

Best Electric Machine (BEM)

“Higher Purpose” Summary

Innovation For A Clean, Efficient, and Sustainable Energy Future

BEM's "Higher Purpose"

- **Be The OEM of a *Novel & Patented* Electric Motor System (EMS)¹, called SYNCHRO-SYM E-Motor:**
 - ✓ **Only Brushless Symmetric EMS (S-EMS) Circuit and Control Technology!**
 - ✓ **Eliminates** The Environmental & Geopolitical Harm of Rare-Earth Permanent Magnets (RE-PM) (*by a global adversary seeking world dominance*)!
 - ✓ **Reduces** Copper & Electrical Steel Usage!
 - ✓ **Multiplies** The "Performance/Price Ratio" (**PPR**) of The Typical Asymmetric EMS (**A-EMS**) By At Least 2-8x (*lighter, smaller, more efficient, less expensive*)!
 - ✓ **Multiplies** The Expected **PPR** of EMS Enabling Packaging Techniques By At Least 2-8x (*e.g., emerging WBG technologies*)!

¹ An **EMS** is an electric motor (or generator) "system," which should include the *compounding* loss, cost, and size of all enabling components for practical application, such as the motor, gearbox, and electronic controller entities

BEM's "Higher Purpose" (*Continued*)

- **Revolutionize EMS Manufacturing with a Novel & Patented 3D Printer Method, called MOTORPRINTER:**
 - ✓ **Only EMS 3D Printer Method**
 - ✓ **Only SYNCHRO-SYM CAD Tool, called BEM-CAD!**
 - ✓ **Eliminates Unethical Offshoring** (*to exploit low-cost labor or to avoid global restrictions on RE-PMs by a global adversary*)!
 - ✓ **Protects IP & Product Ownership** (*with secure inhouse manufacturing*)!
 - ✓ **Solves Unforeseen and Costly Manufacturing Bottlenecks** (*by re-programmable, JIT, additive manufacturing*)!
 - ✓ **Solves Material Handling Issues** (*e.g., emerging nano-materials*)!
 - ✓ **Democratizes Distributed Manufacturing** (*e.g., manufacturing franchising*)!

BEM's "Higher Purpose" Outcome

- ✓ EMS manufacturing will become democratized!
- ✓ The U.S.A. will again become the leading global EMS manufacturer with a superior *RE-PM free* EMS & an additive EMS manufacturing method!
- ✓ The Global harm being caused by RE-PMs will be greatly reduced!¹
- ✓ The U.S. will again lead the fight against human rights abuses, improving climate circumstances, and transforming the electricity infrastructure!²

***BEM Will Be The Go-To Manufacturer of
Electric Motor Propulsion and Regeneration Systems!***

¹ By *unethically ignoring monopolization by a global adversary*, the **RE-PM EMS** is anecdotally considered the most efficient! But with higher PPR and without RE-PMs, SYNCHRO-SYM's substitution would re-allocated RE-PMs to other strategic applications without a solution!

² As the backbone of the electricity infrastructure, the EMS has a significant impact on global warming, carbon footprint, electricity efficiency & cost

BEM's "Higher Purpose" Product Brief

- **SYNCHRO-SYM** is a *novel but verified* EMS "Circuit and Control Technology" with "*two unique*" performance-contributing features:
 1. **Optimal electromagnetic "symmetry"** of a "performance-contributing Active Rotor" (S-EMS) [*without delicate rare-earth permanent magnets*]!¹
 - The A-EMS (of all others) has the *non-optimal electromagnetic "asymmetry"* of a "performance-robbing Passive Rotor" (A-EMS)!²
 2. **No performance-robbing Torque Core Saturation, Core Loss, or Cogging!**

**Retrofitting Any A-EMS Package³ With SYNCHRO-SYM Technology
Multiplies The Original A-EMS PPR by 2-8x!**

³The performance/price ratio of any **A-EMS** package footprint is *limited* to available "design specification," such as voltage, air-gap flux density, and maximum load speed, and "packaging techniques," such as material science, winding arrangements, electronic components, package style, and thermal management, with *similar results*, if equally applied, but a SYNCHRO-SYM *retrofit* will deliver at least 2-8x *the expected PPR!*

BEM's SYNCHRO-SYM Vs EMS (or All Others)

Category	Continuous Power ¹	Peak Torque (Power) ¹	cost ¹	Loss ¹	Size ¹	weight ¹	Material Amount ¹	Strategic Rare-Earth Materials ^{1,4}	Inductance (Torque) ⁵	Core Saturation (Torque) ⁶	Compounding rotor Loss, Cost, and Size ⁹	Magnetizing MMF Sharing ¹⁰
S-EMS²	2x	8x ⁷	1/2x	1/2x	1/2x	1/2x	1/2x	No	No	No	No	Yes
A-EMS³	1x	1x	1x	1x	1x	1x	1x	Yes ⁸	Yes	Yes	Yes	No

¹ Per Unit of Power Rating with the same port voltage, air-gap flux density, and packaging and footprint

² The Symmetric EMS (S-EMS) [as only possible with SYNCHRO-SYM with a power producing “active rotor” as only possible with BRTEC] reaches the theoretical limit in EMS performance/price ratio

³ The Asymmetric EMS (A-EMS) with a passive rotor of slip-induction windings, reluctance saliencies, DC field windings or permanent magnets, such as rare-earth permanent magnets (RE-PM), that wastes loss, cost, and size without any power production

⁴ Rare Earth Materials, such as for RE-PMs, are monopolized by a global adversary seeking world dominance with harmful environmental, human exploitation, innovation, and geopolitical consequences

⁵ The lower the inductance (due to “torque MMF cancellation” as a result of symmetrical transformer physics), the faster servo response time

⁶ The lower the core saturation potential (due to Torque MMF cancellation), the higher the peak torque

⁷ Due to Torque MMF cancellation, the air-gap flux density can be designed closer to the saturation limit of the core material and SYNCHRO-SYM uniquely has another degree of power density adjustment, which is torque current magnitude adjustment, over packaging techniques.

⁸ Only RE-PM A-EMS

⁹ The rotor loss, cost, and size of any A-EMS, including the RE-PM A-EMS, are compounded through the Stator. For instance, without a directly-excited (or passive) rotor, the loss of the rotor must be passed through the power producing active stator, which will compound the loss (size and cost) of the stator. In contrast, the rotor and stator of SYNCHRO-SYM are independently excited.

¹⁰ With the symmetry of two independently excited winding sets on the rotor and stator of the S-EMS, as only possible with SYNCHRO-SYM, Magnetizing MMF is shared between the rotor and stator winding sets and as a result, the total winding I^2R loss (and core loss) is halved.

SYNCHRO-SYM Demonstration

<https://youtu.be/IZ8cxSLLCR8?t=5>

BEM's "Higher Purpose" Value-Added

- **A *Unique* EMS** that is the most efficient, lightest, smallest, and lowest cost possible ¹: ***Driving higher profits & redefining technology***
- **A *Unique* EMS without rare-earth minerals: *Best addresses climate-friendly objectives and associated harm by a global adversary's monopoly***
- **A *Unique* EMS 3D Printing Method with reprogrammable BEM-CAD for secure, inhouse, JIT manufacturing:² *Quickly & Locally serving customer prototyping and production needs***

¹ Uniquely 3D Prints a superior thermal management & System of System (SoS) Integration

BEM's "Higher Purpose" TAM (>\$370B) ¹

- Automobile \$100B+
- Wind Turbines \$45B+
- Industrial & Commercial Motors \$220B+
- Others
 - Aircraft, including drone fleets, Boats and Ships, Rail and Trucks, Recreational Vehicles (e.g., scooters, golf carts, go-carts), Construction Machines (e.g. forklifts, power drills/hammers, backhoes)

¹ Only Served By The "Asymmetric" EMS (A-EMS) With a "Passive Rotor" of RE-PMs, Slip-Induction Windings, Reluctance Saliencies, or DC Field Windings!

BEM's “Higher Purpose” *Immediate* TAM

- **BEM will help PPR Centric Producers** of (i) EVs; (ii) land, rail, air and sea craft; and (iii) generators and wind turbines achieve their goals of:
 - ✓ Greater profitability with greater impact on achieving climate friendly objectives, greater efficiency, lighter weight, smaller size, lower cost, and greater range!
 - ✓ Avoiding the cost-driving need for offshoring with exploited labor and lost IP by *cost-effective, inhouse, additive* EMS manufacturing!
 - ✓ Providing best performance/price ratio over creative branding of another “me-too” product!

BEM's “Immediate” Global TAM is expected to exceed \$145B

BEM's Competitors' "Lower Purpose" A-EMS

<i>Funded Company</i> ^a	Market	Funding ^b	TAM
<u>Infinitem Electric</u>	<u>Industrial RE-PM PCB</u>	\$350M since 2014 ^d	\$186B
<u>TurnTide Technology</u> ^c	Industrial Synchronous Reluctance	\$491M since 2013	\$186B
<u>Magnix</u>	Electric Airplane	\$74M since 2022	\$13B
<u>H3X</u>	Electric Airplane	\$9M since 2023	\$13B
<u>BMW's 5th Generation E-Drive</u> ^c	Electric Vehicle	\$?	\$100B
<u>DeepDrive</u>	Electric Vehicle	\$34M since Sept. 2024	\$100B
<i>Emerging Company</i> ^e	Market	Amortizing ^b	TAM
<u>Best Electric Machine (BEM)</u> ^c	Electric Vehicles, etc.	Kickstart Sales Plan	\$370B

- a. All are "me-too" Asymmetric EMS (A-EMS) with a "performance-robbing passive rotor" and a remotely placed, estimating field-oriented controller derivative that are typically different technical disciplines from different manufacturers
- b. For "validation (NRE) and commercialization" of an EMS packaging technique
- c. Only EMS manufacturers with the "higher purpose" of eliminating the environmental, human exploitation, and geopolitical harm of RE-PMs.
- d. The funding includes offshoring manufacturing to Mexico
- e. Only BEM's SYNCHRO-SYM is an S-EMS with "performance-contributing active rotor" and "integral" brushless real time emulation control (BRTEC) and 3D Printing Manufacturing

BEM's "Higher Purpose" Accomplishments¹

- **BEM's EMS (SYNCHRO-SYM)** is ½ the size, ½ the weight, ½ the cost, 8x the peak torque, and 2x as efficient with the same A-EMS packaging [*but without [the harm of RE-PMs](#)*]:
 - ✓ *Verified* by a century of [theoretical EMS study & R+D](#) ²
 - ✓ *Verified* by *tangible* BEM Persistent R+D, Prototyping, and Domestic & International Patenting
- **BEM's 3D Printer Method (MOTORPRINTER) for JIT SYNCHRO-SYM Manufacture:**
 - ✓ *Verified* by BEM orchestrating empirical studies with leading manufacturers of amorphous metal and fiber laser cutting [& now in [fabrication](#)]
- **BEM's EMS Computer Aided Design Tool (BEM-CAD) for JIT SYNCHRO-SYM design:**
 - ✓ *Verified* by BEM cross-comparing design results with A-EMS published product specification
- **BEM's Team Developed [& Executing] "Validation & Commercialization" Plan:**
 - ✓ *Verified* by BEM cross-comparing with "[High Value Funded Contestants' A-EMS Validation Plan](#)"

Technology & Market Verified! Low Technical or Market Risk!

“Higher Purpose” *Issues* To Overcome

- **Confusion:** EMS “Terminology” that evolved from a century of *applied A-EMS practice* must be accurately redefined to describe the *theoretical S-EMS practice* enabled by BRTEC!
- **Ignoring Facts:** SYNCHRO-SYM is the only stable “symmetric” EMS (S-EMS), which was verified by a century of *theoretical* EMS study & research and BEM persistent R+D, prototyping, & patents!
- **Conflicts of Interest:** Substantial investment in practicing “me-too” A-EMS packaging, such as RE-PMs, snubs the novel S-EMS technology of SYNCHRO-SYM!
- **Confusion:** SYNCHRO-SYM is a “newly invented” S-EMS circuit and control technology that easily retrofits any A-EMS package but IAW physics, greatly magnifies the PPR!
- **Confusion:** SYNCHRO-SYM is *wrongly* confused with the *unstable* field-oriented controlled, doubly-fed, “induction” A-EMS (WRDF-EMS) with multiphase brush-slip-ring assembly!
- **Creative Marketing (contrary to physics):** Extraordinary performance/price between “me-too” A-EMSS is easily shown by not fairly providing legacy packaging details, such as standard versus custom frame size, or design specification details, such as operating voltage, maximum load speed, or duty cycle!

Need “Validation & Commercialization” To Overcome Issues!

BEM's "Higher Purpose" BUSINESS PLAN

- **Implement BEM's "Kickstart Sales Plan:"**

- ✓ **Amortize "Validation and Commercialization" Cost Over MPV!**

- Implement Scientific Sales Approach to Reach MPV (AI, Big Data, Digital Tools, etc.)!

- ✓ **Validation: SYNCHRO-SYM E-Motor Meets Beta (Customer) Testing!**

- Fabricate MOTORPRINTER for JIT *Axial-Flux* Sample Production!
- Redesign the *Verified* Radial-Flux Prototyping With Upgraded Components, BEM-CAD Axial-Flux Footprint, and Alpha (Inhouse) & Beta Testing!

- ✓ **Publish/Advertise Validated Results** of Beta Testing To Entice Sales!

- ✓ **Commercialization: Scale MOTORPRINTER For *Inhouse* Production!**

BEM's "Higher Purpose" Team ¹

Today:

- Founder, Chief Technology Officer (Fred Klatt)
- Chief Executive Officer (Kaylyn)
- Chief Operating Officer (Garrett)
- VP Marketing (Carol)

Tomorrow:

- Add Sales & Marketing
- Add CIO for SYNCHRO-SYM
Enabled Products:
 - Compact, Light Weight Wind Turbines
 - Universal EV Power Train Cradle
 - Hydrogen Capture
 - Distributed Power Management

IT'S THE MARKET *NEED* FOR BEM'S HIGHER PURPOSE TECHNOLOGY!
[ITS NOT The Creative Market Plan or The Who's Who Marketing Team!]

¹ BEM's committed team is not the Who's Who of creative marketing that is essential to sell another "me-too" A-EMS product but instead, is sole keeper of S-EMS knowledge base with the IP protection integrity, functional expertise, mission centric flexibility, and ethical resolve to compete against the RE-PM A-EMS juggernaut that is monopolized by a global adversary seeking world dominance by environmental and geopolitical harm!

THANK YOU

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