

HWP inventory in Finland

Anna-Leena Perälä

VTT Technical Research Centre of Finland

Anna-Leena.Perala@vtt.fi

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Business from technology

Content

- VTT shortly
- Topics of HWP inventory
- Construction and wooden construction in Finland
- Building stock in Finland
- Method to estimate carbon stock in building stock in Finland
- Results of inventories in 1995, 2000, 2005
- Fitting to IPCC
- Conclusions

VTT Technical Research Centre of Finland

VTT IS

- the biggest multitechnological applied research organisation in Northern Europe

VTT HAS

- polytechnic R&D covering different fields of technology from electronics to building technology
- clients and partners: industrial and business enterprises, organisations, universities and research institutes

VTT CREATES

- new technology and science-based innovations in co-operation with domestic and foreign partners

VTT in brief 2008

Global presence

Headquartered in Finland

- 4 main domestic sites
- Brussels, Belgium
- Silicon Valley, US
- St. Petersburg, Russia
- Shanghai, China
- Seoul, South Korea



- Turnover 232 M€
- Personnel 2,740
- 76 % with higher academic degree
- 5,730 customers
- Established 1942
- VTT has been granted ISO9001:2000 certificate.

VTT: BUILT ASSETS AND BUSINESS INTELLIGENCE TEAM



- Business environment analyses for domestic and international construction markets
 - New construction, renovation, civil engineering, building stock.
- Strategic studies
 - Forecasts of demand: building materials, workforce, construction technology
 - Analyses of branch
- End user and environmental aspects

Topics of HWP inventory in Finland

1. Construction
Finland

2. Building stock
Finland

3. Wood products
in building stock
and other constr.

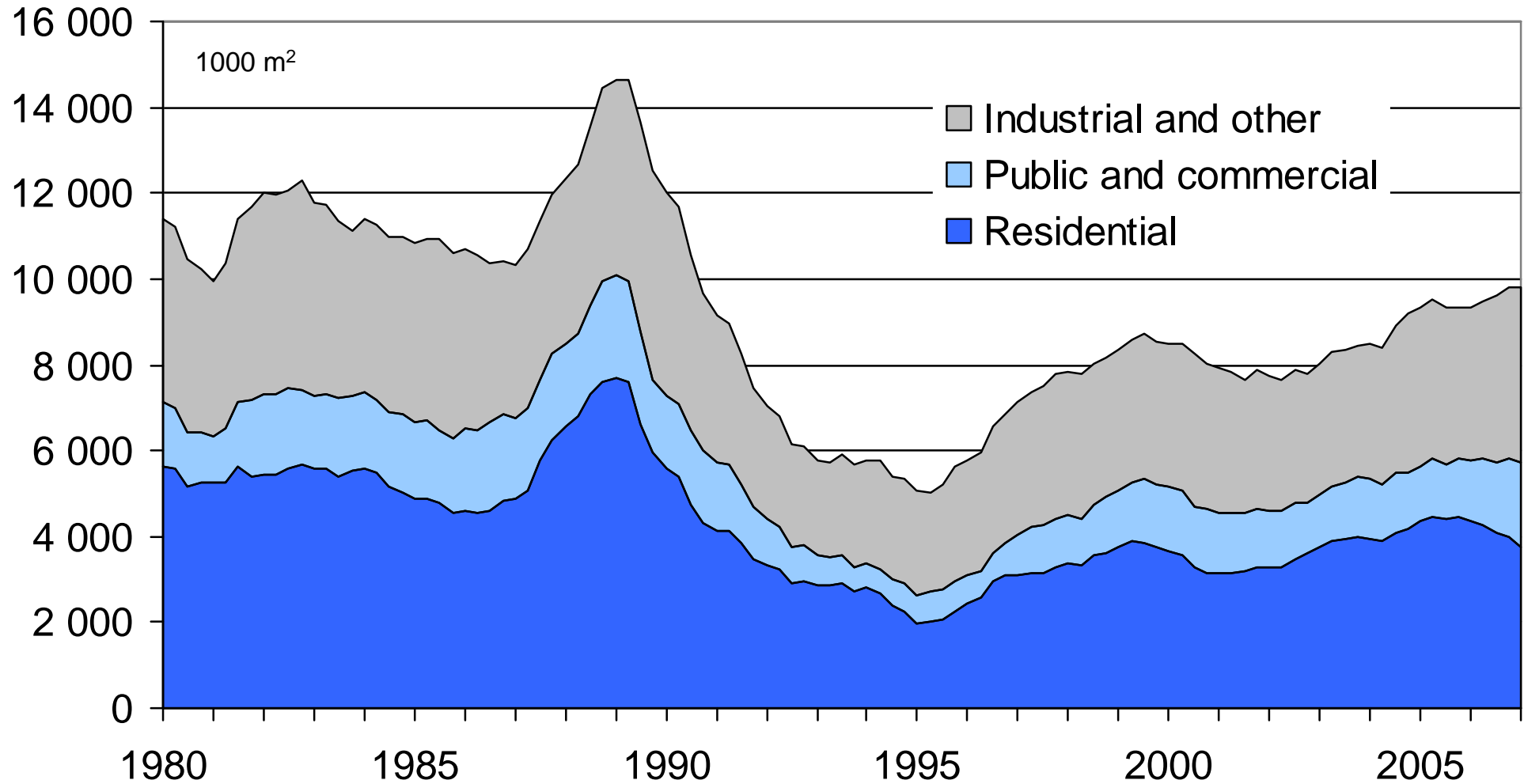
4. Results
C calculations
in building stock,
other
1995, 2000, 2005

5. Fitting IPCC
HWP model
to results

6. Conclusions

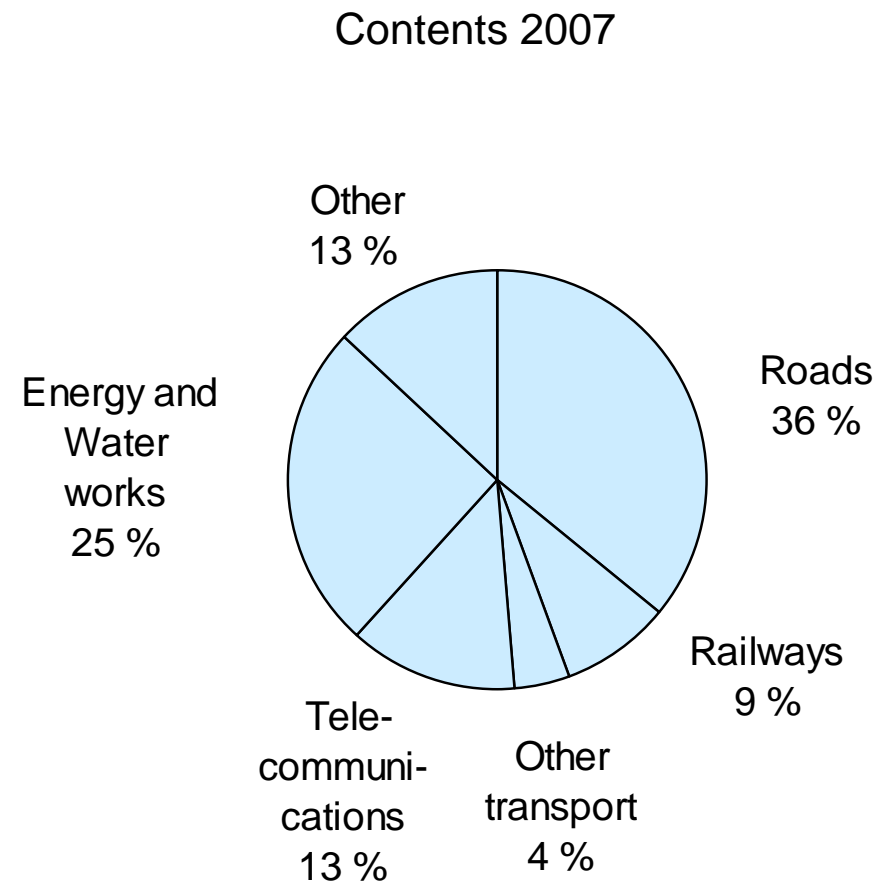
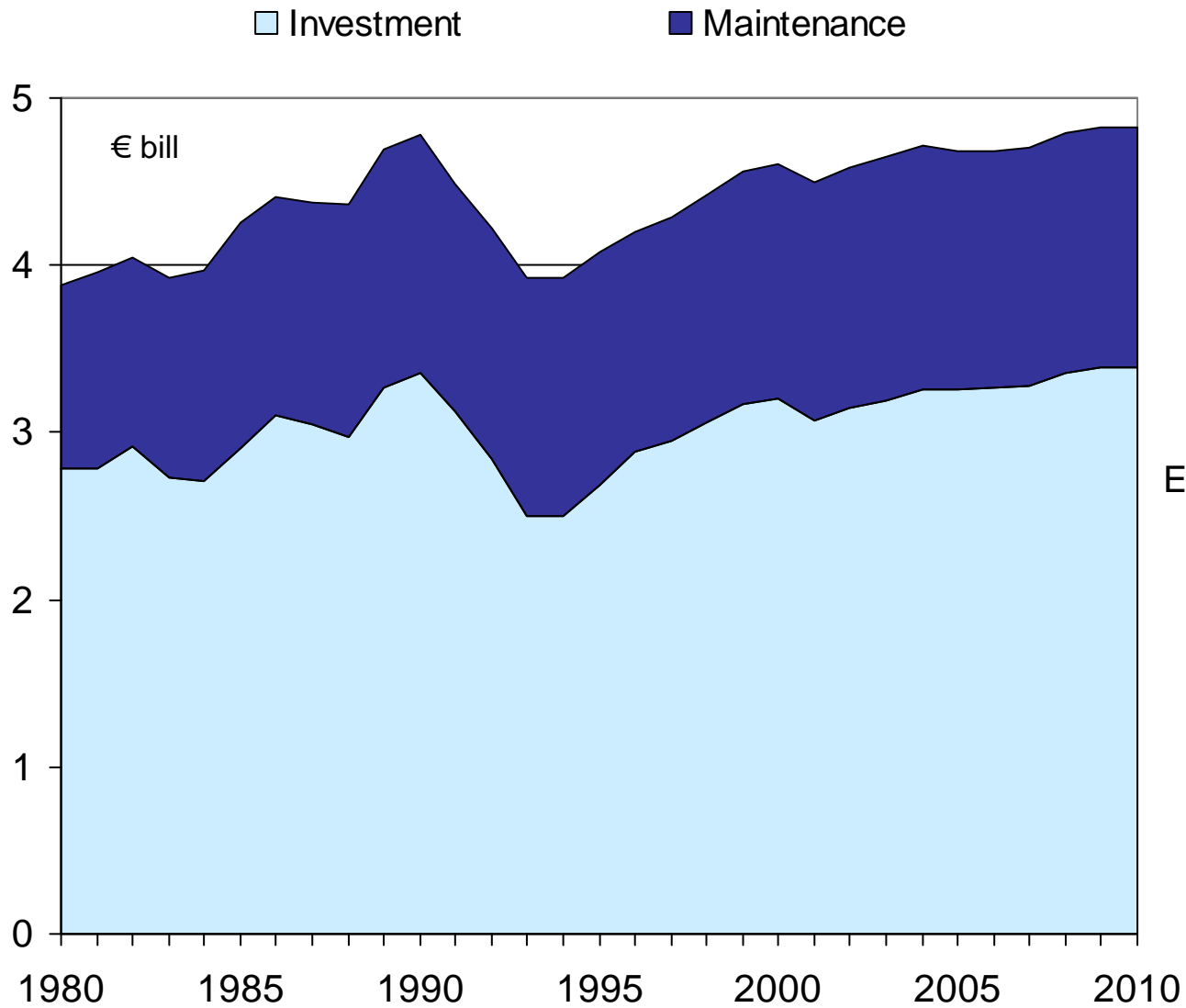
Construction in Finland

New Building Construction in Finland



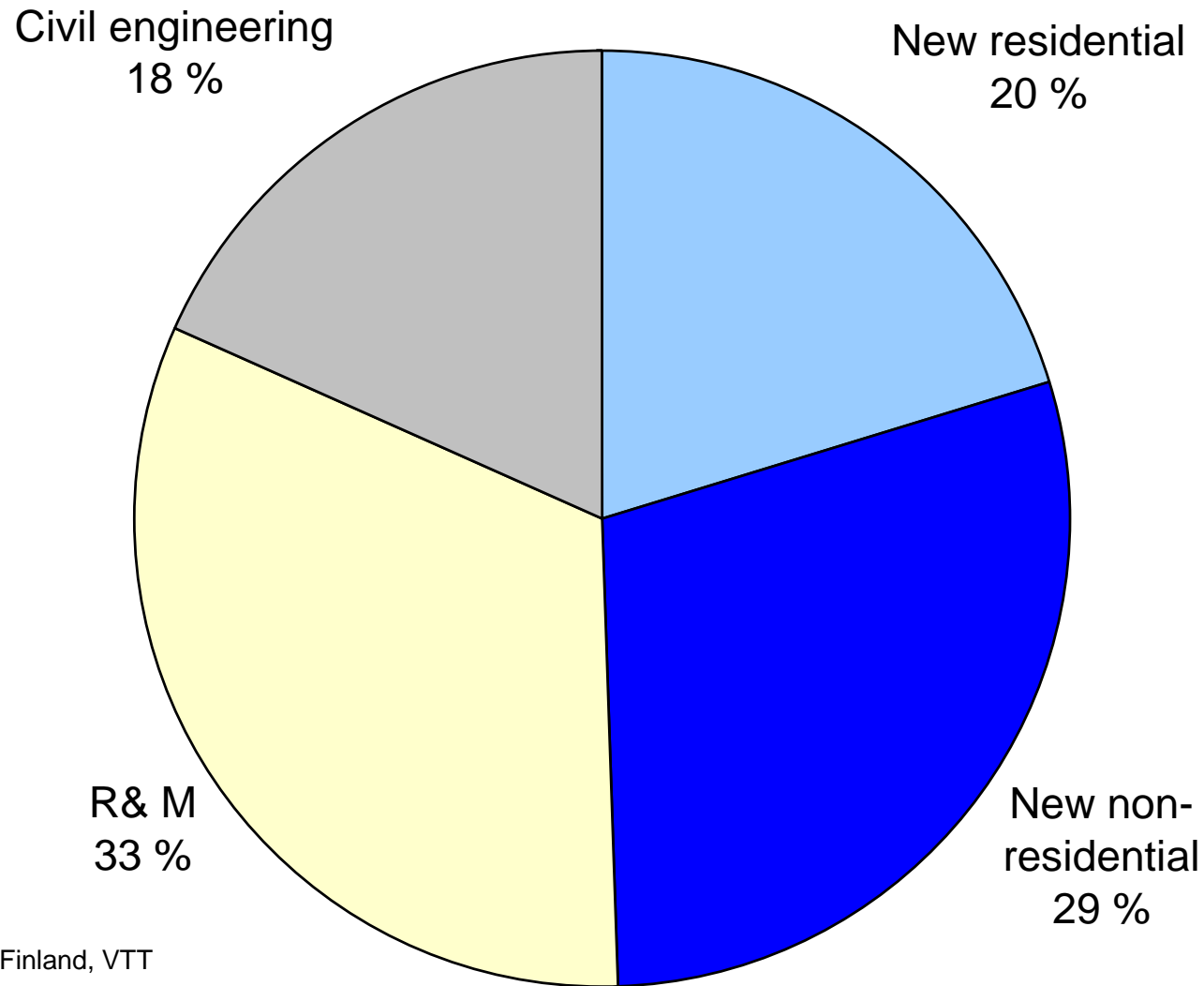
Source: Statistics Finland, Construction Statistics

Civil Engineering in Finland (fixed 2006 prices)



Source: Statistics Finland, National Account & VTT

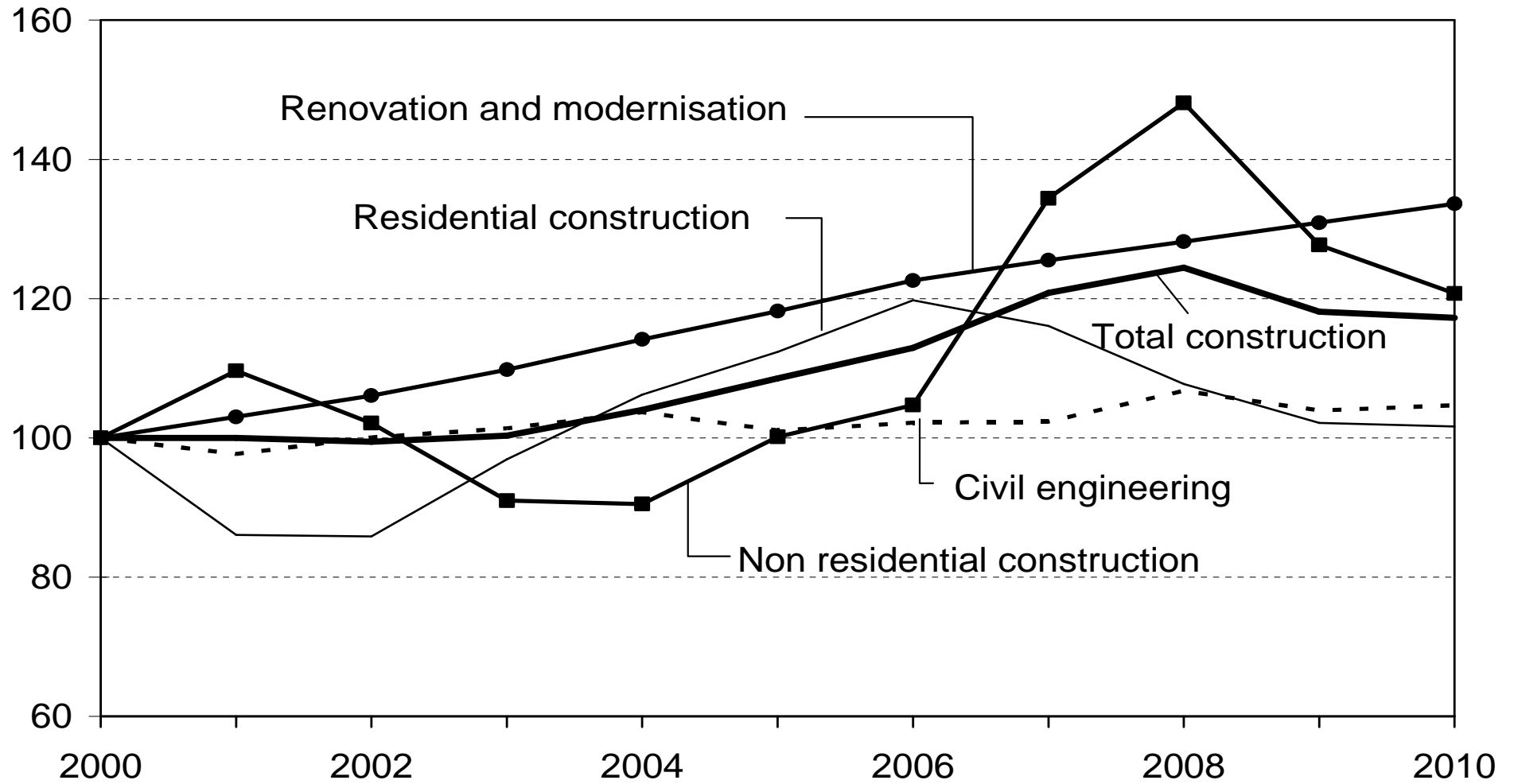
Value of Construction in 2007, Finland Total 27.4 bill €



Source: Statistics Finland, VTT

CONSTRUCTION OUTPUT BY SECTORS IN FINLAND

index 2000=100

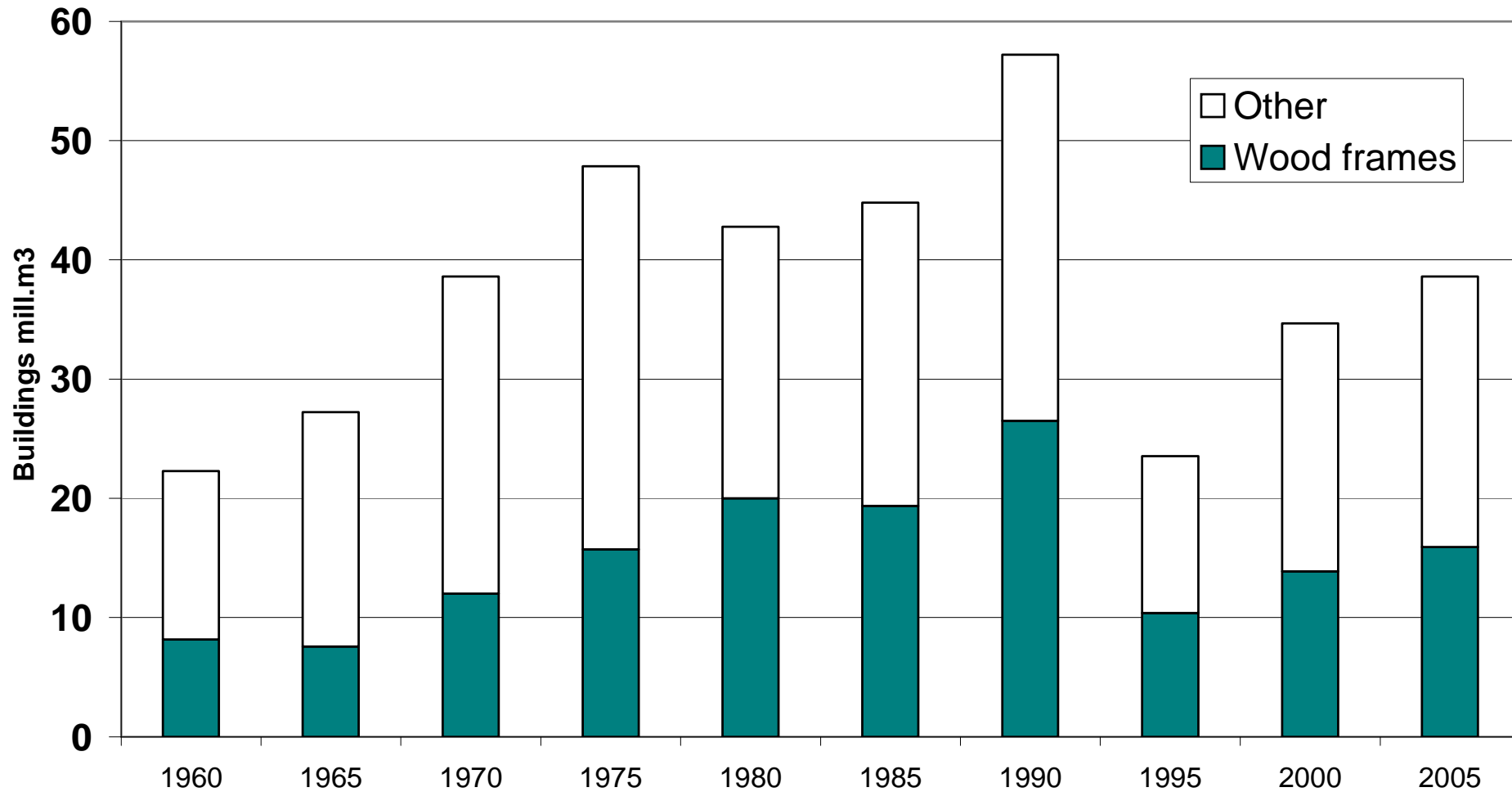


Sources: Statistics Finland and VTT

VTT 5/2008

Frame materials in new construction

Wood in main bearing structures in new buildings in Finland between 1960...2005

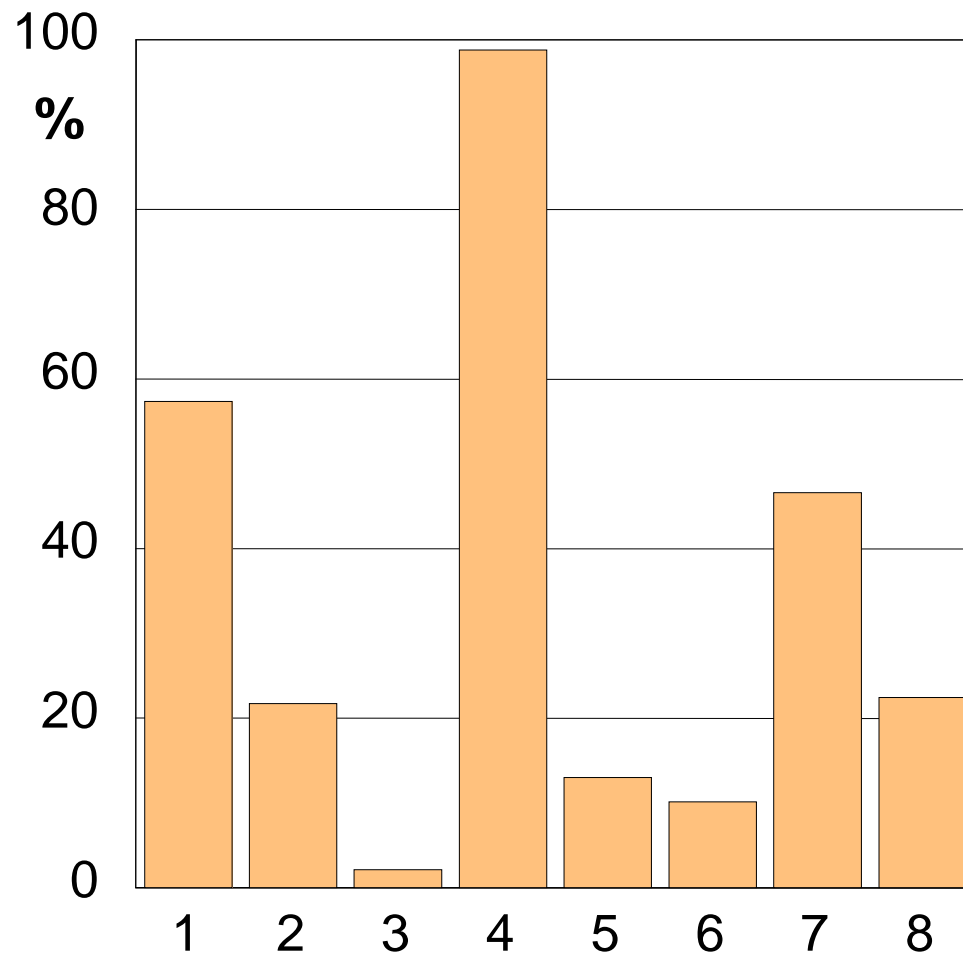


Source: Statistics Finland

VTT 2008



The share of wooden facades in new construction, 1999, % - facade m²



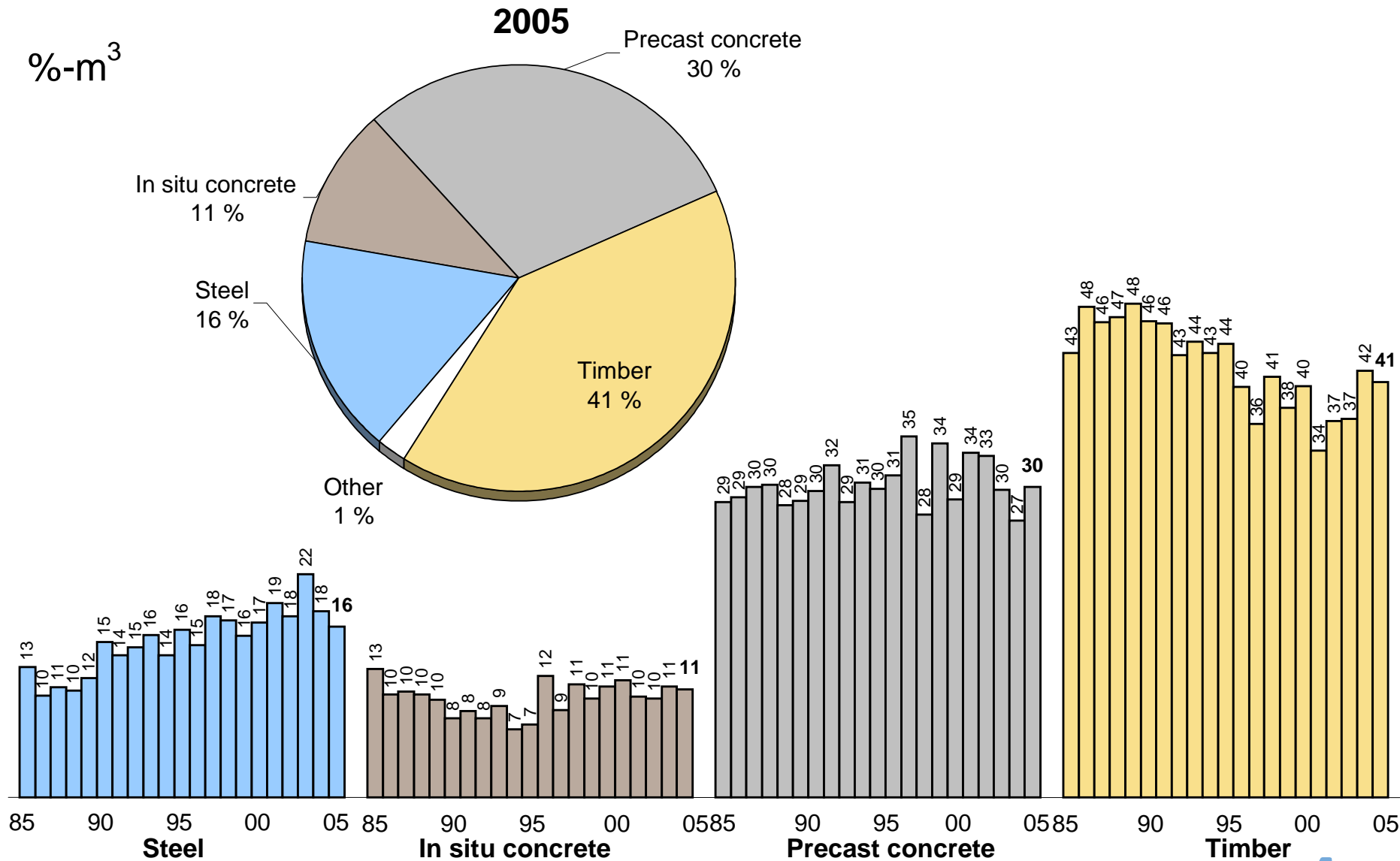
Completed buildings, %-m² (facades)

- 1 Detached houses
- 2 Semi detached houses
- 3 Blocks of flats
- 4 Free-time buildings
- 5 Commercial- and public buildings
- 6 Industry and storages
- 7 Agricultural buildings
- 8 Transport buildings

Source: Statistics Finland and VTT

Shares of frame materials in new buildings in Finland

All buildings



Source: Statistics Finland and VTT, completed new buildings

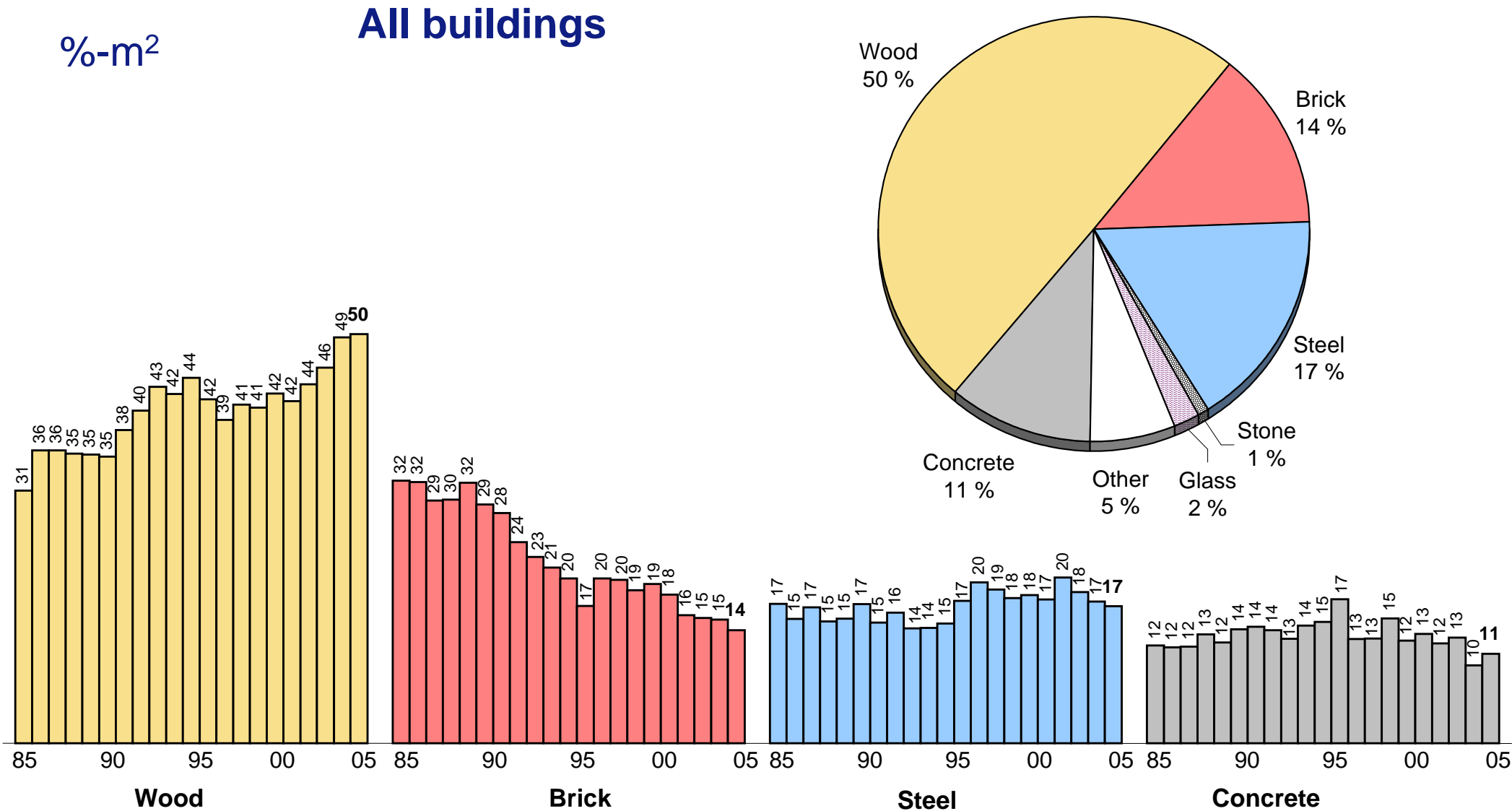
Facade materials in new buildings in Finland

Market shares %-of facades

2005

All buildings

%-m²

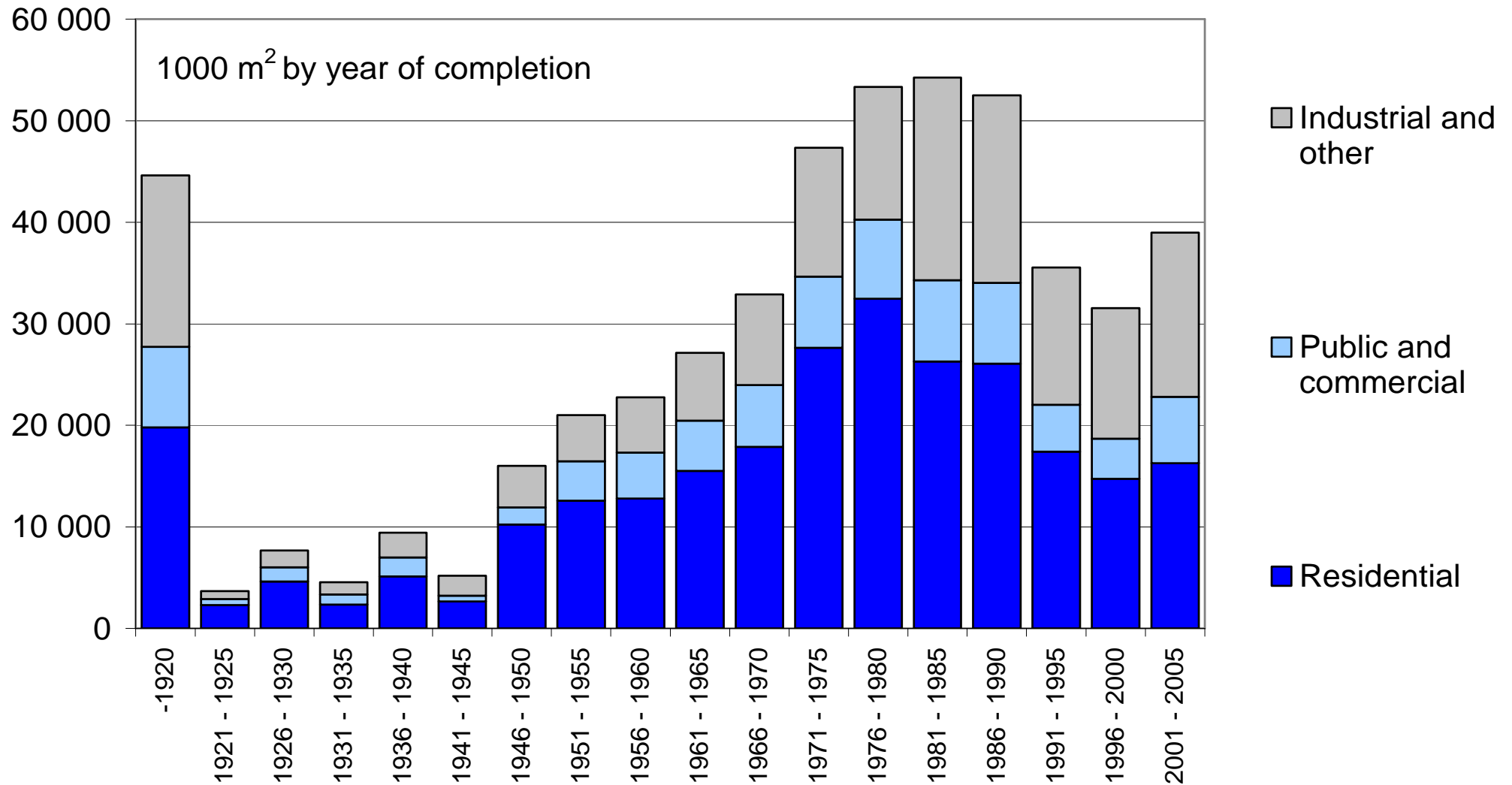


Main Building Types in Construction Statistics

- Detached houses
- Attached houses
- Blocks of flats
- Free time buildings (cottages)
- Commercial buildings
- Offices
- Public buildings
- Industrial buildings
- Storage buildings
- Agricultural buildings
- Other buildings

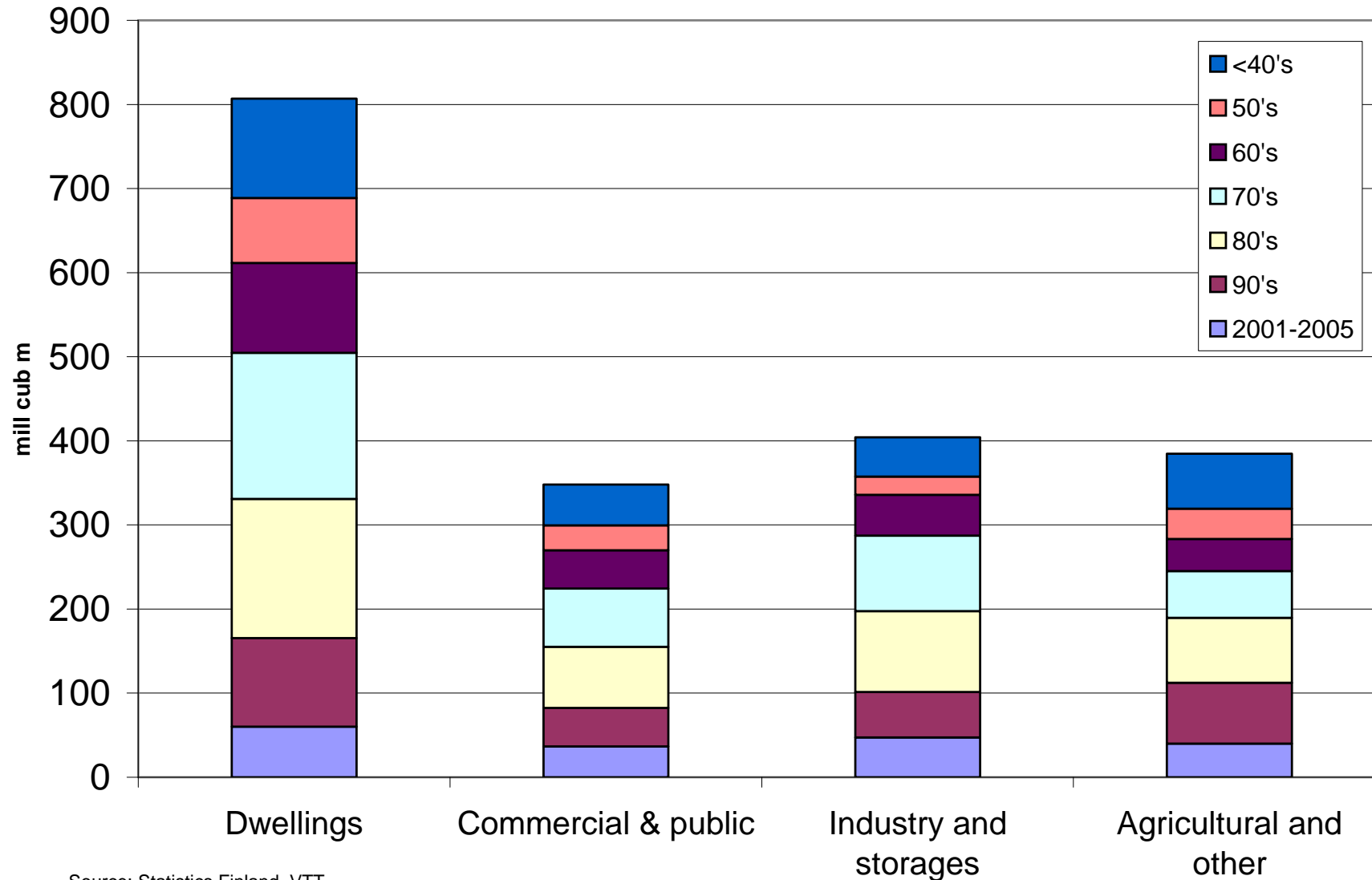
Building stock in Finland

Building Stock, Total 510 milj.m², Year 2005



Source: Statistics Finland, VTT

Building stock in Finland in 2005, total 1.94 bill m3 space



Source: Statistics Finland, VTT

Building stock in Finland

- Building stock in Finland is rather young, if we compare with the situation in many other European countries.
- Almost 65 % of the building stock has been built after 1970.
- Use of wood is very common in building construction
- The carbon pool has been increasing during last decades.

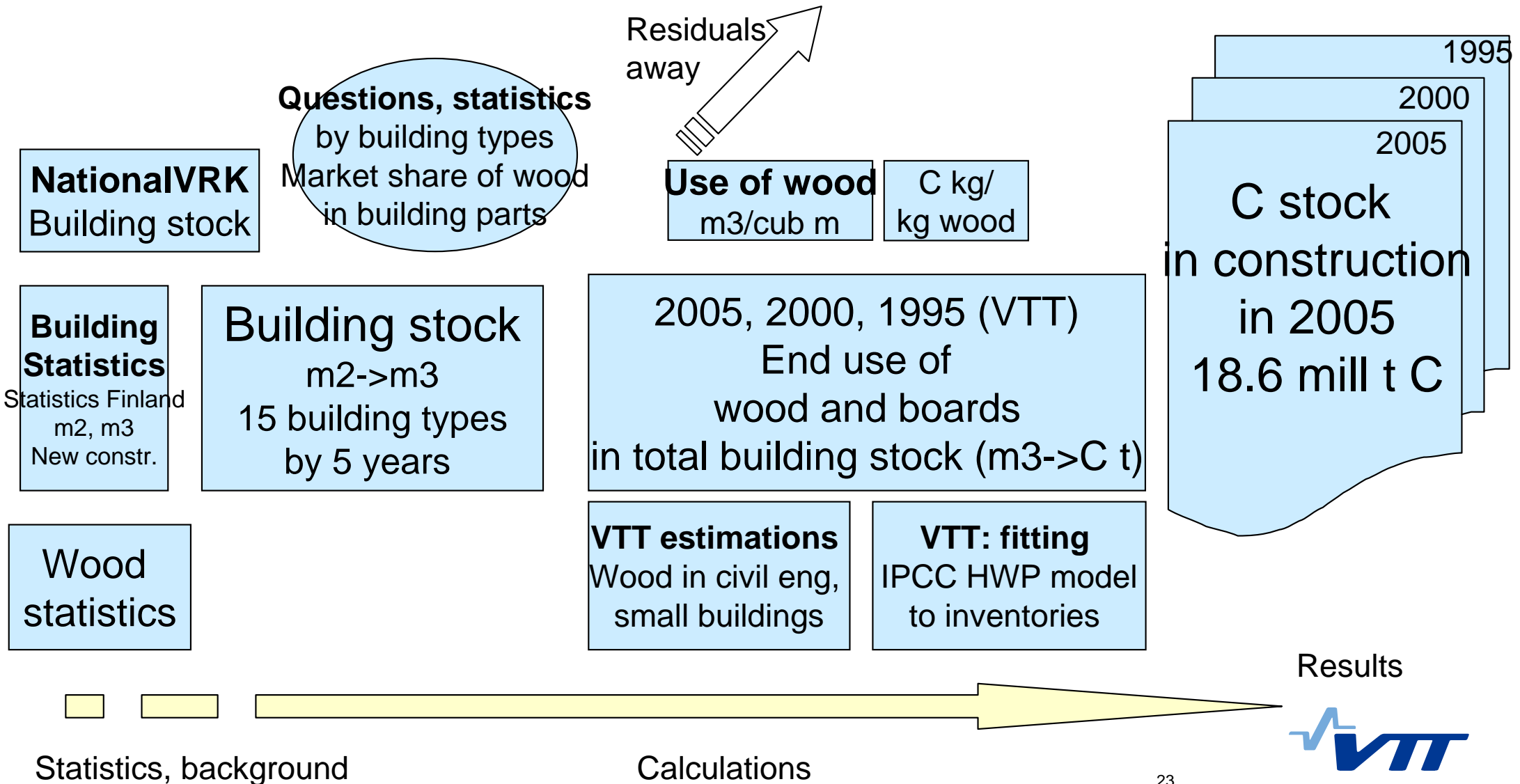
- In addition the official building stock calculations include an estimate of small wooden buildings, which need no building permits and wood used in civil engineering area.

Sources to estimate C stock in wood products in Finnish building stock

- Different construction statistics by Statistics Finland
- Wood statistics by Metla, Statistics Finland and organizations of industry
- Questionnaires of VTT by building types and building parts, other related research
- End use projects of wood by VTT
- Building stock calculations in 1995, 2000, 2005
- Estimations of wood in small buildings and civil engineering (VTT)

Calculations of tonnes of C in total building stock in 1995, 2000 and 2005

The process to estimate wooden C stock in total building stock in Finland



The total C stock calculated by the formula

$$C = \sum_{i,j}[A_{ij}(S_{ij} + P_{ij})]$$

where

C = total C reservoir of wooden materials in building stock (t C),

A_{ij} = building stock of building type i in age class j (building-m³)

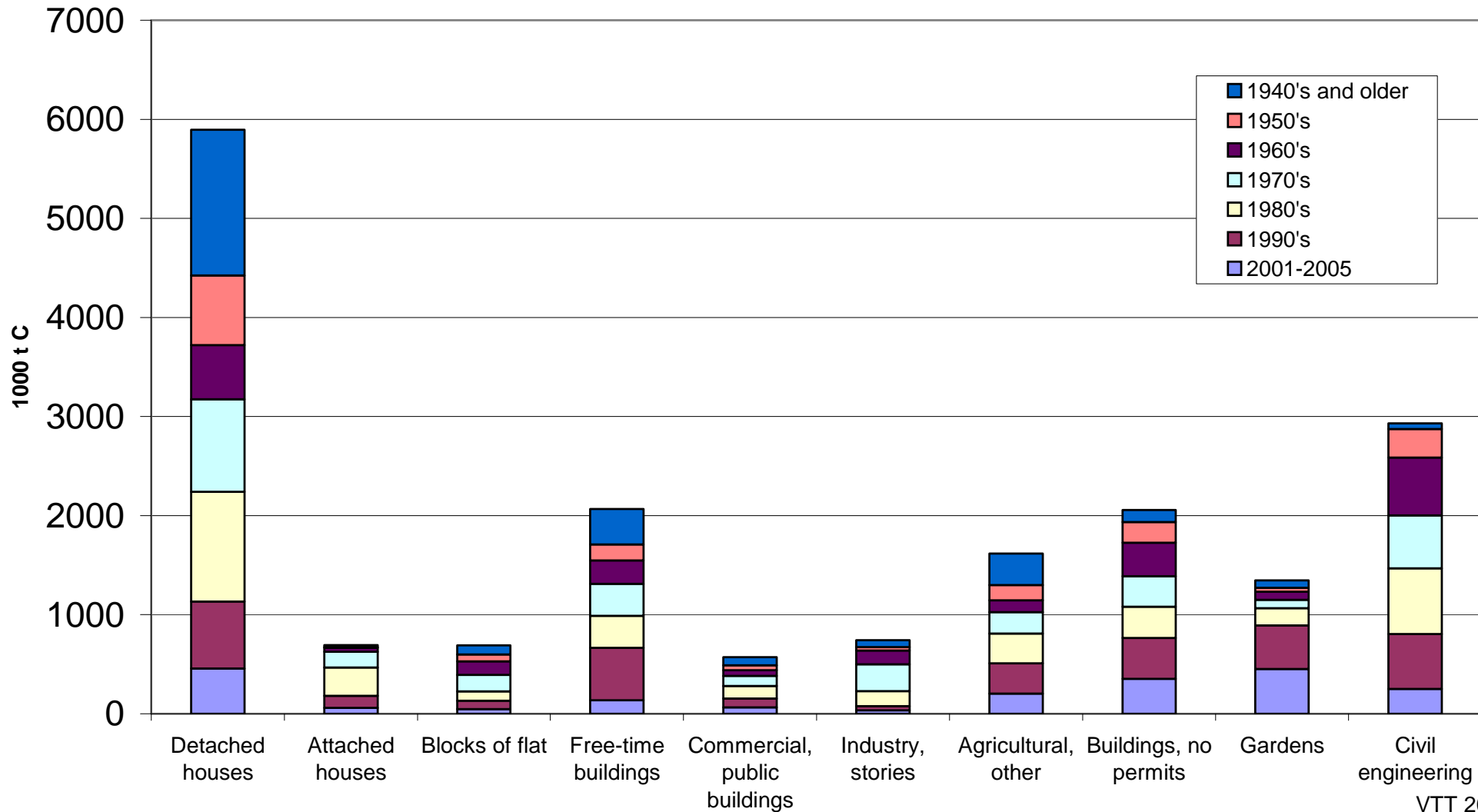
S_{ij} = amount of C in sawn wood and logs in building type i
and age class j (t C / building-m³)

P_{ij} = amount of C in wood-based panels in building type i
and age class j (t C / building-m³)

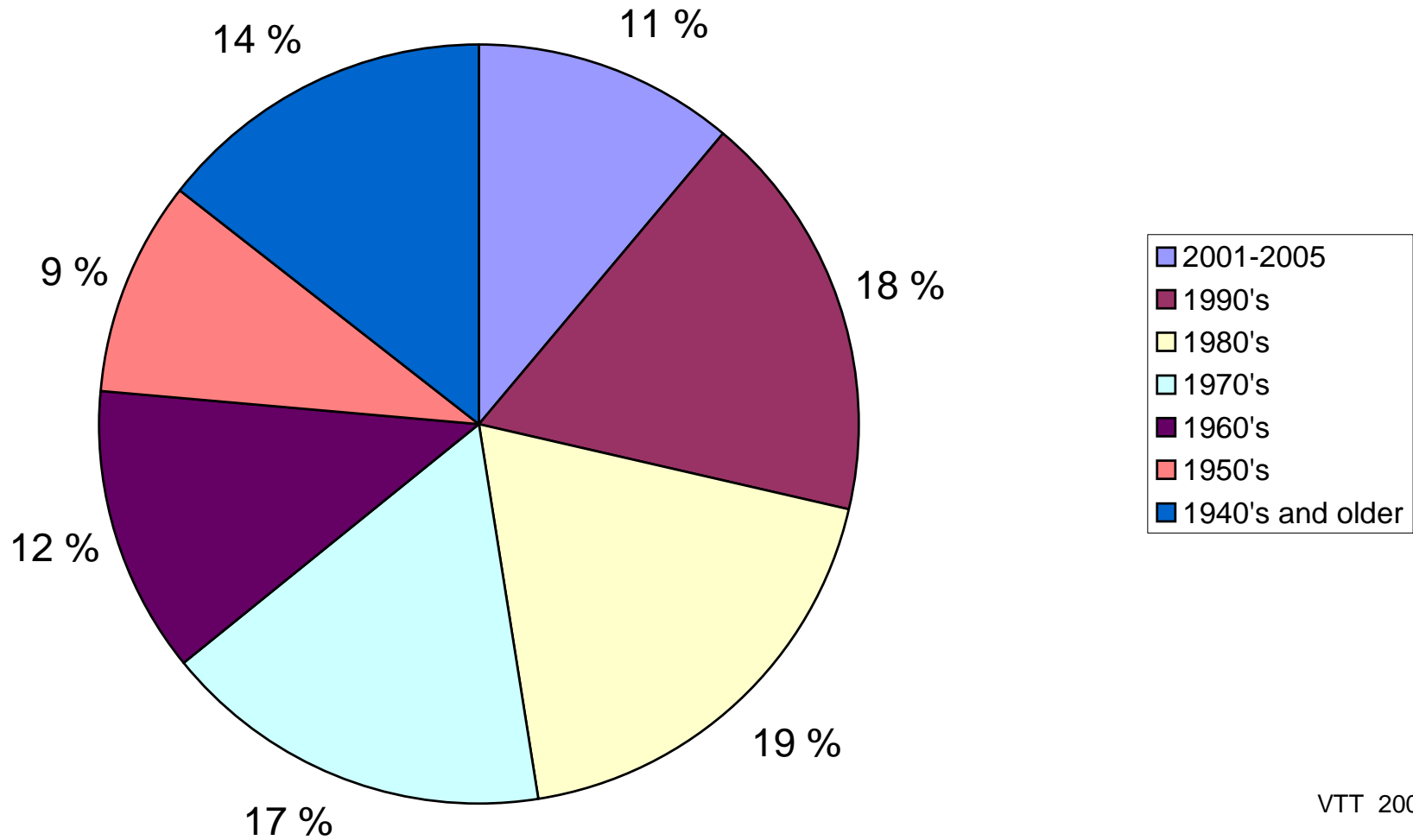
and where age class j refers to the decade of its construction.

Results:
Carbon stock in building stock in 2005
in Finland

Carbon Stock of Wood Products in Finnish Building Stock in 2005 18.6 mill. T C (sawn wood, bearings logs, wood based panels)



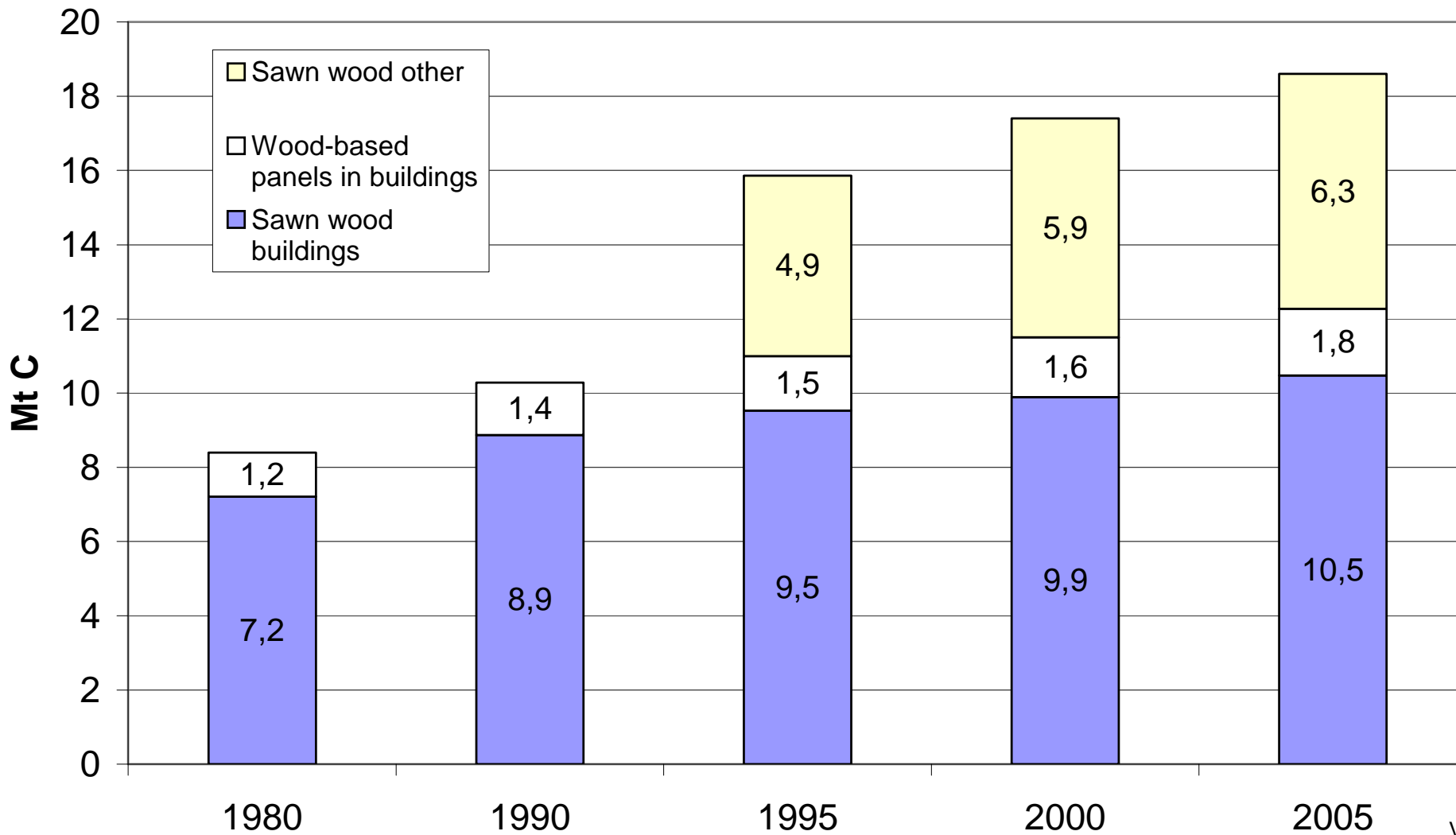
The Share of Carbon Stock by Decades in the Whole Finnish Buildings Stock in 2005 (18.6 mill. T C)



VTT 2007



C storage of wood products in Finnish construction



VTT 2007



Uncertainty in total building stock in 2005

	%
Dwellings	$\pm 4\% \dots \pm 6\%$
Non-residential	$\pm 6\% \dots \pm 9\%$
Civil engineering, other small buildings	$\pm 11\% \dots \pm 20\%$
Total building stock	$\pm 11\%$
VTT 2007	

Fitting the IPCC HWP model to the inventories and estimating the C balance of HWP in use

Based on the HWP model published as a part of the 2006 IPCC Guidelines

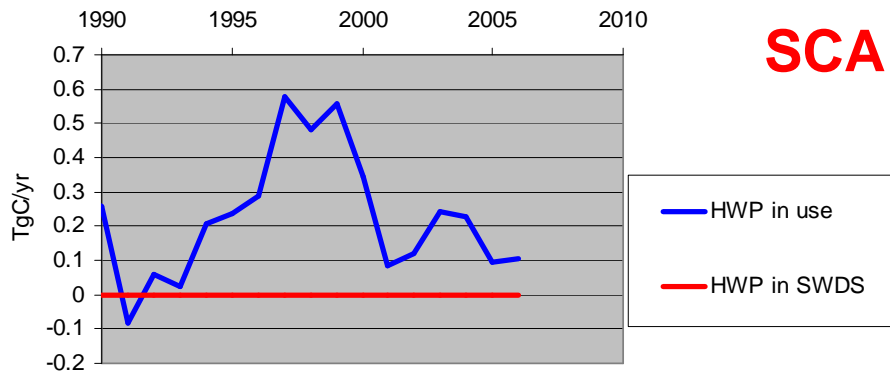
- 1) Model slightly modified to allow different half-life of solid wood products within different time intervals.
- 2) The activity data of Finland (time series of trade and domestic production of various wood products since 1961) downloaded from the FAO database to be used as input data of the model; default values (2006 IPCC GL) used for all parameters except half-life of solid wood products.
- 3) Solid wood products (sawnwood, wood-based panels): the annual C stock and stock-change of solid wood products calculated by the model; the half-life constant of solid wood adjusted so that a fit to the direct stock inventories of 1995, 2000, and 2005 was obtained.
- 4) Paper products (paper and paperboard): stock and stock-change calculated using the default half-life of 2 yrs (2006 IPCC GL)
- 5) The sum of 3) and 4) is the Finnish estimate of HWP stock and stock-change; HWP stock-change from 1990 to 2007 on annual basis presented in the Finnish National GHG Inventory

Results

- Only HWP in use included, HWP in landfills excluded from the national inventory report (NIR) of Finland.
- Best fit obtained with the HWP to the inventories when the half-life of solid wood products in the model is only 15-16 years (or equally average lifetime 21-23) for the period 1900-2000.
- The half-life dependent on national conditions, e.g. the mix of short and long-term use of HWP (could also vary in time).
- Even lower half-life had to be used for the period 2000-2005.
- Contribution of paper products to the total HWP balance is essentially smaller than that of solid wood products (appears to be a source in Finland during last years due to decreasing consumption).
- Besides Stock-Change Approach (SCA) the HWP balance using other approaches can be calculated by the IPCC model, but the uncertainties are higher.

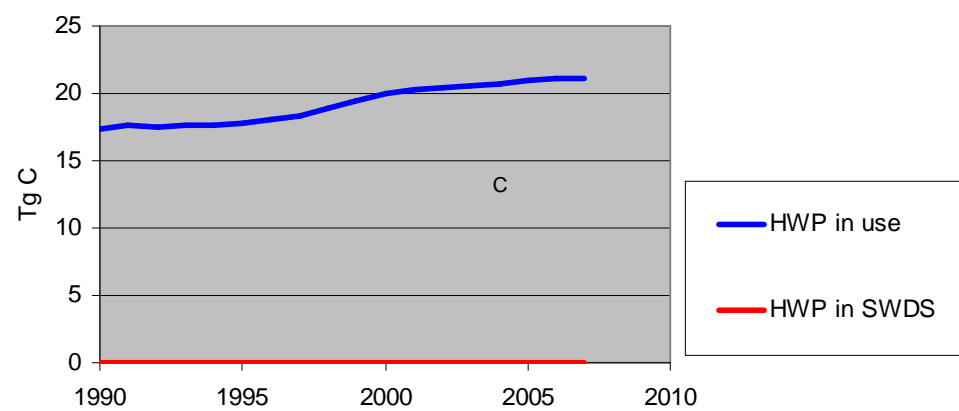
Finland

Stock change approach:
1) C stock changes = C removal



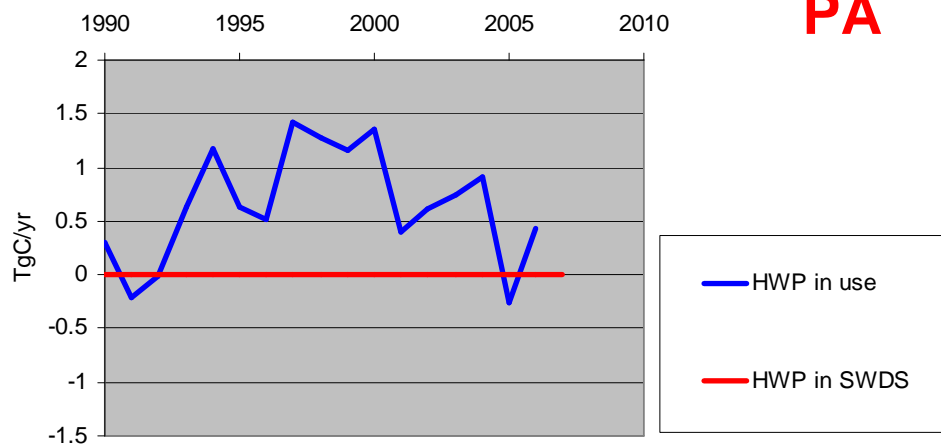
Finland

Stock change approach:
2) C stocks



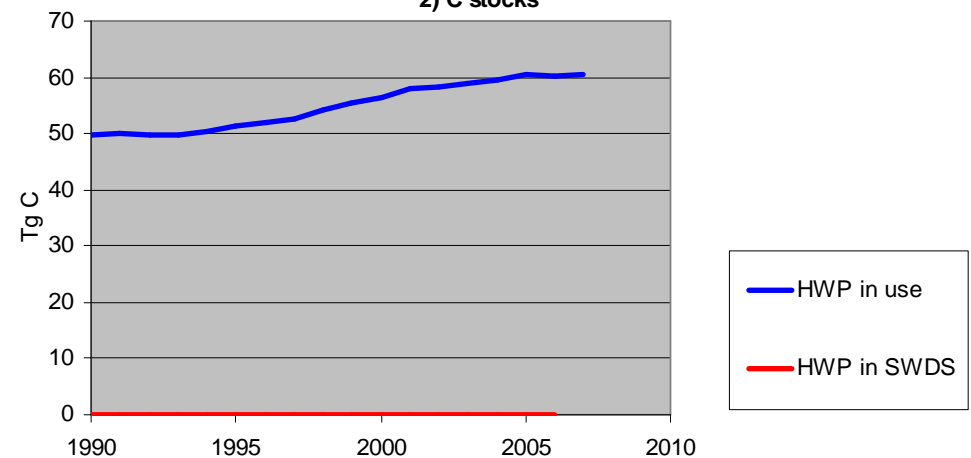
Finland

Production approach:
1) C stock changes = C removal



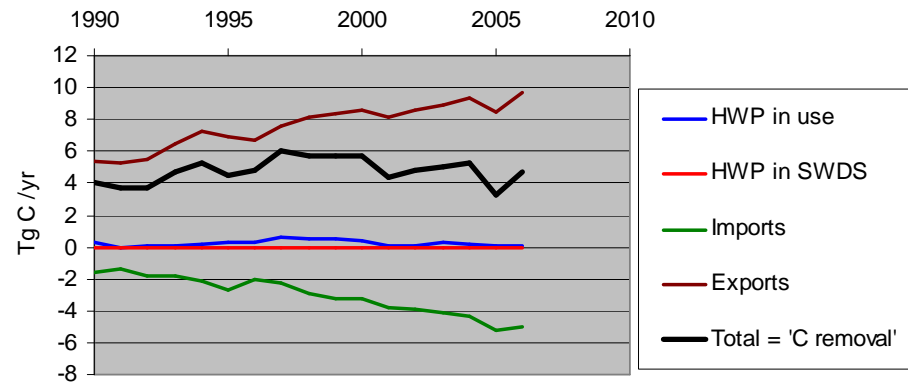
Finland

Production approach:
2) C stocks



Finland

Atmospheric flow approach:
Total = C removal



Further planned improvements of the method

- Trade of final products (e.g. pre-fabricated houses, furniture etc) not included in the IPCC HWP model (nor supported by the FAO database). Consequently, the true domestic consumption of HWP not correctly described in the model.
- The same decay rate for all solid wood products in the model; more product groups (short-, medium-, long-lived) could be added in case more information of the product use-life would be available.
- Exponential decay assumed in the model. Other alternatives could be considered.
- However, the key issue in the method are the direct stock inventories of solid wood products and their reliability. The HWP model is used only in interpolation of the intermediate years.
- Direct inventories of paper product stock not practicable. The default value of the decay of paper products (=half-life of 2 yrs) is likely an overestimate. Better estimates could be found.

Direct HWP inventories of buildings stock in other countries ?

- Dwelling stock statistics are produced in many countries
- Non-residential building stock statistics are not so common in most countries
- Some European countries produce statistics from wood in bearing structures in new building construction by building types (like Germany, Norway, other?)
- Wooden buildings are not so common in Europe.
- Wooden building parts are more used, like windows, doors, kitchen furnitures, structures of roofs.
- Different questionnaires and research are needed from the end use of wooden products in building stock and civil engineering area.
- More research is needed in the future for direct HWP inventories

2.1 Average useful floor area per dwelling and per person (m^2)

	Dwelling				Person	
	Year	Total dwelling stock	Year	Dwellings completed	Year	Occupied dwelling stock ¹¹
Austria	2003	93.9 ⁹⁾	2002	101.0	2003	38.3 ⁹⁾
Belgium	1991	86.3	2001	119.0	-	na
Cyprus	-	na	2002	197.6	-	na
Czech Republic	2001	76.3 ⁸⁾	2003	104.9	2001	28.7 ⁸⁾
Denmark	2002	109.1 ²⁾	2001	112.4	2003	50.6
Estonia	2003	60.2	2003	89.1	2003	27.7
Finland	2002	77.0	2003	90.2	2002	36.3
France	2002	89.6 ¹⁾	2002	112.6	2002	37.5
Germany	2002	89.7	2003	113.9 ³⁾	2002	40.1
Greece	1994	82.7	2001	124.6 ⁴⁾	-	na
Hungary	2001	75.0	2002	94.1	2001	28.0
Ireland	2003	104.0	2003	105.0	2002	35.0
Italy	1991	90.3	2000	81.5	-	na
Latvia	2003	55.4	2003	194.3 ¹²⁾	2003	23.9
Lithuania	2003	60.6	2003	106.2	2003	23.0
Luxembourg	2001	125.0	2001	120.2	-	na
Malta ¹⁰⁾	2002	106.4	-	na	2002	34.3
Netherlands	2000	98.0	2000	115.5	2000	41.0
Poland	2002	68.2	2002	99.3	2002	22.2
Portugal	2001	83.0 ¹⁾	2003	88.9	-	na
Slovak Republic	2001	56.1	2002	117.8	2001	26.0
Slovenia	2002	75.0	2002	113.5	2002	29.5
Spain	2001	90.0 ⁵⁾	2002	96.1	-	na
Sweden	2003	91.6	2003	128.0	2003	44.4
United Kingdom ⁶⁾	2001	86.9	1981–2001	82.7	2001	44.0 ⁷⁾

Conclusions

An end use analysis of wooden materials in construction is possible, if:

- Construction statistics by building types, building stock and some wooden indicators are produced during long time.
- Building stock in Finland is rather young, if we compare it to many other countries in Europe. The carbon stock has increased continuously during last decades.
- Distribution of long lived use of wooden products is quite different in each country.
- Stock loss in buildings varies between 0.3-2 % depending on building type, the average building about 1 %.
- Statistics of trade associations can produce some important indicators.
- Questionnaires about the end use of wood in new construction and building stock are needed .
- Wood in civil engineering area is spread very many sectors.
- Wood is used in many small buildings, which is also an important end use sector.