Fr	B	C	NY	S	T	Total
9	7	4	9	9	5	43

Beispiel:
Freiburg/Berlin/Copenhagen: As shown in the differentiated description of the key field (see below), there are European and national requirements for the refurbishment of buildings that impact on all three European cities that act as an example here. In Freiburg, the energy-efficient refurbishment of existing buildings is a key issue, which is being tackled with self-imposed building standards e.g. for the town's own housing associations. With the example of the Märkisches Viertel, Berlin is demonstrating that the initiative for energy-efficient refurbishment on a large-scale can also come from a housing association and not from the city itself. In Copenhagen, the goal of CO2 neutrality is to be achieved by 2025 largely via a CO2-neutral energy supply. In this case, although it is true that the energy-efficient refurbishment of existing buildings is being done, it clashes with the preservation of the cityscape so that some measures are difficult to implement (exterior insulation, solar panels, etc.).

In **Singapore** in 2005, a government building certification system (Green Mark Scheme) was introduced to accelerate energy efficiency in existing buildings. In addition, various incentive schemes (e.g., Green Mark Incentive Scheme) are offered. In general, energy upgrades are carried out with a focus on improving the efficiency of air conditioners.

In **Tokyo**, the available programmes are decisively limited to lowering the energy consumed by the operation of buildings by the use of energy-saving plant and equipment, and less on improving the structural shell. Account must be taken here of the fact that the service life of a building is significantly shorter than in Europe.

In **New York City,** the aim is to achieve a 30% reduction in emissions compared to 2005 by 2030. PlaNYC 2030, the programme designated to achieve this, includes a provision for energy upgrades for the very first time. According to this, all private buildings larger than 50,000 ft² (4,645 m²) must undergo energy-efficient refurbishment. In addition, the city itself has imposed higher standards and have to renovate all public buildings larger than 20,000 ft2 (1,858 m²) so they are energy efficient. Buildings larger than 50,000 sq. ft. consume about 45% of the total energy.

1. Differentiated description of the key field

Buildings consume 40% of Europe's energy. The majority of the buildings were built before 1980 and are, therefore, in need of refurbishment, if this has not yet been undertaken. In Germany, for example, 75% of the housing units were built before 1979 and consume 80% of the energy used specifically by residential building units. The energy-efficient refurbishment of existing buildings in the area of the building envelope but also in that of the building services (heating, water heating, and possibly ventilation and cooling) can reduce the energy consumption of a building commonly by 50% or more. Standards emanating from the Energy Performance of Buildings Directive (EPBD) and their national implementation exist for component refurbishment and the total refurbishment of buildings. In the Energy Efficiency Directive, the EU requires member states to achieve a 3% refurbishment rate per year in the area of public buildings. Public buildings in general should take a leading role. This also has an impact on all European cities.

In general, the greatest progress in the field of energy saving can be achieved in the building sector. These days, new buildings can already be erected as positive-energy houses, i.e. they produce (usually averaged out over the year) more energy than they consume. Some pilot projects have demonstrated that this is also possible when renovating existing buildings, although this does not apply to the average sort of energy-efficient refurbishments carried out.

2. Reference to sustainability:

The major savings that can be achieved with regard to energy consumption and thus also in the field of associated emissions by improving the energy efficiency of existing buildings are of great relevance to the sustainable development of a city. If the potentials available here – which are mostly amortisable in 20-30 years' time, in part (depending on the desired target consumption and the savings measures implemented) in less time – are not exhausted, a significant improvement in the overall balance of the city with respect to energy consumption, emissions and consumption of resources (fuels) will not be possible. In addition, the buildings decline in value faster: A more efficient building has a higher selling or rental price, and energy-efficient refurbishment is almost always coupled with the renovation of areas that have no impact on energy efficiency. With smart planning, resilience to climate change impacts increases (e.g. temperature increase).

Successful refurbishment requires good planning of the technologies used, such as insulation, window replacement, efficient energy supply, and a financing plan, and will result in a short- to medium-term payback period due to lower energy costs. However, it should be noted that, with rental properties, the investment is made by the building owner and returns cannot always be gained by rent increases. The goal is often to achieve the same rent (inclu-

ding heating) before and after refurbishment, i.e. the rent increase is offset by the savings in energy costs. This is not always achieved and this is always a risk that the building owner faces. Financial support, e.g. in Germany from the Reconstruction Loan Corporation (KfW) and in Singapore from the Green Mark Incentive Scheme, can reduce the financial risk.

3. Relevance to industrial sectors?

Mobility:	Low
Energy:	High
Production & logistics:	Medium
Security:	Medium
ICT:	Medium
Water infrastructure:	Low
Buildings:	High
Governance:	High

Brief description of the high level of importance:
Energy-efficient refurbishment standards are set by the governance (EU/country/city); there are also some private initiators. The power supply is directly related to the energy consumption of the buildings. Increased structural quality has an impact on the efficiency and choice of the energy supply. The district heating supply temperature, for example, can thus be lowered if an entire urban district is refurbished. Some forms of energy supply are preferably combined with the high thermal quality of the building envelope (e.g. heat pumps).

4. Impact (positive & negative)

Positive:
- High level of energy savings and emission reduction
- By reducing energy consumption, energy costs can be saved
- Increase in the value of the building
- Creation of jobs
- Reduction of risks, e.g. of a property that cannot be rented out
- Increase in comfort for the users

Negative:
- Investment costs that must be financed, but can be recouped through energy savings
- Changes in the appearance of the buildings by some refurbishment measures (e.g. external heat insulation); with many buildings, however, not detrimental

5. Implementation measures:

1. Educating people about the effect of energy-saving refurbishment (awareness/education)
2. Create inducements for refurbishment (incentives, model projects, state/city guidelines)
3. Refurbish and disseminate urban buildings as a trailblazers or role models
4. If necessary, use a revolving fund to do so (Intracting)
5. Develop financing models for private and industrial owners (e.g. contracting (PPP)), but go beyond a refurbishment that is purely based on systems engineering, otherwise the chances for greater possible savings are usually not used for years)
6. Supporting private owners by means of advice or monitoring
7. Documentation of the savings and lessons learned
8. Further development of technical solutions with faster market maturity and greater reliability

6. Actors: Who can shape things?

The city or the federal state can implement the standards and (financial) incentives and lead the way as models when implementing them.

Energy consultants can assist private owners with their planning.

Development banks can support the requisite investment through favourable loans. Other financing options such as contracting can be initiated or their quality monitored.

Tradespeople can advise owners on the basis of training courses and carry out high-quality refurbishment work.

Construction companies can carry out larger refurbishments; a training course and monitoring of quality should also be carried out here.

Research and industry should work on existing and new energy-efficient refurbishment technologies with the aim of increasing energy efficiency, simplifying solutions, better cost effectiveness, lowering costs for the owner or user and increasing the quality guarantee).

7. Prerequisites:

Educating the actors involved about the impacts, opportunities and financing options. Customised refurbishment concepts for each climate region, building use, etc. Incentives or standards for implementation. Support through good pilot projects. Quality assurance and dissemination of experiences.

8. Obstacles/barriers:

- Relatively high investment costs, which pay off to a large extent
- Relatively high cost to the owner (initiative, planning, implementation with an impact on building use, financing)

• Listed buildings
• Cities often have no funds available (solution: contracting or Intracting)
• Personnel in the city administration must be increased for this area
• Refurbishment technologies should be developed further

9. Indicators:

• Determine the statistics relating to the energy consumption of buildings and track them over the years
• Determine the refurbishment rate and energy quality before and after the refurbishment

10. Special features/remarks:

In addition to developing financing options, the focus should be placed on quality assurance and the further development of refurbishment technologies. Targets for industry, cities and research institutions are in place here. Collaboration between cities, research and industry may also arise in the field of pilot projects. Last but not least, the burden on the user should be kept as low as possible by, for example, good coordination of the processes on the building site and the carrying out of the work in as short a time as possible.