INTEGRATION OF SGE SYSTEMS IN BUILDINGS
The implementation of SGE is dependent on the type of building and also on the availability of the ground. The underground aspects for different zones in a city are covered in the next chapter.

### REGULATIONS FOR REFURBISHMENT AND REGULATIONS FOR GSHP INSTALLATIONS

In Sweden, Denmark, Netherlands, Belgium, Germany and France the building code sets energy requirements of delivered energy for new buildings. For refurbishment of buildings there are requirements on components such as insulation and windows that improve the building energy efficiency. In Sweden, new buildings are considered heated with electricity if the installed power for heating (including heat pumps) is more than 10 W/m². Buildings heated with electricity must use less purchased energy than buildings heated with other purchased energy carriers (oil, district heating, etc.).

In France, the final energy calculation is expressed in primary energy requirements and not in final energy. The conversion coefficient is 2.58 for electricity and it is only 1 for oil and gas.

Also in Belgium, the energy performances of new buildings are expressed through primary energy and the PEF for electricity used is 2.5. The three regions; Flanders, Walonia and Brussels have their own transposition of the EPBD. Since January 2014, Flanders imposed a minimal share of RES production in every new building. For Heat Pumps the obligation in case of installation is the covering at least 50 % to 75 % of the heating demand and an SPF above 4.

The German regulations include limits for specific primary energy use both for new and refurbished buildings. Because GSHP can achieve primary energy savings over gas boilers etc., the result is an incentive for using geothermal heat pump technology. One German state, Baden-Württemberg, has established an obligation that when refurbishing (defined as the replacement of the core components of a heating system), a minimum of 10 % of the annual heat demand has to be provided from renewable sources. This is considered as being fulfilled if a heat pump with a minimum of 3.5 is installed to cover the whole heating demand; with this SPF, typically a GSHP will be the only solution.

The Greek, Spanish and Italian regulations include quantitative targets for renewable energy (included GSHP installations) concerning new buildings and major renovation of buildings. In Greece and Spain there are for example requirements on 60 % of the DHW supplied by RES systems, that could be heat pumps that fulfils the requirements on SPF. As above, regulations for refurbishment are focussed on improved energy efficiency measures.

In Ireland, the compliance of building regulations for domestic buildings and regulations for SGE systems sets out operating parameters including COP (2.5) and minimum contribution of a heat pump to the overall heating and sanitary hot water (10kW/m²/yr or better) for new build developments. The Irish requirements for new non-residential buildings over 1,000m² slightly differ with consideration of alternative energy systems. This includes: decentralised energy supply systems based on renewable energy, Combined Heat and Power (CHP), district or block heating or cooling and heat pumps.

In Romania, the current legislation set that the specific energy consumption for heating in rehabilitated buildings should be under 100 kWh/m². The regulations on energy audits and Certificates are setting the same limit. The current average yearly consumption for heating in Romanian buildings is 265 kWh/m² (compared with 125 kWh/m² European average).

### CHALLENGES FOR SGE INSTALLATIONS IN EXISTING BUILDING STOCK

A detailed analysis of the energy demand and system design parameters is essential when evaluating different building types. The table with parameters considers energy demand and energy balance. The energy demand for heating, cooling and sanitary hot water determines the requirements and the size of the SGE-system. The buildings energy demands depend on the climate as well as the technical characteristic of the building, building type and construction. Where a balanced heating and cooling demand exists for a building or a neighbourhood, a BTES or ATES system can be considered suitable where the energy demand is high.