Finding Unity: Why & How to Correct Power Factor

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If your plant uses induction motors, power factor may be draining your energy and money.

Ah, unity! The very word brings up images of harmony, balance, togetherness and peace … unless you know a thing or two about electric power. If so, then you know that unity is what you get when all the energy generated by a power source is consumed by one or more loads (anything that runs on electricity). Unity also is known as a power factor of 1, and it doesn't happen very often. We have some options for you to improve your power factor.

A few fundamentals

What is power factor? It's the ratio of real power being used to perform work at your site versus the amount of power your utility must generate to meet your demand. You'd think they'd be perfectly balanced, but they're not because of something called reactive power, which is what you get when voltage and current are out of sync.

How does that happen? Well, unlike an incandescent light bulb, which has a power factor of 1 because all the energy flowing into it gets converted to light or heat, inductive loads use a coil or windings that need to be magnetized before they can do the useful work of turning the actual motor. Inductive equipment like transformers, motors and induction furnaces use reactive power to establish and maintain the motor's magnetic field so that it can use real power to do actual work.

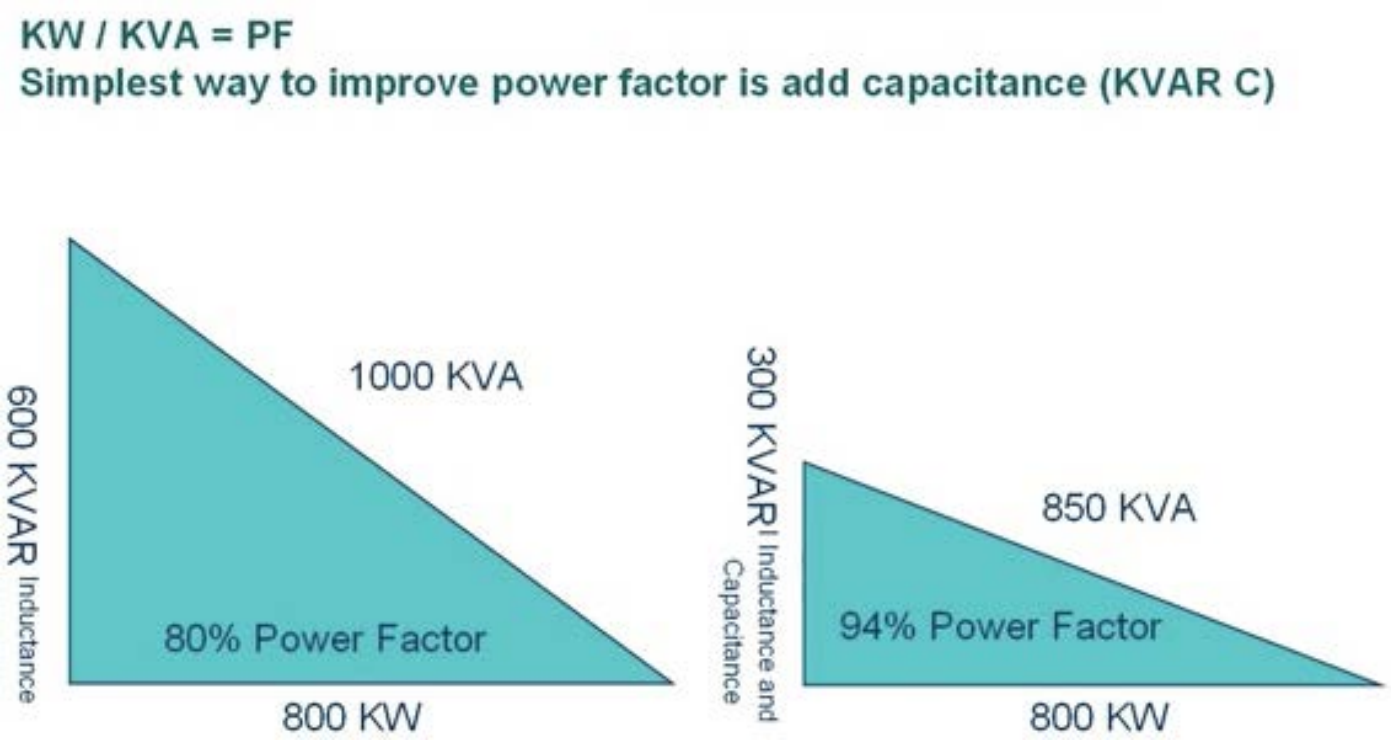
Consequently, reactive power – a.k.a. a low power factor – is often considered wasted energy. And that's why utilities charge customers extra who have low power factors at their facilities – it costs the utilities more to supply. For more on how this part of power factor works, check out our blog .

What does a lower power factor mean?

Lower power factor could not only be affecting your energy costs, but could also be reflecting something is off in your operations. Here are a few things to consider when it comes to lower power factor:

- There may be inefficiency in your operation. Low power factors often reflect low load conditions on an induction motor. At full load, a 10-horsepower motor typically has a power factor of around 85 per cent, but it drops into the mid-60s at half load and can go into the 40s when only loaded to one quarter of its nameplate capacity. So, low power factor could be a signal that you could run motors and production more efficiently.
- You may have voltage issues, which can impact the life of your equipment. Electric motors have nameplate ratings for voltage and amperage, and the power required to run them is roughly equal to volts x amps. If the voltage drops – which happens with power factor problems – the amperage increases, which in turn can overheat the motor and shorten its life. Along with the expense of a new motor, many manufacturing facilities also lose plenty from unplanned downtime.
- You're paying higher energy bills than you should. Low power factor also may earn you a power factor penalty from your utility because the amount of electricity the utility must deliver to you is a combination of real power and reactive power.

Correcting your power factor with capacitors



Here is an example borrowed from a great webinar put on by Partners in Project Green, an eco-business group led by the Greater Toronto Airports Authority and the Toronto and Region Conservation Authority. In the webinar, Don McQueen, president and founder of Power Factor Services Ltd., uses the diagram above to demonstrate how capacitors reduce the amount of overall power that must be supplied to your facility.

Reactive power is expressed in kilovolt amperes reactive or kVAR. Real power is shown in kilowatts, and apparent power, which reflects both kVAR and kW, is shown in kilovolt amperes or kVA. If you use capacitors to negate half of the reactive power, your apparent power or kVA drops from 1,000 to 850.

Tackling power factor at your plant

Before you can address power factor, you need to determine if there is a problem. An easy way to do that is to with an energy analysis and management tool like the Bruce Power Saver. We use the Bruce Power Saver's bill verification capabilities to help our clients identify energy use and patterns and get a comprehensive view of your electricity. Through this analysis, we can determine if there is a power factor issues.

If you decide to add capacitors to improve your power factor, here are some things you should consider:

- **Individual vs. banked installations:** You might pay less per kVAR for a bank installation of capacitors, plus it's likely to have an impact on your entire plant. It's also easy to automate switching to avoid over-capacitance or over-voltage. But, it's easier to match capacitors to the load if you put individual units along-side each motor that needs one. This configuration is also more efficient and flexible.
- **Load type.** Generally speaking, you'll want one load per motor if you have a lot of motors that are 50 hp or more. If you have a lot of small loads – say ½ to 25 hp – you might want to go with a bank installation. For plants with many sizes of motors, a combination of these options may be the best bet.
- **Load consistency.** Plants that run full-out eight hours per day will do fine with fixed capacitors. But, if load fluctuates during the day, you'll need a way to switch the capacitors off to avoid causing voltage problems during light-load times.

Of course, you'll also want to consider load size. If you only have one or two large motors impacting your power factor, one or two capacitors may lift power factor enough to help the whole plant.

With any of these considerations, your goal should be to match load characteristics to your capacitor solution. After all, unity comes from balance.

Interested in learning more about how your energy bills may hold the secrets to reducing consumption and saving on energy costs? Take a quick tour of the Bruce Power Saver.