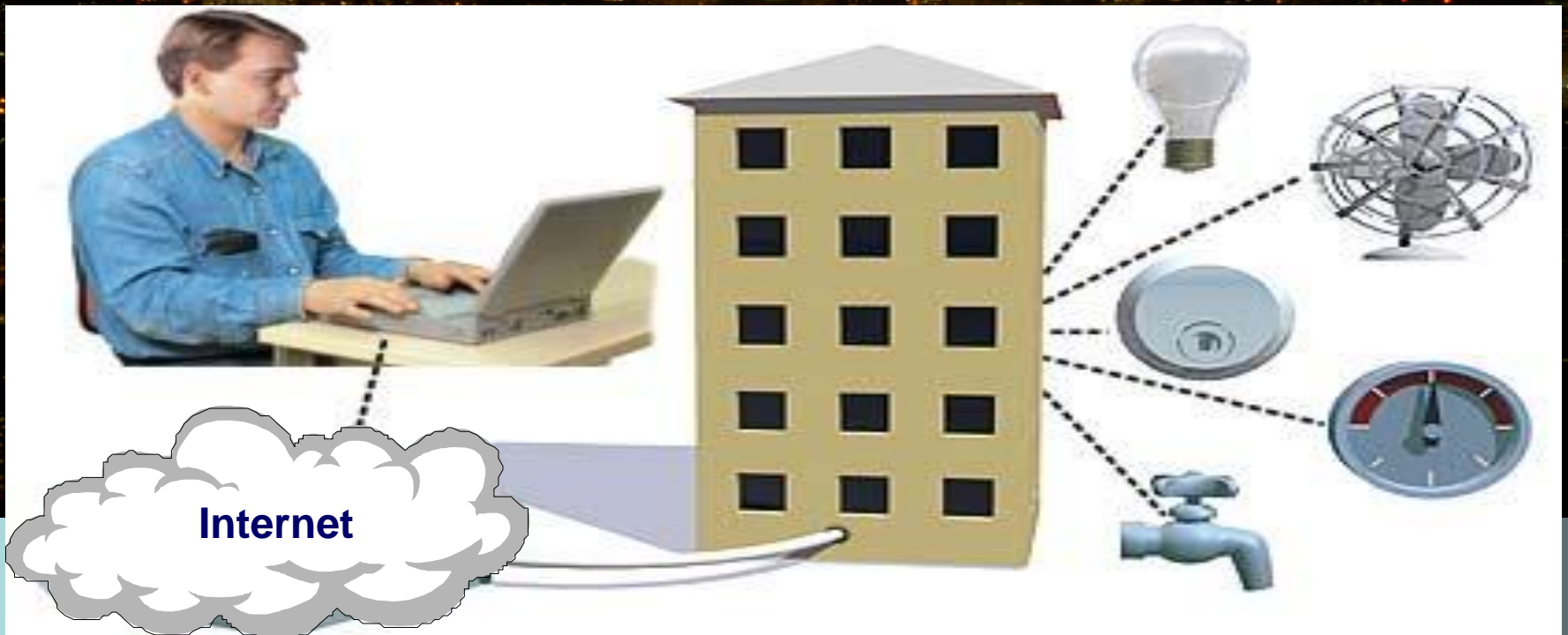
Average temperature distribution at the Concert Hall, ground floor



21 °C air produced in the ground floor air conditioning unit (AHU) warms up 1- 2 °C while reaches the occupation zone.

What can be done for existing buildings and systems to
conduct commissioning cost-effectively?

Existing buildings - no documentation



Needs to
commissioning

Commissioning
process

Commissioning in
the design phase

**Commissioning in
the operation phase**

iSERV project



NH Hotel Eurobuilding Madrid, Spain

The hotel was built in 1969 and has recently been renovated for approximately 20 million Euros.

This audit focuses only on one of the main buildings, the high-rise, a building of approximately 50 100 m².

Methodology

- Defining the demands, complaints
- Collect historical data of energy use
- Collect general building data
- Check up energy systems
 - Building envelope
 - Internal heat gains
 - HVAC systems
 - Domestic hot water
- Potential savings
- Results



Needs to
commissioning

Commissioning
process

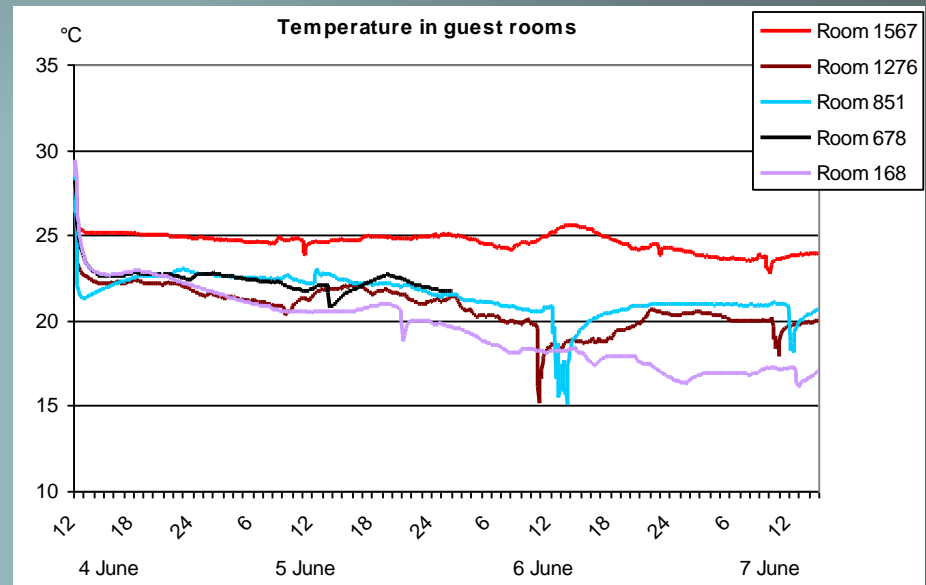
Commissioning in
the design phase

**Commissioning in
the operation phase**

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Temperature measuring data logging



Needs to
commissioning

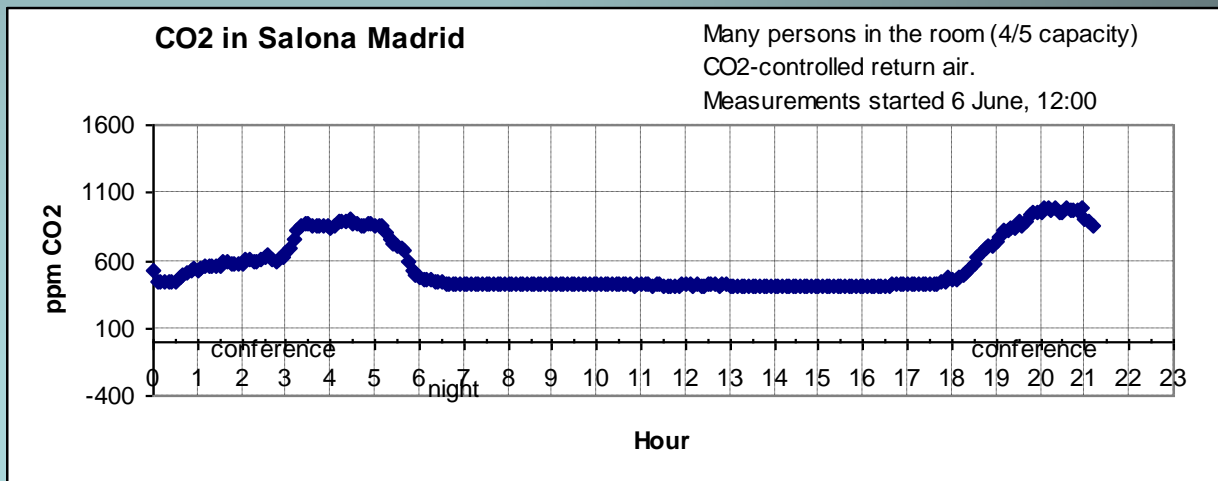
Commissioning
process

Commissioning in
the design phase

**Commissioning in
the operation phase**

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CO₂ measuring data logging



Needs to
commissioning

Commissioning
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Commissioning in
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Some example:

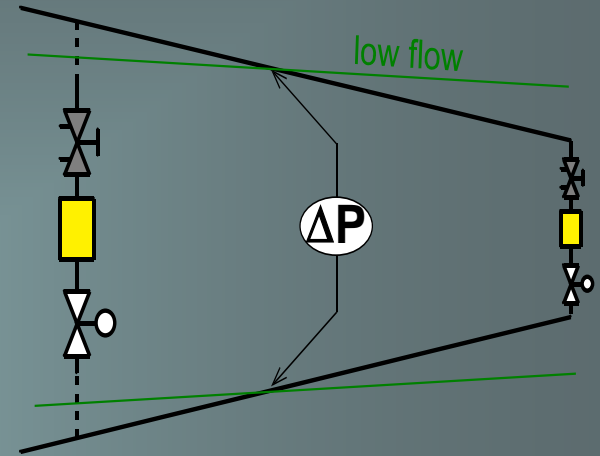
Balancing of the heating system



The 2-pipe systems to the fan-coils in the guest rooms are not balanced. In some cases the partner valve is missing in the system, making it impossible to balance with reliable methods. On each floor there are balancing valves for the floor and for the two branches on each floor. All these valves are fully open.

Some example:

Setting the pump



The two fan-coil pipe systems work as heating in winter and as cooling in summer. The pumps are not changed between summer and winter although the correct water flows are lower in wintertime.

Needs to
commissioning

Commissioning
process

Commissioning in
the design phase

**Commissioning in
the operation phase**

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Some example:

Supply temperature of cooling machines



The cooling machines are working constantly with 8/6 °C in/out temperature on the evaporator side during the whole year. These temperatures are only needed during the warmest period in the summer. In all other periods it is possible to increase the temperatures. This will increase the cooling machines Coefficient Of Performance (COP)

The energy audit resulted in 15 potential energy saving measures
Summary of all the potential energy saving measures:

	Potential electricity savings	Potential heat savings	Potential water savings
Calculated potential savings	790 MWh/yr	345 MWh/yr	4 000 m ³ /yr
Calculated potential savings compared to calculated total need	14 %	21 %	10 %
Total operation cost savings (Euro/yr)	42 660	23 110	3 140

Needs to
commissioning

Commissioning
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Commissioning in
the design phase

**Commissioning in
the operation phase**

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Average simple payback in the difference measures

	Cost savings (Eur/yr)	Cost of investment (Eur)	Simple payback (yr)
Lighting	9 882	6 736	0,7
Air handling	12 203	1 650	0,1
Heating	14 802	51 240	3,5 ¹
Cooling	21 679	17 960	0,8
Domestic hot water	7 357	2 560	0,3
Solar	1 206	5 000	4,1

Needs to
commissioning

Commissioning
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Commissioning in
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Commissioning in
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**Inspection of
HVAC systems
through
continuous
monitoring and
benchmarking**

www.iservcmb.info

**iSERV - a practical process
for achieving long-term
energy reductions in
buildings**

Needs to
commissioning

Commissioning
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Commissioning in
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iSERV project

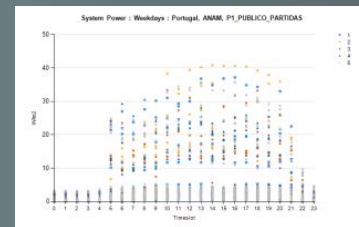
The recipe

A Spreadsheet



+

Sub-hourly
data



+ A database



+

Component
benchmarks

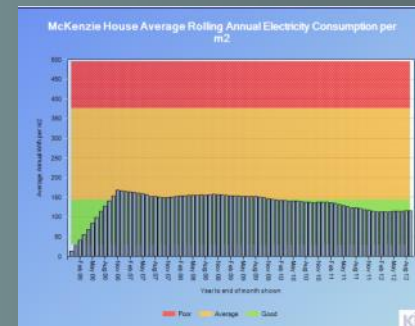


+ Targeted
reports



=

Energy
savings



What iSERVcmb is doing

Remotely monitoring HVAC systems
across Europe

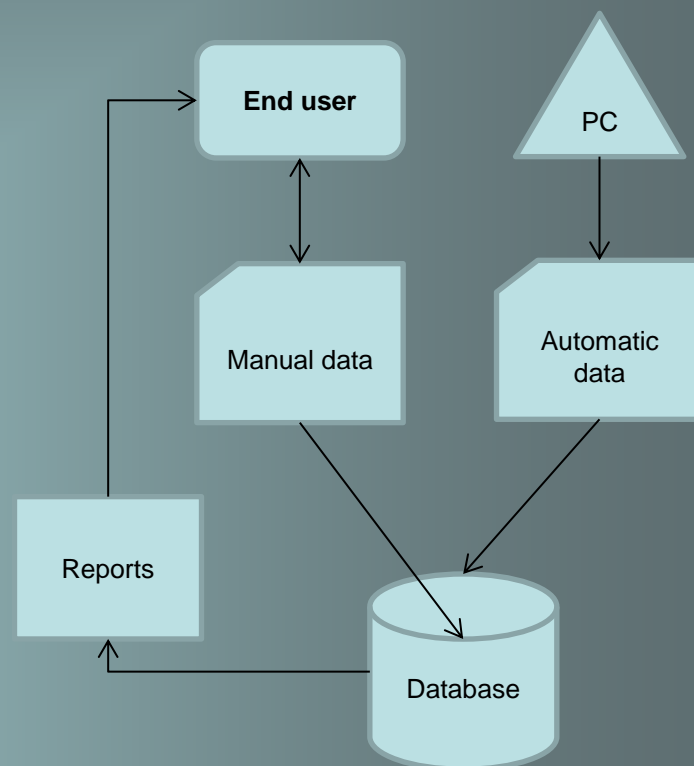
Target 1600 HVAC systems of all
types in EU countries.

Range of building sectors.

Sub-hourly data for individual
HVAC components.

Mostly using existing or easy-to-
add monitoring.

Collating and analysing all data in
a web-based database.



Needs to
commissioning

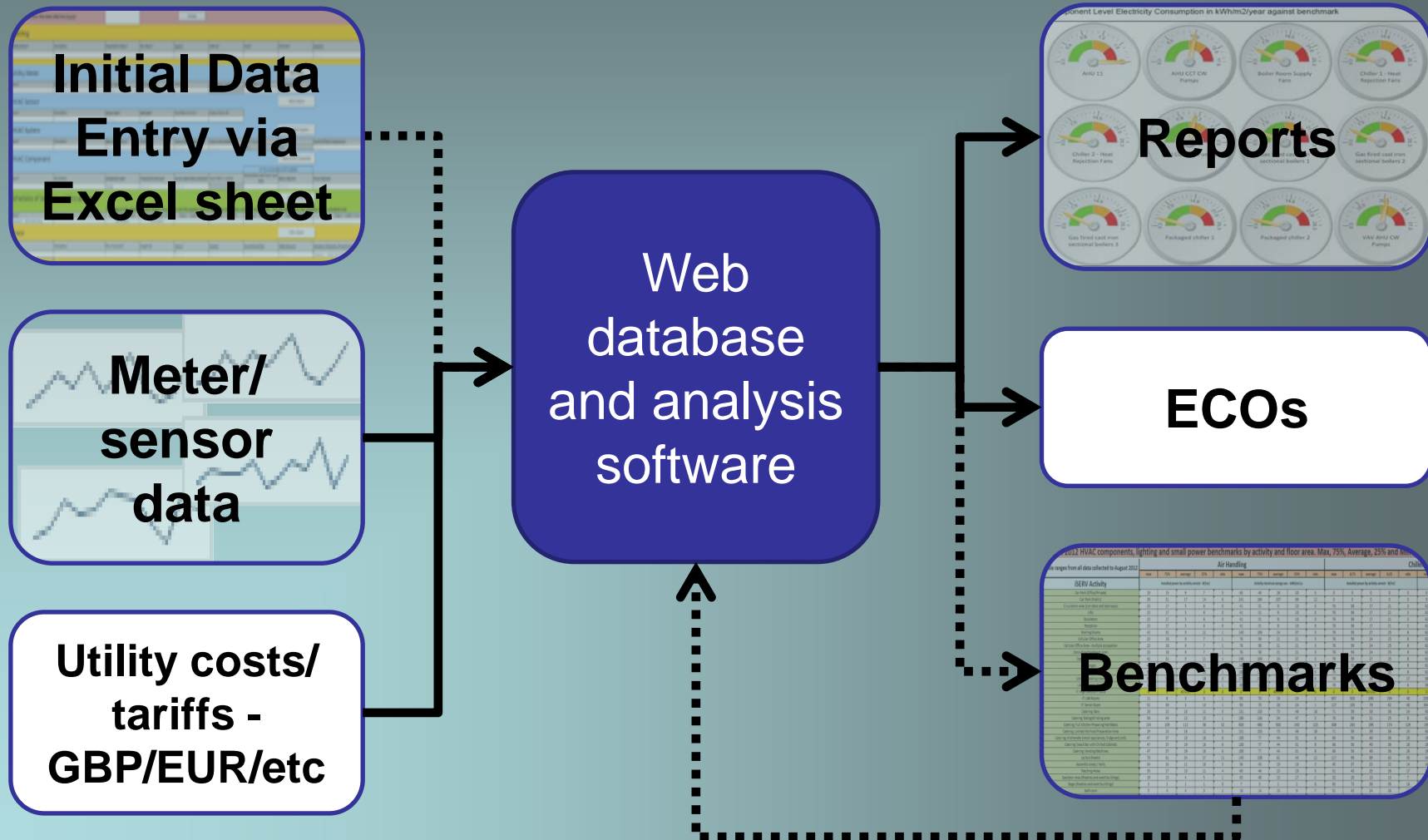
Commissioning
process

Commissioning in
the design phase

Commissioning in
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iSERV project

Overview of basic process



Needs to commissioning

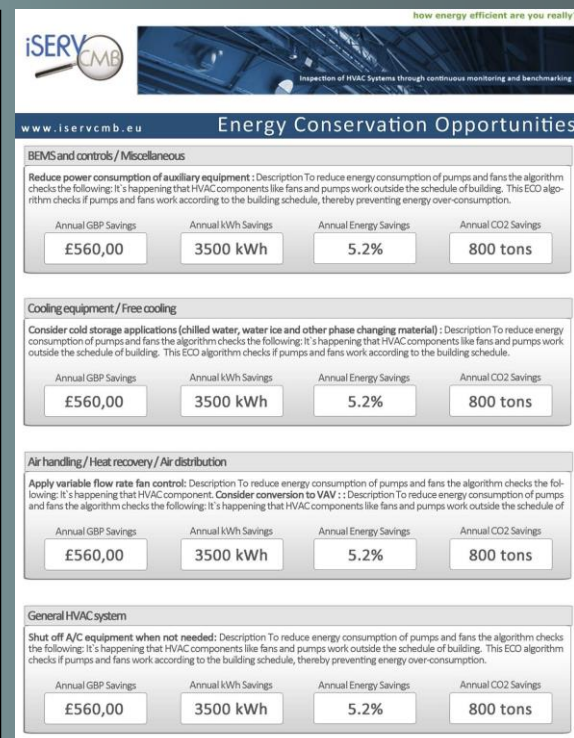
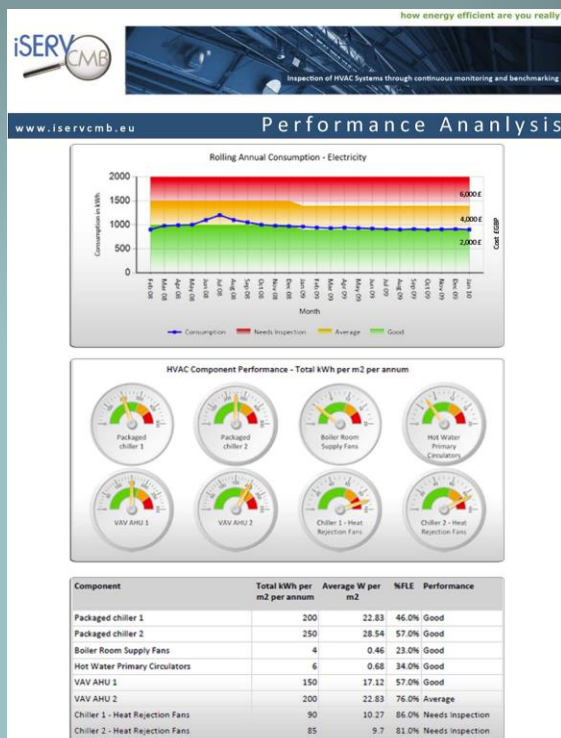
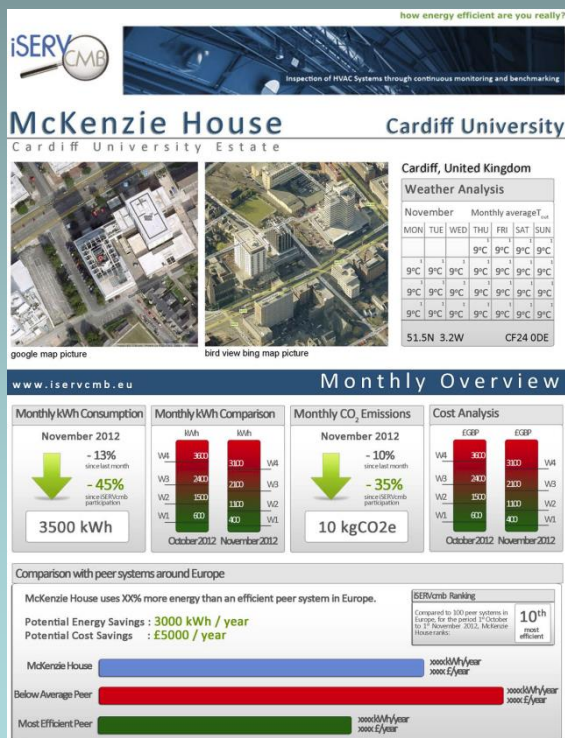
Commissioning process

Commissioning in the design phase

Commissioning in the operation phase

iSERV project

Reports



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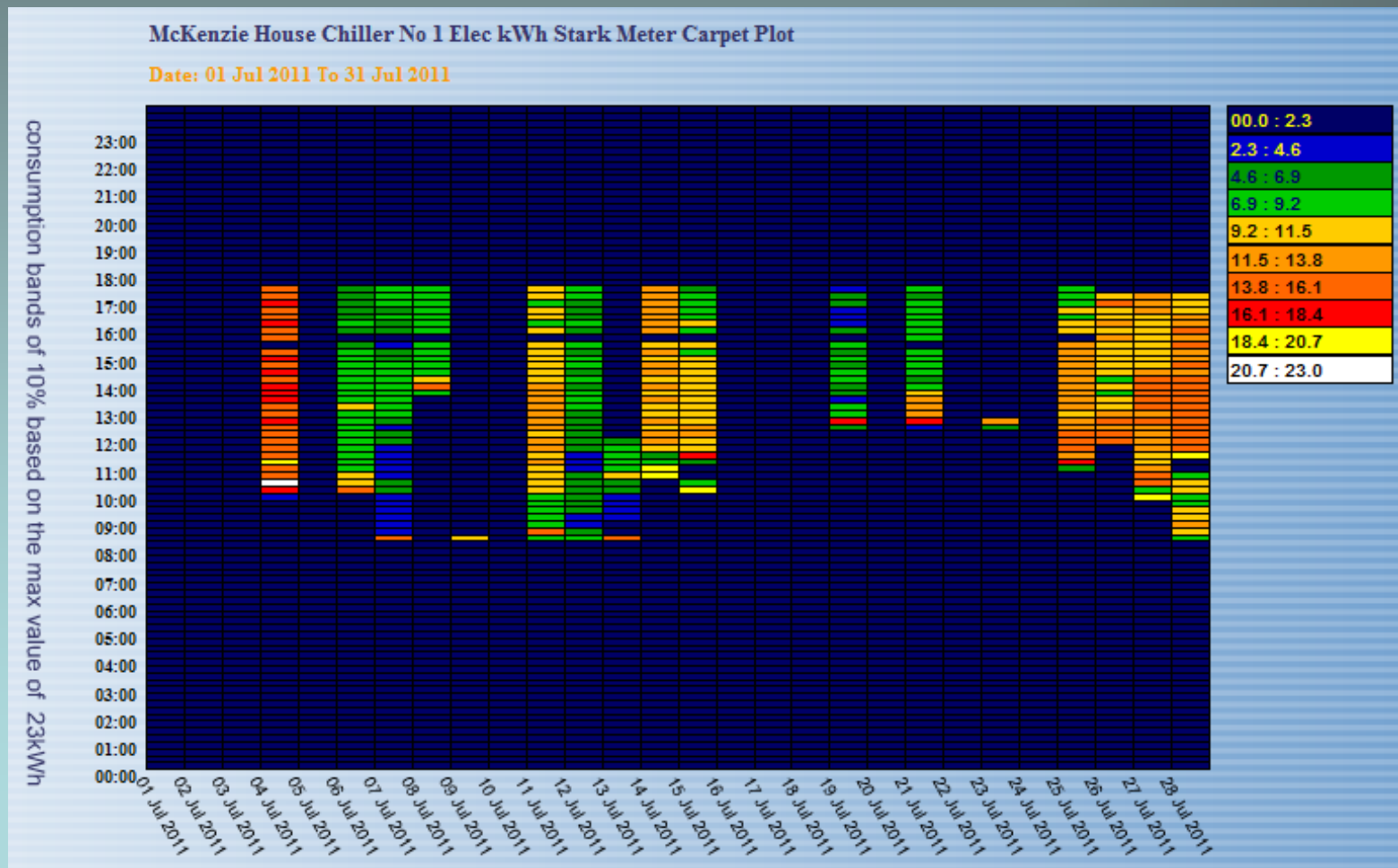
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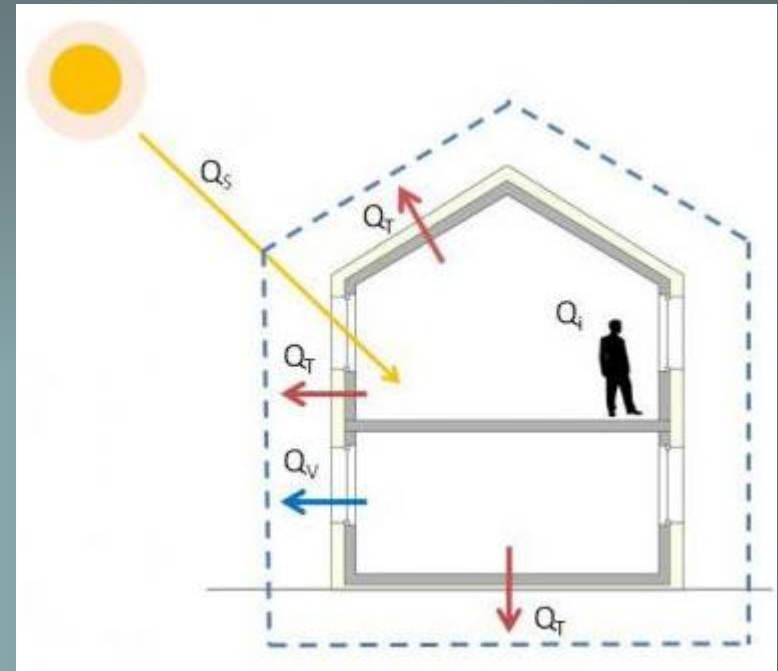
Identification of Energy Conservation Opportunities (ECOs)



The near future

Nearly zero energy buildings will require us to **BALANCE** the energy loads in a building with minimum **NET** use of energy.

With highly insulated structures this balance is mainly about how Solar Gains, Internal Gains and Ventilation energy needs interact with each other.



Ref: <https://www.educate-sustainability.eu/portal/content/thermal-balance-buildings>

In both hot and cold climates energy efficiency can be achieved by **MINIMISING** ventilation rates, with the attendant potential for IAQ problems and Health.

Monitoring savings

Building electrical savings of between 19% to 33% p.a.

Building electrical savings/m² between 61 to 100 kWh/m²/a

In economic terms:

- Measured recurrent savings of 9 to 14 EUR/m²/a

- Recorded 'one-off' setup costs between 0.1 to 2 EUR/m²

- Estimated 0.1 – 3 EUR/m²/a to maintain.

- Net returns between 7 – 13 EUR/m²/a

Success in reducing HVAC energy use is providing the confidence and finance (from savings) to tackle other electrical use as well.

Conclusion

- We need the commissioning
- Better indoor climate
- Energy saving with commissioning
- Commissioning in the design phase (good practice)
- Commissioning in the operational phase
- Monitoring, commissioning – iSERV EU project



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THANK YOU FOR YOUR ATTENTION!

Zoltan Magyar

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IEA Annex 40, IEA Annex 47

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