

Life cycle primary energy implication of the new Swedish Building Code

Ambrose Dodoo, Leif Gustavsson, Roger Sathre
leif.gustavsson@miun.se

Department of Engineering and Sustainable Development
Mid Sweden University, Östersund

New Swedish Building Code (BBR 09) Introduced in February 2009

Climate Zone	Specific end-use energy* (kWh/m ² yr)		Average U-value (W/m ² K)	
	Electric heating	Non-electric heating	Electric heating	Non-electric heating
I	95	150	0.40	0.50
II	75	130	0.40	0.50
III	55	110	0.40	0.50

* Specific end-use energy is delivered energy for space and tap water heating including electricity for fans and pumps

Life cycle primary energy implication of the new building code - Case study building

- Växjö, Sweden
- Climate Zone III
- 4 stories
- 16 apartments
- 1190 m² usable floor area



We compared 2 versions of this building, built to the Swedish energy standards of the mid-1990s and to the new 2009 code

We consider

- The full building life cycle
 - Production phase
 - Extraction, processing and transport of materials
 - Energy recovery from biomass residues
 - On-site construction work
 - Operation phase
 - Space heating and ventilation (including electricity for fans and pumps)
 - Tap water heating
 - Electricity for household use and facility management
 - End-of-life phase
 - Demolition
 - Energy recovery from wood, and recycling of concrete and steel
- Different energy supply systems
 - Heating system: resistance heating or district heating
 - Energy supply: biomass, (coal, or fossil gas)
- Different building frame materials
 - Wood or reinforced concrete structural frame

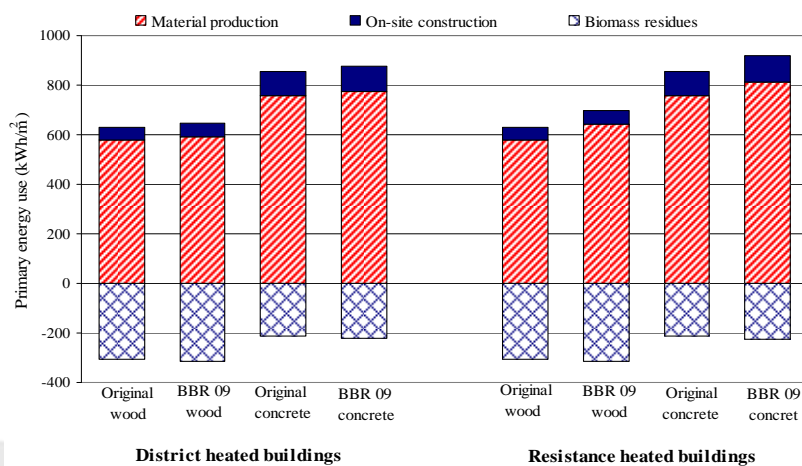
Energy characteristics of analyzed buildings

Description	Original buildings (mid-1990s buildings)	BBR 09 district heated buildings	BBR 09 resistance heated buildings
Ground floor U-value	0.23	0.23	0.20
External walls U-value	0.23	0.23	0.10
Windows U-value	1.9	1.2	1.0
Doors U-value	1.19	1.19	1.0
Roof U-value	0.13	0.13	0.10
Mechanical Ventilation	For exhaust air	For exhaust air	With heat recovery
Hot water taps	Conventional	Conventional	Energy efficient
Specific end-energy use	113	102	52

U-values in $W/m^2 K$

Specific end-energy use in kWh/m^2 year

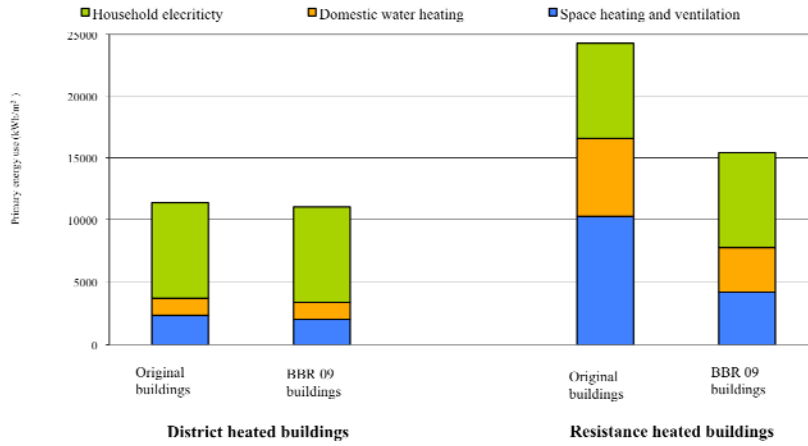
Primary energy use: production phase



District heated buildings

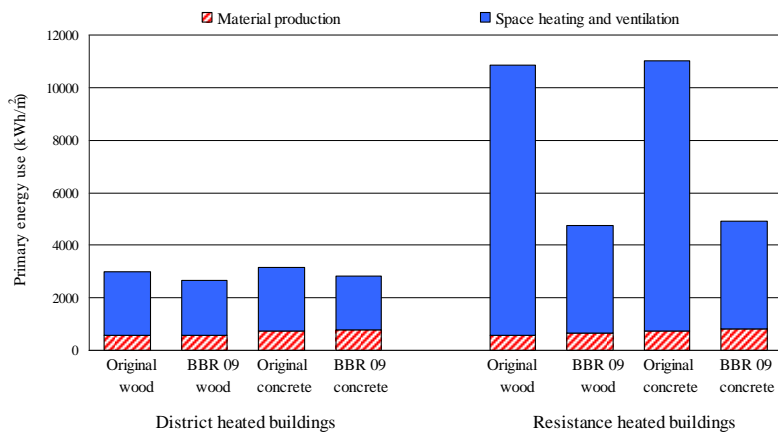
Resistance heated buildings

Primary energy use: operation for 50 years



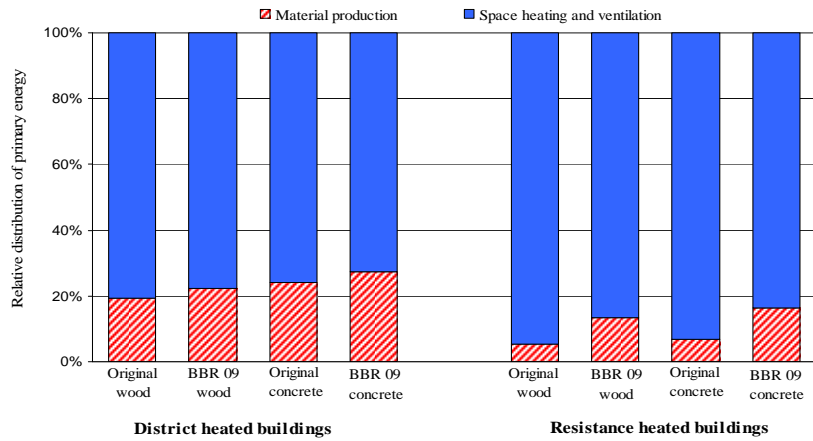
Biomass-based system (steam turbine technology)

Primary energy use for material production and space heating/ventilation



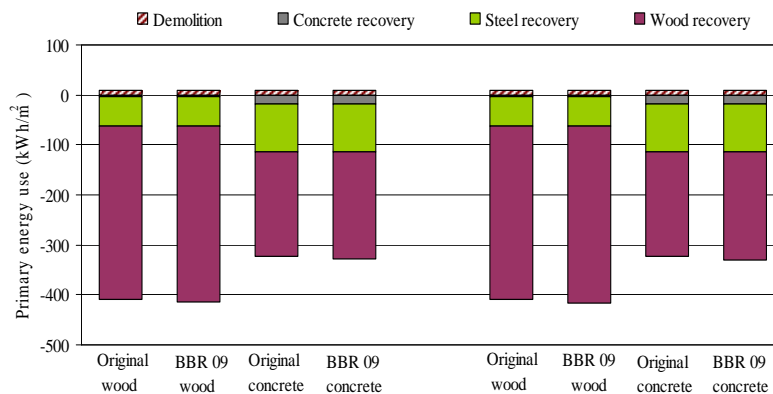
Biomass-based system (steam turbine technology)

Relative primary energy use for material production and space heating/ventilation



Biomass-based system (steam turbine technology)

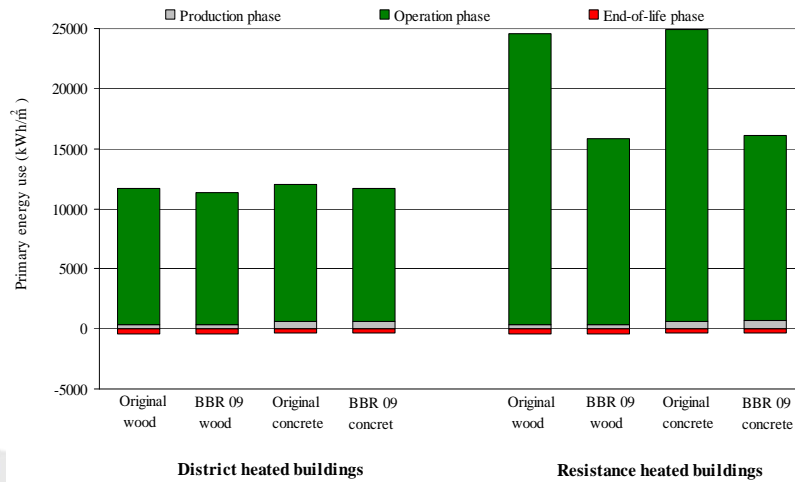
Primary energy use: end-of-life phase



District heated buildings

Resistance heated buildings

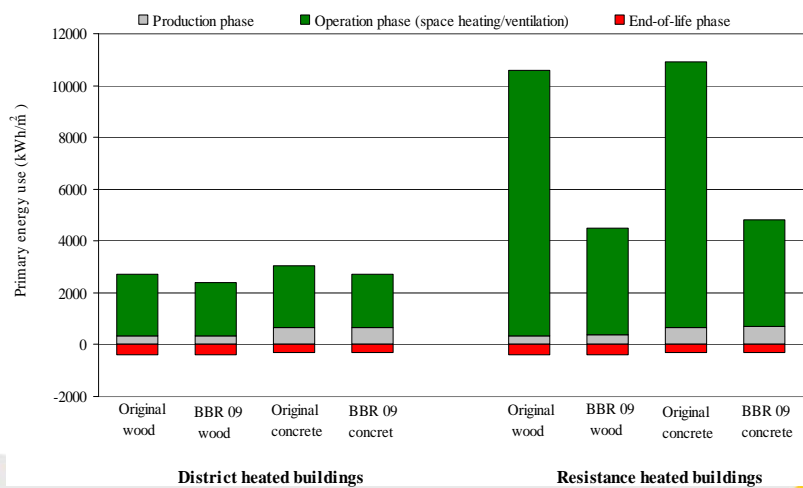
Primary energy balance: life cycle phases



Biomass-based system (steam turbine technology)

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Primary energy balance: production, space heating/ventilation and end of life



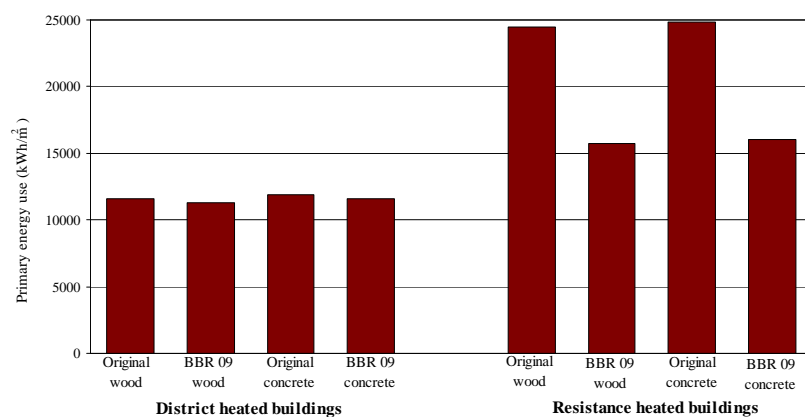
Biomass-based system (steam turbine technology)

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Conclusions

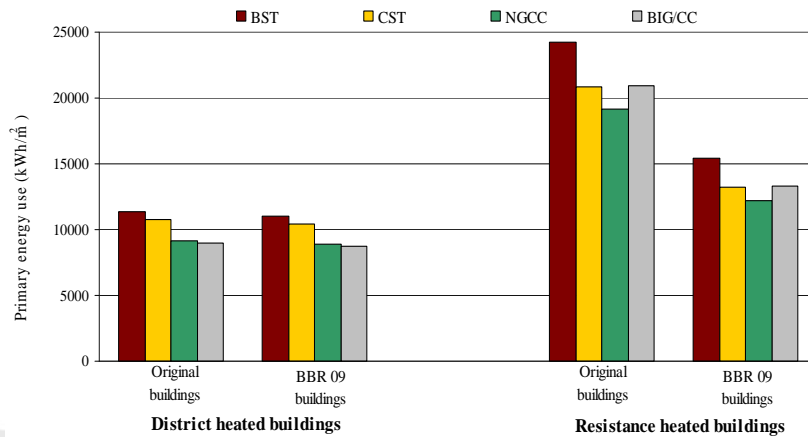
- The building code regulates only end-use energy for space heating, ventilation, and water heating
- The code does not cover these significant energy flows:
 - Primary energy losses to deliver end-use energy services
 - Electricity for household use
 - Primary energy for building production
 - End-of-life recovery of materials
- A life cycle primary energy perspective is needed to minimize overall primary energy use
- A wood-framed building with cogeneration of district heating and electricity gives low life cycle primary energy use

Primary energy use: complete life cycle



Biomass-based system (steam turbine technology)

Primary energy use: operation for 50 years with different energy supply systems



BST = Biomass steam turbine

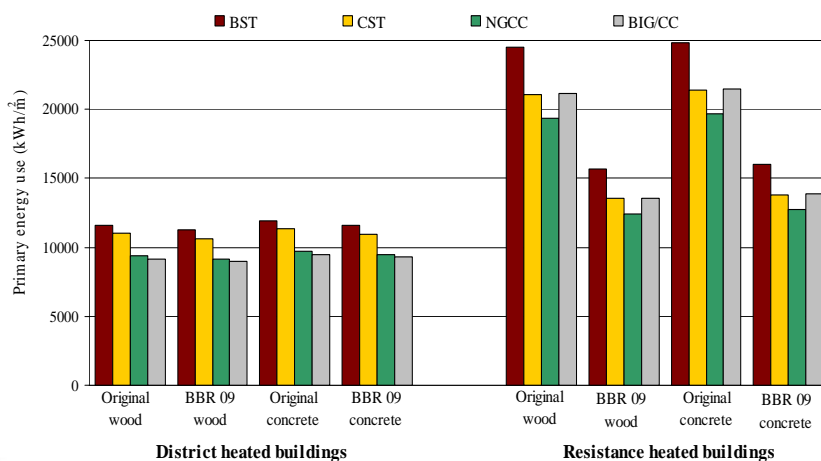
CST = Coal steam turbine

NGCC = Natural gas combine cycle

BIG/CC = Biomass integrated gasification combined cycle



Primary energy use: complete life cycle



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