

12th ECCRIA CONFERENCE

Cardiff University, Cardiff, UK
5th-7th September 2018

The role of buildings in future energy thinking

Zero carbon; Low energy; Zero energy; Near-zero energy; Energy positive

Phil Jones



- Globally, 50% of energy used in buildings
- Potential to reduce demand
- Also to generate and store energy at building scale

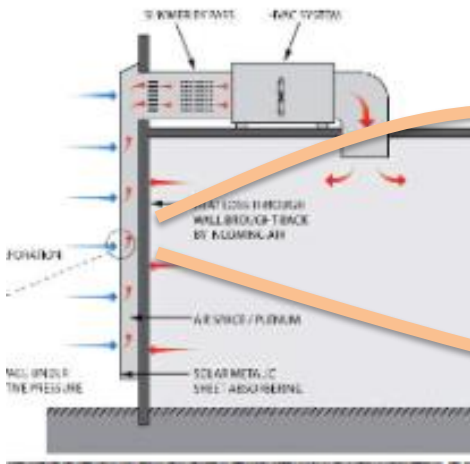




Energy Generating Building Envelopes

Solar PV and Solar thermal

LCRI LOW CARBON RESEARCH INSTITUTE



HOUSE

BON - LOW COST

SYSTEM

**PERFORMANCE
REPLICABILITY
AFFORDABILITY**

AIR COLLECTOR

HEATING SYSTEM

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PRIFYSGOL CAERDYDD



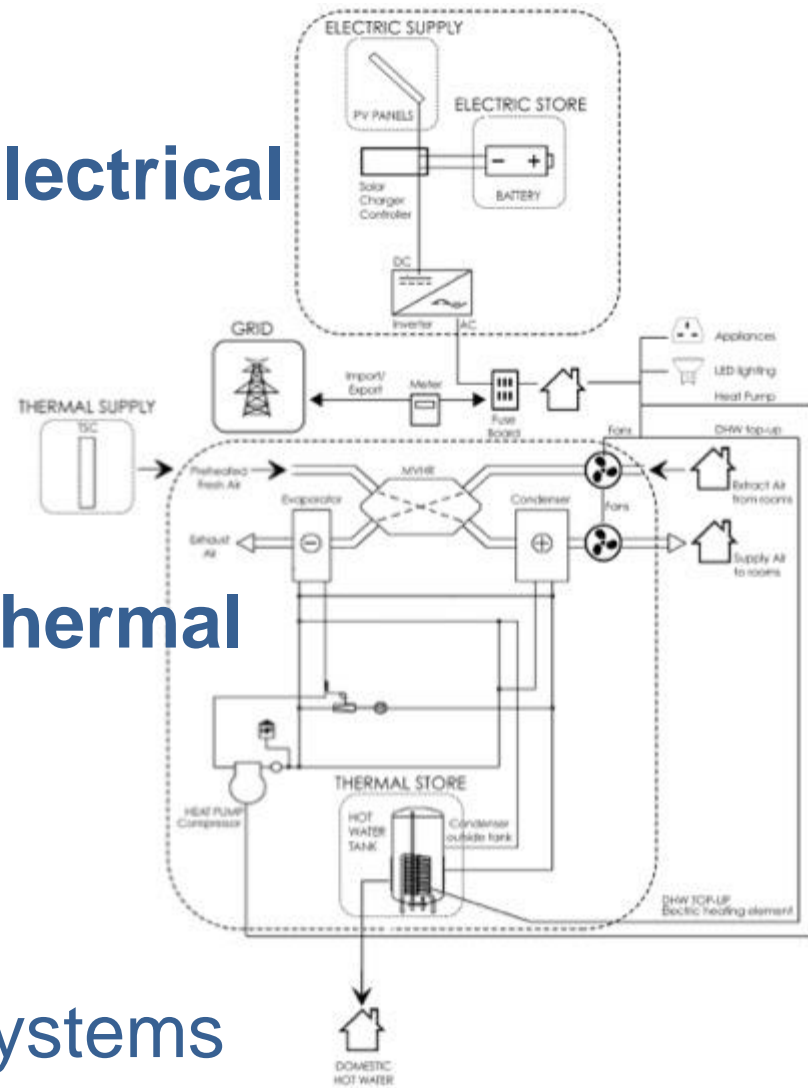
SIPS FRAME INTERNAL WALLS BUILDING FABRIC SYSTEMS SOLCER HOUSE

SYSTEM INTEGRATION



Electrical

Thermal



Technologies:

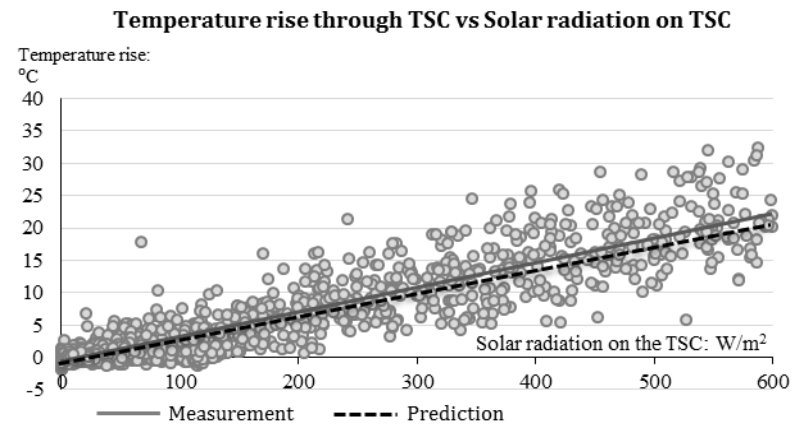
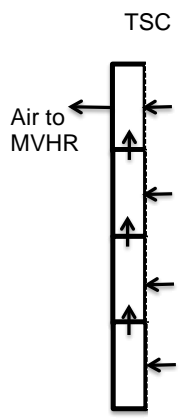
Thermal and electrical energy systems

Technologies and building design:

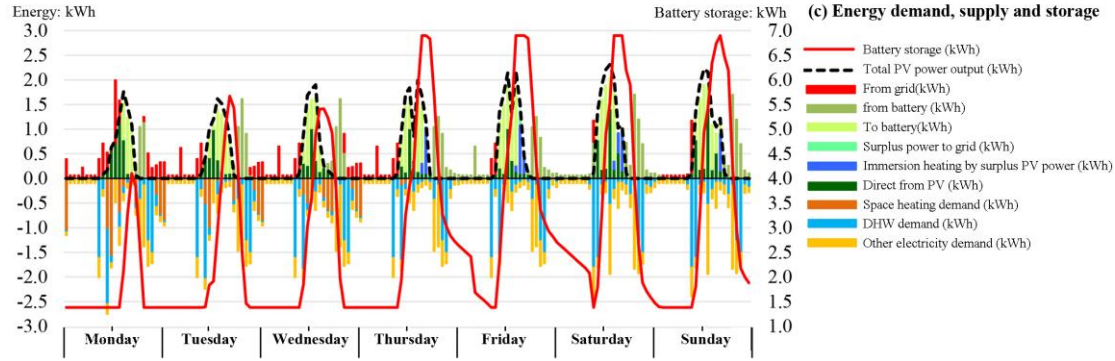
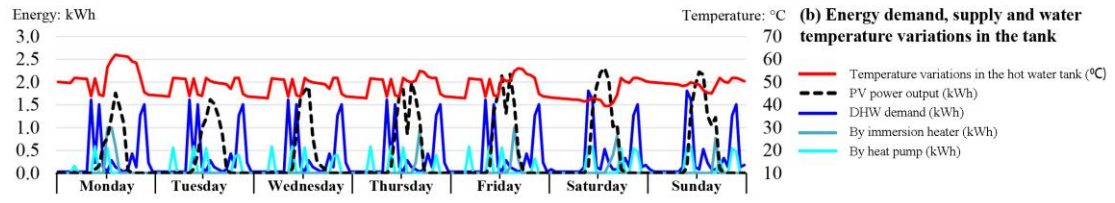
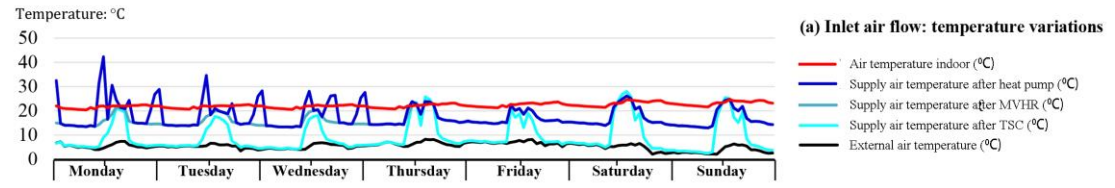
Renewable energy systems as construction elements

SOLCER MODELLING

Components



Whole Building



ENERGY POSITIVE PERFORMANCE

Energy: kWh/yr

Annual electricity demand, supply and storage

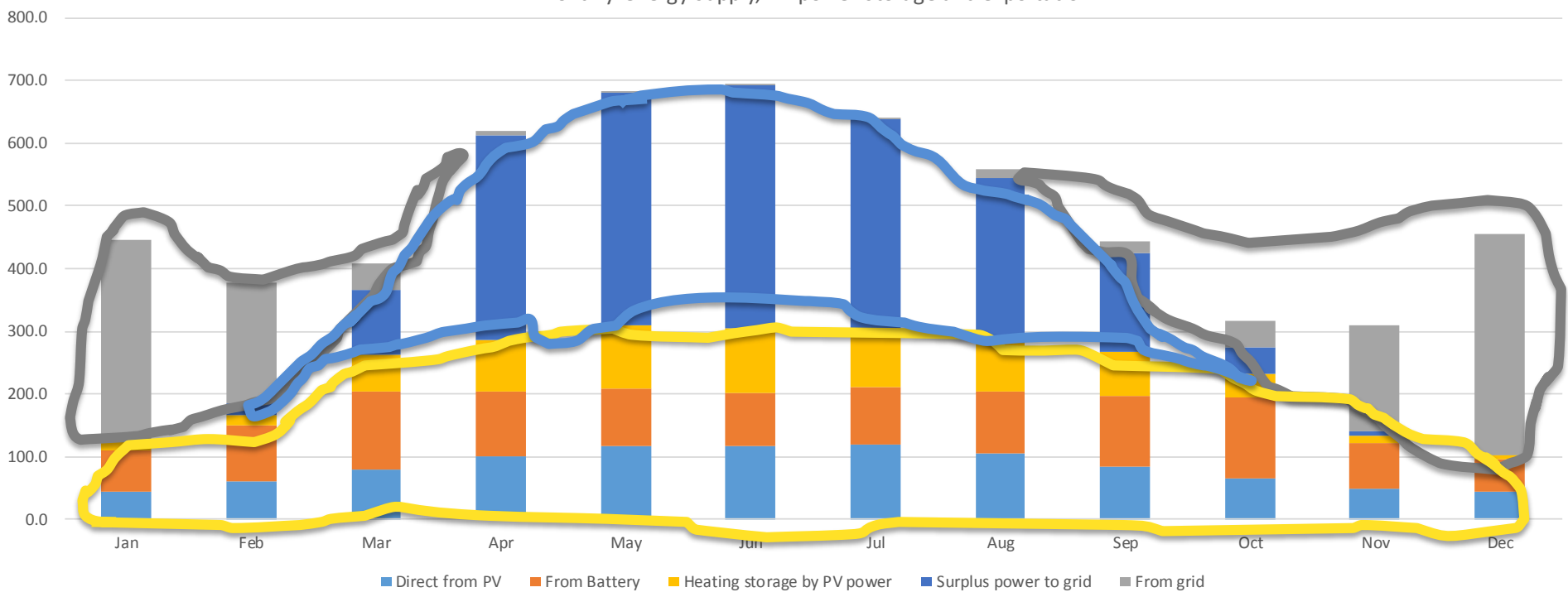
Annual self sufficiency rate: **75%**

Annual power to grid/from grid ratio: **1.5**

total demand total PV output total from grid total to grid total losses

Energy: kWh

Monthly energy supply, PV power storage and exportation



SOLCER: the **energy positive** house

COSTS £1,200/m²

16 weeks construction

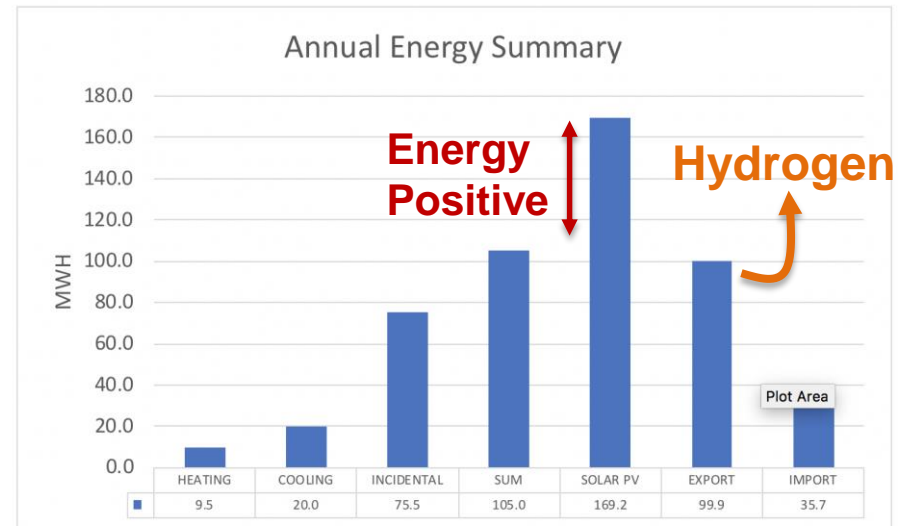
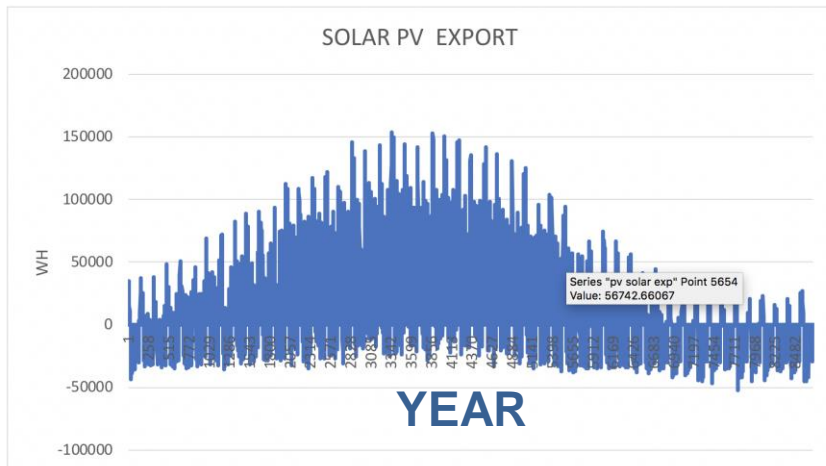
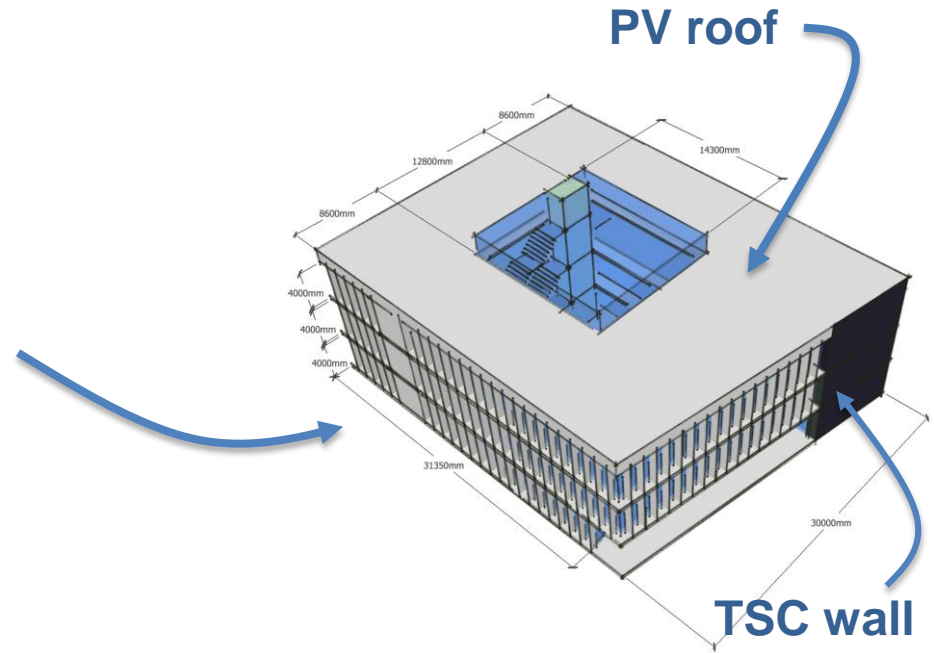


Typical new house energy costs **£780/year**

SOLCER earns **£166/year**

Benefit **£946/year**

Energy Positive Office Concept



Existing Built Environment

80% of buildings around in 2050 already exist (in the UK)

Retrofitting properties

50% of existing buildings have had some energy efficiency measures installed .

Without energy efficiency improvements from 1970 energy consumption would be twice current levels.

SOLCER low carbon Retrofits

Before retrofit



Whole House Deep Retrofits



PV roof



Batteries



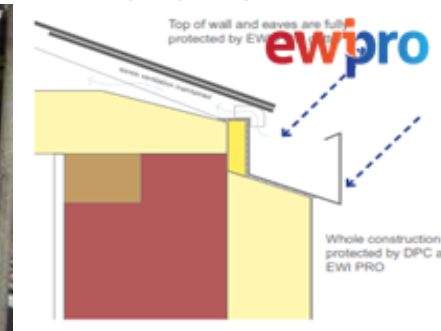
MVHR



EWI



Details



SOLCER low carbon Retrofits

Before retrofit



After retrofit



Energy savings £450/year

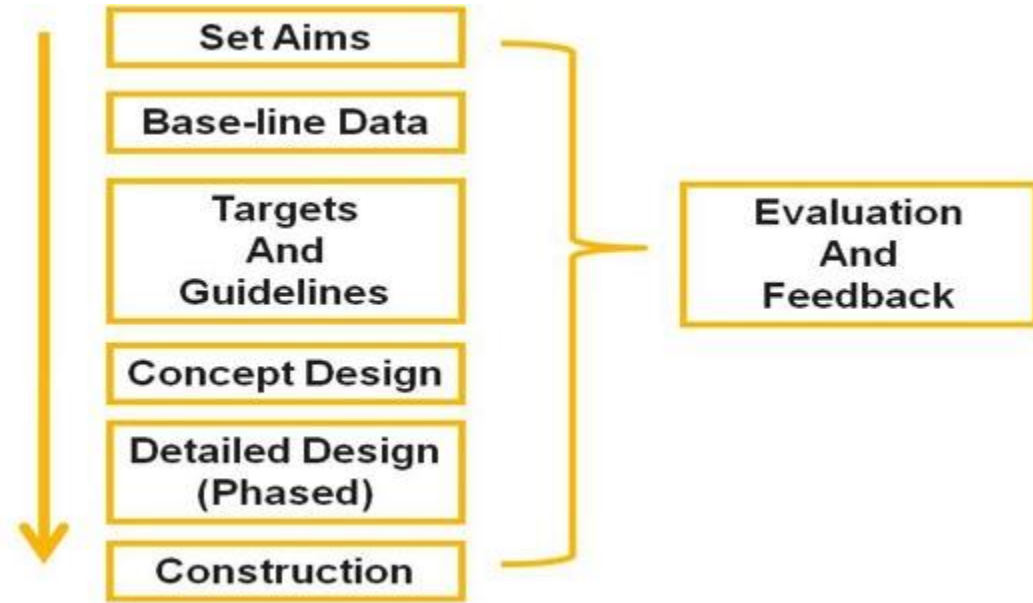
(average energy bill £1000/year)

Cost of whole house retrofit £25,000 and reducing

New Developments

Sustainable Urban Master-planning

Tianjin



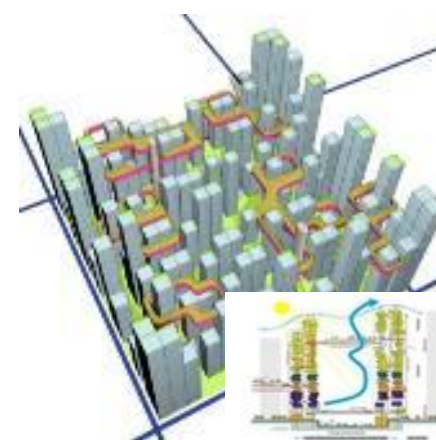
Qatar



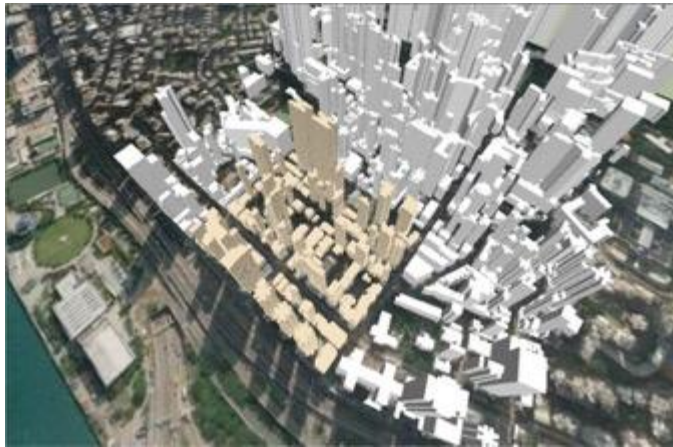
Ras al Khaimah



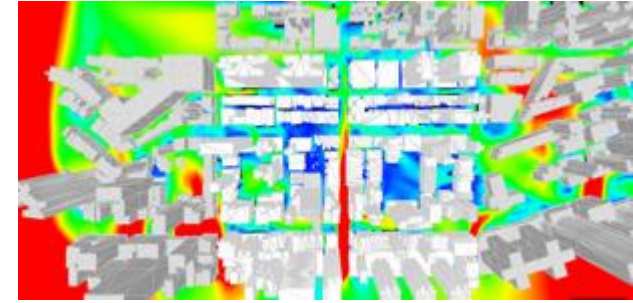
Hanoi



URBAN SCALE

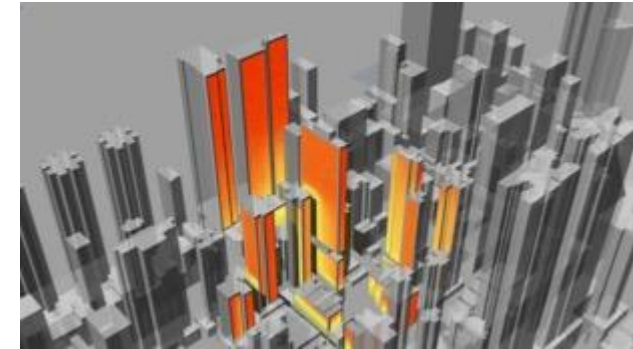


Air Ventilation Analysis:



Daylighting Analysis:

DIVA FOR RHINO



Existing condition



Option1

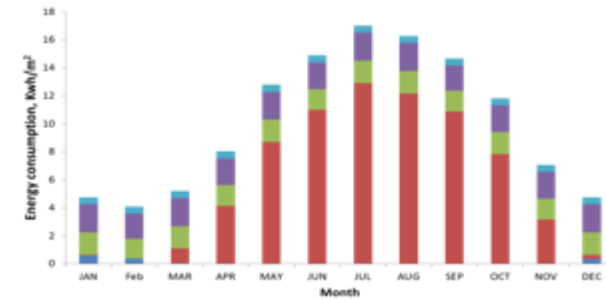


Option2



Option3

Building Energy:

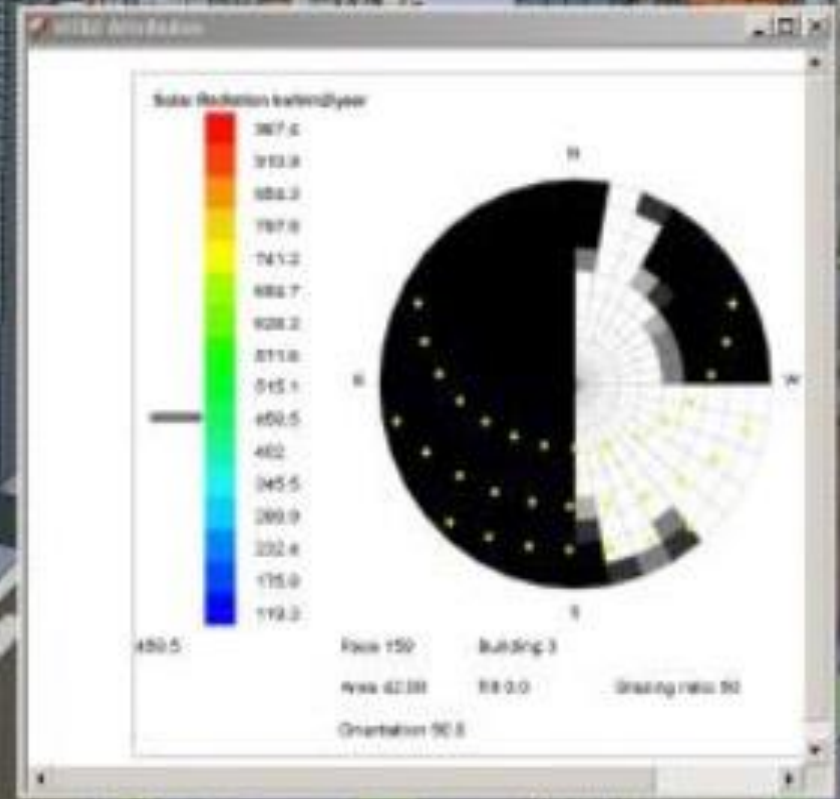
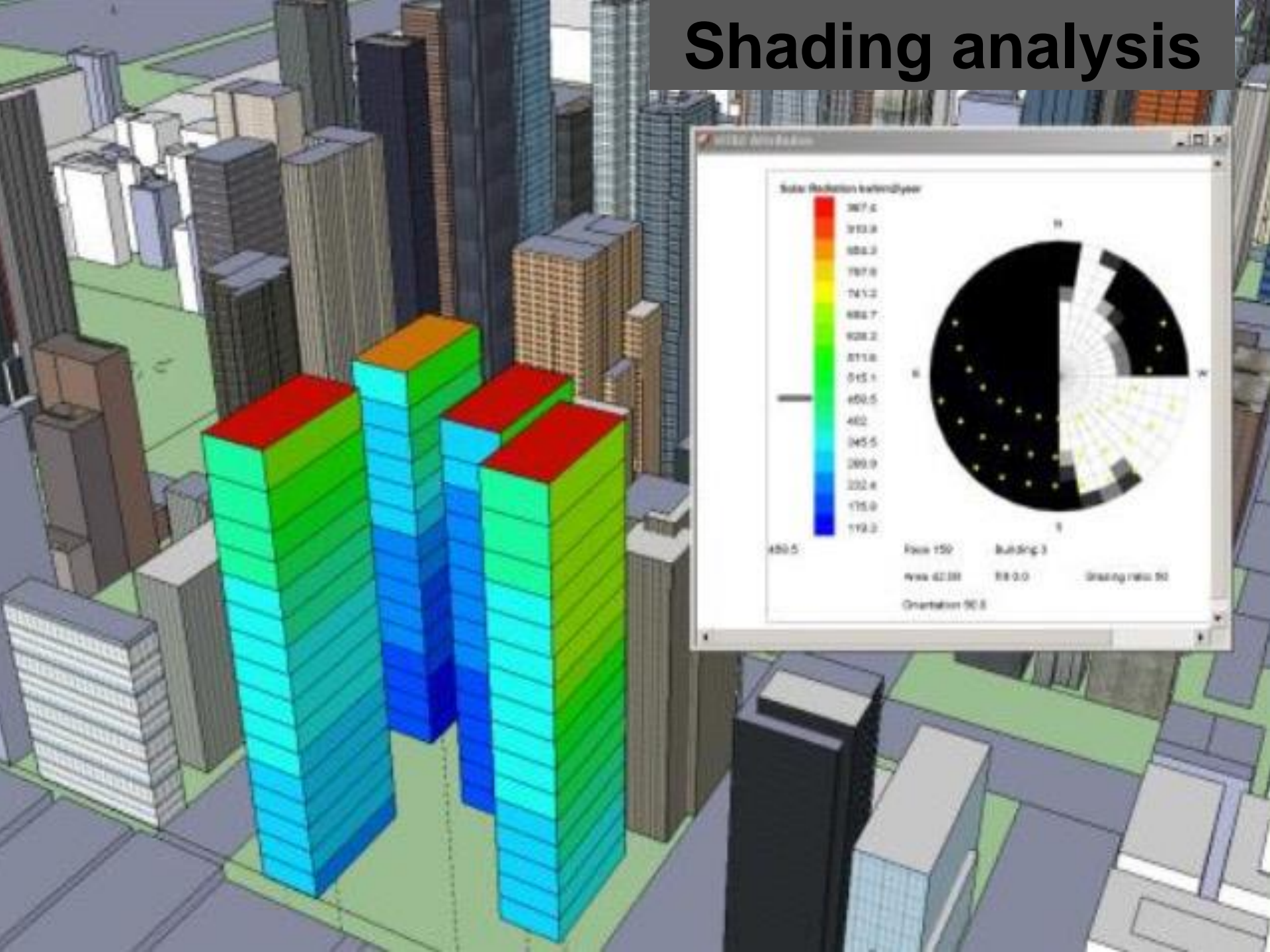


Thermal comfort:

CityComfort+

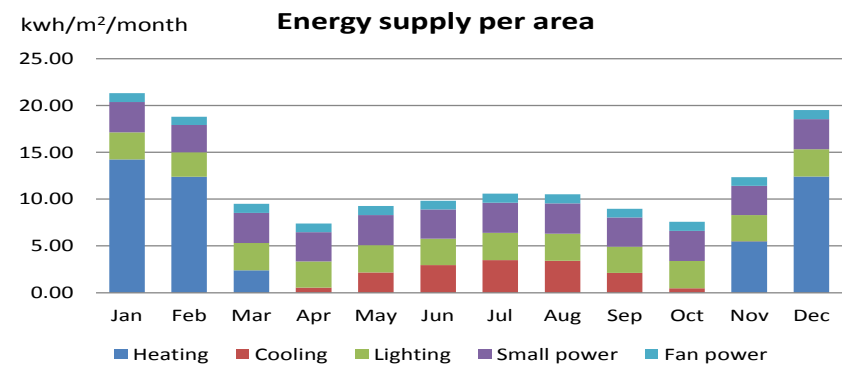
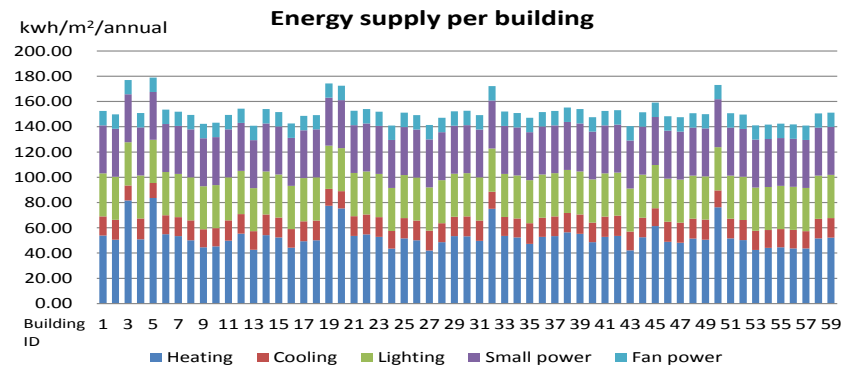


Shading analysis

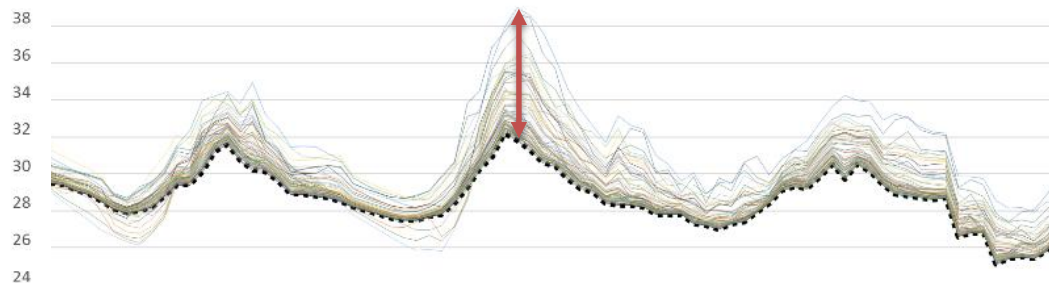
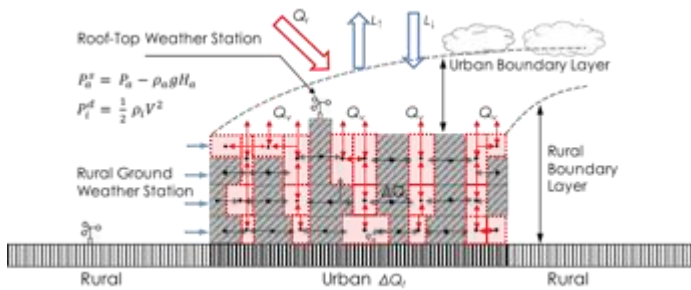
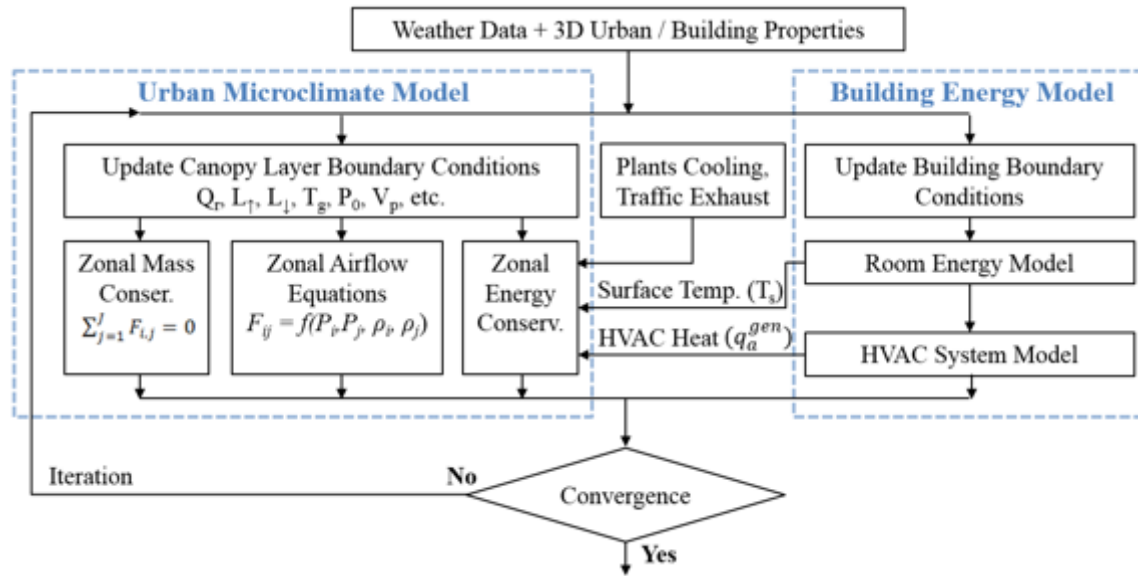


Large Scale Urban Developments

Energy Modelling

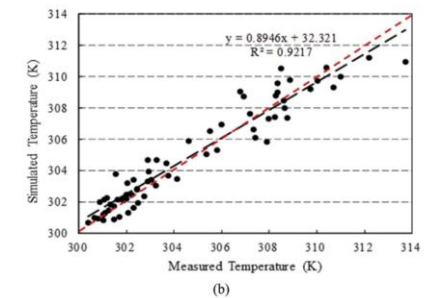
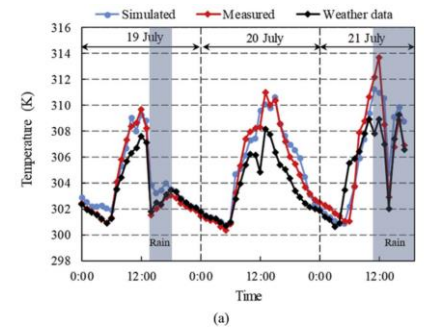


An Integrated Model for Urban Microclimate & Building Energy



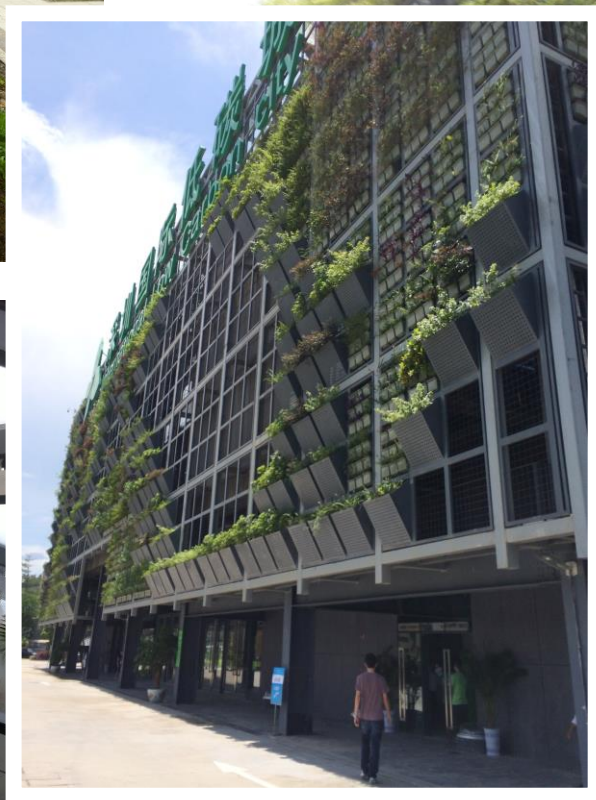
PREDICT URBAN HEAT ISLAND – LOCAL EXTERNAL CONDITIONS

Model Testing on a Scale Concrete City (Guangzhou)



A zonal model for assessing street canyon air temperature of high-density cities
Weihui Liang, Jianxiang Huang, Phil Jones, Qun Wang, Jian Hang
Building and Environment Vol 132, 15 March 2018, Pages 160-169

Plants and Architecture



**URBAN HEAT ISLAND
MICRO-CLIMATE
GREEN WALLS ROOF
BIOMATERIALS
INDOOR ENVIRONMENT**

Range of performance



New Build



Low Carbon



Near-Zero Carbon



Zero Carbon



Energy Positive



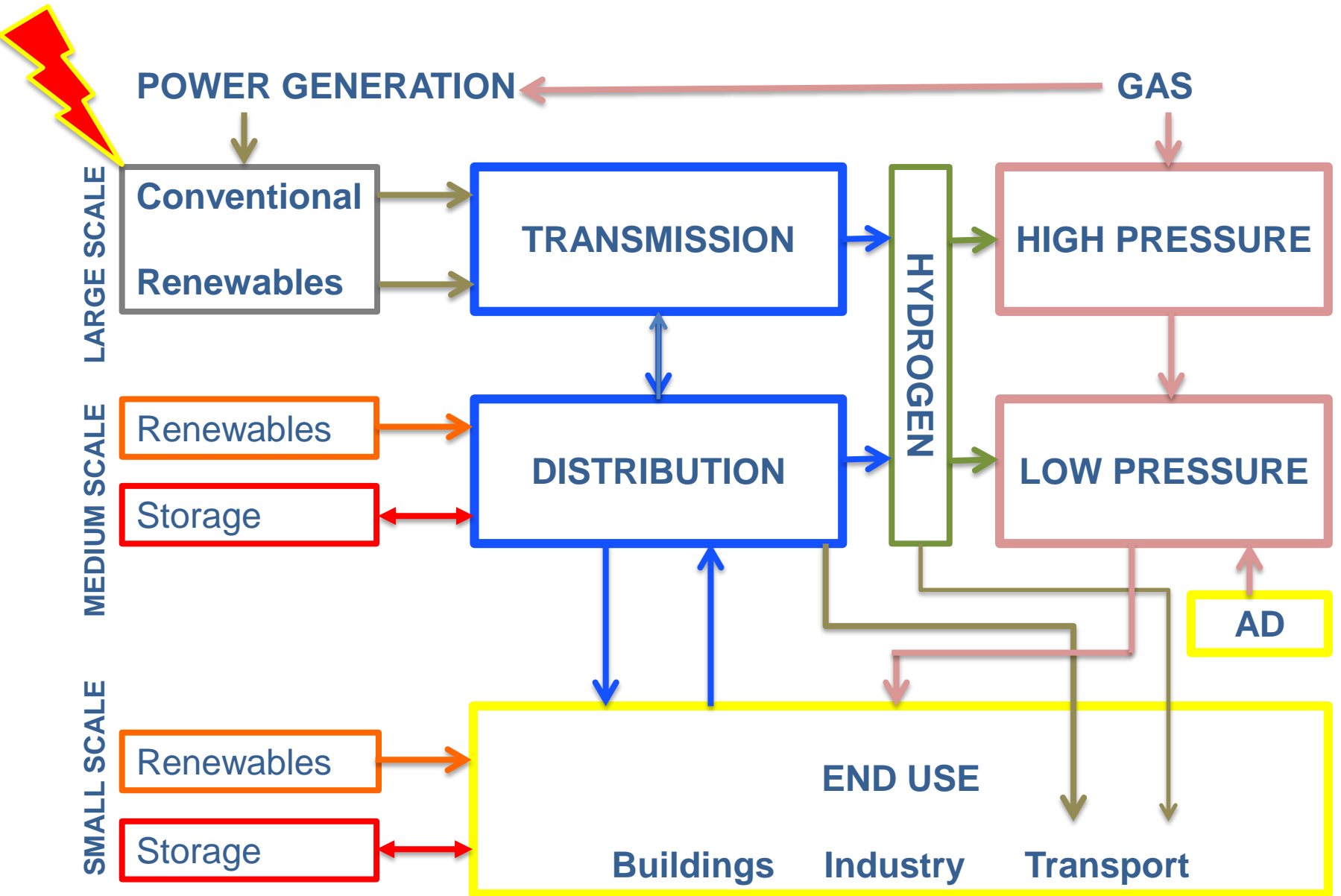
Retrofit



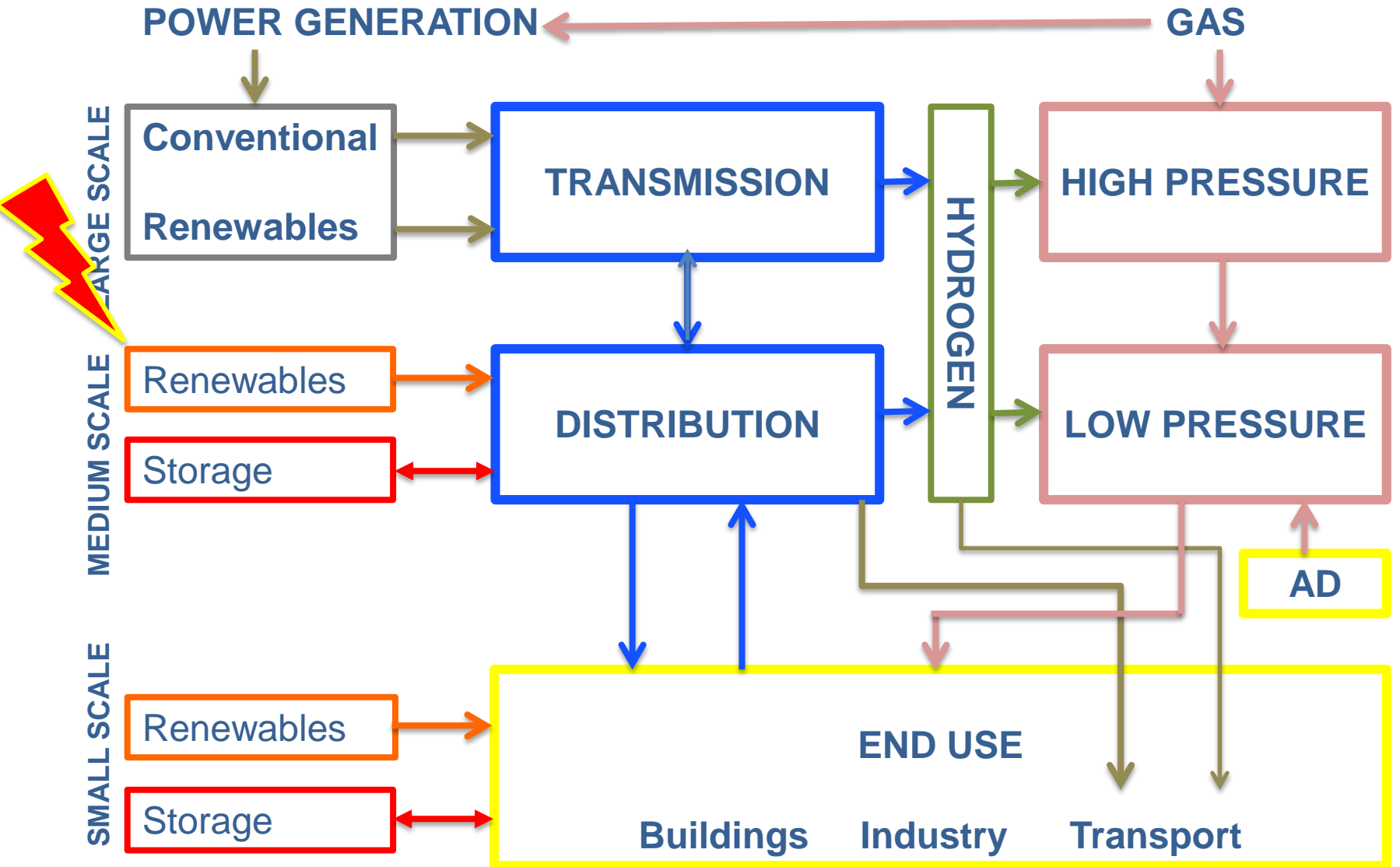
Urban Scale



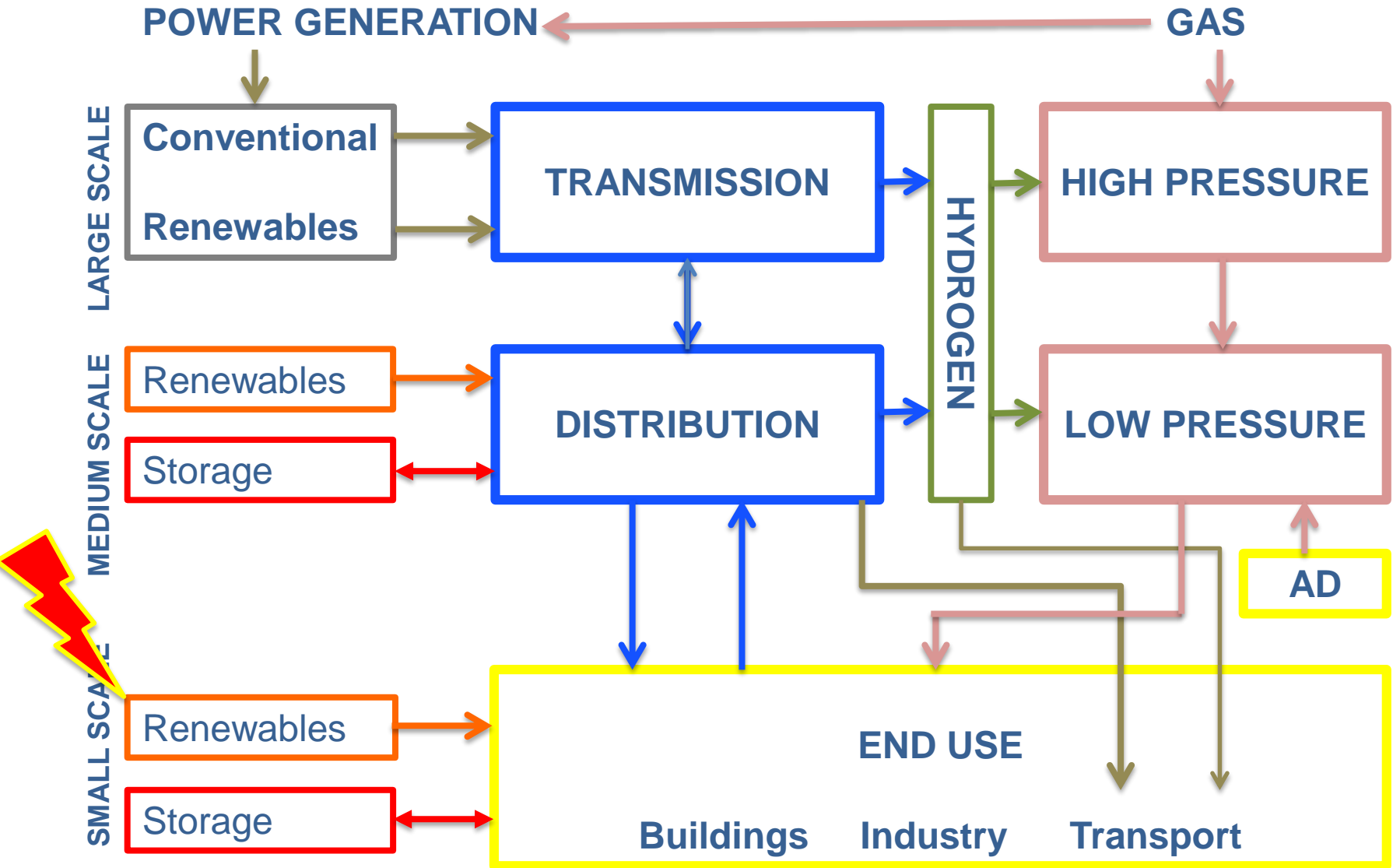
INTERNET OF ENERGY



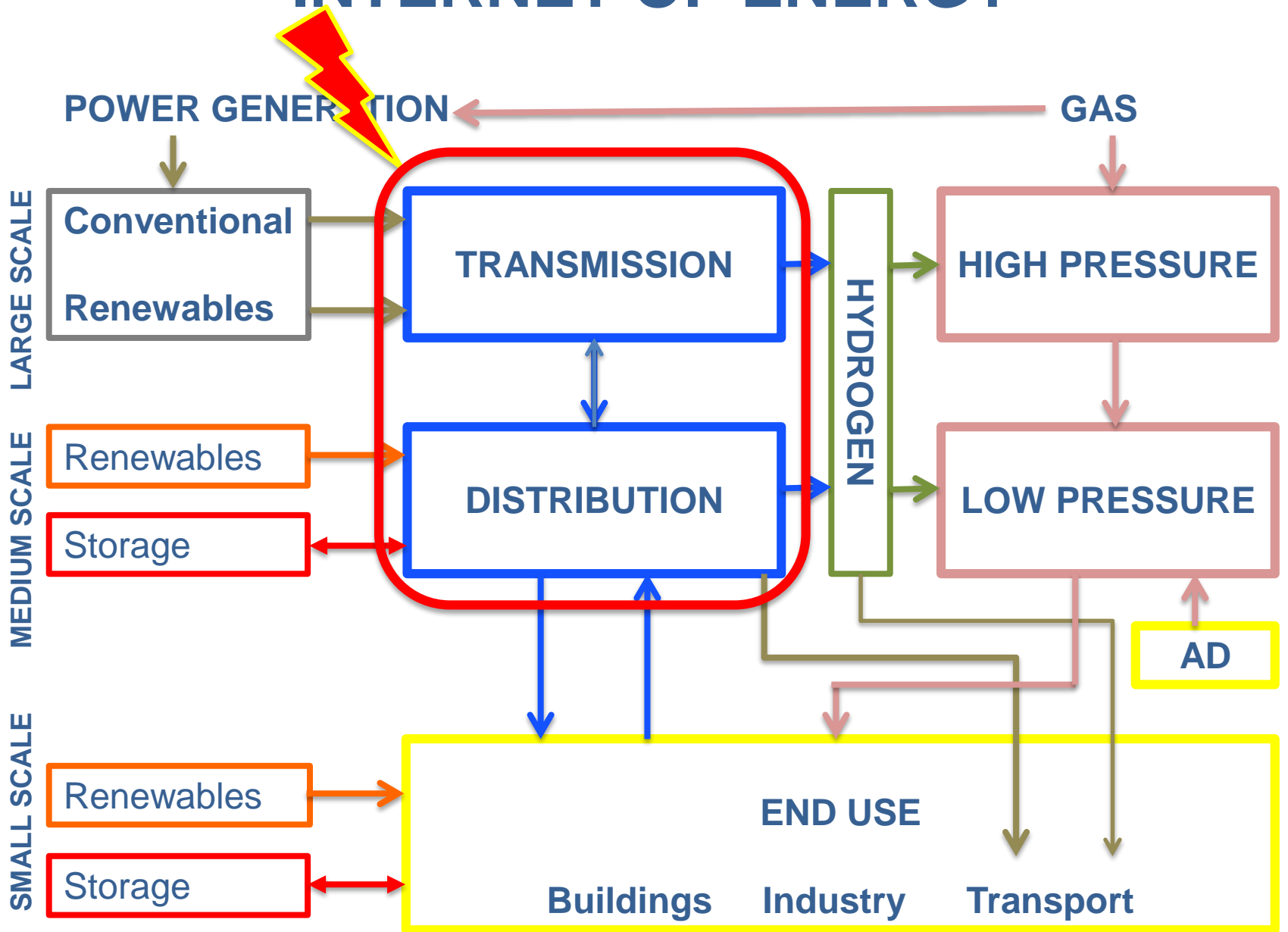
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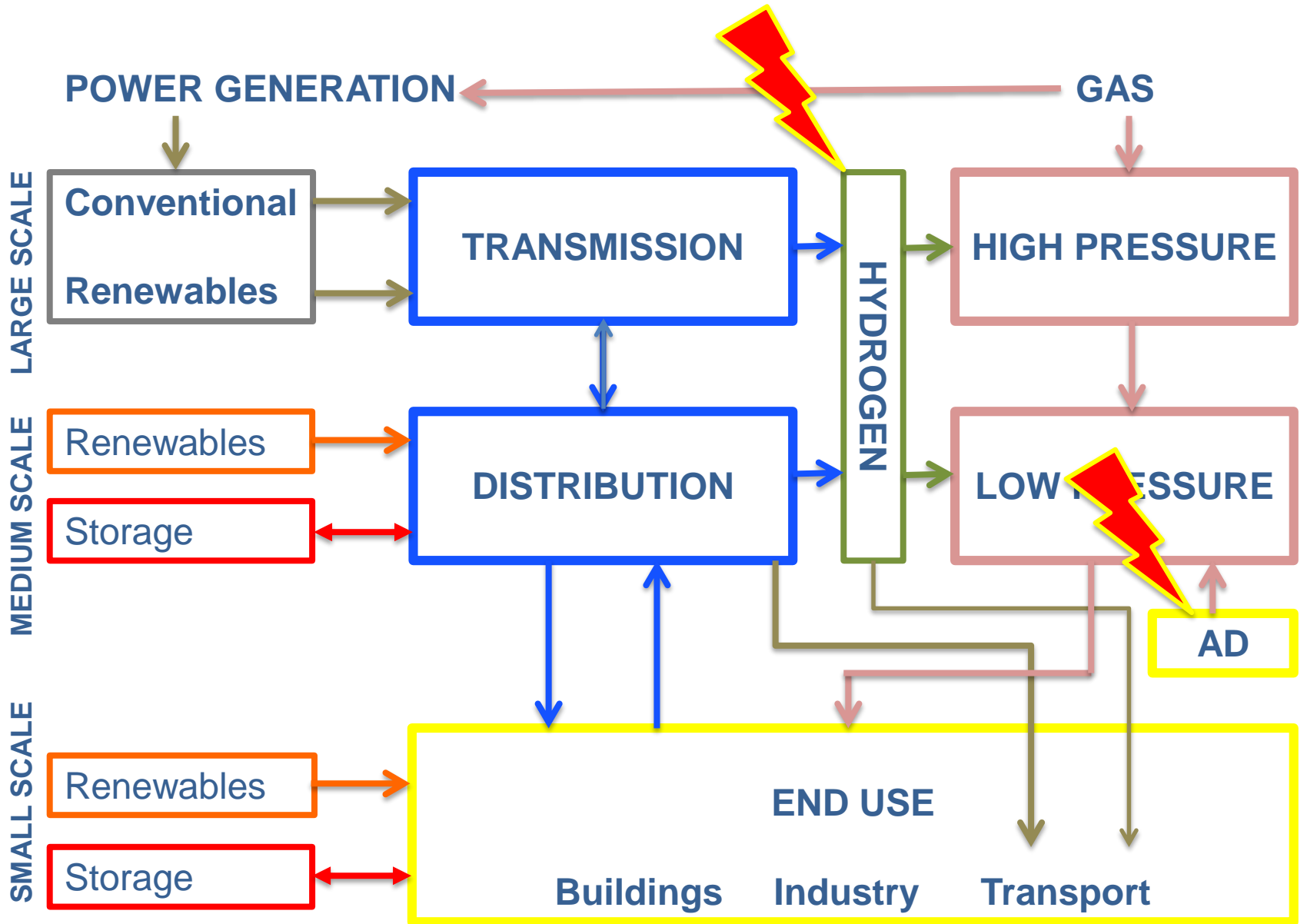
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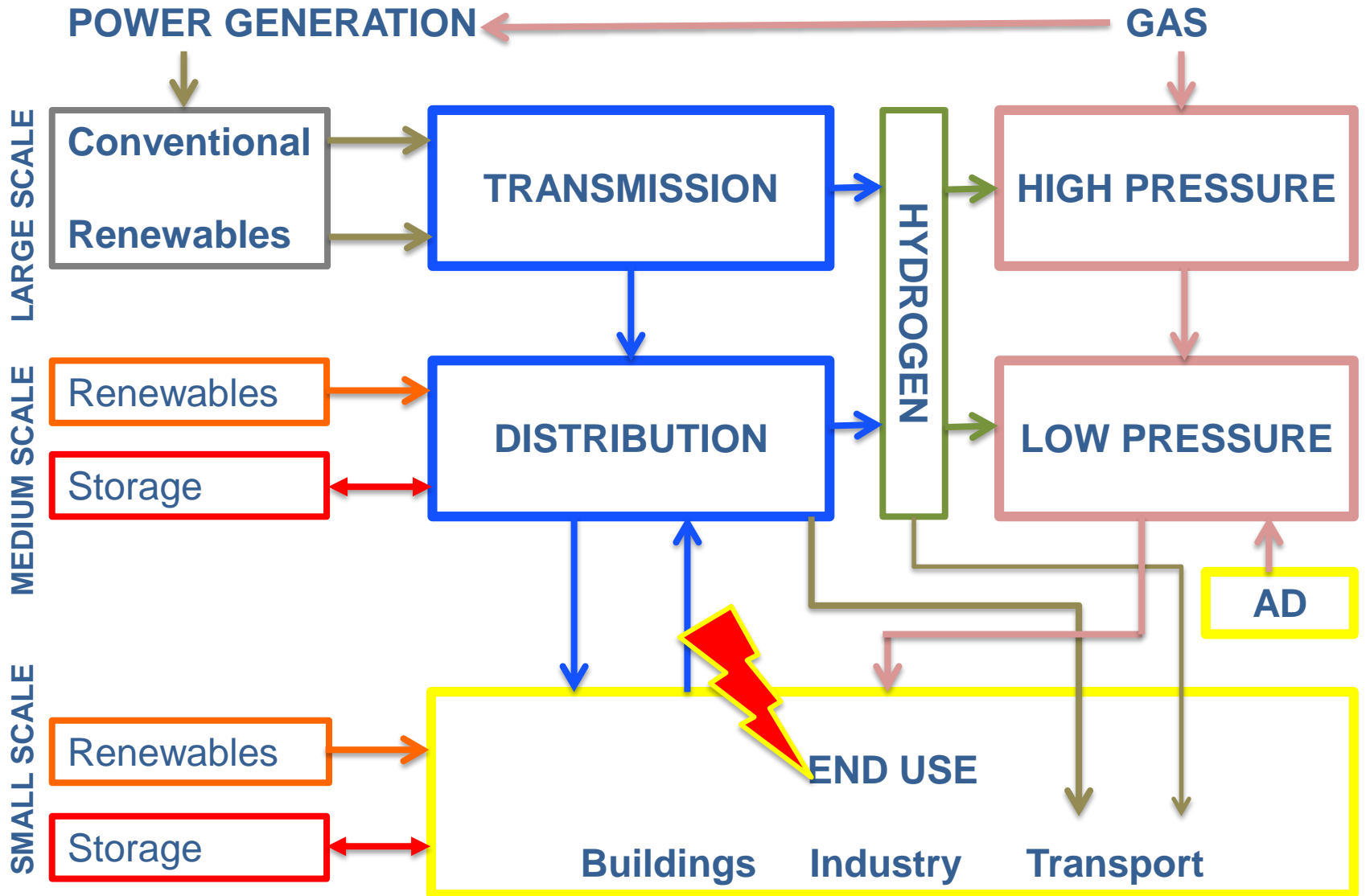
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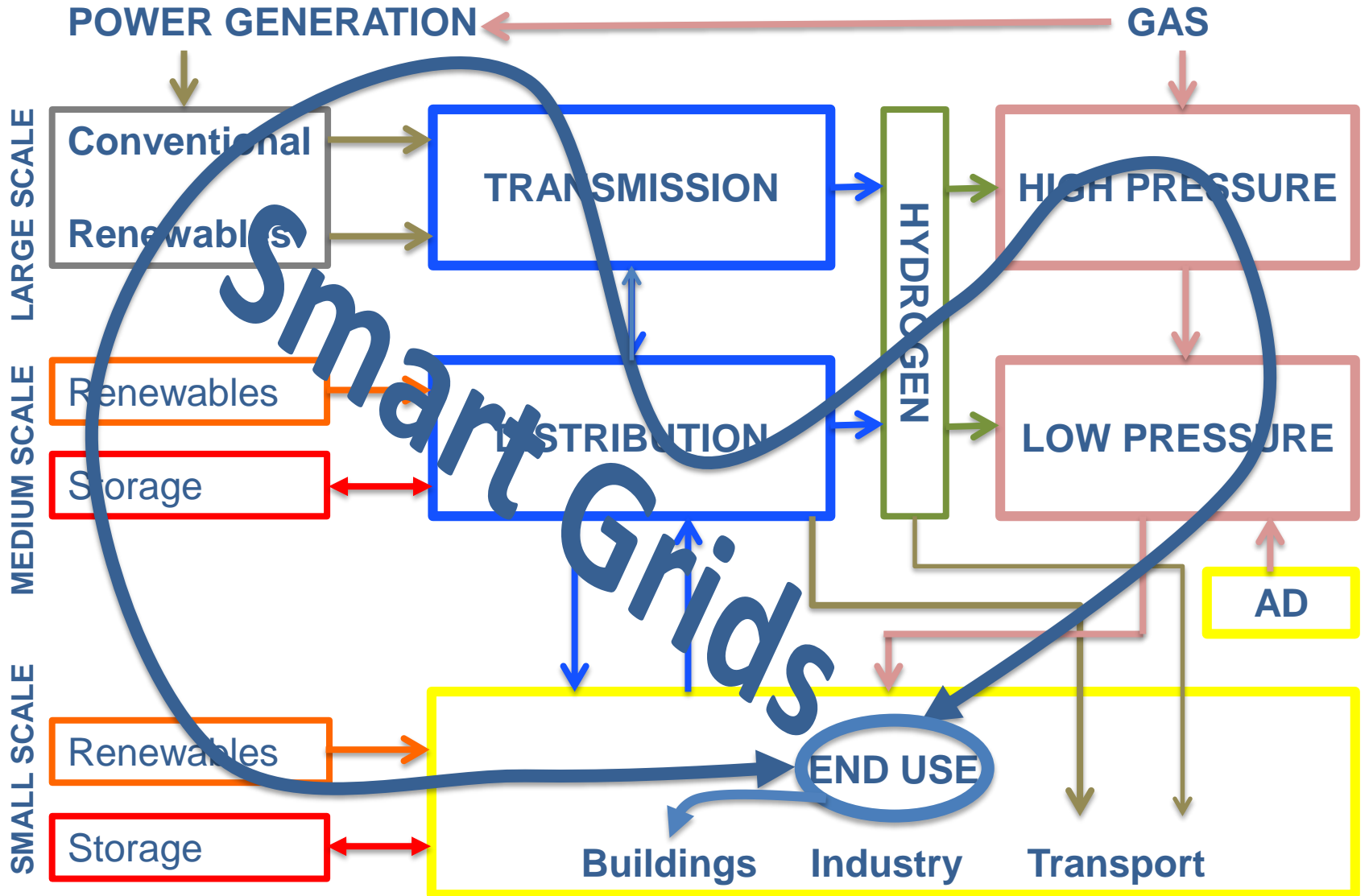
INTERNET OF ENERGY



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INTERNET OF ENERGY



The role of buildings in future energy thinking

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Thank You

