

# Environmental Benefits of Implementing ECM'S PCB Stator Technology

## Overview

Electric motor driven systems account for over 40% of global electricity consumption according to the International Energy Agency. The United States Department of Energy confirms that the average efficiency of these motors is approximately 75%. In other words, 10% of global electricity consumption is wasted due to inefficient motor systems. With increasing electrification, we can expect the impact of this waste to grow. ECM has developed a new motor and software technology package that presents a unique opportunity to reduce this impact. Adoption of motors integrated with ECM's printed circuit board (PCB) stators and designed with PrintStator will reduce energy waste and provide further environmental benefits when compared to conventional machines.

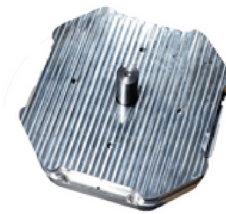
“Over half of all electrical energy consumed in the United States is used by electric motors. Improving the efficiency of electric motors and the equipment they drive can save energy, reduce operating costs, and improve our nation’s productivity.”

United States Department of Energy

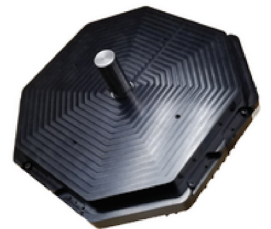


## Increased Efficiency

ECM's intelligent software package designs ultra-efficient electric motors. PrintStator transforms motor characteristics into custom, manufacture-ready PCB Stator motor designs with efficiencies in the mid to high 90s. PrintStator optimizes the copper geometries within each PCB stator to reduce resistance and eddy current losses and optimize energy flow. In standard motor topologies, a uniform copper wire is used throughout the windings, inhibiting energy flow in the end turns, increasing eddy current losses in the active area, and limiting motor efficiency. By manipulating the shape and thickness of the copper traces throughout each PCB Stator design, PrintStator enables motors with superior efficiencies and optimizes the use of copper. With the software's embedded feedback loop, PCB Stator motors will continue to evolve and set the standard for efficiency. ECM's efficient motors do more work with less power, less waste, and a reduced carbon footprint.



**750W**  
90% Efficiency  
9lbs, 7.1" Ø x 2.4" L



**2.2kW**  
92% Efficiency  
11lbs, 12.8" Ø x 3.4" L



**4.5kW**  
93% Efficiency  
33lbs, 14.5" Ø x 4.2" L

## Recycled Magnets

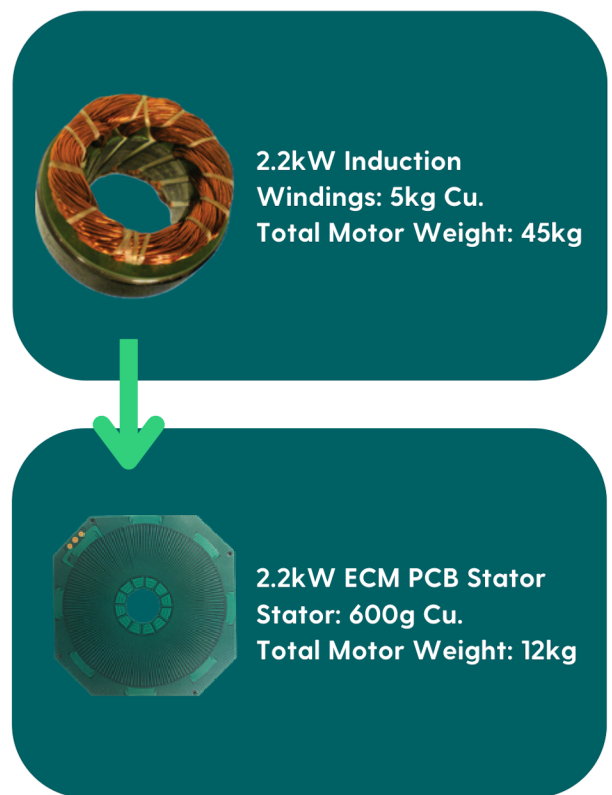
The carbon footprint of ECM's PCB Stator machines is further reduced by the opportunity to recycle permanent magnets. Permanent magnets, if properly cared for, only lose about 1% of their magnetism every 100 years. At the end of an ECM's motor's lifecycle, it can be dismantled, and the magnets removed for re-use in other PCB Stator motor applications.

## Reduced Raw Materials and Weight

ECM's novel technology enables remarkably thin, lightweight motors that have a reduced environmental footprint. ECM motors require up to 70% less raw materials and are up to 70% lighter than traditionally wound machines. Motors with PCB Stators eliminate the need for the wire winding and iron laminations used in conventional motors and generators, and PrintStator has the ability to optimize copper use in its designs to further reduce raw material requirements. By decreasing the weight and volume of its motors, ECM reduces the energy required to transport them, a significant adaptation considering the shipping industry is one of the largest consumers of fossil fuels. More importantly, ECM motors are reducing energy use when deployed in the vehicles that are carrying all goods, replacing large and inefficient motors and generators on ships and planes, and serving as traction motors for last-mile package delivery. By optimizing the use of copper and other raw materials in PCB Stators, ECM's motors provide superior torque with less mass and less environmental impact.

## Infinite Catalog of Exact Solutions

PrintStator's design and optimization capabilities enable tailored solutions for any application. Currently, most system designers are forced to pick their motor solution from a catalog with a finite number of designs. The result is that many systems involve motors that are the 'best' fit but not the exact fit, usually translating to an oversized motor with unnecessary power requirements not running at peak efficiency. PrintStator quickly and cost effectively creates system-specific stators, optimized for any application's set of exact operating characteristics. Further, PrintStator can customize motor form factor based on system requirements. For example, PCB Stator motors have been designed as thin annual rings for fan applications, integrating the propeller blades in the motor center to optimize for airflow. PCB Stators can also be created in stacks or segments based on specific applications needs. PrintStator's ability to design custom solutions for any application creates a nearly infinite number of motor designs. Utilizing a purpose built machine over the 'best' fit solution can increase system efficiency in many ways and positively impact the environment.



## Next Steps

ECM is currently expanding its PCB Stator Technology and PrintStator software to accommodate solutions from a wide range of commercial applications. Sustainable PCB Stator motors have already been utilized in many industries including e-mobility, HVAC systems, military applications, robotics, home appliances, and generators. Increasing system efficiency, weight reduction, and use of less raw materials are some of the environmental benefits of a motor designed with ECM's PrintStator, making PCB Stator technology valuable for almost any industry.

To discuss the environmental benefits of ECM's PCB stator technology within your product line, please email us at [info@pcbstator.com](mailto:info@pcbstator.com) or visit [pcbstator.com/design-your-own](http://pcbstator.com/design-your-own) to learn more about our 5-step integration process.

