

**Framework of  
Continual Commissioning to Produce  
and Maintain Energy-efficient  
Buildings**

***- definition and examples -***

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Association***

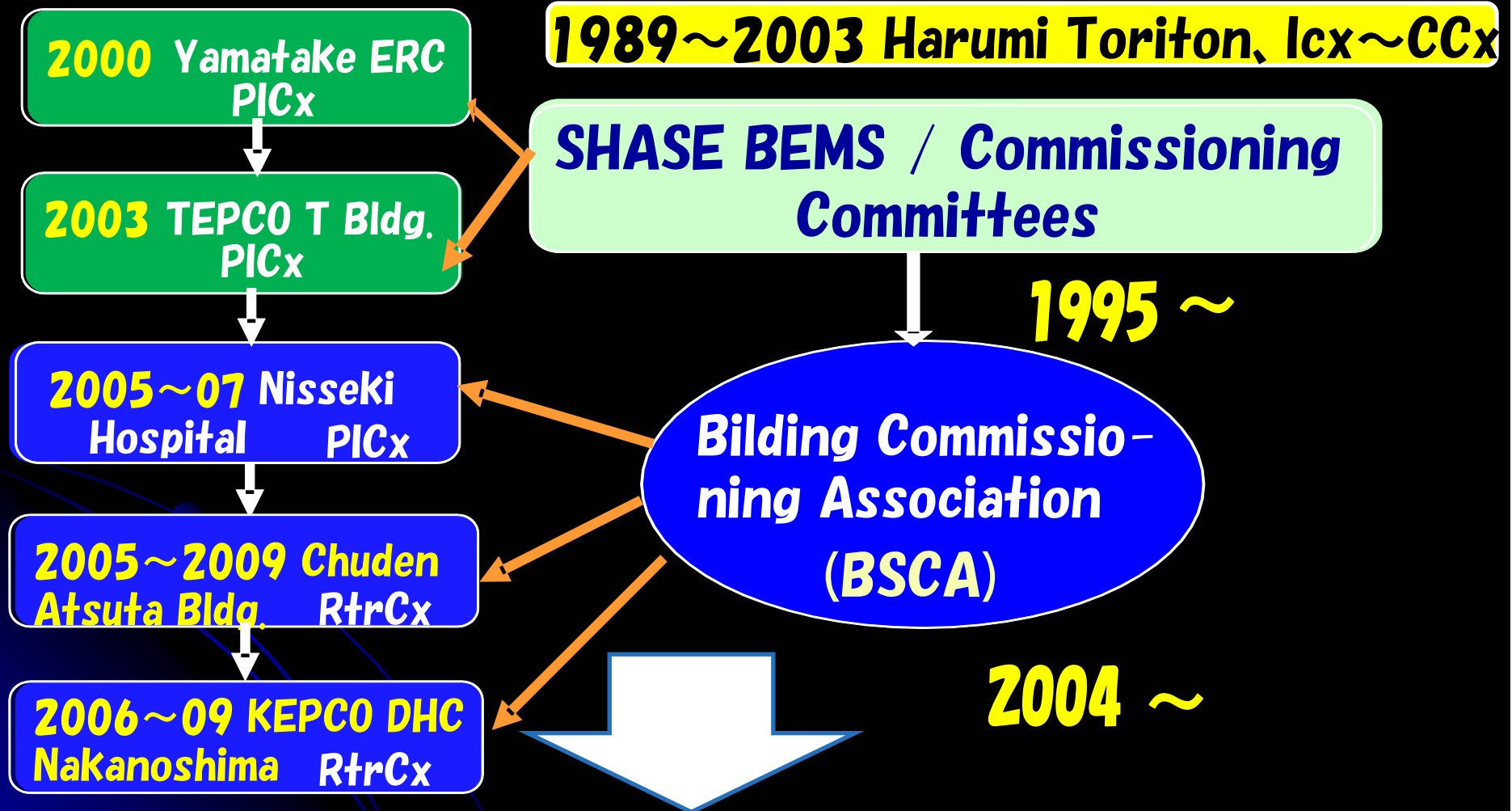
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- **Promoting commissioning activities in Japan**
- **International view of HVAC commissioning**
- **Definition of commissioning process**
- **Defining performance goal-OPR, Key to Cx**
- **Simulation for OPR, design Cx and BOFD**
- **Discussion on Continual Commissioning (CC), concept and its new definition for LCCx**
- **Framework of CC and on-going PDCA**
- **Role of BOFD and BEMS (BACS), and BACS Cx.**
- **Principle of Environmental Circle**
- **Topics on GWG issue**

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# Cx Process Application in Japan and Role of BSCA



**CxPE, CA Qualification, Tool Development**

# Author's Experience as CA on HVAC

- **Harumi DHC, Initial Cx, for System selection**
  - Total floor area: 670,000m<sup>2</sup>
  - Land area: 8ha
  - From Program phase to Post-acceptance phase
- **Y Office/Laboratory, Initial (partial) Cx.**
  - Approx. 1,700m<sup>2</sup>
  - After Construction phase to Operation phase
- **A Office Building, (full for retrofit stage) RetroCx,**
  - Approx. 9,400m<sup>2</sup>
  - From Pre-design phase but After FDD to Operation phase
- **N Hospital Facility, Initial (partial) Cx.**
  - Approx. 82,000m<sup>2</sup> and Annexes
  - After Schematic design step to Elaboration phase



# International Collaboration on Commissioning

## SHASE Commissioning Committee

1995 JPN BEMS Committee  
2002 JPN Cx Committee

2004~

**Building Services Cx Association (BSCA)**

2000~

CSTB, Fr

IBEC, Jp

IEA/Annex40, 47  
Cx Process

NESTEC

Tsinghua U.

Taiwan

NIST

PECI/NCRC  
Cx Projects

1965~

UK  
CIBSE/BSRIA

NEBB/AABC

DOE GSA

ASHRAE

Asia Pacific  
Conference on  
Building Cx  
(APCBC)

Hong Kong  
Bldg. Cx Center

1985~

1999~

BCA(USA)  
Total Building Cx

2006~

ICEBO

Texas  
A&M Univ.

Wisconsin  
Univ.

Laurence  
Berkley NL

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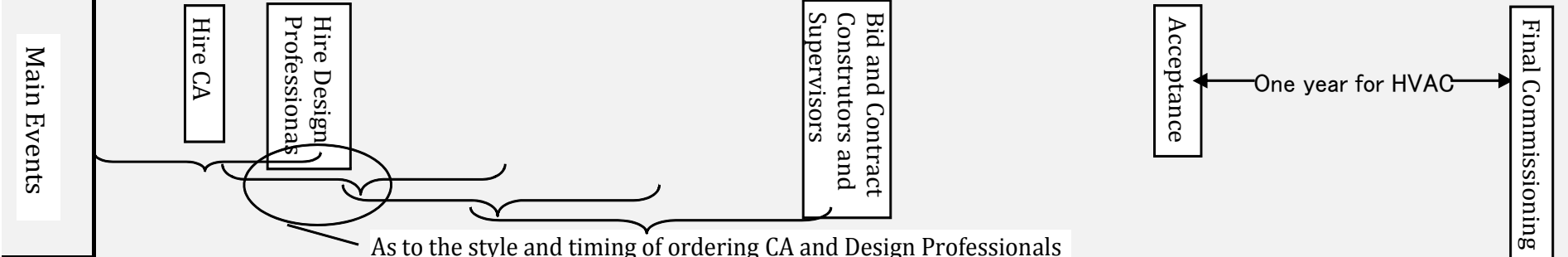
Role of BOFD and BEMS

Principle of Environmental Circle

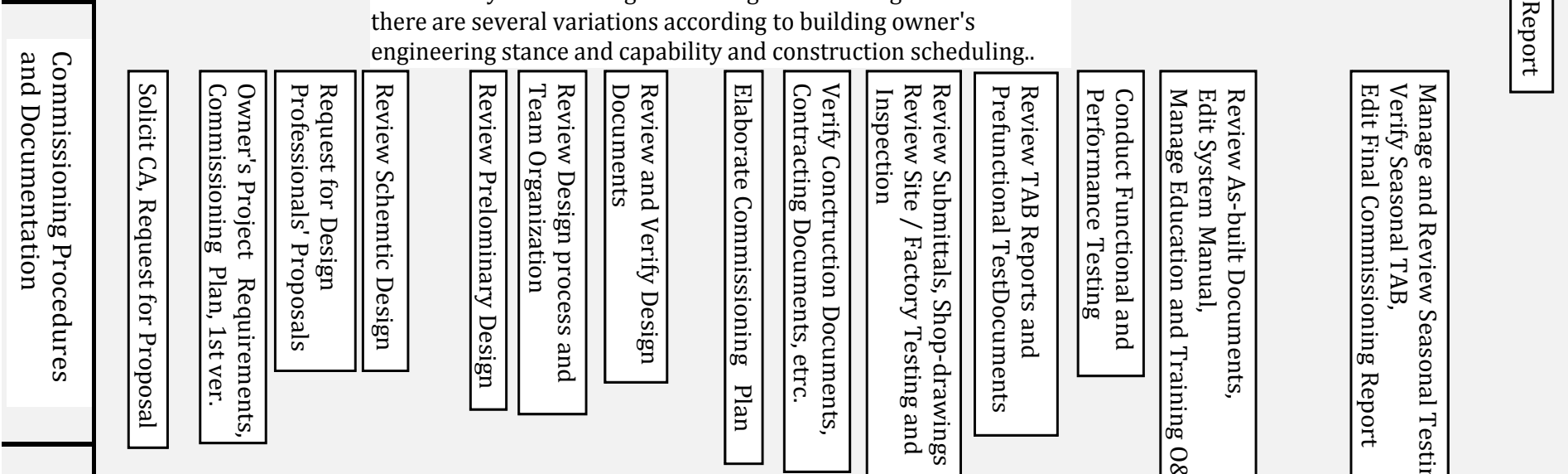
Topics on GWG issue



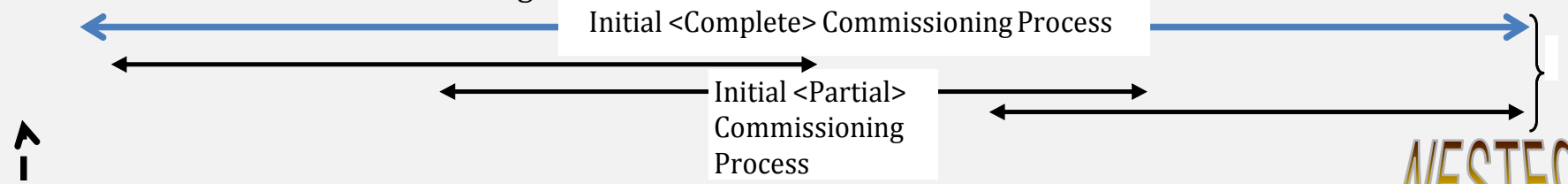
Stage	Production Stage						Oper	
Phase	Program Phase (Pre-Design Phase)		Design Phase		Elaboration Phase	Construction Phase		(Occur
Step	Program Step	Plannning Step	Preliminary Design Step	Working Design Step	Elaboration Step	Construction Step	Acceptance Step	Post-Acceptance Step



As to the style and timing of ordering CA and Design Professionals there are several variations according to building owner's engineering stance and capability and construction scheduling.



**Definition of Kinds of Commissioning**



Operation & Maintenance Stage

Operation Phase  
(Occupancy and Operations Phase)

Post-Acceptance Step

Post Post-Acceptance Step

Acceptance

One year for HVAC

Final Commissioning Report

On-going Cx Process

Continuous Commissioning

Review As-built Documents,  
Edit System Manual,  
Manage Education and Training O&M

Manage and Review Seasonal Testing,  
Verify Seasonal TAB,  
Edit Final Commissioning Report

Fault Detection, Diagnosis and  
System Optimization

Renewal and / or Large-scaled Repair

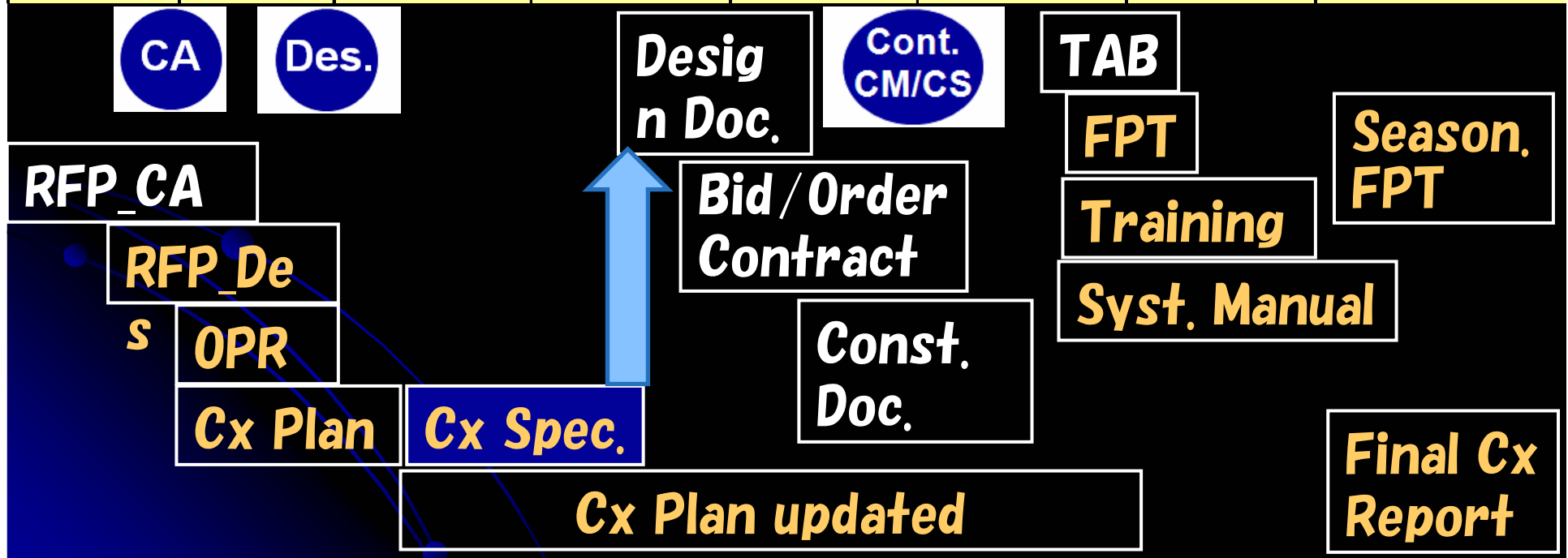
Initial Commissioning Process

Re-Commissioning



# Commissioning Process for New Construction

Production Stage							Operation Stage
Program Phase (Pre-Design Phase)		Design Phase		Elabolation Phase	Construction Phase		(Occupancy & Operation Phase)
Program Step	Planning Step	Preliminary Design Step	Working Design Step	Elabolation Step	Construction Step	Acceptance Step	Post-Acceptance Step



**Cx Meeting, Progress Report, Issue Log, Review & Verif.**



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# Why HVAC Simulations as Cx?

- **Pre-design Phase**

- To establish Project Plan and/or OPR for owner's decision-making

- **Design Phase**

- Degraded quality of Design Documents, due to

- less time
- less fee
- less skill, less training

- Electronic standard documents easily sum up enormous volume of apparently beautiful docs

- Prevailed distributed packaged system

- Order BACS design outside without sufficient spec. with narratives and flowcharts.

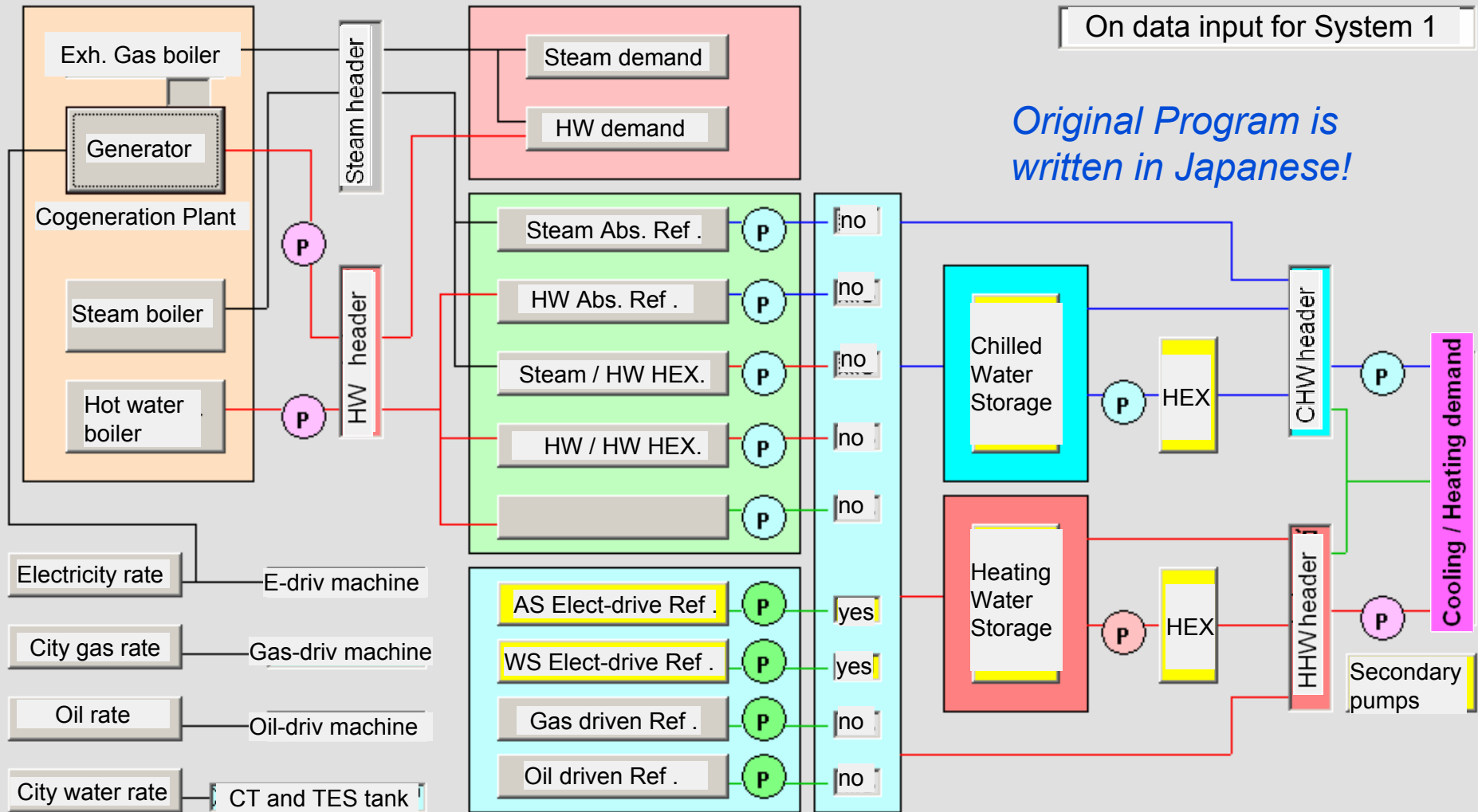
# Why Simulation and Design Cx? **cont.**

- **Design Phase** cont.

- **Calculation/Simulation Tools developed too further for designers to handle in short worktime.**
- **And yet, design professionals are erroneously too much expected to do perfect work even with insufficient fee due to excessive competition.**
- **Building owners should recognize they must anyhow pay for a good job**
- **Commissioning process during design phase should make sure of successful achievement, and that owners hire well qualified commissioning authority from the third party.**

# Energy Plant Menu of TES\_ECO

System Structuring Figure



# Energy System Options



	System feature	Combination
A0	Non-Storage Centrifugal	INV-driven Centrifugal Ref.(695RT × 4) +Boiler(5t/h × 2)
A2	Thermal Storage Centrifugal + HRHP	Centrifugal (920RT × 2)+HRHP(527/664kW) +Boiler(5t/h × 2)
B2	Thermal Storage w/CGS600kW Centrifugal + HRHP	CGS(600kW) × 2+ExAR(210RT) +Centrifugal(650RT × 2)+HRHP(527/664kW) +Boiler(4t/h × 3)
C2	Thermal Storage w/CGS300kW Centrifugal + HRHP	CGS(300kW) × 2+ExAR(100RT) +Centrifugal (700RT × 2)+HRHP(527/664kW) +Boiler(4t/h × 3)
E1	Thermal Storage E/G=2/1 Complex w/CGS600	CGS(600kW) × 2+ExAR(210RT) +Centrifugal (920RT)+HRHP(527/664kW) +AR(300RT)+Boiler(4t/h × 3)
E2	Thermal Storage E/G=1/1 Complex w/CGS600	CGS(600kW) × 2 + 台 +ExAR(210RT) +HRHP(527/664kW) +AR(630RT)+Boiler(5t/h × 3)
F	Non-Storage w/CGS600 AR E/G=0/100	CGS(600kW) × 2+ExAR(210RT) +AR(630RT × 4)+Boiler(5t/h × 5)

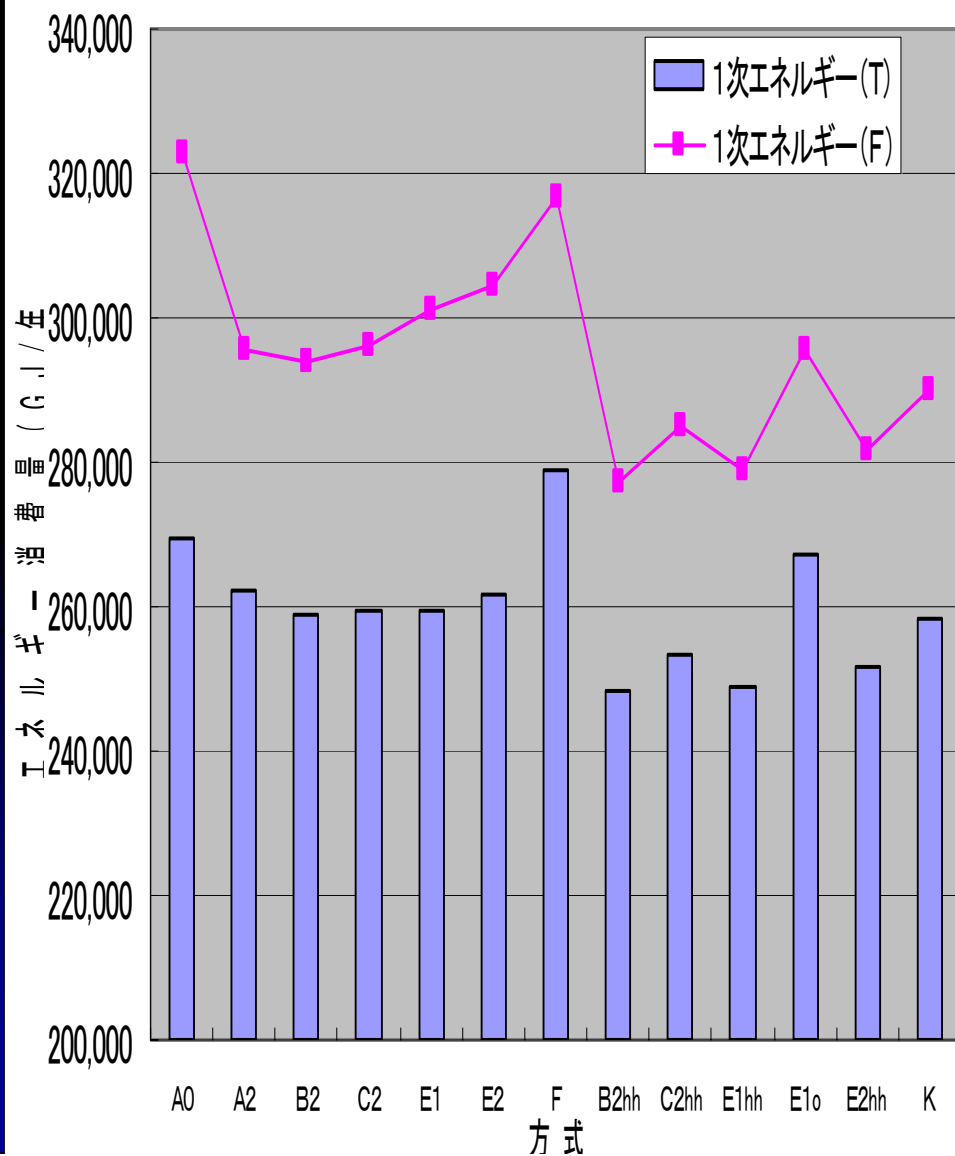
Note: HRHP: Heat Recovery Heat Pump, water source  
CGS: Co-generation system w/Exhaust gas  
ExAR: Exhausted heat driven Absorption machine



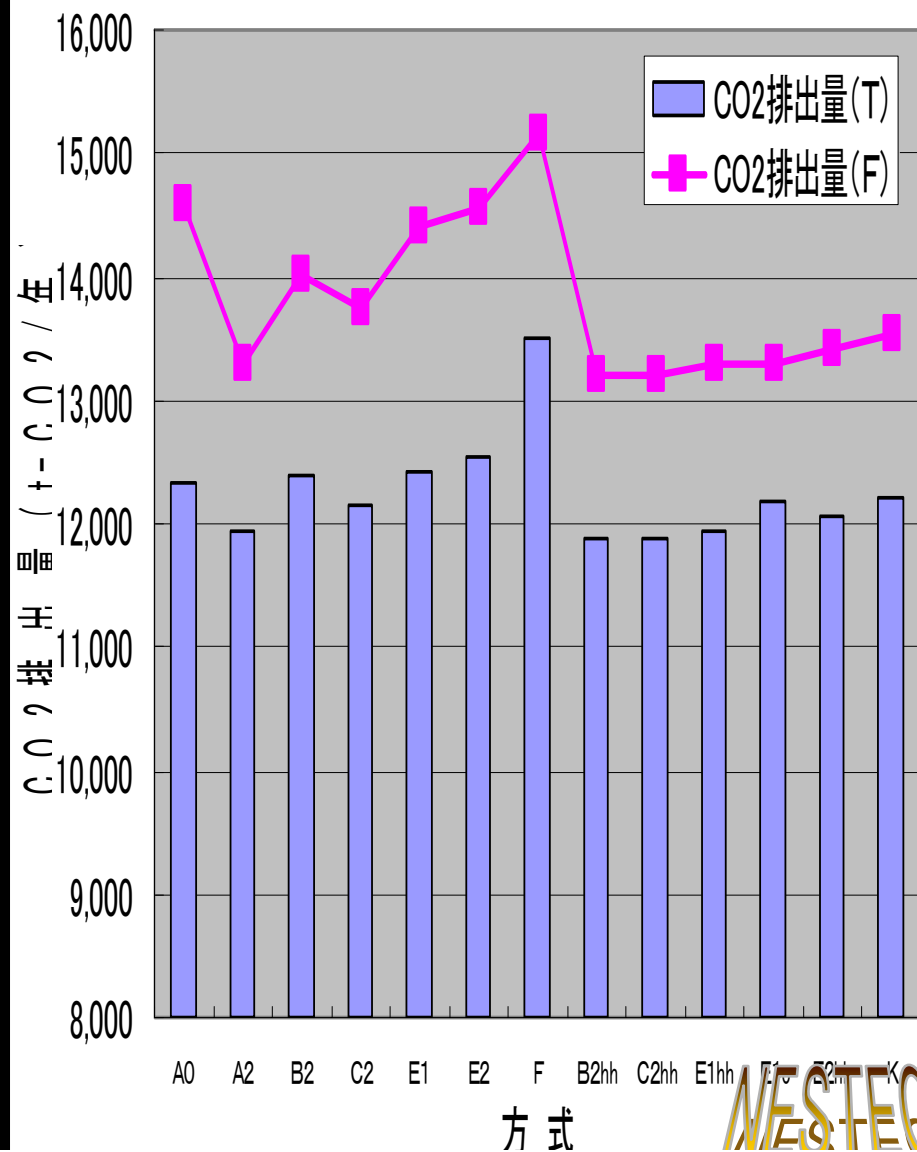
# Annual primary energy

# Annual CO2

## Primary Energy Consumption



## CO2 Exhaustion



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# Continuous Commissioning Process (ASHRAE 0-2005)

- **Continuous Commissioning Process: A continuation of the Commissioning Process well into the Occupancy and Operations Phase to verify that a project continues to meet current and evolving Owner's Project Requirements. Continuous Commissioning Process activities are on-going for the life of the facility**

# **On-Going Commissioning Process** **(ASHRAE 0-2005)**

- **On-Going Commissioning Process: A continuation of the Commissioning Process well into the Occupancy and Operations Phase to verify that a project continues to meet current and evolving Owner's Project Requirements. On-Going Commissioning Process activities occur throughout the life of the facility; some of these will be close to continuous in implementation, and others will be either scheduled or un-scheduled (as needed)**

# Re-Commissioning (ASHRAE 0-2005)

- **Re-Commissioning: An application of the Commissioning Process requirements to a project that has been delivered using the Commissioning Process. This may be a scheduled re-commissioning developed as part of an On-Going Commissioning Process, or it may be triggered by use change, operations problems, or other needs.**

# **Continual (*or continuous*) Commissioning - new definition -**

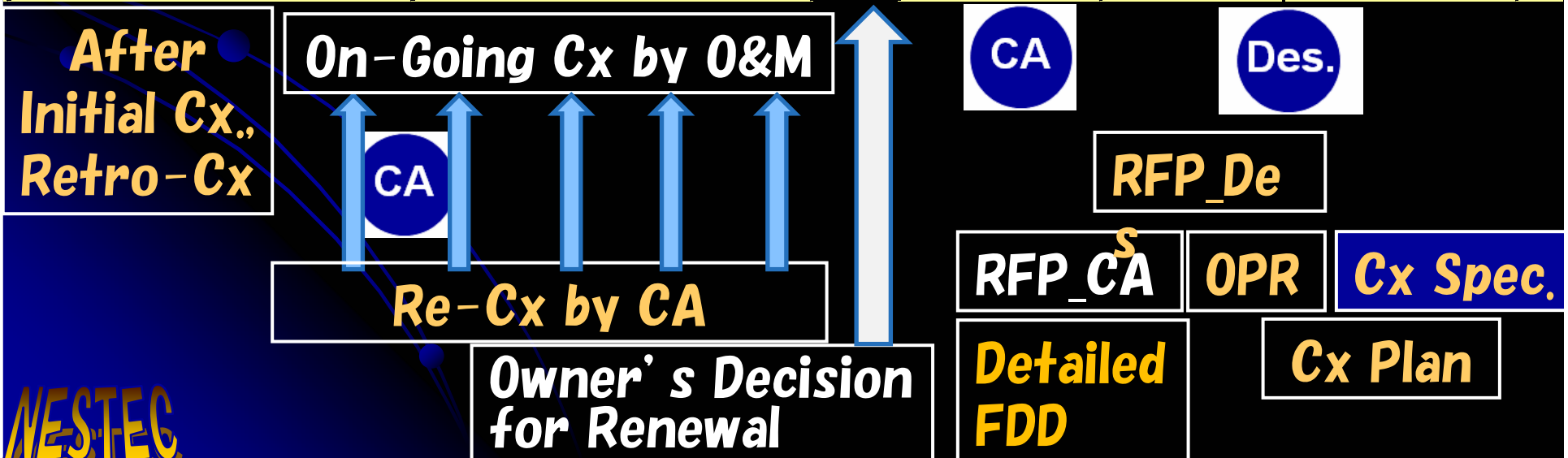
- **Continual (*or continuous*) commissioning (Cx) consists of on-going Cx carried out by O&M staff and re-Cx by commissioning professionals outside the O&M organization.**
- **The performance goal, or the kind of OPR, for a new cycle of on-going Cx is given in the report of foregoing commissioning process, i.e., either initial-Cx, retro-Cx or re-Cx process.**
- **However, the term 'continual' is just tentatively used in order not to be mistaken for the conventional meaning.**

# Continuous Commissioning for Existing Buildings

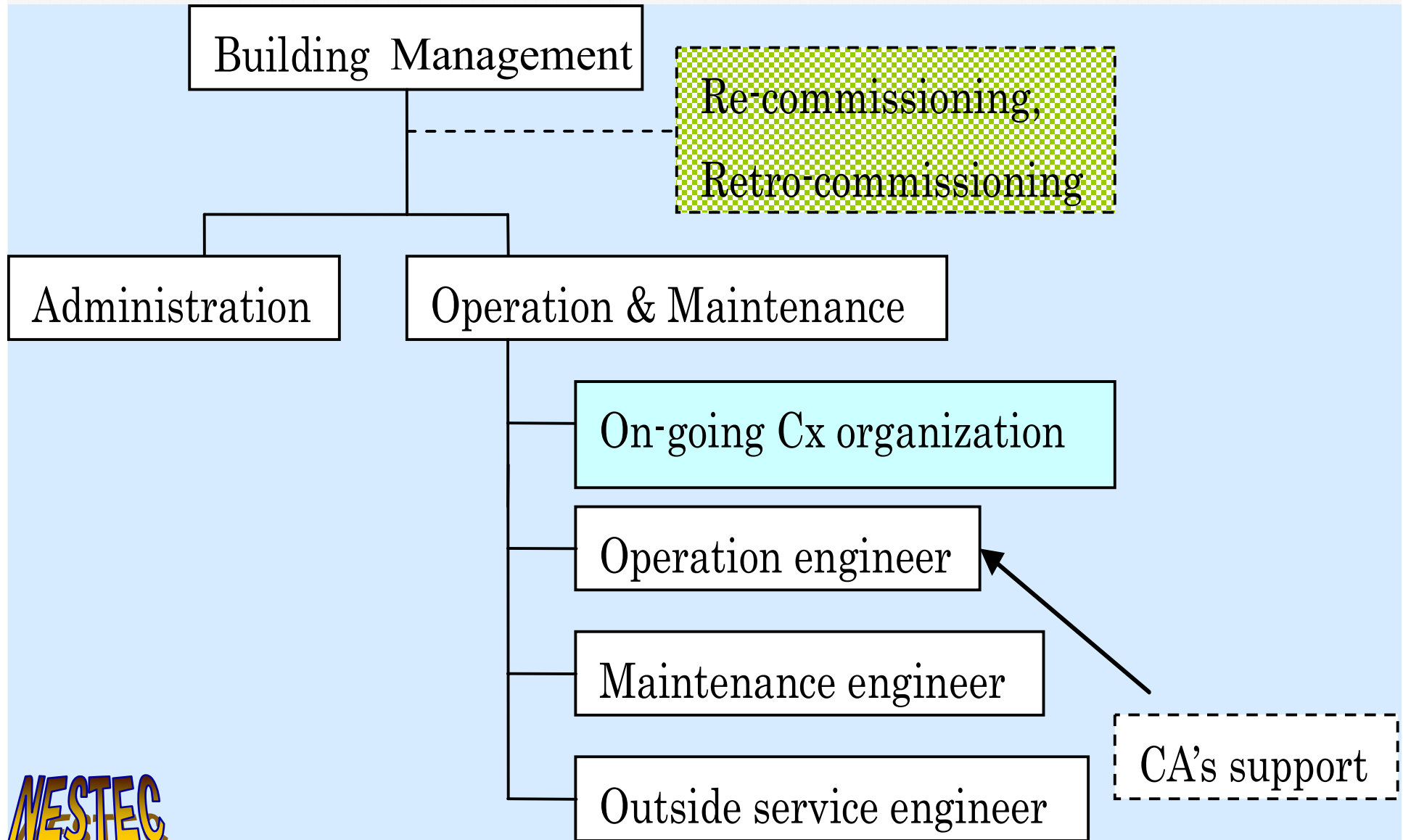
# Follow Initial Cx Process

**Renewal Process**

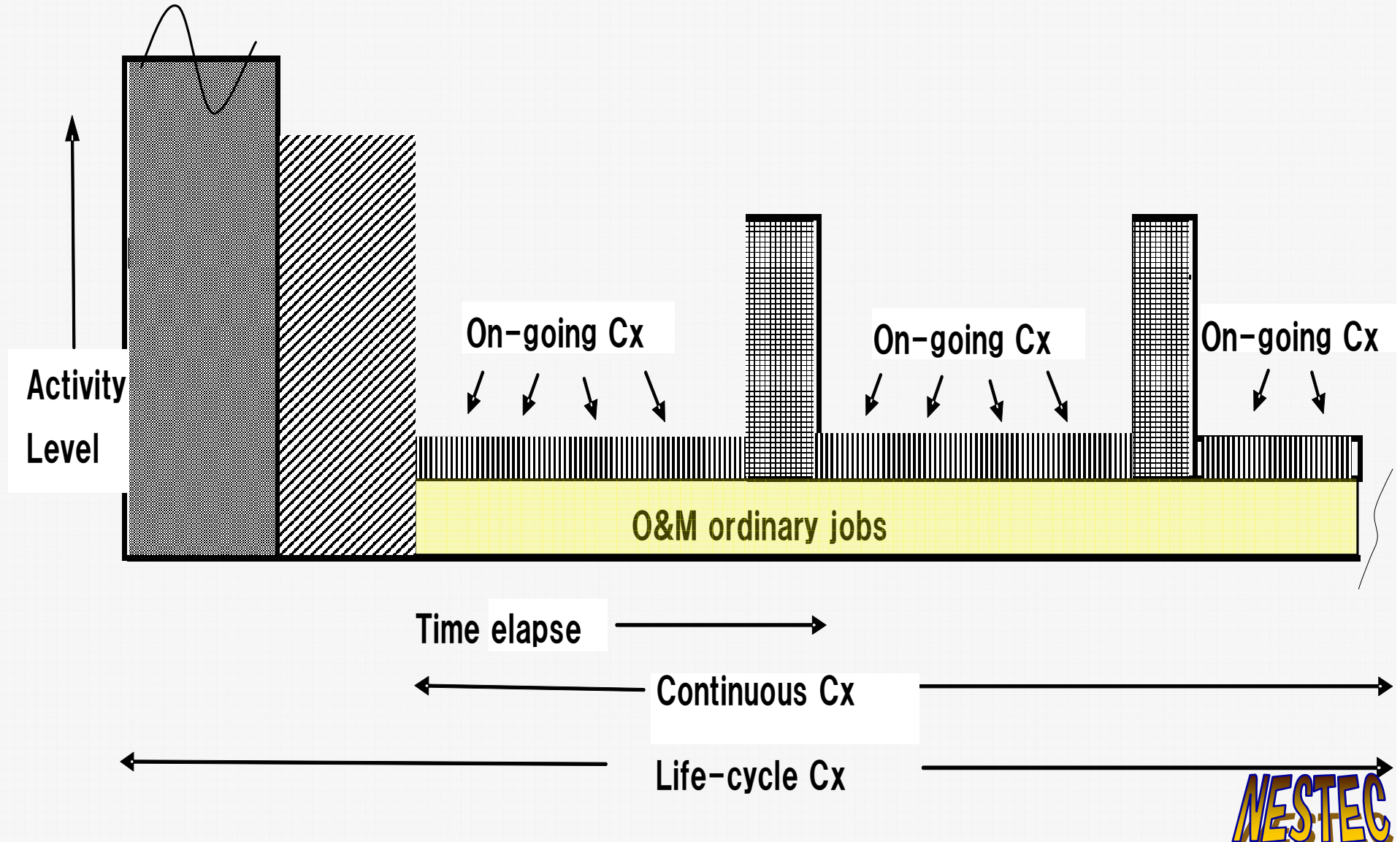
Operation and Maintenance Stage		Program Phase (Pre-Design Phase)			
(Occupancy & Operation Phase)		Design Phase			
Post-Acceptance Step	Post-Post-Acceptance Step	Program Step	Planning Step	Preliminary Design Step	Design Step



# O&M's Organization for Building Services Systems



# Relation among Commission Types and Structure of Continuous Cx



# On-going Commissioning Process Phases

Preparation Phase

Acceptance of documents on TAB and FPT reports, system manual and special notice from foregoing Cx process

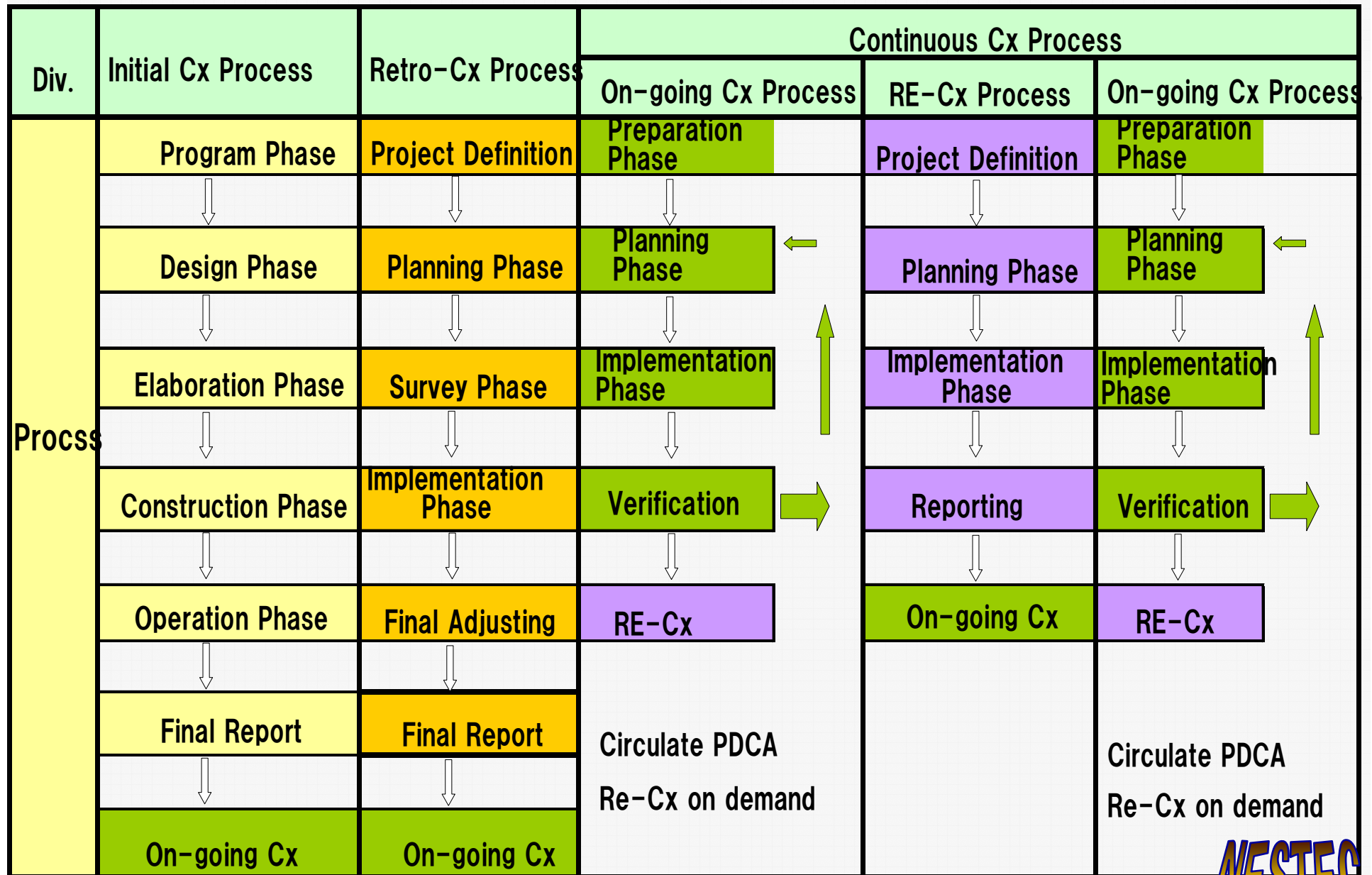
Planning phase

Goal of the Performance index, Method of data acquisition and analysis, Cx organization

Implementation Phase

O&M activities, Monitoring and data analysis, Verification of the analyzed results, Check performance, Report to owner, Fault detection, diagnosis and recovery

# Life-cycle Commissioning



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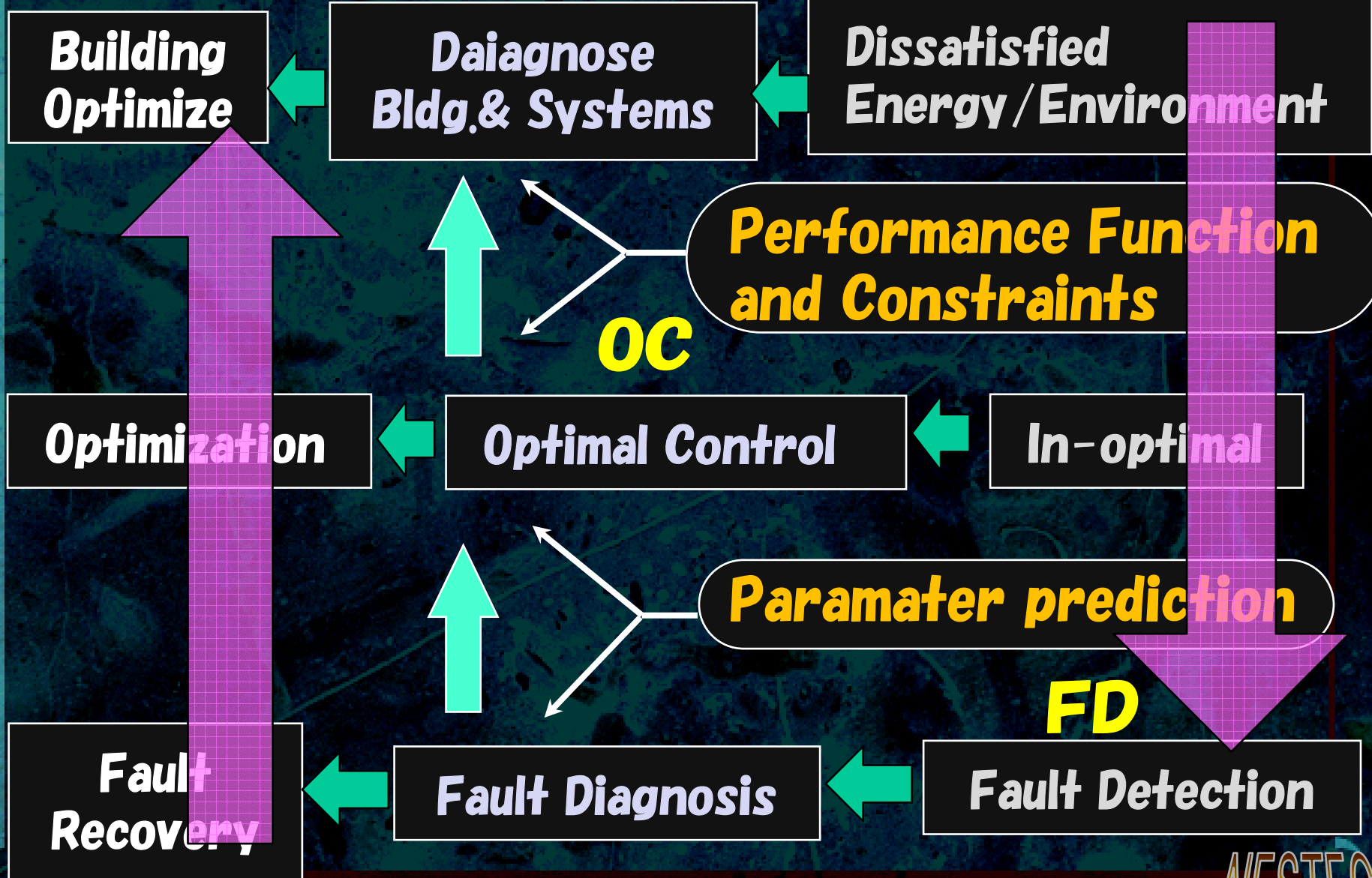
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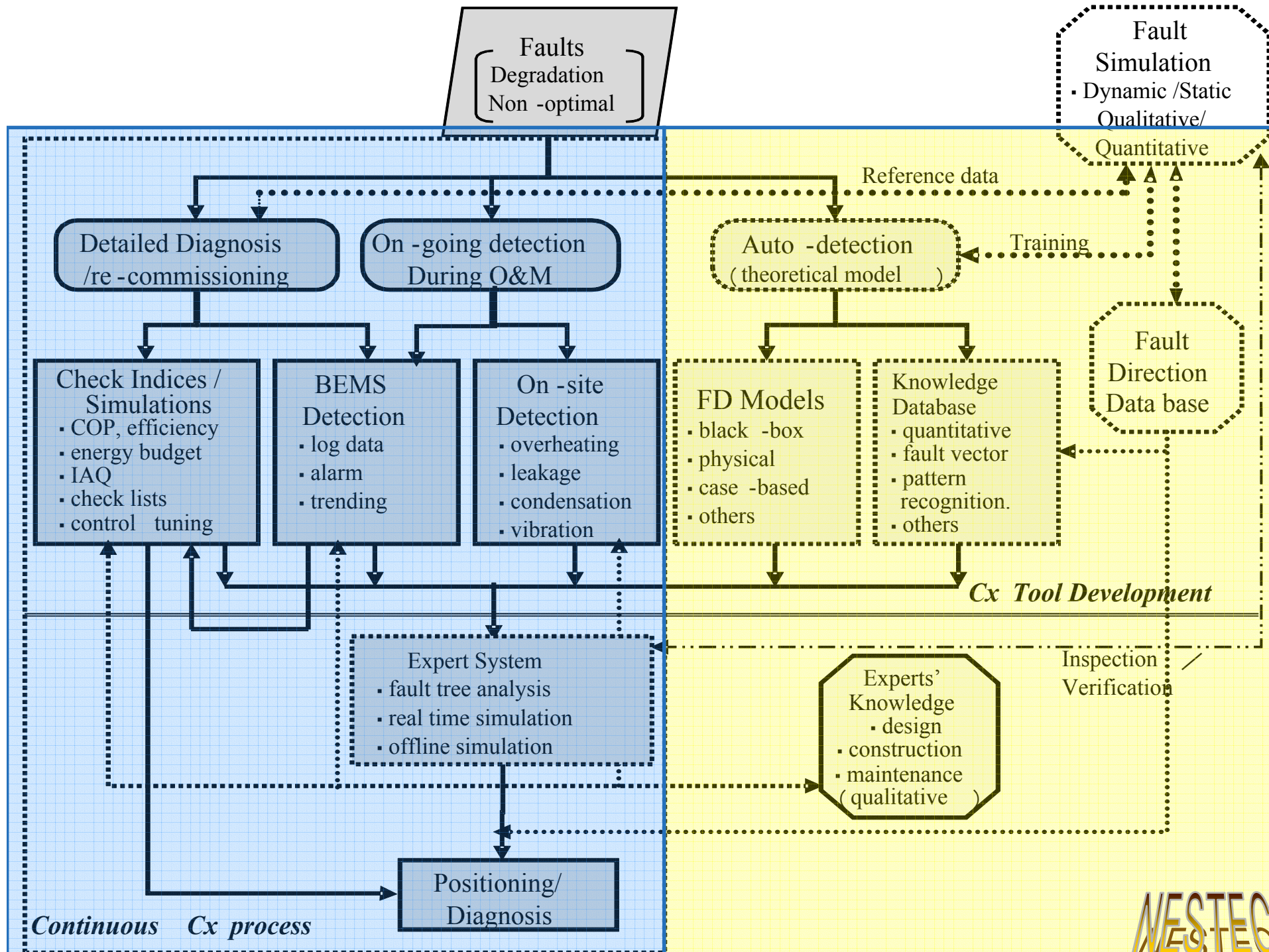
**Principle of Environmental Circle**

**Topics on GWG issue**

# BOFDD

**BO**





# Composition of BEMS

**BEMS /  
BACS**

**EMS  
(Energy  
Management)**

**BAS  
(Building  
Automation)**

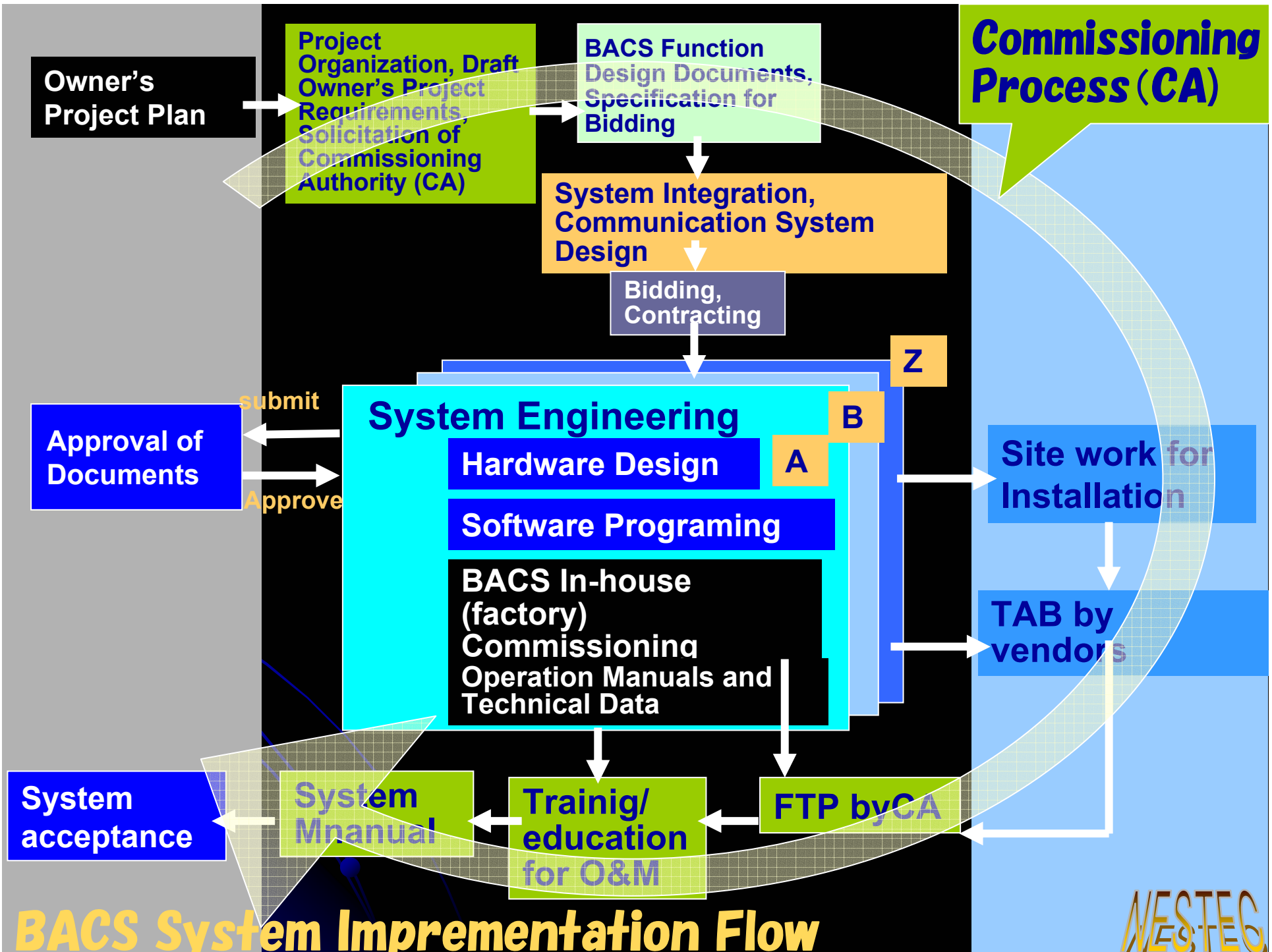
**BMS  
(Building  
Management)**

**HVAC ACS  
(Automatic Control)**

**BOFDD /  
Cx**

**HVAC / Building  
Systems**

**FDS  
Fire / Disaster  
Prevention & Security**



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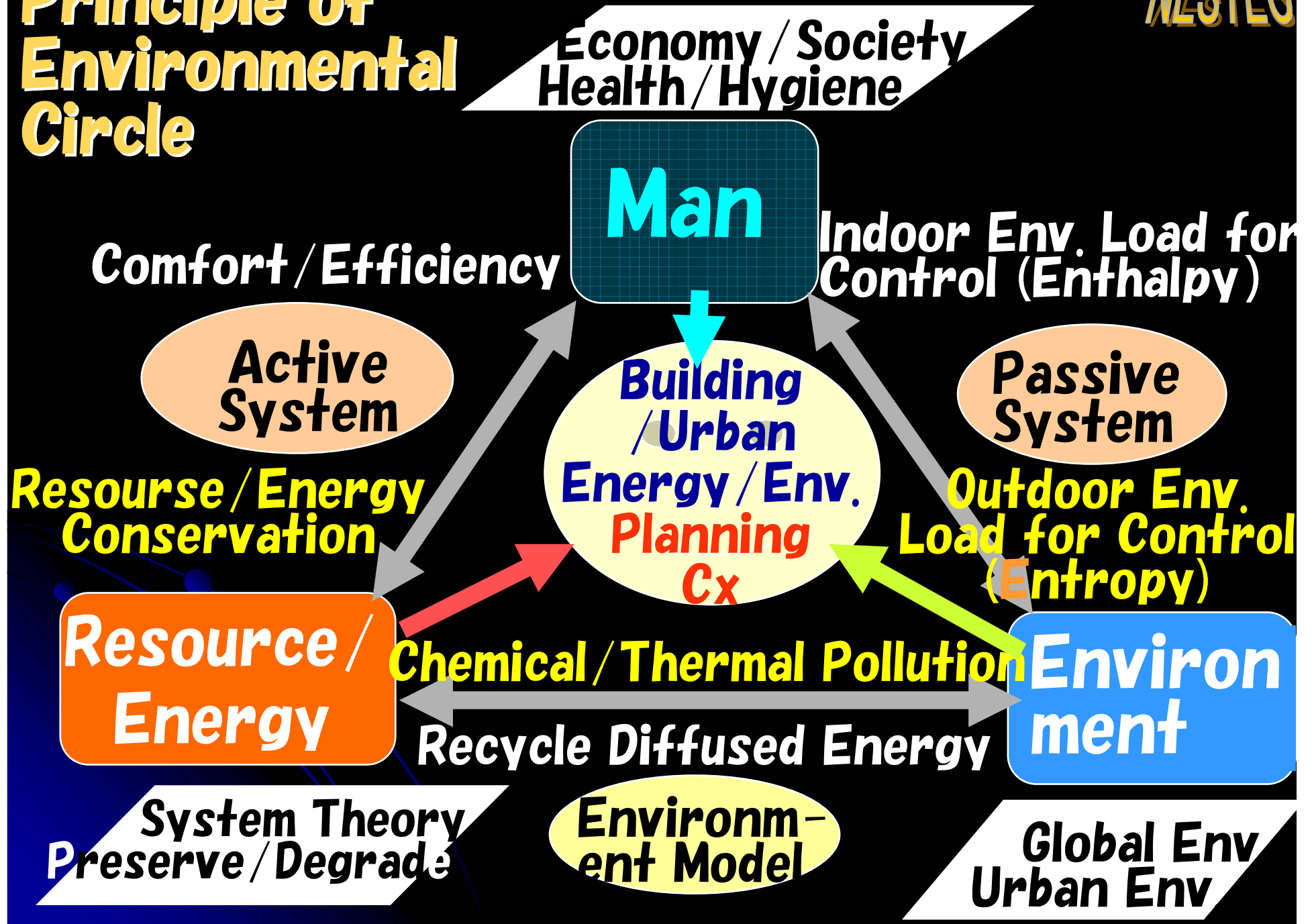
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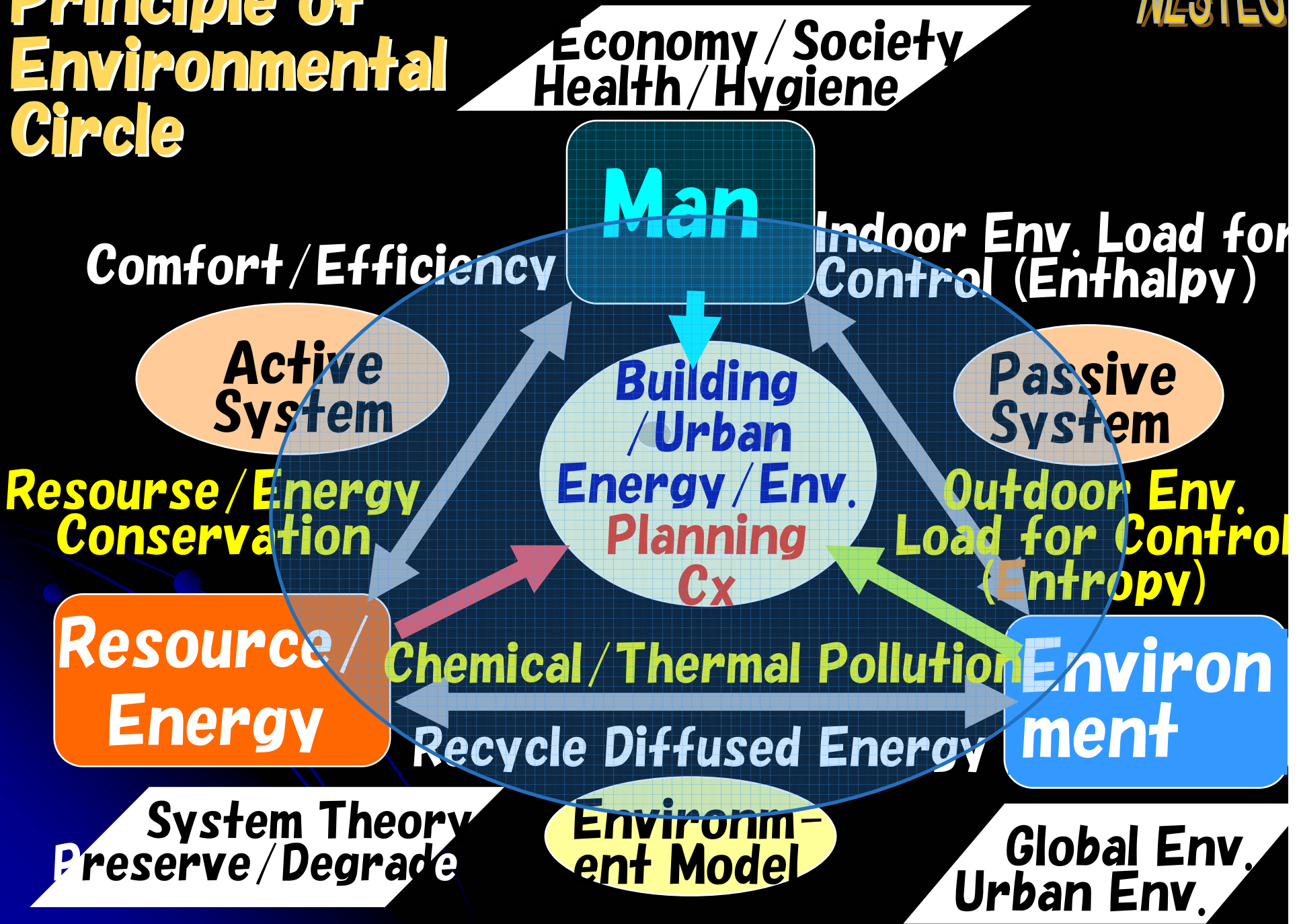
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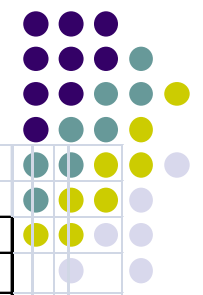
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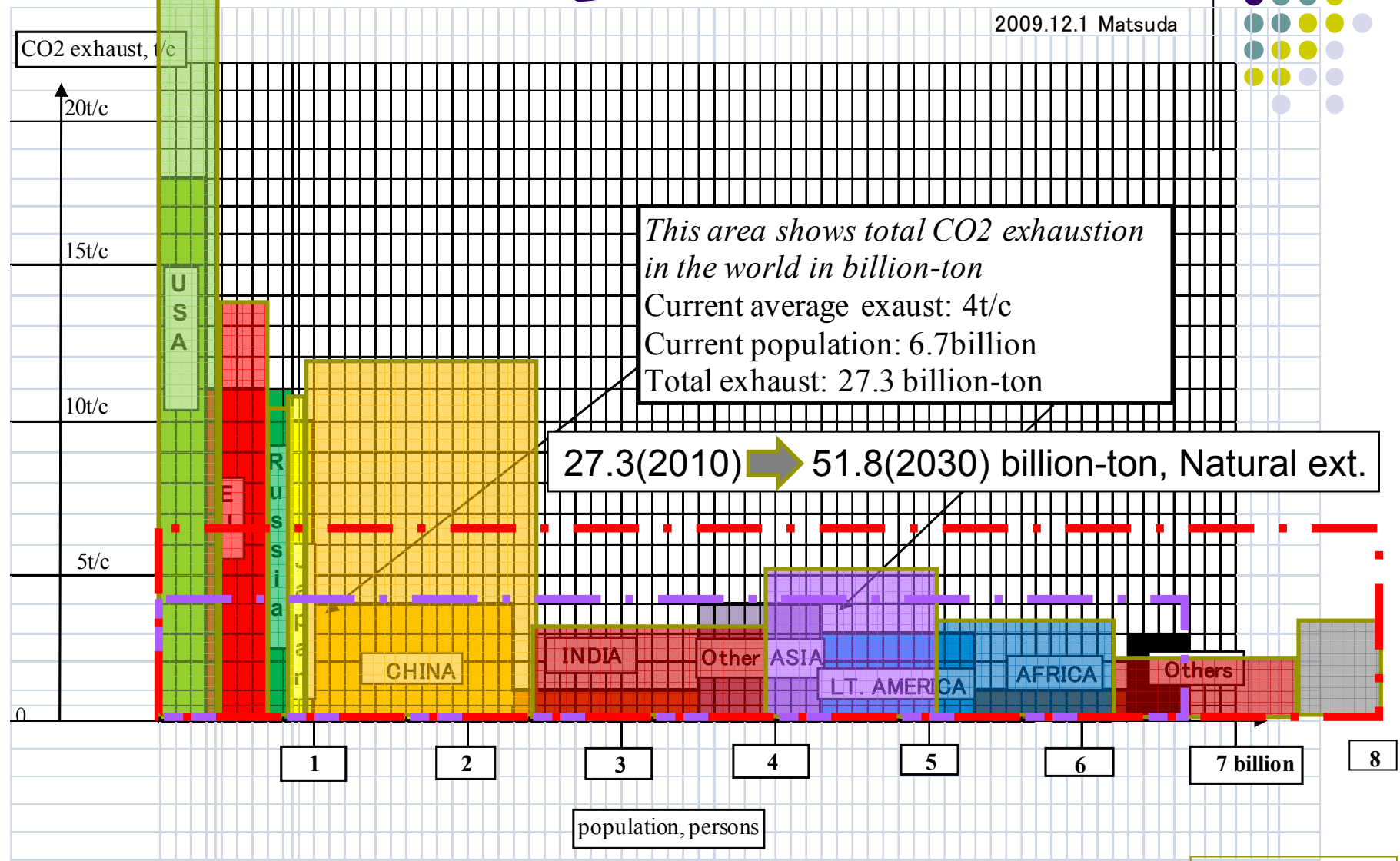
# Principle of Environmental Circle



# World CO<sub>2</sub> Exhaustion



2009.12.1 Matsuda

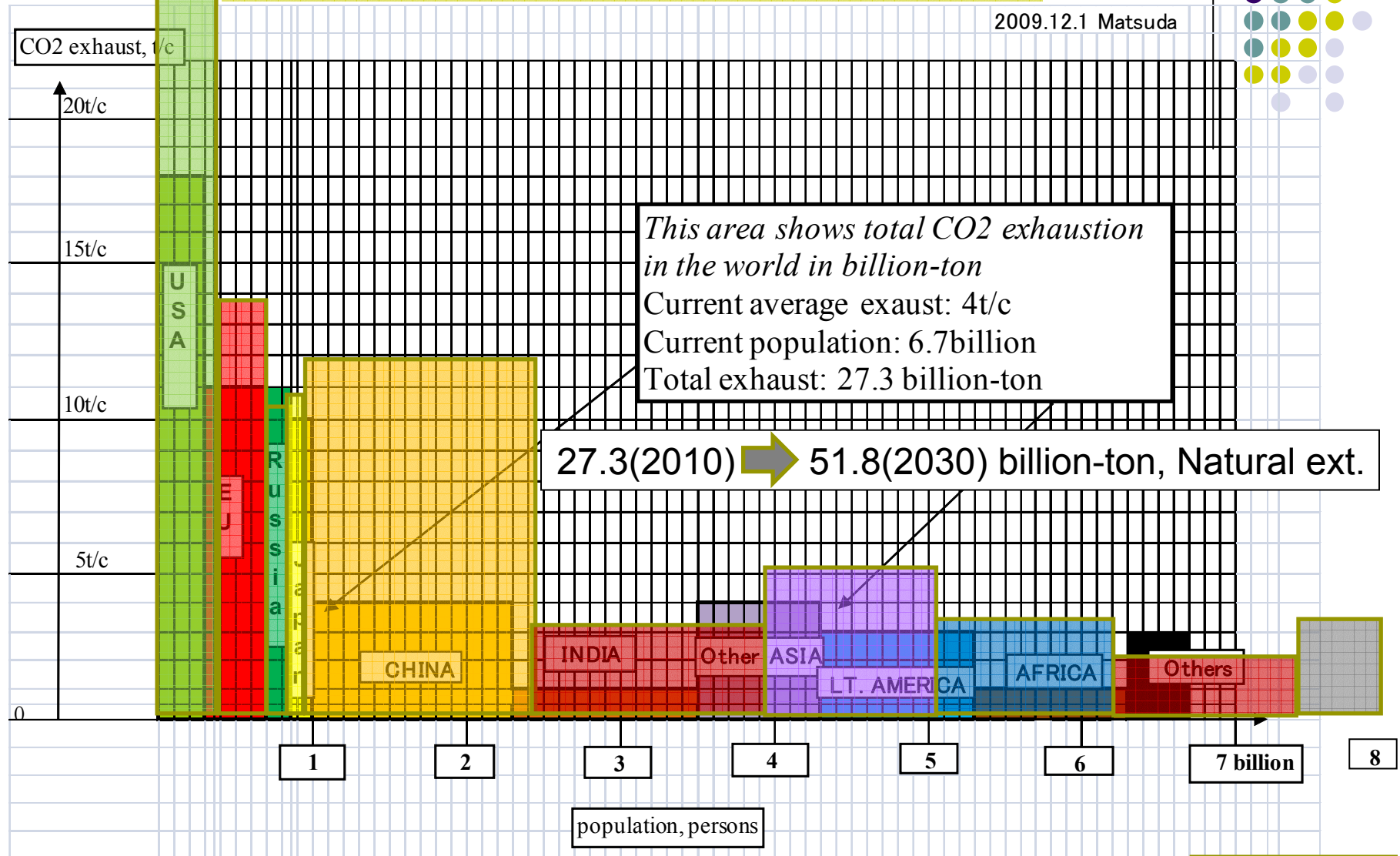
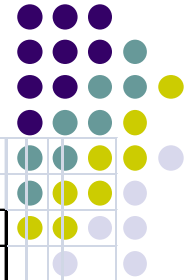


N. Matsuda



# World CO<sub>2</sub> Exhaustion

2009.12.1 Matsuda



N. Matsuda



# Conclusions

- **Continuous Cx in lifecycle view was introduced together with Cx activity in Japan and international viewpoint.**
- **HVAC simulation tools shall be used both at the initial Cx at pre-design phase and design phase for OPR and design review, and during the continual Cx for BOFD and optimal operation.**
- **On-going realization of building energy efficiency cannot be achieved without involving O&M's Cx activity.**
- **Continuous, or continual, Cx is newly defined as the combination of on-going Cx by O&M and re-Cx by Cx professionals.**

# Conclusions - continued

- **The new definition will give O&M staff a strong motivation for their jobs, while they should be fairly paid for their contribution. To energy and cost saving.**
- **Continual Cx, whether it follows the initial Cx or not, is most desirable to achieve the global goal for energy conservation.**
- **BEMS, or BACS, shall be well designed and commissioned in order to fully use as the continual Cx tool together with simulations.**
- **Principle of Environmental Circle, together with global warming gas issue, was discussed.**

**Thank you  
for your kind attention!**

**See you at the next meeting.**

**NESTEC**