Efficiency of flow

The Manning coefficient, which currently is for most applications the only way to pinpoint efficiency of free energy conversion that scales dissipation. Any parameter which characterizes roughness is ultimately related to the conversion process of free energy to heat, describing the capacity of the system to create flow from a gradient of free energy. In fact, expressing this in steady state as the flux of kinetic energy J_f^{ke} over stream power *P:*

$$E_Q = \frac{J_f^{ke}}{P} = \frac{\frac{1}{2}\rho Q v^2}{\rho g S Q} = \frac{v^2}{2gS}$$

with a formula that links average flow velocity and driving gradient such as the Manning equation:

$$S = \left(\frac{vn}{R^{\frac{2}{3}}}\right)^2$$

E_Q becomes:

$$E_Q = \frac{R^{\frac{4}{9}}}{2gn^2}$$

The efficiency of a system to convert a gradient of free energy into kinetic energy is therefore expressed as a function of geometry (hydraulic radius) and roughness.