A Sankey diagram is a visual display of the flow of a scalar. In a Sankey diagram, the width of each branch of the flow is proportional to the magnitude of the scalar.

An excellent way to visualize the flow of a scalar is to plot a Sankey diagram, in which the width of each branch of the flow is proportional to the magnitude of the scalar, and different branches are additive. Thus, a Sankey diagram visualizes the flow by taking advantage of the scalar properties: additivity, scalability, and proportionality.

Energy flow chart. Every year the Lawrence Livermore National Laboratory publishes a Sankey diagram of the flow of energy in the United States. The diagram is called the energy flow chart.

Energy is a commodity, and therefore forms a scalar set. The diagram uses the quad as a unit of energy. This unit converts to the SI unit of energy as

\[ 1 \text{ quad} = 1.055 \times 10^{18} \text{ J} = 1055 \text{ PJ}. \]

Here J is the unit of energy in the SI system, J = joule, which is about the energy needed to raise an apple by a meter. P is a prefix and stands for peta, \( P = 10^{15} \).

The consumption of energy in 2015 was a little under 100 quads. This amount has been nearly constant for many years.

Energy flows from producers to consumers. Energy came from multiple sources: solar, nuclear, hydro, wind, geothermal, natural gas, coal, biomass, and petroleum. Energy overwhelmingly came from fossil fuels: 28.3 quads of natural gas, 15.7 quads of coal, and 35.4 quads of petroleum. The contribution from solar was minute: 0.532 quads.
Of the 38 quads of energy used to generate electricity, 14.3 quads came from coal, and 8.34 quads came from nuclear.

Of the 35.4 quads of energy from petroleum, 27.7 quads went for transportation.

Nearly 60% energy was wasted.
Energy flow charts in different years. A comparison between the 2015 chart and 2005 chart reveals many important trends. The total energy consumption has drops somewhat, reflecting the stability of the US economy and more efficient use of energy. Nuclear, hydro, and geothermal remain unchanged. Solar and wind increase nearly tenfold. What will happen in another ten years?

Natural gas increases, but coal and petroleum drop.

Once again, about 60% energy is wasted.

Energy flow charts of different countries. Total energy consumptions of the US and China are comparable, but the use of coal in China is much higher than that of the US. The consequence is obvious when you visit China: the smog. The relation between coal and smog is so predictable that the government can order blue sky on demand, simply by shutting down factories for a period.

The widths of coal in the two charts also tell another story. In the US, the coal is mainly used to generate electricity, with a small portion for other industrial use. In China, significant portion of coal is used in industry.