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Shallow geothermal energy potential of south-west Germany

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A large-scale transformation of the heating and cooling sector is needed to achieve the climate neutrality goals by 2050 as outlined in the European Green Deal. One frequently discussed option for reducing the greenhouse gas emissions is the widespread use of ground source heat pumps (GSHPs) for heating and cooling living spaces. Here, the technical potential of GSHPs to supply heat to buildings in the state of Baden-Württemberg, Germany, is analysed. This study is based on the yearly demand for heating energy at a building block scale, geological conditions, mean annual surface temperatures, as well as legal restrictions such as temperature differences at the heat pump, maximum monthly heat extraction rates as well as areas restricted from drilling. It is shown that for many densely populated areas many GSHPs would be needed to supply all the energy needed for heating. However, in less densely populated areas GSHPs can be used for heating. If future heating demand is lower due to wide-spread insulation retrofitting, GSHPs could supply most of the energy needed for heating even in densely populated areas.