D2.5 and D2.6 : RETROCOMMISSIONING METHOD (15.01.2012)

PARTICIPANTS :

Scientific partners (conception). SHOs and NHAs (data collection)

OBJECTIVES :

The document presents a synthesis of the retrocommissioning methods.
This deliverable brings together a state-of-the-at presenting what is retrocommissioning (and what are its conditions, tools, etc...) and a first step-by-step approach to implement a retrocommissioning method on a pilot site.
The objective is to explain the principle and the usefulness of this method and to present what are the documents needed to implement it and what could be a timeline to begin the process.

EVALUATION :

- The retrocommissioning method is a very simple and pedagogical tool.
  The document will be completed during the pilot sites implementation in relationship with the tested ESMs.
  The on-going of the project will help to refine the different indicators used during the retrocommissioning process and try to adapt the global methodology to the existing case studies.

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1. WHAT IS RETROCOMMISSIONING ?

1.1 Definition

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Commissioning is a «systematic method for investigating how a building's systems are operated and maintained, and identifying ways to improve how building equipment and systems function togethern enhancing overall building performance» {American Society of Heating, Refrigerating and Air-Conditioning Engineers - ASHRAE}.

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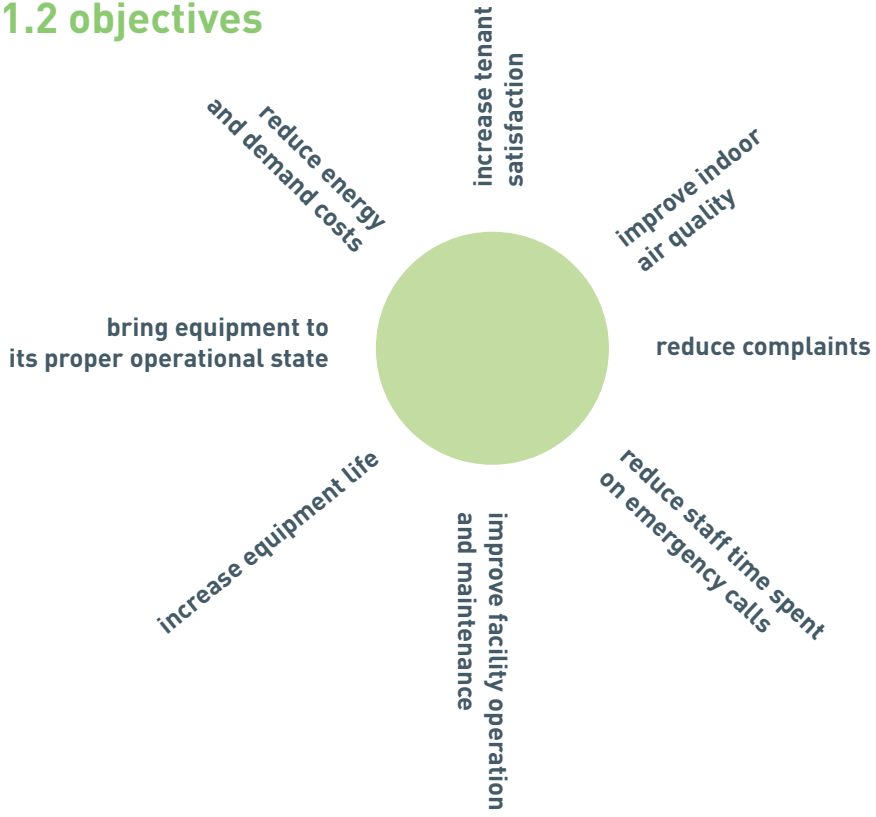
Retrocommissioning is the application of the commissioning process to existing buildings. Retro commissioning aims at obtaining and identifying cost-effective energy savings. Verification will require limited performance monitoring of selected building systems. The final goal is to identify and recommend improvements to operational strategies and maintenance procedures focusing on those measures that sustain optimal energy performance and reduce operationg costs.
Retro-commissioning helps also to identify HVAC(Heat ventilation, Ventilation and Air Conditioning)-related health and safety issues as they present themselves during the normal course of commissioning work.

Recommissioning is another type of commissioning that occurs when a building that has already been commissioned undergoes another commissioning process.

when to do it ?

- an unjustified, high energy-use index
- persistent failure of equipment and/or control system (worn out, old equipment should be replaced before the commission begins)
- tenants complaints
- indoor air quality problems

1.2 objectives



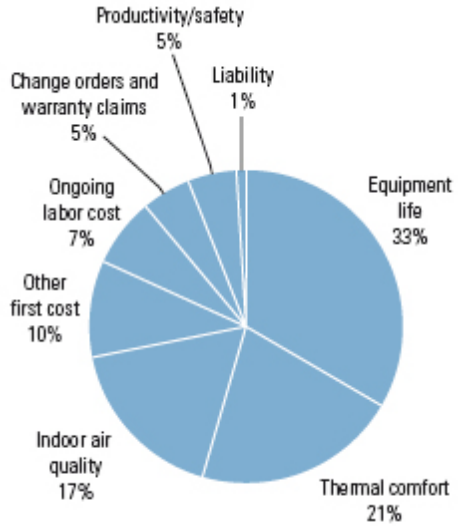
1.4 example of retrocommissioning economic benefits

Description	
Value of energy savings	$0.11-*$0.72/sqft
Value of non-energy savings	$0.10-*$0.45/sqft

Description	
Total RCx Cost	$0.13 to $0.45 sqft
Provider Fee as % of Total RCx Cost	35-71%
Average RCx Cost Allocation	
Planning and investigation	69%
Implementation	27%
Verification, Tracking and Reporting	4%
Simple Payback Time	0.2 to 2.1 years

Retrocommissioning can produce significant cost savings in existing buildings.
Savings vary depending on the building types, and the scope of the retrocommissioning process. A comprehensive study found average cost savings in the ranges .

Commissioning guide -California Commissioning collaborative



1.3 RCx impacts

datas from
Lawrence Berkeley National Laboratory, Portland Energy Conservation Inc
and Energy Systems Laboratory, Texas A&M University

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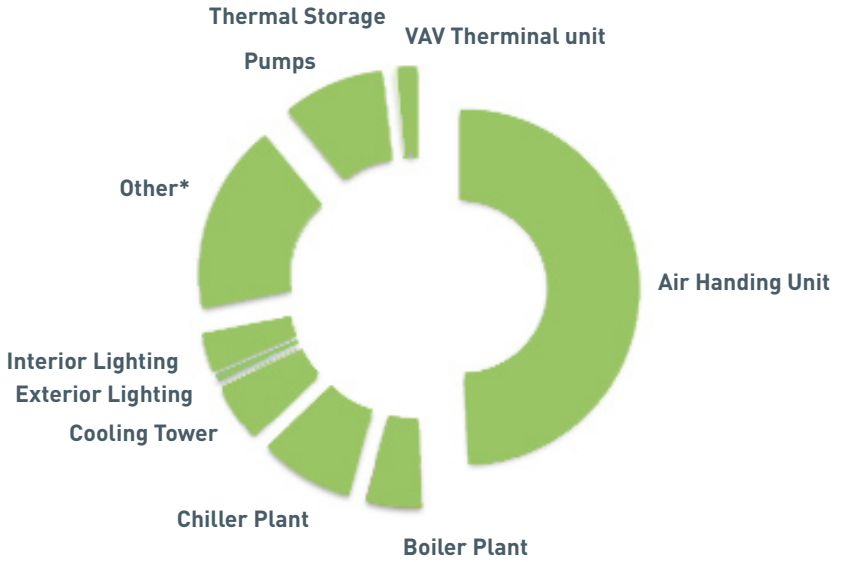
2. OBJECTIVES AND IMPACTS

Retrocommissioning involves a systematic, in-depht investigation of building operations, finding deficiencies that may not be immediatly obvious or visible.
Some examples of these deficiencies includes :

- variable speed drives no longer modulate appropriately
- controls are circumvented or set up improperly
- equipment runs more than necessary or runs inefficiently because of improper sequences of operation
- controls were never tuned or require retuning to provide appropriate response time or to avoid hunting

2.1 Systems and equipments affected by RCx measures

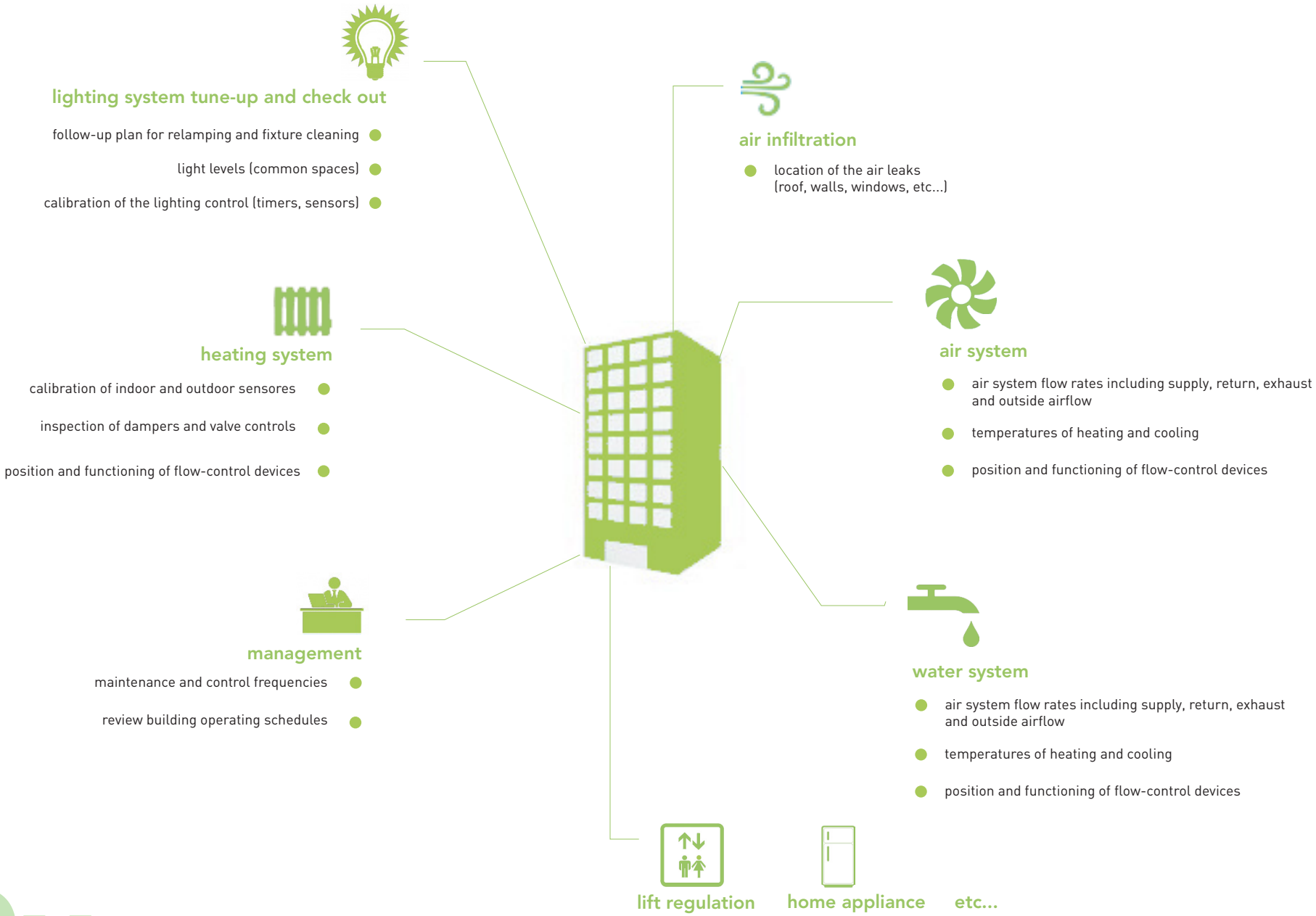


* including garage and exhaust fans, OA temperature sensors, plate and frame heat exchangers, and smaller unitary equipment

2.2 Most frequently implemented measures

- optimize airside economizer
- reduce equipment runtime
- reduce/rest duct static pressure setpoint
- revise control sequence
- add optimize supply air temperature reset
- add variable frequency drive to pump
- other
- reduce lighting schedule
- replace/repair/calibrate sensors
- add/optimize condenser water supply
- temperature reset
- add/optimize star-stop

ASHRAE



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3. A GLOBAL APPROACH OF THE BUILDING EFFICIENCY

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4. ORGANIZING YOUR TEAM AND YOUR TIME

A Retrocommissioning involves different kind of jobs and competences.
The final aim is to gather all the different actors involved in the life of building around a common process.

(a) review facility documentation

(b) develop the commissioning plan and hold the scoping meeting

(c) perform a site assessment

(d) develop an initial list of findings

(e) develop and present an interim report

(f) develop the diagnostic monitoring and test plans

(g) implement diagnostic monitoring and test plans

(h) select the most cost-effective opportunities for implementation

actual implementation of the major cost-effective improvements to realize results

(a) reset and remonitor

(b) update building documentation

(c) train operators

investigation phase | **implementation phase** | **final adjustment**

5. TIMELINE

Deliverables

- Short-term diagnostic monitoring and functional test plans
- The Master list of deficiencies and potential improvements
- Completed site-assessment forms (optional)
- Completed functional tests
- List of repairs, adjustments and other improvements made during investigation
- List of selected improvements or immediate implementation including costs and ROIs

A Systems Manual that includes :

- a brief design narrative of all systems investigated (brief description of the system, its purpose and general operation) with corrected and created sequences of operations
- a description for all energy-saving features and strategies with operating instructions and caveats about their function and maintenance relative to energy use
- recommandations for recalibration frequency of sensors and actuators by type and use
- specific recommandations regarding seasonal operational issues that affect energy use
- a list of all user adjustable setpoints and reset schedules with a discussion of the purpose of each and the range of reasonable adjustments with energy implications. Include schedule frequency to review the various setpoints ad reset schedules to ensure they are at current relevant and efficient values

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6. INVESTIGATE AN EXISTING BUILDING

• BUILDING DATAS

- general **building description**
- **drawings relevant to the systems** scheduled for commissioning, especially control drawings
- **sequences of operation** for all or most equipment
- **energy-efficient operating strategies** for all or most equipment
- **equipment list** with nameplate information for all or most equipment
- **operations and maintenance** manuals for all or most equipment
- **TAB reports**
- **Preventative management logs** for all or most equipment
- **energy bill (electric and gas) information** for at least 12 months along with a rate schedule.

WHAT INFORMATION DO I NEED ?

ENERGY DATAS •

- annual **hours of operation**
- **kWh** per year
- annual electric use in **kWh** per square foot
- **peak demand** for last 12 months
- **natural gas ccf** per year
- annual **gas use** in BTU per square foot
- **BTP** per square foot per year all fuels
- **district heating** (lbs. of Steam per year)
- **district cooling** (TN hours per year)
- average annual BTU per square foot for region or city for **similar type of buildings**

BUILDING EQUIPMENT •

- central **heating plant** (boilers)
- central **cooling plant** (chillers)
- **packaged units**
- **district heating**
- **district cooling**
- **computer** energy **management system**
- **age** of primary heating equipment
- **age** of primary cooling equipment

7. PROCESS

PRE-IMPLEMENTATION STAGE | **IMPLEMENTATION STAGE** | **POST-IMPLEMENTATION STAGE**

SELECTION **PLANNING** **INVESTIGATING** **FINAL ADJUSTMENT** **HANDS OFF**

1 ☐
determinate objectives and expected impacts (cf. 1.2 and 1.3) for the retrocommissioning process

2 ☐
provide main informations about the building (cf

3 ☐
provide the documentation linked with the needed informations (cf.

4 ☐
present an overview of the retrocommissioning process expected.
A step-by-step approach can adopted.
This overview should include a list of :
- the different building systems needig a retrocommissioning
- a global planning
- a task repartition

5 ☐
expose the data acquisition process (datalogging, trending, staff management, functional testing, tenants implication, watch-out)

6 ☐
plan the action

7 ☐
identify a retrocommissioning plan (cf.

8 ☐
evaluate what should be the inputs given by the facility staff and what additionnal contacts do you need (monitory and testing plan)

9 ☐
list what are the indicators and way to test the existing equipments according to your team (cf Annex)

10 ☐
give a cost range for the project

11 ☐
give a cost range for the project

13 ☐
Retrocommissioning investigation report

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SHORT BIBLIOGRAPHY

information in this document is drawn from several existing guides to commissioning and retrocommissioning:

MILLS E. 2009
«Building Commissioning : a Golden Opportunity for Reducing Energy Cost and Greenhouse Gas Emissions.»
http://cx.lbl.gov/2009-assessment.html

FRIEDMAN H. et al. 2009
«IEA Annex 47 : Cost-effective Commissioning for Existing and Low-Energy Buildings»
prepared for US Department of Energy.
http://peci.org/documents/annex_reprt_0910.pdf

PECI and LBNL
«Functunial Testing Guide - From the Fundamentals to the Field»
prepared for the US Dept. of Energy and the California Energy Commissions' Public Interest Energy Research program

PECI, 1999
«A Pratical Guide for Commissioning Existing buildings»
prepared by Oak Ridge National Laboratory and Portland Energy Conservation, Inc.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE) 2005.
«Guideline 0-2005, The Commissioning Process»

CALIFORNIA COMMISSIONING COLLABORATIVE 2006
«California Commissioning Guide : Existing buildings»

PECI, 2001
«Retrocommissioning Handbook for Facility Managers»
prepared for Oregon Department of Energy.

ENERGY STAR 2005
«Building Manual. Chapter 5 : Retrocommissioning»
www.energystar.gov/ia/business/EPA_BUM_CH5_RetroComm.pdf

PORTLAND ENERGY CONSERVATION INC. 2007
«A retrocommissioning for building owners»
www.peci.org/sites/default/files/documents/epaguide.pdf

EFFNINGER J. FRIEDMAN H. 2010
«The Right Measures - What saves Energy in Existing Buildings»

RCx ANNEXES

Examples of checklist for equipments

HVAC COMMISSIONING
SYSTEM VERIFICATION/START-UP CHECKLIST
HOT WATER BOILER

PROJECT:_____

Equipment Name/Tag:_____ Location:_____

System/ Area Served:_____ Related Equipment:_____

ITEM	√	COMMENTS
PRE-START-UP INSPECTION		
Commissioning lock-out procedures reviewed		
Operation and maintenance information		
Boiler certificate / registration (copy attached)		
Mounting/support system		
Seismic restraints		
Maintenance clearance		
Local valving/piping correct (including expansion tanks and make-up water).		
Chemical cleaning and treatment (report attached)		
Temperature and pressure gauges		
Pressure relief valve		
Pressurization and leak tests		
Blowdown system		
Safety interlocks- low water and high temperature		
Combustion air supply and ventilation		
Insulation/lagging		
Stack and breaching		
Combustion chamber inspection		
Fuel system (including emergency shutdown and gas inspection certificate)		
Electrical wiring		
Overload protection (sized correctly)		
Disconnect switch (tested)		
Control system - point to point checks complete		
START-UP		
Start HWS pumps to create load.		
Start boiler circulation pumps.		
Boiler startup by supplier		
Supplier certificate or log provided for start-up and all specified and regulatory tests.		

Pre-start checks by:_____ _____ Date:_____

Start-up checks by:_____ _____ Date:_____

print name signature

HVAC COMMISSIONING
PRE-START/START-UP CHECKLIST
PUMPS

PROJECT:_____

Equipment Name/Tag:_____ Location:_____

System/Area Served:_____ Related Equipment:_____

ITEM	✓	COMMENTS
PRE-START-UP INSPECTION		
Commissioning lock-out procedures reviewed		
Operation and maintenance information		
Piping and valving		
Seismic restraints		
Mounting/support system and vibration isolation		
Freedom of rotation		
Lubrication		
Electrical wiring		
Overload protection (sized correctly)		
Disconnect switch (tested)		
Control system - point to point checks complete		
START-UP		
HWS or CHWS available		
Direction of rotation		
Electrical interlocks - stop&start		
Vibration & noise level acceptable		
Motor Amps - Rated :__ Actual :_____		
Motor Volts - Rated :__ Actual :_____		

Pre-start checks by:_____ _____ Date:_____

Start-up checks by:_____ _____ Date:_____

print name signature