COST ACTION E31 AND IEA BIOENERGY TASK 38
WORKSHOP IN Dublin 2005

RECOVERED WOOD FROM RESIDENTIAL AND OFFICE BUILDINGS

ASSESSMENT OF GHG-EMISSIONS FROM REUSE, RECYCLING, AND ENERGY GENERATION

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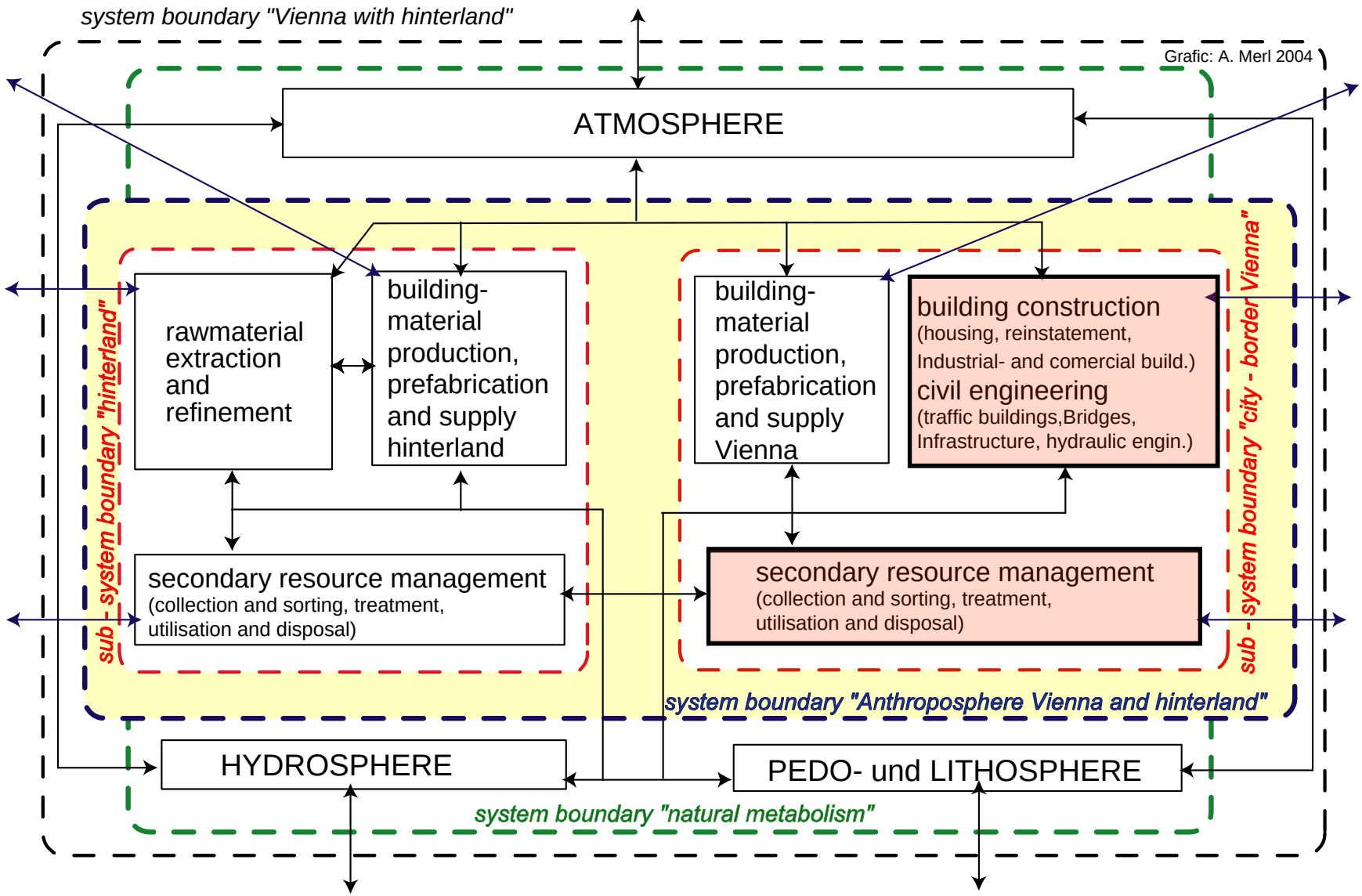
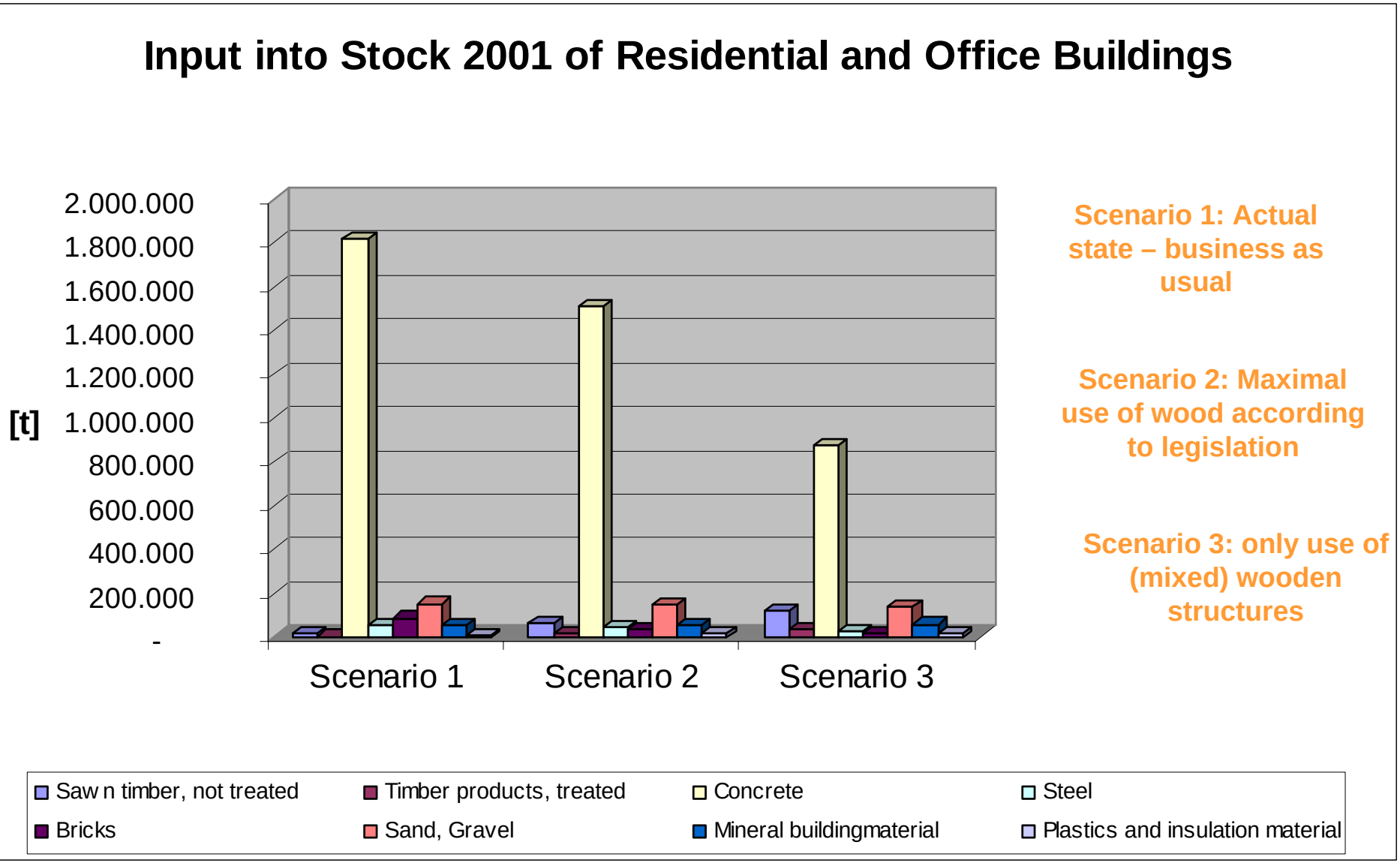
INTRODUCTION

- Current research work aims at establishing a sustainable resource management for office and residential buildings in Vienna
- Special focus is set on the use of wood and GHG mitigation
- Use of wood for structures in an urban area (Vienna) – 3 Scenarios
- Examination of the flows of building timber, the stored timber within the buildings and the waste wood management for 3 Scenarios
- The investigated system covers 63 % (27,600 t) of annual building and demolition timber (44,000 t), which is 75 % of total amount of annual waste wood in Vienna (62,000 t)
- Analysis of properties and amounts of waste wood and available infrastructure
- Assessment of future resource potential for material and thermal use
- Assessment of carbon sink , green house effect

CITY OF VIENNA – ANALYSIS OF THE SYSTEM



3 SCENARIOS

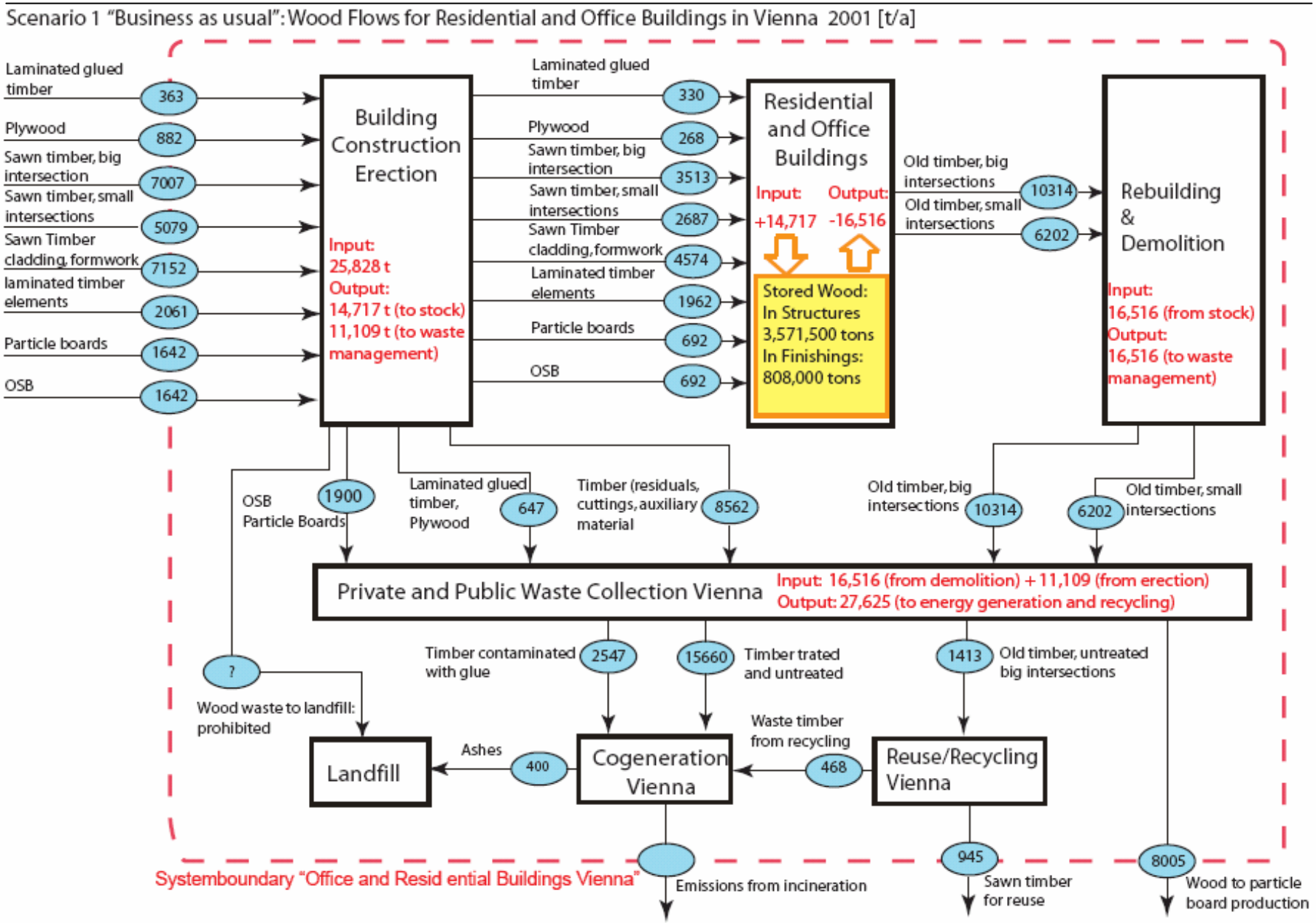


Scenario 1: Actual state – business as usual

Scenario 2: Maximal use of wood according to legislation

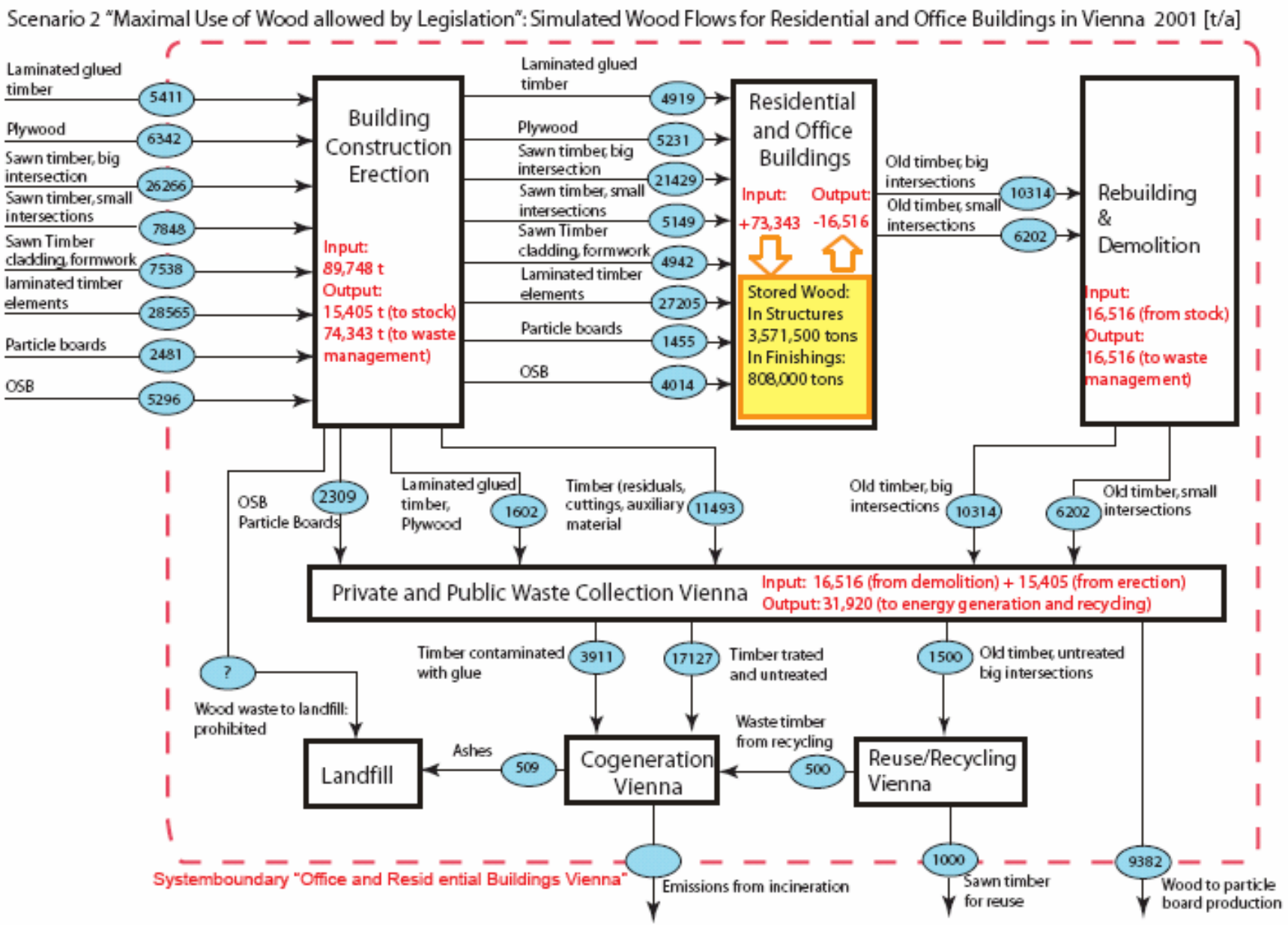
Scenario 3: only use of (mixed) wooden structures

SCENARIO 1: FLOWS OF TIMBER IN VIENNA 2001



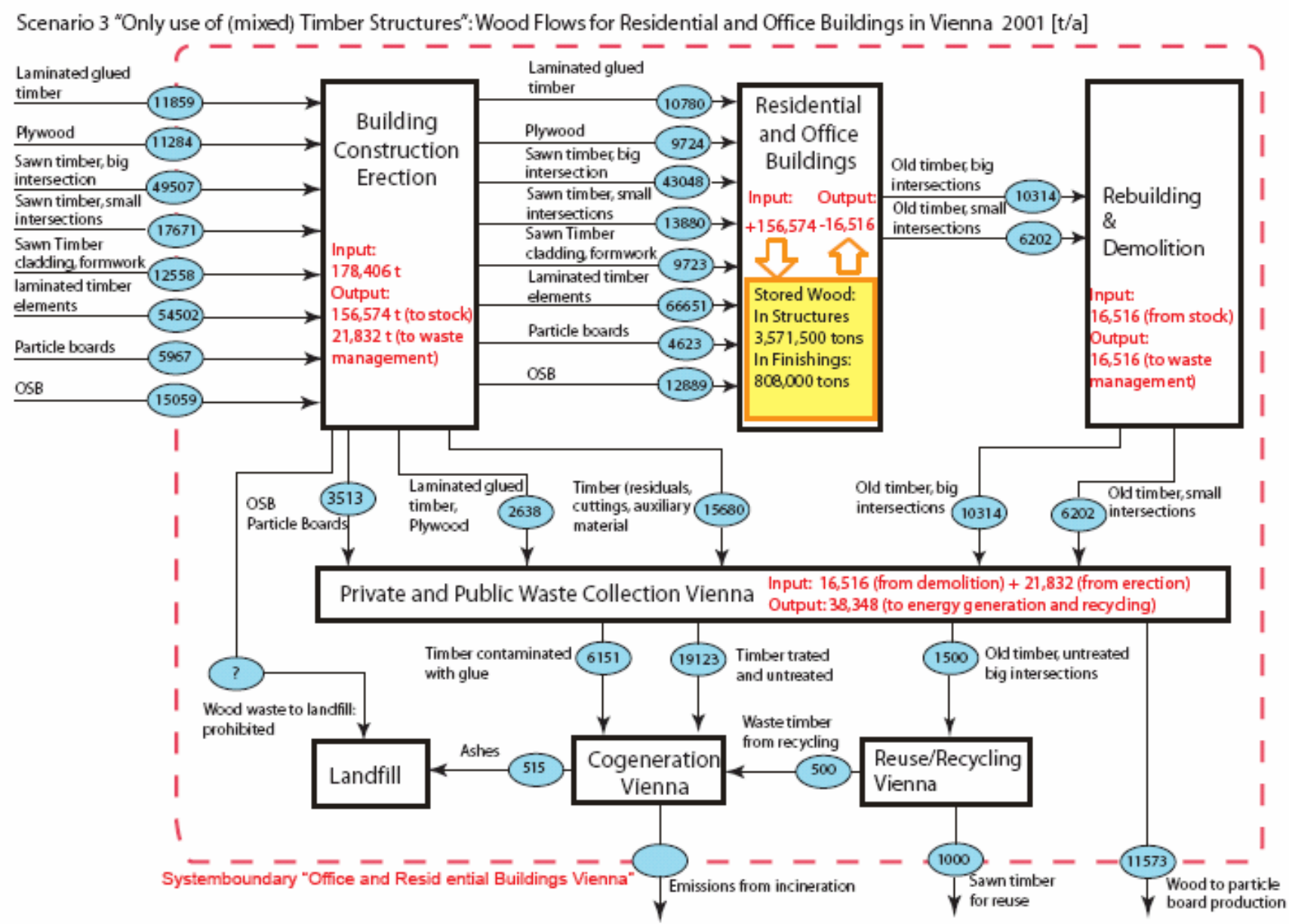
ghg-emissions from reuse, recycling, and energy generation

SCENARIO 2: SIMULATED FLOWS OF TIMBER



ghg-emissions from reuse, recycling, and energy generation

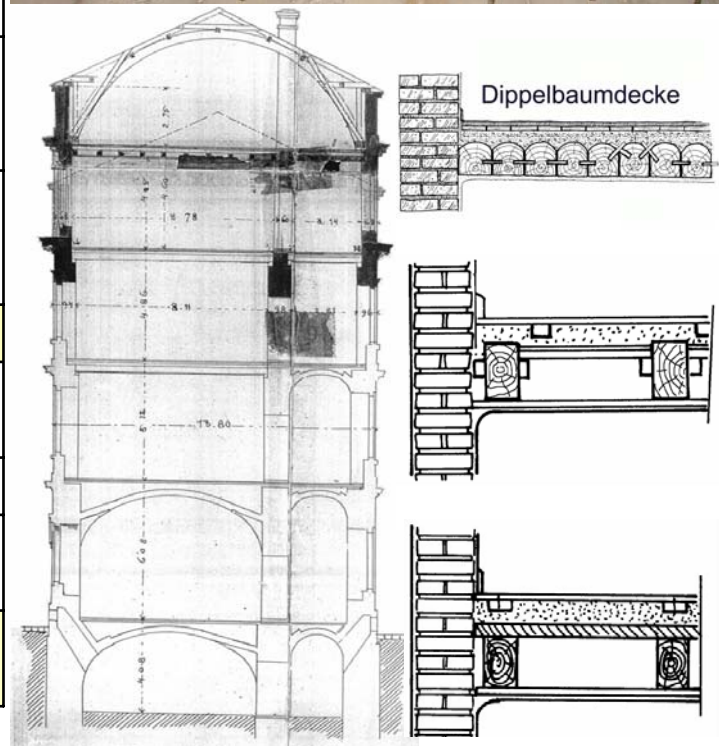
SCENARIO 3: SIMULATED FLOWS OF TIMBER



ghg-emissions from reuse, recycling, and energy generation

WOOD STORED IN BUILDINGS - STOCK

Kind of wood stored in the buildings, measurements.	**Amount [t]**	Waste management option
Beams in ceilings, big intersections, span from 4 to 6 m (10 m), not treated	1,616,800	Reuse, recycling, thermal use
Wood integrated in various structures, small intersections, not treated	141,000	recycling, thermal use
Boards integrated in various structures, not treated	986,500	recycling, thermal use
Beams in roof frames and roof structures, big intersections treated and not treated	481,600	Reuse, recycling, thermal use
Small intersections in roof frames and roof structures, treated and not treated	110,600	Recycling (not treated), thermal use
Wood stored in Structures	**3.571.500**	
Boards in various floors, various measurements, treated	352,500	thermal use
Wood in doors, windows etc, treated	399,000	thermal use
Interior components like wall and ceiling panelling etc, treated	56,500	thermal use
Total amount of treated and untreated natural wood in Vienna	**4,370,500**	



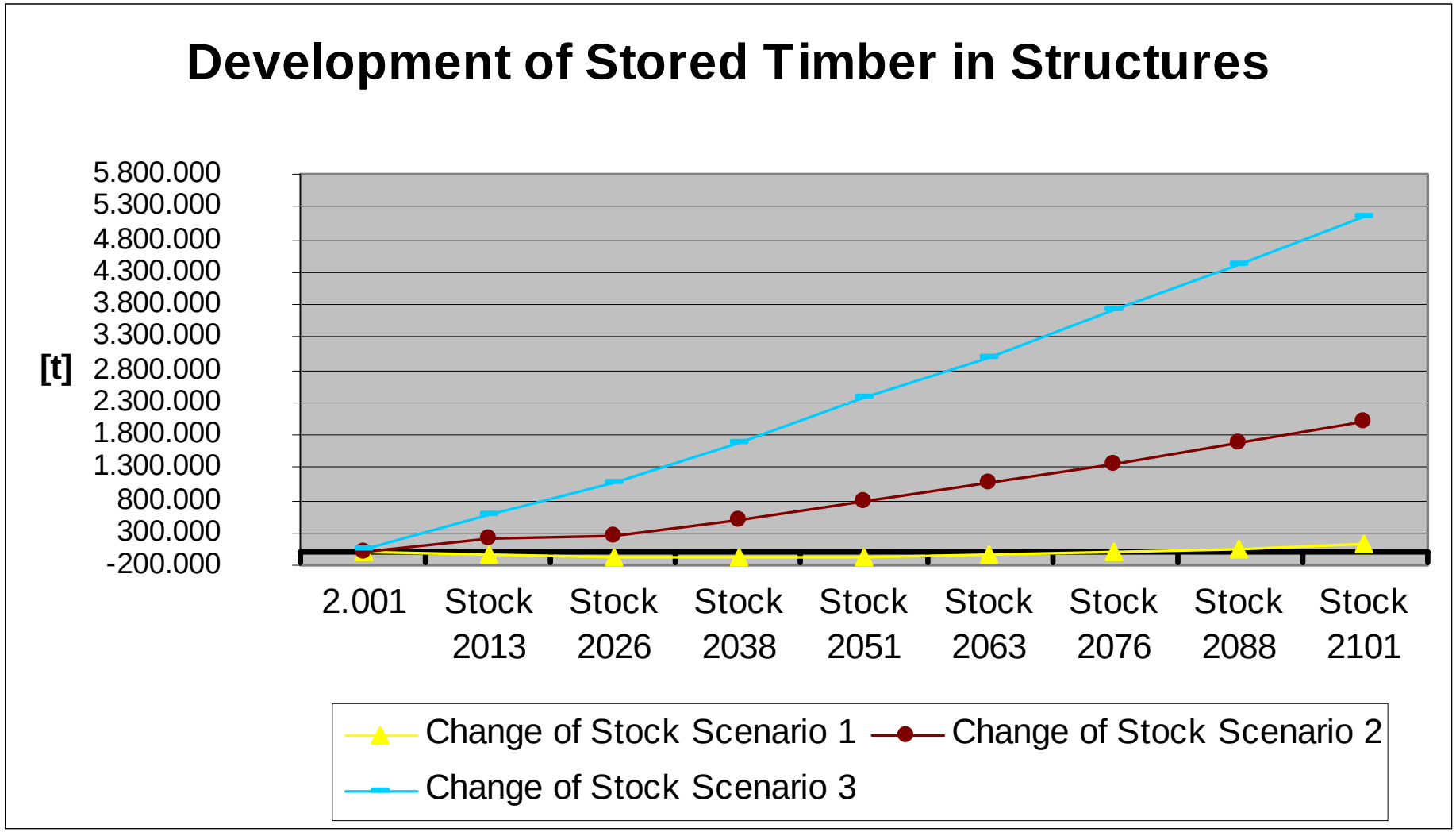
CARBON REPOSITORY, STORED ENERGY

Amount of Wood and CO_2-Equvivalents stored in Buildings in Vienna 2001

	Wood stored in Structures	Wood stored in Finishings	Total
Amount of stored Wood [t]	3.571500	808.000	4.379.500
CO2 - Equv. [t]	6.543.606	1480.396	8.024.001
Stored Energy [PJ]	67,9	15,4	83,3

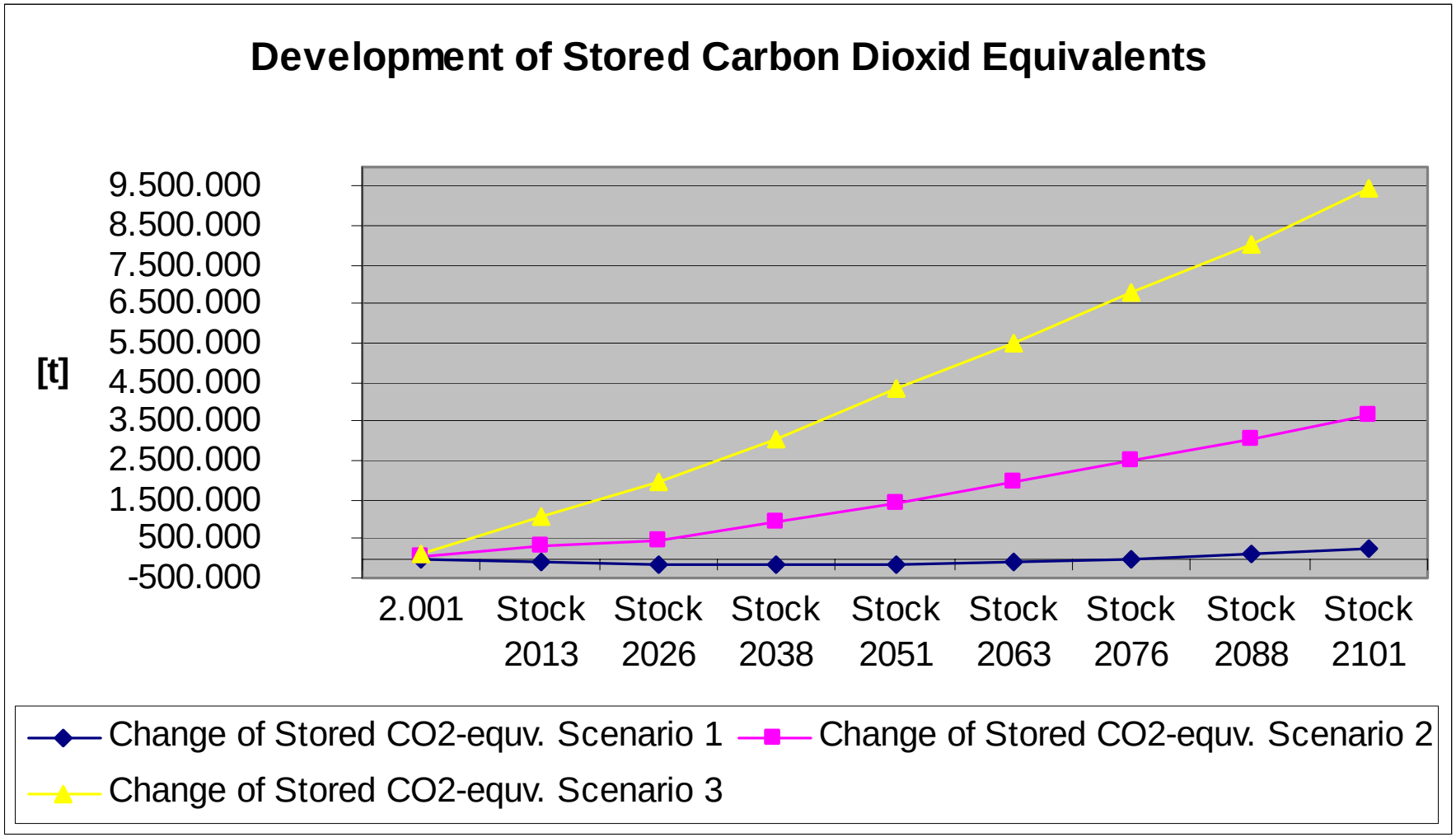
Annual CO_2 – Emissions of the City of Vienna: 9 Mio. tons

TIMBER STORED IN STRUCTURES - CHANGE

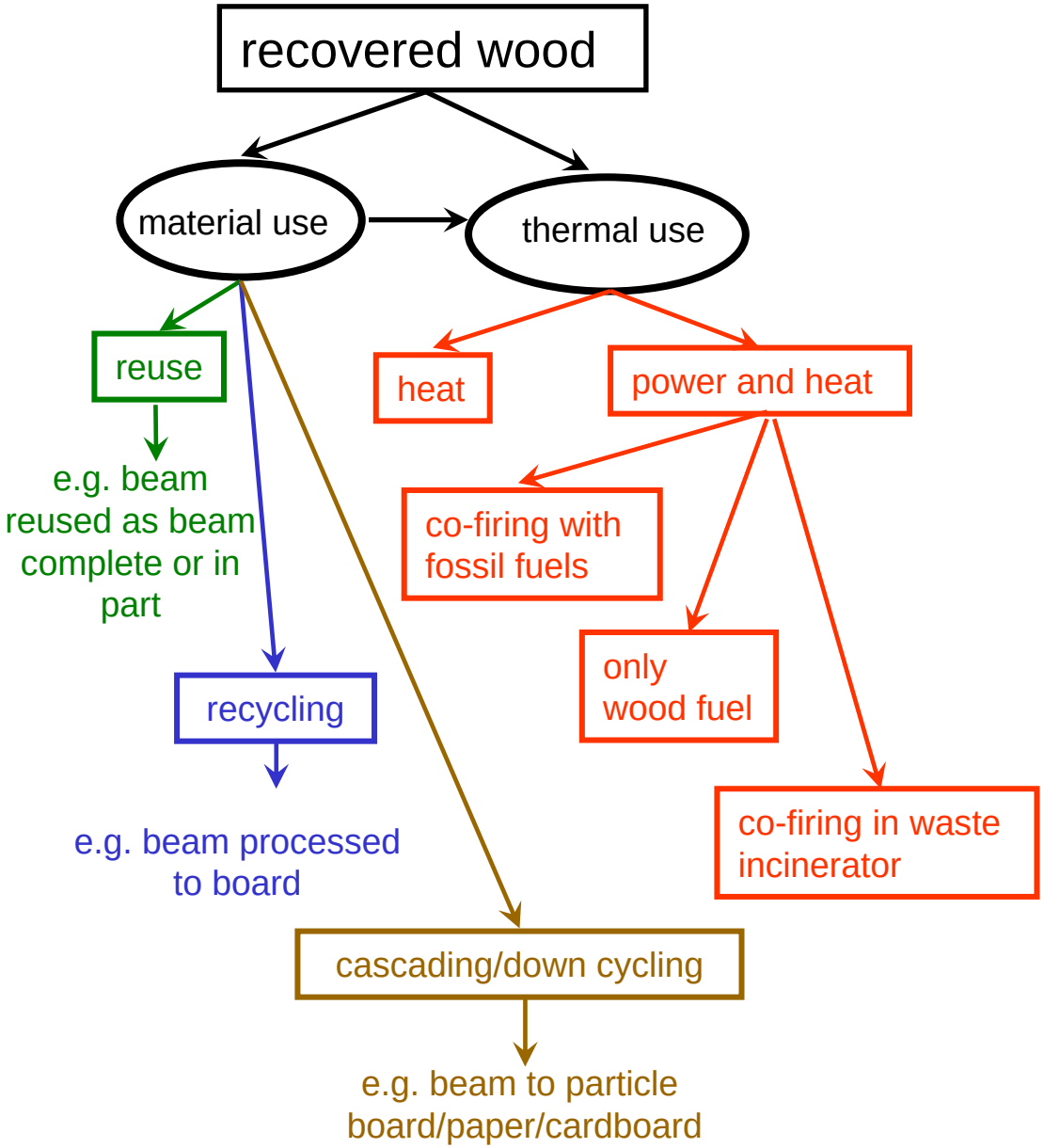


Amount stored in Structures until 2001: 3,570,000 t

CO_2 – EQUIV. STORED IN STRUCTURES - CHANGE



MATERIAL AND/OR THERMAL USE



- measurements
- optic condition
- strength property
- careful dismantling
- disconnection of parts
- contamination (mechanical, chemical, inorganic matter)
- damage from varmints
- feasibility of separation (economically & technically)

WASTE MANAGEMENT OPTIONS 2001 IN VIENNA

recovered from wood from structures

disposal

Landfill Prohibited:
landfill ordinance 1996

secondary resource management 2001

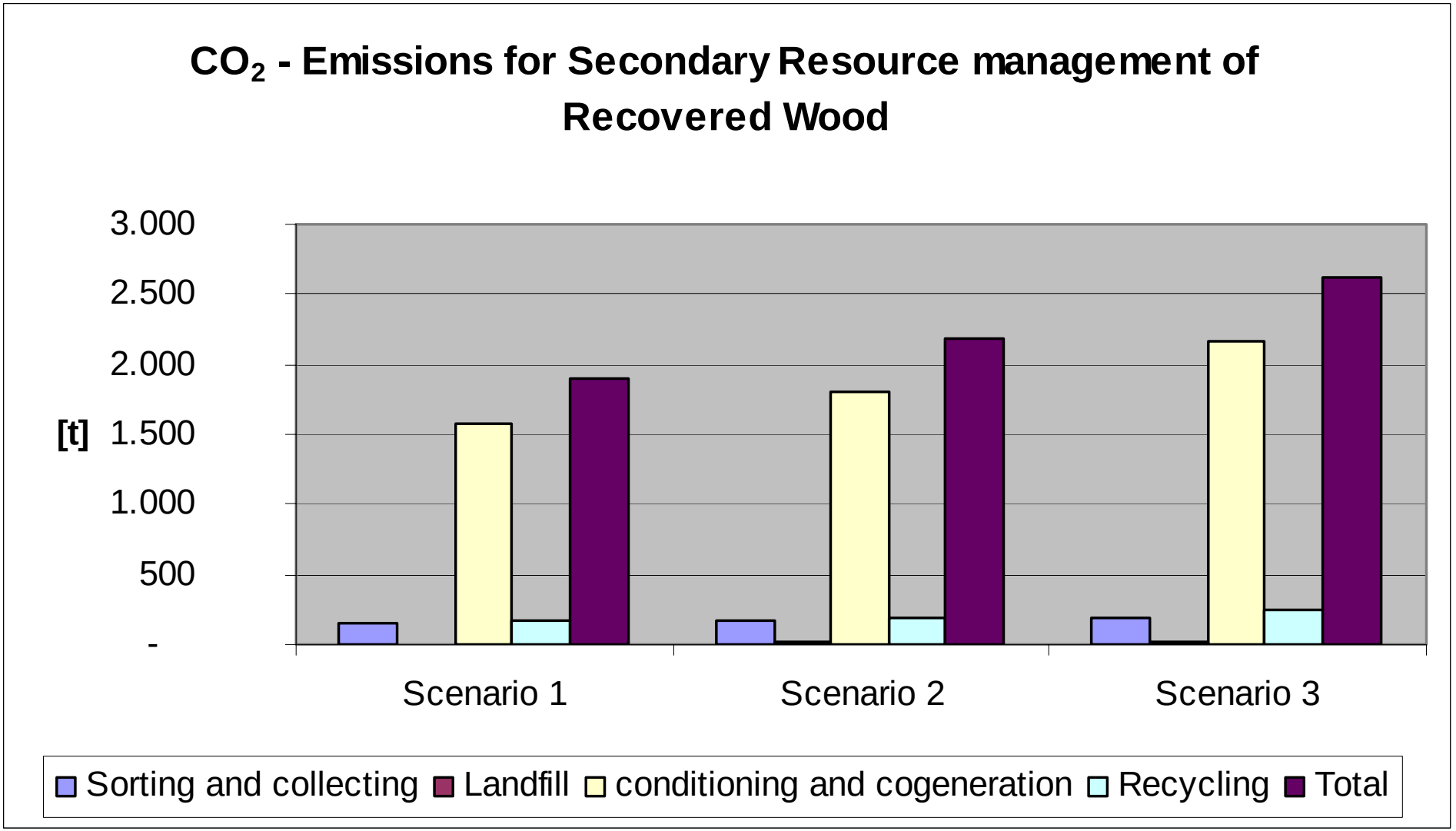
Energy use

Material use

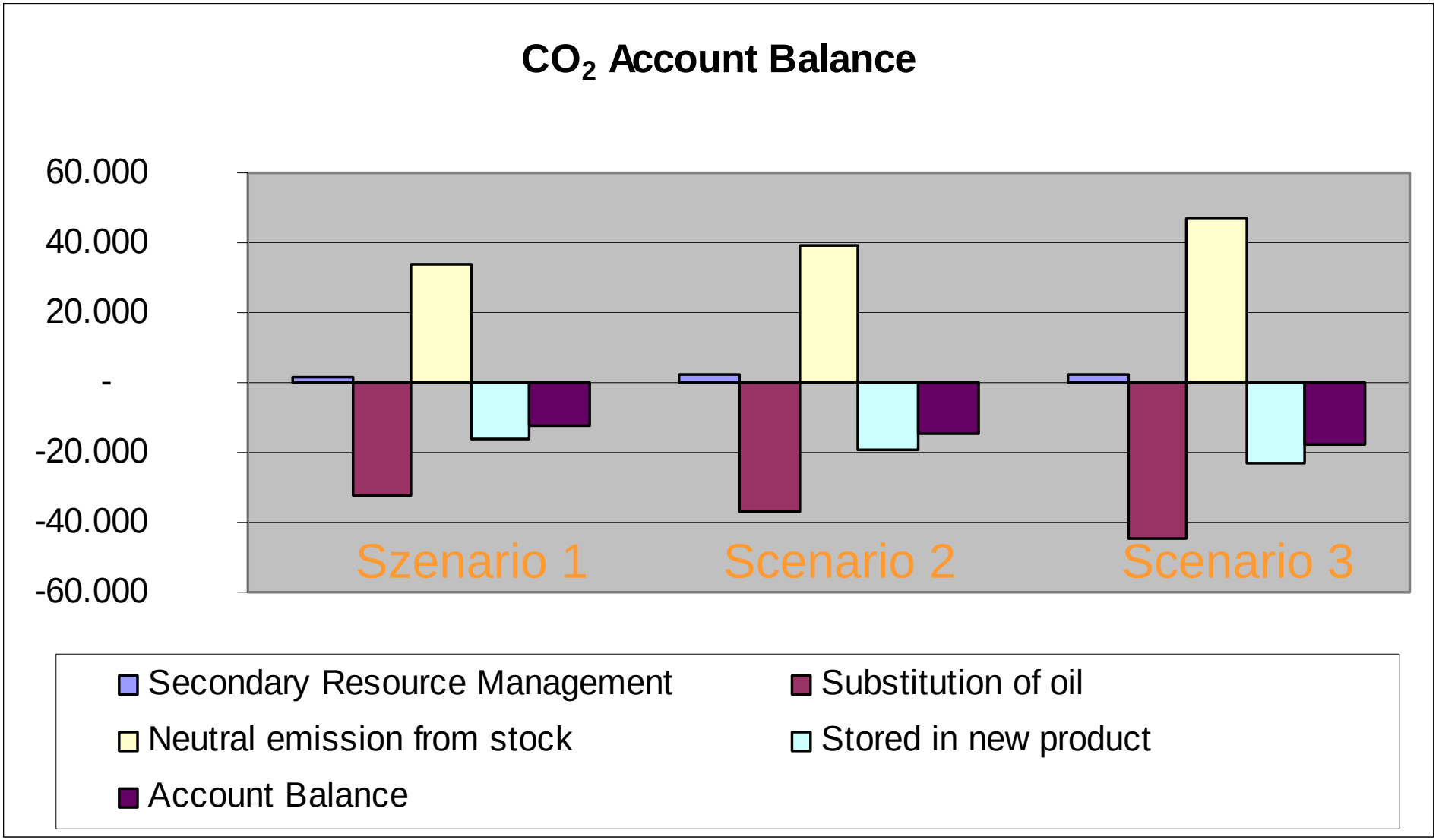
Thermal use of recovered wood 2001 in Vienna: 18,207 t/a (66%) + 468 t residuals from recycling
Available infrastructure:
6 Incinerators: 836,500 t/a
2 Incinerators: no data
20 (in-plant) Incinerators: no data
Average transport distance: 5 – 10 km
Starting 2006: Biomass CHP – Plant, only for fresh wood (186,000 t/a, u=40% - 133,000 dry wood); average Transport distance for 80%: 70-80 km, for 20% no data, assumption: 100 km

Material use of recovered wood 2001 in Vienna: 30,100 t/a (34 %)
Type of utilisation/recycling:
- particle board industry: 8,005 t, transport distance is
- Sawmill in Vienna (flooring, furniture industry, etc): 1,500 t, average transport distance is 5 – 20 km)
- Agriculture (small amount from recycling sawmill

GHG – EMISSIONS OF WASTE MANAGENT PROCESSES



ACCOUNT BALANCE OF GHG - EMISSIONS



ADDITIONAL BENEFITS FOR RECYCLING

Benefits for recovered wood to sawn timber (reuse, recycling) and recovered wood to particle boards:

- Substitution of stand establishment / tending / site development, debarking (2 – 3 kg CO_2-equiv./m³) – Scenario 1: 52 t
- Substitution of forest area (sawn timber 1 ha/1,075 $t_{dry\ mass}$; chips for particle boards 1ha/1,67 $t_{dry\ mass}$) : Scenario 1: 5.672 ha

Benefits recovered wood sawn timber

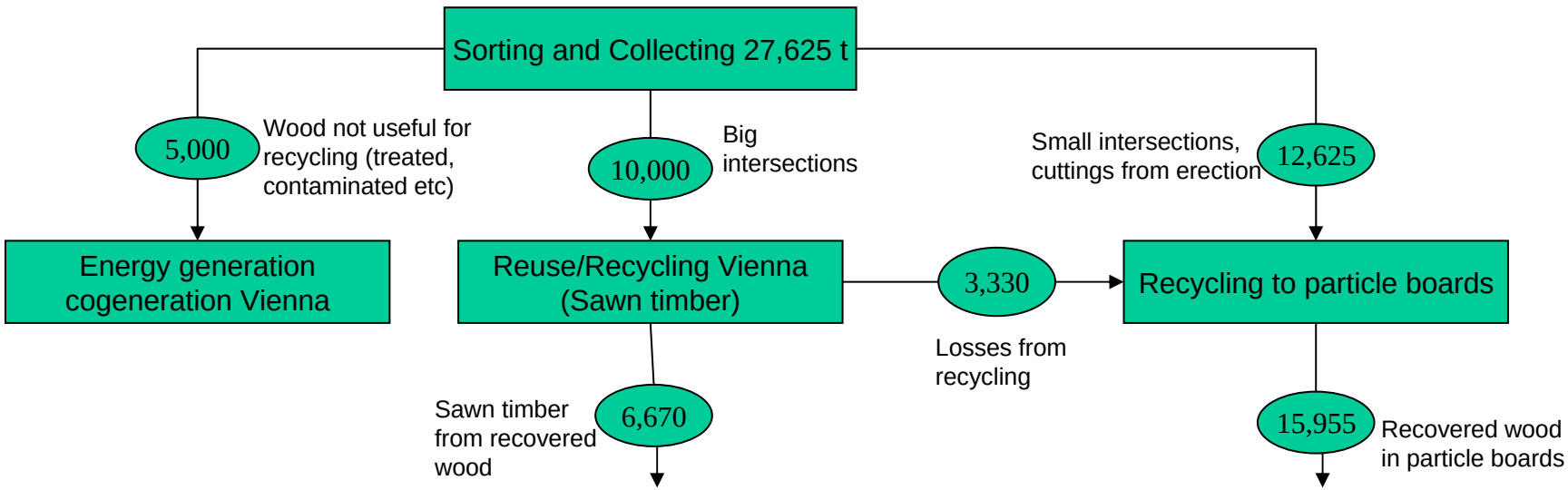
(reuse, recycling; processes located in Vienna):

- Substitution of drying process, for reuse also substitution of sawing process (approximately 20 kg CO_2-equiv./m³) Scenario 1: 44 t
- Substitution of transports from saw mill to Vienna (in average 80 tkm/t of sawn timber) Scenario 1: 32 t

SCENARIO 1: COMPARISON OF WMO`s

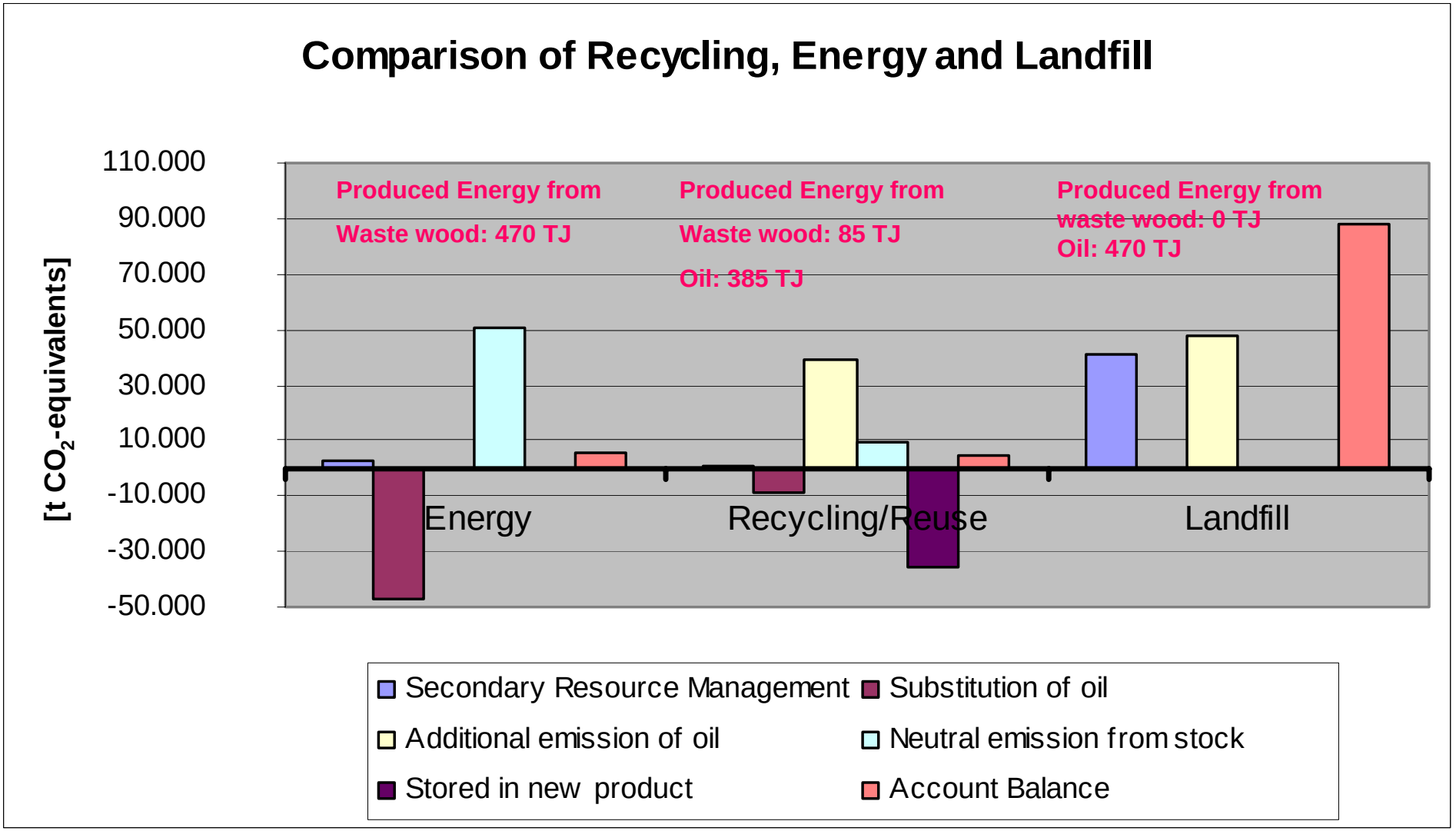
For Scenario 1 three Waste Management Options are compared:

1. All recovered wood 2001 (27,625 t) to energy generation in CHP plants, substituting fossil fuels (12,788 tons of oil), produced energy from wood: 470 TJ
2. Maximal recycling: 22,625 tons of wooden products, 85 TJ energy from wood and 385 TJ energy from oil



3. All recovered wood (25,625 t) going to landfill – which is prohibited in Austria – only for demonstration reasons. 470 TJ energy from oil has to be produced

RECYCLING, ENERGY AND LANDFILL

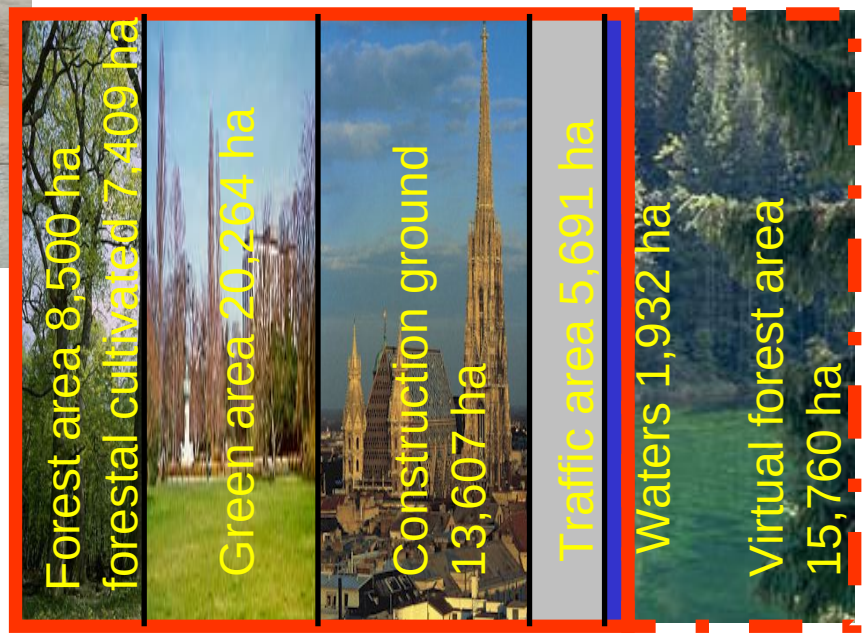


LANDUSE – CITY FORESTRY

Substituted forest area from recycling/reuse: 15.760 ha

Vienna total Area
41,495 ha

Additional
virtual area
15,760 ha



FINDINGS AND CONCLUSIONS

- The stored wood within the buildings in Vienna represents both a source of reusable construction material and a potential substitute for fossil fuels.
- For any future material and/or energetic uses, it is necessary to know the configuration and the potential of the stock built in the city.
- After the final service life of a (recycled) wooden product energy generation should take place in order to contribute efficiently to GHG – mitigation.
- In order to optimise the management of recovered wood with respect to both ecological and economical concerns, the design of wood building components must reflect recycling considerations in addition to criteria for thermal utilisation.
- Recommendations on appropriate component design shall be given for building design practitioners (e.g., “design for recycling,” “design for energy generation”)

FINDINGS AND CONCLUSIONS

- All involved actors (e.g., wood industry, energy experts, building industry, building design practitioners, etc.) together shall develop a strategy how to optimise the life cycle of wooden building materials (e.g., design and property of building elements and the consequences for management of recovered wood, accurate and quick deconstruction, reuse, recycling, energy generation, etc.).

- The use of renewable materials in the building sector can be expected to continue increasing. To realise the potential of these renewable resources, a well-equipped infrastructure for the management of recovered wood must be established.

- Recycling or reuse of wood substitutes forest area and contributes to protection of natural ecosystems and increase the availability of wood for several applications.

- Transport distances should kept short.