# Documentation of TIMES-DK energy efficiency potentials

The TIMES-DK energy efficiency potentials are based on the DEA project "Kortlægning af energibesparende potentialer i erhvervslivet" (Mapping of EE potentials in the corporate sector). This project assesses potentials within 20 out of 27 different uses of energy in 57 corporate sectors found in an 2012 energy use matrix prepared by Viegand & Maagøe 2015 (thus assessing 141,6 PJ out of a total energy use of 198,9 PJ). Notable uses not accounted for is transport and other process heat (which includes greenhouses in the agricultural sector). The EE potentials mapping account for potentials in grouped in terms of payback times (PBT) of 2, 4 and 10 years, all measured according to the situation in the Danish corporate energy use in 2015, as well as the 20 energy uses mentioned.

The TIMES-DK potentials further excludes 3 sectors for production of some specific chemicals. In total, the EE potentials account for 138,7 PJ final energy use in the corporate sector. Also, the potentials for TIMES-DK are aggregated into from 20 to 8 energy uses and from 54 to 10 corporate sectors.

The mapping of EE potentials does not consider future potential (e.g. energy saving technologies, which have not yet matured or been invented). Neither does the mapping predict a specific timing for realisation of the EE potentials assessed. Since TIMES-DK is a dynamic model, it is necessary to decide for some timing of the introduction of the EE realisation. Letting TIMES-DK choose the timing endogenously is problematic, since the low PBT indicates a quite high internal rate of return for the EE investments. In fact, the return is so high that TIMES-DK would choose to realise all of the potential immediately in 2015.

Since such behaviour seem somewhat unrealistic, the potentials are instead realised exogenously over the modelled years of 2015, 2020 and 2025. The most attractive potentials are assumed to be realised early in this period, while the remaining potentials are realised later in the period.

Specifically, 80% of the 2 year PBT potentials are realised in 2015 (together with 25% of the 4 year PBT and 10% of the 10 year PBT). In 2020, 20% of the 2 year PBT, 70% of the 4 year PBT and 30% of the 10 year PBT is realised. In 2025 the remaining potentials are realised. In raw numbers, roughly 11 GJ of EE potentials will be realised in each of the years 2015, 2020 and 2025. The TIMES-DK implementation of EE savings mean that the projected energy demand will simply be reduced with these amounts in those years.

After 2025 no further potentials are assumed to be realised. While the realisation of these potentials during 2015-2025 will keep the TIMES-DK energy use to GDP ratio at a roughly constant level (broadly consistent with historical observations), the lack of further energy savings potentials after 2025 mean that the TIMES-DK assumed ratio will start to increase at that point.

This somewhat odd behaviour illustrates a fundamental theoretical problem within dealing with EE potentials. At some point it must *ceteris paribus* be expected that an energy using piece of equipment will be replaced with a (supposedly – depending on the technological development) more energy efficient piece. This will happen regardless of whether the motivation is the age of the equipment and performance of the equipment or its possibly excessive energy cost. Thus, policy induced realisation of energy potentials (e.g. by subsidies, information etc.) can be said to just expedite the replacement of an older piece of equipment with a newer effectively shortening the lifetime of energy intensive capital (either if the subsidies are permanent, or information is learnt by the companies). When calculating the real EE savings, it is thus necessary that the calculated potential is interpreted as what will happen including policies and the companies' own actions rather than just potential effects of policies.