Projections of industrial combustion fuel and electricity use were made by Energy Information Administration Manufacturing Energy Consumption Survey end use category (U.S. Energy Information Administration 2015). Only manufacturing industries and not construction, agriculture, or mining industries were included in the analysis. QER Base Case fuel-weighted annual growth rates of 0.6% and 0.74% were assumed for combustion fuel and electricity use, respectively, for the baseline and electrification technical potential scenarios. No consideration of costs or efficiency improvement was made in either scenario.

Annual growth rates of electrotechnologies in the electrification scenario were derived from the Electric Power Research Institute (EPRI) Electrotechnology Reference Guide (EPRI 2010). Six technologies, shown in Table 1 along with their annual growth rates, were selected for the scenario based on the magnitude of EPRI’s estimated national growth potential. These six technologies represent over 75% of EPRI’s projected growth potential. Although ERPI did not identify industrial process heat pumps as having significant growth potential, this technology was included in the electrification scenario based on other estimates of its future growth potential (Heat Pump & Thermal Storage Technology Center of Japan 2010; Greenblatt, Wei, and McMahon 2012). The ERPI estimated annual growth rate was applied to the appropriate end use and industry for 2017 – 2020. Growth rates for 2021 – 2050 were an assumed fraction of the EPRI growth rates (25% of the 2010-2020 annual growth rate for technologies 1-4, 50% of the 2010-2020 annual growth rate for direct arc melting, and a 100% increase in the 2010-2020 annual growth for industrial process heat pumps), based on expert judgement; electrotechnology substitution was assumed to stop in 2051. Expert judgment was used based on an extensive literature review and the fact that continuing the same growth rate as used in 2010-2020 fully electrifies several industrial sub-sectors by 2040 which seems unlikely. In the case of heat pumps, the annual growth rate was increased after 2020, because EPRI is more conservative on electrification potential than other sources.

Table 1 Electrification Technical Potential Scenario: Annual Growth Rates of Selected Electrotechnologies

|  |  |  |
| --- | --- | --- |
| **Electrotechnology and Applicable Industry** | **ERPI Estimated Annual Growth rate (2010 - 2020) (EPRI 2010)** | **Assumed Technical Potential Annual Growth Rate (2021 – 2050)** |
| Electrolytic Reduction (Nonferrous Metals, excluding Aluminum) | 7% | 1.8% |
| Induction Heating (Metal Fabrication) | 2.4% | 0.6% |
| Electric Boilers (All industries) | 8.6% | 2.2% |
| Resistance Heating and Melting (Glass) | 3.6% | 0.9% |
| Direct Arc Melting (Iron and Steel) | 4.8% | 2.4% |
| Industrial Process Heat Pump (Food, Paper, Chemicals) | 1.3% | 2.6% |

The substitution of electricity for combustion fuels was not assumed to occur on a 1:1 basis. Instead, relative efficiencies were estimated by fuel and end use based on energy losses from Pellegrino et al. (2004) and efficiency data from Council of Industrial Boiler Owners (CIBO) (n.d.) and S. Wolf (2012). Note that projections were for site, not primary, energy.

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