Conventions that were used to calculate the primary energy balances (WTT)-justifying renewables efficiency of 100% wind and PV

The physical energy content method:

This method uses the physical energy content of the primary energy source as its primary energy equivalent. As a consequence, there is an obvious link between the principles adopted in defining the primary energy forms of energy sources and the primary energy equivalent of these sources. For instance, in the case of nuclear electricity production, as heat is the primary energy form selected by the IEA, the primary energy equivalent is the quantity of heat generated in the reactors. However, as the amount of heat produced is not always known, the IEA estimates the primary energy equivalent from the electricity generation by assuming an efficiency of 33%, which is the average of nuclear power plants in Europe. In the case of hydro, as electricity is the primary energy form selected, the primary energy equivalent is the physical energy content of the electricity generated in the plant, which amounts to assuming an efficiency of **100%.**

The general principle of this method is that the primary energy form is taken as the first flow in the production

process that has a practical energy use. This leads to different situations depending on the energy product:

• For directly combustible energy products (for example lignite, natural gas, motor gasoline, biogas, firewood

and combustible municipal waste) the primary energy is defined as the heat generated during combustion.

• For products that are not directly combustible, the application of this principle leads to:

– the choice of heat as the primary energy form for nuclear, geothermal, solar thermal and ambient

heat; and

– the choice of electricity as the primary energy form for solar photovoltaic, wind, hydro, tide, wave, ocean.

In cases when the amount of heat produced in the nuclear reactor is not known, the primary energy equivalent is calculated from the electricity generation by assuming an efficiency of 33 %. In the case of electricity and heat generated by geothermal energy: if the actual amount of geothermal heat is not known, the primary energy equivalent is calculated assuming an efficiency of 10 % for electricity production and 50 % for derived heat production.

If two energy balances are constructed with different methodological choices and respective assumptions on efficiency conversions and calorific values, it will lead to different results for the share of renewables.