DC-to-AC Oversizing

Introduction:

Inverter clipping occurs because the DC (input) rating of the Solar system is higher than the AC (output) rating of the Inverter(s). This may seem to be a design error, but it is actually done on purpose. This ratio between your DC and AC rating is commonly known as a DC-to-AC ratio in the Solar Industry.

Purposes of DC-to AC Oversizing:

1. System Performance: When converting Solar Energy from DC to AC there are power losses. If your system is designed with a 1:1 ratio, the Solar Inverter will never reach its peak output. So over sizing the DC-to-AC ratio is the best method to get the most out of your system. Especially during mornings and afternoons when sunlight is less intense, a larger solar array can still produce enough DC power to fully utilize the microinverter's AC capacity.

Oversizing a Solar array, such that the DC-to-AC ratio is greater than 1, allows for a greater energy harvest when production is below the inverter's rating, which it typically is for most of the day. The following illustration shows what happens when the power inverter's DC-to-AC ratio is not large enough to process the higher power output of mid-day. The power lost due to a limiting inverter AC output rating is called inverter clipping (also known as power limiting). You can see in the Illustration that having a higher DC-to-AC ratio results in more production throughout the day.

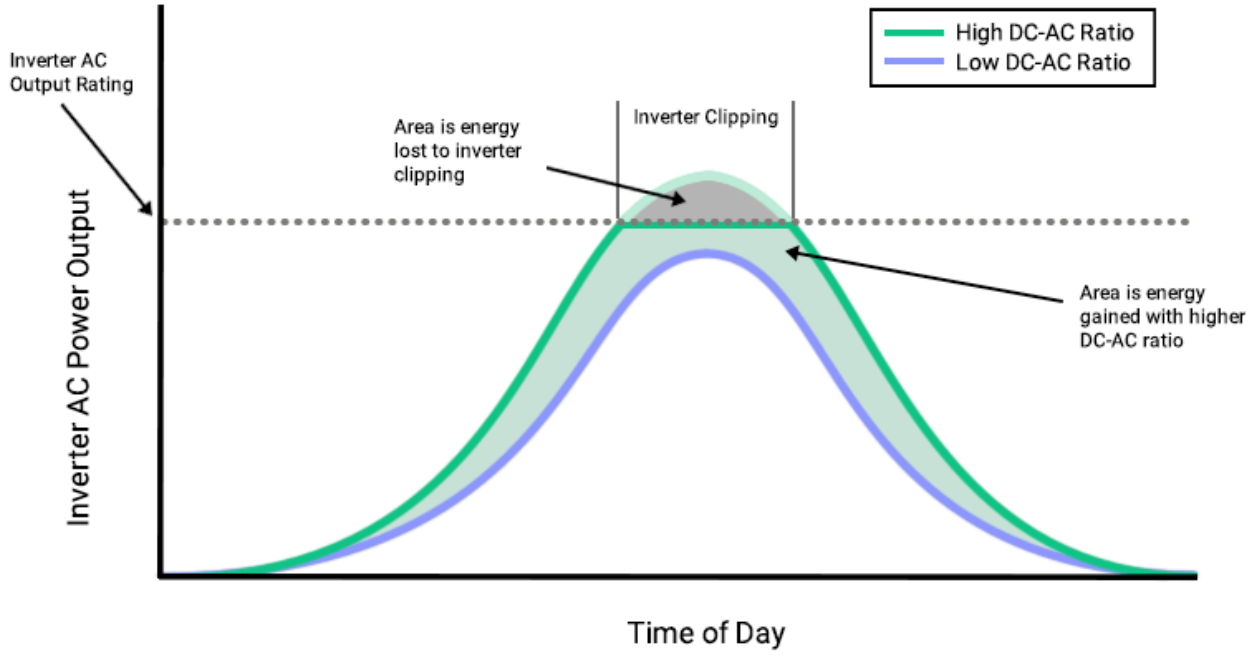

Figure 1: Inverter AC output over the course of a day for a system with a low DC-to-AC ratio (purple curve) and high DC-to-AC ratio (green curve). The chart represents an idealized case; in practice, power output varies considerably based on weather conditions.

2. Longevity: The system is designed to last 30 years. With inevitable Solar Panel degradation, the efficiency of the Solar Panels will decrease overtime. With the system being oversized already, the degradation will just decrease the DC-to-AC ratio, resulting in slightly less production but also less losses. This results in a much more consistent performance over the Solar lifespan.

3. Optimal Performance in Variable Conditions: Solar irradiance and panel efficiency can vary throughout the day due to factors like cloud cover, shading, and temperature changes. Oversizing the system ensures that even during suboptimal conditions, such as partial shading or lower sunlight intensity, the solar panels can still produce sufficient DC power to maximize the inverter's output.

4. Increases Annual Production: When compared to a 1:1 system a higher DC-to-AC ratio has more Annual Production. The chart below shows three DC-to-AC ratios and their estimated losses to clipping.

DC-to-AC Ratio	Annual AC Energy Production	Energy Lost to Clipping
1.0	163.06 MWh	0.0 MWh
1.3	193.86 MWh	1.8 MWh (0.9%)
1.5	217.24 MWh	11.0 MWh (4.8%)

Table 1: Annual energy production out of a 100 kW inverter as a function of DC-to-AC ratio. As the DC-to-AC ratio increases, so does the AC output and clipped energy.

System Design/Investment:

The design software we use is called Aurora. Aurora is an industry leading software tool that helps solar professionals design and analyze solar energy systems. It uses 3D modeling to place solar panels on your roof, considers shading from trees or buildings, calculates energy production, and provides financial projections like savings and ROI. Aurora's solar design and sales software automatically takes inverter clipping into account in its performance simulations. The system loss diagram automatically calculates the amount of energy that is clipped throughout the year and the percentage of total energy that amount represents. With the Inverter clipping already being factored into your Annual production the accuracy of your proposal is still intact.

Microgen Application:

With the Annual offset limitations of 104% being in effect, we must adhere to those limitations when we design and submit your Microgen Application. Within those limits your system's size and performance is designed as efficiently as possible to give you the maximum, or close to, amount of annual offset as possible.

Code Compliance:

When sizing your system we must also adhere to CEC (Canadian Electrical Code). We are restricted to the amount of AC output your Inverter(s) will produce on your existing electrical infrastructure. With our designs always aimed to reach the maximum offset, typically we are at the maximum allowance of Solar generated power on your residential service. This means that even though larger inverters do exist that would reduce the clipping of your system, they more than likely will not be allowed by City Inspections to be installed in your home.

What is a good DC-to-AC ratio?

A 1:0.8 ratio (or 1.25 ratio) is the sweet spot for minimizing potential losses and improving efficiency. This is for ideal situations in which the entire Solar array is South facing. In instances where there are multiple arrays facing different directions or not facing due South, a higher DC-to-AC ratio (up to 1.55) may be used. This helps to increase the system's maximum output over the course of the day since the sun won't be hitting all the Panels with the same irradiance at the same time. Choosing an inverter that's around 80 percent lower capacity than the PV system's nameplate output is ideal.