Data on the potential generation of energy from wind, solar and biomass is crucial for analysing their development, as it sets the limits on how much additional capacity it is feasible to install. This paper presents the methodologies used for the development of ENSPRESO, the ENergy System Potentials for Renewable Energy SOURces, an EU-28 wide, open dataset for energy models on renewable energy potentials, at national and regional levels for the 2010–2050 period. In ENSPRESO, coherent GIS-based land-restriction scenarios are developed. For wind, resource evaluation also considers setback distances, as well as high resolution geo-spatial wind speed data. For solar, potentials are derived from irradiation data and available area for solar applications. Both wind and solar have separately a potential electricity production which is equivalent to three times the EU's 2016 electricity demand, with wind onshore and solar requiring 16% and 1.4% of total land, respectively. For biomass, agriculture, forestry and waste sectors are considered. Their respective sustainable potentials are equivalent to a minimum 10%, 1.5% and 1% of the total EU primary energy use. ENSPRESO can enrich the results of any energy model (e.g. JRC-EU-TIMES) by improving its analyses of the competition and complementarity of energy technologies.