# Why 45% and 81% are not the same MHD efficiency

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## The claim under review

A proposed comparison contrasted a roughly 45 percent kinetic-energy fraction in an Ames accelerator with roughly 81 percent in a cycle study. A difference of 36 percentage points would be meaningful only if both quantities used the same numerator, denominator, flow state and measurement boundary. They do not.

## Ames: a core-flow partition

Bogdanoff and Mehta, Experimental Demonstration of MHD Acceleration, AIAA 2003-4285, section IV.E (printed p.19), derive core-flow load factors LF=2.1-2.3 using electrical and velocity diagnostics. Their relation partitions core electromagnetic work into kinetic and Joule contributions. Thus 1/LF gives 43.478-47.619 percent kinetic share and 1-1/LF gives 52.381-56.522 percent Joule share. At LF=2.2 the values are 45.455 and 54.545 percent. This is an author-derived partition, not separate calorimetric measurements of an entire installed accelerator. Sheath and boundary-layer losses are outside this split. The LF range is not a confidence interval.

## Schneider: a thermodynamic pressure/enthalpy metric

NASA/TM-2011-217210, printed pp.8-11, reports calculated isentropic efficiencies of 84 percent for the generator and 81 percent for the accelerator. Isentropic efficiency characterizes a thermodynamic process through its pressure and enthalpy relationships. It is not the direct ratio of axial kinetic-energy increase to terminal electrical input. The 81 percent number should not be described as measured, nor simply as an arbitrary fitted replacement for the Ames fraction.

## Why the distinction changes the argument

Electrical work can appear as kinetic energy, internal energy and losses at different boundaries. Joule heating is not destroyed energy: some can affect later nozzle expansion, while entropy generation and pressure loss reduce recoverability. An isentropic measure, a core-flow partition, terminal conversion and installed efficiency each answer different questions. Substituting 0.45 for an isentropic 0.81 in an existing cycle relation is not a validated correction. Conversely, using 0.81 as direct terminal-to-kinetic conversion is also unsupported by that source.

## Data needed for a legitimate translation

Use common inlet and outlet control surfaces, synchronized mass flux and velocity profiles, total/static pressure and temperature, electrical terminal power, sheath voltage, wall heat, composition and magnetic/cooling auxiliaries. State whether the comparison includes subsequent nozzle expansion. Propagate joint uncertainty and keep a calibration dataset separate from validation cases. A measured change in averaged velocity alone cannot supply these quantities.

## Consequence for the threshold map

The map's accelerator axis is an explicitly assumed useful-energy conversion. It is not labeled an Ames whole-device measurement or a Schneider isentropic efficiency. Values 0.45, 0.60 and 0.81 can be inspected as sensitivity values, but only a compatible calibrated dataset could assign them empirical meaning. The useful publication is a definition and evidence audit, not a demonstrated 36-point efficiency deficit.

## References

Bogdanoff and Mehta (2003): https://doi.org/10.2514/6.2003-4285

Schneider (2011): https://ntrs.nasa.gov/citations/20110016528

Kato et al. (2004), velocity-response comparison: https://ntrs.nasa.gov/citations/20040105526