



**New Buildings Energy Renovation Business Models
incorporating dual energy services**

Lifecycle performance of building energy upgrade technologies

ANNEX:

**TECHNOLOGY KITS FOR ENERGY EFFICIENCY AND
DEMAND RESPONSE STRATEGIES**



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

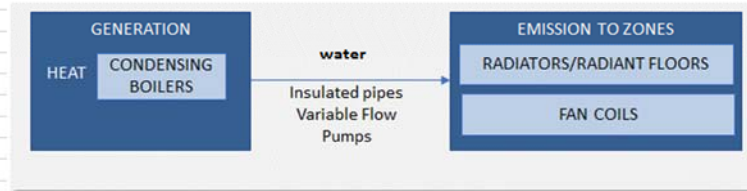
DUAL DR& EE KIT

Gas Boilers with all water system

Energy source

Gas

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	LOW
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	LOW
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES

Independent systems:
Fuel generator
PV
Battery

DR STRATEGIES

Sell PV/fuel generator electricity to the grid
Store electricity to the battery
Use/Sell to the grid electricity from battery

APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES

Water tank
Borehole

DR STRATEGIES

Store heat in the water tank/borehole
Use heat from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats;
Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors.
Remote actuators

Temperature probes,
Water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators;

IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for boiler controls / storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for boiler controls / storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

DUAL DR& EE KIT	CHP with all water system		
Energy source	Gas		
HVAC SCHEMA			
HVAC DR STRATEGIES			
CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	LOW
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	LOW
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW
COMBINATION WITH OTHER SYSTEMS			
APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	PV Battery	DR STRATEGIES	Sell PV/CHP electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat in the water tank/borehole Use heat from the water tank/borehole
IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Water flow probes Remote actuators	Temperature probes Flow probes Remote actuators;
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for CHP controls / storage control		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for CHP controls / storage control and DSR interface		



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

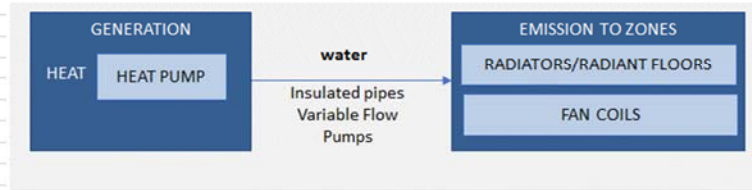
DUAL DR& EE KIT

Heat pump with all water system

Energy source

Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the HP Sell PV/ fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat in the water tank/borehole Use heat from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Water flow probes Remote actuators	Temperature probes Flow probes Remote actuators; Electric energy production and consumption smart meters
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IMPLICIT BEMS TECHNOLOGIES

BEMS with AM and modbus or analogue interface for HP controls / storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AM and modbus or analogue interface for HP controls / storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED COOLING SYSTEM

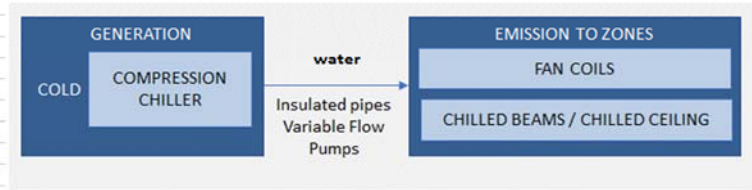
DUAL DR& EE KIT

Compression chiller with all water system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the chiller Sell PV/fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Cold Water tank Borehole	DR STRATEGIES	Store cold in the watertank/ borehole Use cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
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IMPLICIT BEMS TECHNOLOGIES

BEMS with AM and BMS controls over chillers or BEM with AM and BMS with controls over HVA temperature setpoints; Modbus interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems



Technologies for EE and DR strategies

CENTRALIZED COOLING SYSTEM

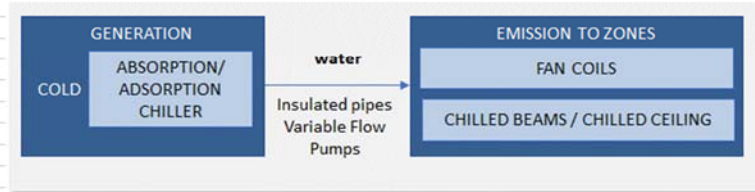
DUAL DR& EE KIT

Absorption/adsorption chiller with all water system

Energy source

Solar thermal or waste heat

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	LOW
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	LOW
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Independent systems: Fuel generator PV Battery	DR STRATEGIES	Sell PV/fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Solar Thermal collectors+water tank Water tank Borehole	DR STRATEGIES	Heat from thermal collectors is the energy source for absorption chillers Store cold in the water tank/borehole Use cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AM and BMS controls over chillers or BEM with AM and BMS with controls over HVA temperature setpoints		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems		



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

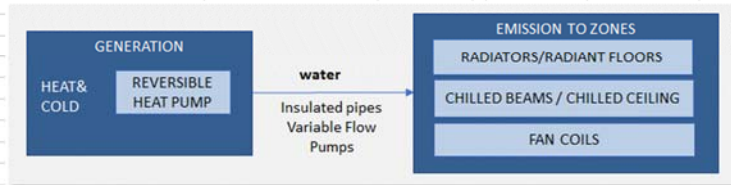
DUAL DR& EE KIT

Reversible heat pumps with all water system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling / Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the HP Sell PV/Fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and BMS controls over HP or BEM with AMI and BMS with controls over HP temperature setpoints		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems		



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

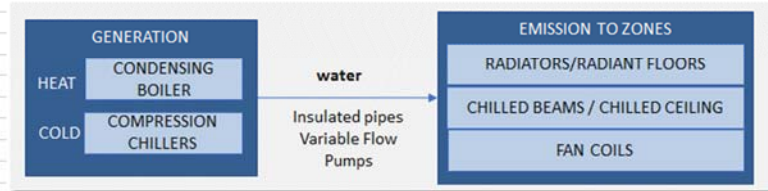
DUAL DR& EE KIT

Boiler and chiller with all water system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling / Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	MODERATE
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	MODERATE
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the Chiller Sell PV/Fuel Generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
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IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

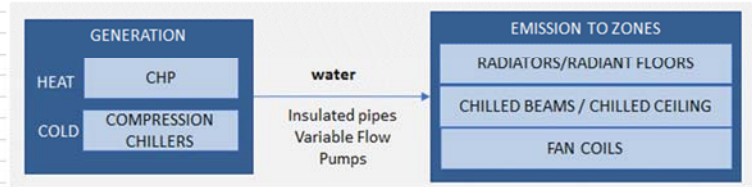
DUAL DR& EE KIT

CHP and chiller with all water system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling / Pre-heating	Reducing pump flow rate Pump shut-down Increasing/decreasing supply water temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	MODERATE
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	MODERATE
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	PV Battery	DR STRATEGIES	Sell PV/CHP electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats;
Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors.
Remote actuators

Temperature probes,
water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators
Electric energy production and consumption smart meters

IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

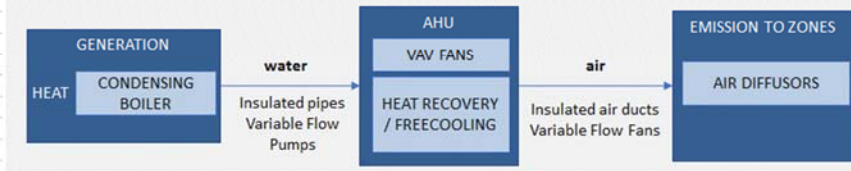
DUAL DR& EE KIT

Gas Boilers with water-air system

Energy source

Gas

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL

STRATEGY AT THERMAL ZONE

STRATEGY AT DISTRIBUTION /AHU

STRATEGY AT GENERATION

DR STRATEGY

Global or zonal temperature setpoint adjustment
Space Pre-heating

Complete control AHU
Primary System: Reducing pump flow rate; Pump shut-down; Increasing/decreasing supply water temperature
Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature

Interruption of loads
Reduction to partial load
Time control schedules for the systems
Control water flow rate
Increasing/decreasing supply water temperature

SUITABILITY FOR IMPLICIT DR

MODERATE

MODERATE

LOW

SUITABILITY FOR EXPLICIT DR

MODERATE

MODERATE

LOW

IMPACT ON EE

HIGH

HIGH

HIGH

CONTROL ON COMFORT CONDITIONS

HIGH

LOW

LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES

Independent systems:
Fuel generator
PV
Battery

DR STRATEGIES

Sell PV/Fuel generator electricity to the grid
Store electricity to the battery
Use/Sell to the grid electricity from battery

APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES

Water tank
Borehole

DR STRATEGIES

Store heat in the water tank/borehole
Use heat from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors
Remote actuators.

Temperature probes,
Water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators

IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

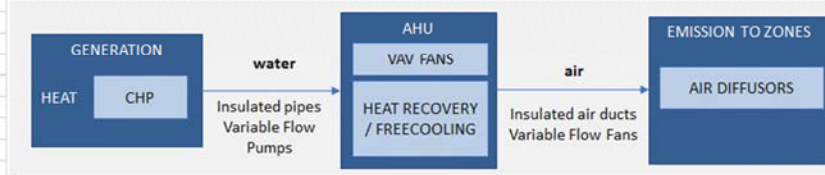
DUAL DR& EE KIT

CHP with water-air system

Energy source

Gas

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION /AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-heating	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing/decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	LOW
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	LOW
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES

PV
Battery

DR STRATEGIES

Sell PV/CHP electricity to the grid
Store electricity to the battery
Use/Sell to the grid electricity from battery

APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES

Water tank
Borehole

DR STRATEGIES

Store heat in the water tank/borehole
Use heat from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors
Remote actuators.

Temperature probes,
Water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators

IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and modbus or analogue interface for storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEMS

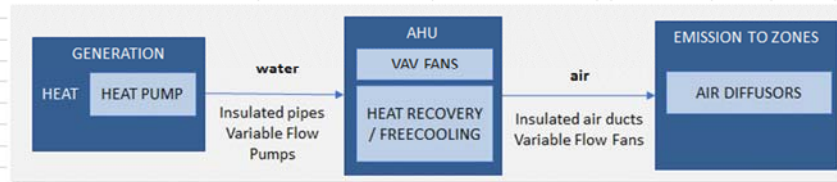
DUAL DR& EE KIT

Heat pump with water-air system

Energy source

Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION / AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-heating	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing /decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from electric grid Sell PV/Fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Energy consumption meter
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats;
Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors.
Remote actuators

Temperature probes,
Water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators
Electric energy production and consumption smart meters

IMPLICIT BEMS TECHNOLOGIES

BEMS with AM and modbus or analogue interface for HP controls / storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AM and modbus or analogue interface for HP controls / storage control and DSR interface



Technologies for EE and DR strategies

CENTRALIZED COOLING SYSTEM

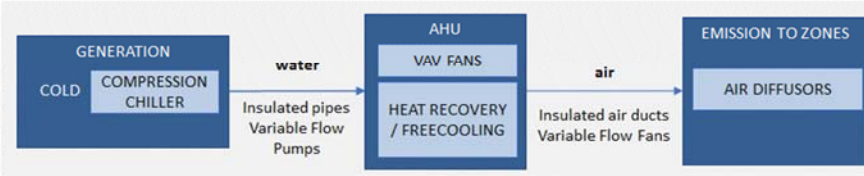
DUAL DR& EE KIT

Chiller with water-air system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION /AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space Pre-cooling	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing/decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES

Fuel generator
PV
Battery

DR STRATEGIES

Use electricity from generator/PV instead of from electric grid
Sell PV/Fuel generator electricity to the grid
Store electricity to the battery
Use/Sell to the grid electricity from battery

APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES

Cold Water tank
Borehole

DR STRATEGIES

Store cold in the watertank/ borehole
Use cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats;
Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO₂ and VOC sensors.
Remote actuators

Temperature probes,
Water flow probes
Remote actuators

Temperature probes
Flow probes
Remote actuators
Electric energy production and consumption smart meters

IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and BMS controls over chillers or BEM with AMI and BMS with controls over HVA temperature setpoints; Modbus interface for storage control

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

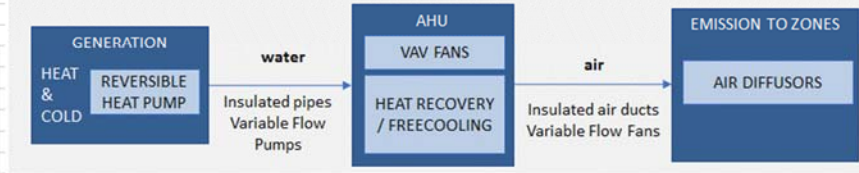
DUAL DR& EE KIT

Reversible heat pumps with water-air system

Energy source

Gas/Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION /AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating/ pre-cooling	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing/ decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/ decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from electric grid Sell PV electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
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IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and BMS controls over HP or BEM with AMI and BMS with controls over HVA temperature setpoints

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

DUAL DR& EE KIT	<i>Boiler and chillers with water-air system</i>		
Energy source	Gas/Electricity		
HVAC SCHEMA			
HVAC DR STRATEGIES			
CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION /AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating/ pre-cooling	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing/ decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/ decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	MODERATE
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	MODERATE
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW
COMBINATION WITH OTHER SYSTEMS			
APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from PV/Generator instead of from electric grid as energy source for the Chiller Sell PV/Generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole
IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for storage control		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for storage control and DSR interface		



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEMS

DUAL DR& EE KIT	CHP and chillers with water-air system		
Energy source	Gas/Electricity		
HVAC SCHEMA			
HVAC DR STRATEGIES			
CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION /AHU	STRATEGY AT GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating/ pre-cooling	Complete control AHU Primary System: Reducing pump flow rate; Pump shut-down; Increasing/ decreasing supply water temperature Secondary System: Reducing fans flow rate; Fans shut-down; Increasing/ decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control water flow rate Increasing/decreasing supply water temperature
SUITABILITY FOR IMPLICIT DR	MODERATE	MODERATE	MODERATE
SUITABILITY FOR EXPLICIT DR	MODERATE	MODERATE	MODERATE
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW
COMBINATION WITH OTHER SYSTEMS			
APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	PV Battery	DR STRATEGIES	Use electricity from PV/CHP instead of from electric grid as energy source for the Chiller Sell PV/CHP electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	Water tank Borehole	DR STRATEGIES	Store heat/cold in the water tank/borehole Use heat/cold from the water tank/borehole
IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Water flow probes Remote actuators	Temperature probes Flow probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for CHP and chiller controls / storage control		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and modbus or analogue interface for CHP and chiller controls / storage control and DSR interface		



Technologies for EE and DR strategies

CENTRALIZED HEATING SYSTEM

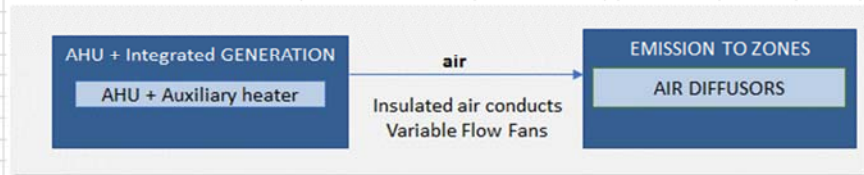
DUAL DR& EE KIT

Air Units with integrated heat generation

Energy source

Electricity

HVAC SCHEMA



HVAC DR STRATEGIES

CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT AHU/GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating	Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control air flow rate Increasing/decreasing supply air temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	MODERATE
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW

COMBINATION WITH OTHER SYSTEMS

APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the heater and fans Sell PV/Fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	NA	DR STRATEGIES	NA

IMPLICIT ICT TECHNOLOGIES

Advanced metering infrastructure.
User displays and energy analytics applications;

EXPLICIT ICT TECHNOLOGIES

Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Remote actuators	Temperature probes Remote actuators Electric energy production and consumption smart meters
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IMPLICIT BEMS TECHNOLOGIES

BEMS with AMI and BMS controls over AHU or BEM with AMI and BMS with controls over HVA temperature setpoints

EXPLICIT BEMS TECHNOLOGIES

BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems



Technologies for EE and DR strategies

CENTRALIZED COOLING SYSTEM

DUAL DR& EE KIT	<i>Air Units with integrated cold generation</i>		
Energy source	Electricity		
HVAC SCHEMA			
HVAC DR STRATEGIES			
CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT AHU/GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating	Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control air flow rate Increasing/decreasing supply air temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW
COMBINATION WITH OTHER SYSTEMS			
APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the compressor and fans. Sell PV/Fuel generator electricity to the grid Store electricity to the battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	NA	DR STRATEGIES	NA
IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Remote actuators	Temperature probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and and BMS controls over AHU or BEM with AMI and BMS with controls over HVA temperature setpoints		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems		



Technologies for EE and DR strategies

CENTRALIZED HVAC SYSTEM

DUAL DR& EE KIT	<i>Air Units with integrated heat and cold generation</i>		
Energy source	Electricity		
HVAC SCHEMA			
HVAC DR STRATEGIES			
CONTROL LEVEL	STRATEGY AT THERMAL ZONE	STRATEGY AT DISTRIBUTION	STRATEGY AT AHU/GENERATION
DR STRATEGY	Global or zonal temperature setpoint adjustment Space pre-heating	Reducing fans flow rate; Fans shut-down; Increasing/decreasing supply air temperature	Interruption of loads Reduction to partial load Time control schedules for the systems Control air flow rate Increasing/decreasing supply air temperature
SUITABILITY FOR IMPLICIT DR	HIGH	HIGH	HIGH
SUITABILITY FOR EXPLICIT DR	HIGH	HIGH	HIGH
IMPACT ON EE	HIGH	HIGH	HIGH
CONTROL ON COMFORT CONDITIONS	HIGH	LOW	LOW
COMBINATION WITH OTHER SYSTEMS			
APPLICABLE ELECTRIC GENERATION AND STORAGE TECHNOLOGIES	Fuel generator PV Battery	DR STRATEGIES	Use electricity from generator/PV instead of from grid as energy source for the HP and fans. Sell PV/Fuel generator electricity to the grid Store electricity to the battery Use/Sell to the grid electricity from battery
APPLICABLE THERMAL GENERATION AND STORAGE TECHNOLOGIES	NA	DR STRATEGIES	NA
IMPLICIT ICT TECHNOLOGIES	Advanced metering infrastructure. User displays and energy analytics applications;		
EXPLICIT ICT TECHNOLOGIES	Smart Thermostats; Remote sensors: temperature sensors; occupancy sensors; humidity sensors; CO ₂ and VOC sensors. Remote actuators	Temperature probes, Remote actuators	Temperature probes Remote actuators Electric energy production and consumption smart meters
IMPLICIT BEMS TECHNOLOGIES	BEMS with AMI and BMS controls over AHU or BEM with AMI and BMS with controls over HVA temperature setpoints		
EXPLICIT BEMS TECHNOLOGIES	BEMS with AMI and Modbus or analogue interfaces with DSR platform and Modbus or analogue interface for BMS and Storage systems		