

Development Outline of

K&E Power Motor

for EV



運動エネルギーで
世界のCO2を
削減！

**KEEP your
Motor
Running**

Innovative
Double Rotor System

Granted Japan Patent Office Number 6729888
Patent Applied for PCT/JP2020/026316



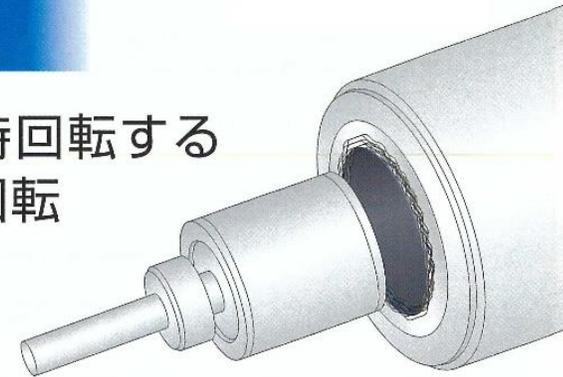
IMI Corporation

K&E パワーモータ作動イメージ

K&E Power Motor Operation Outline

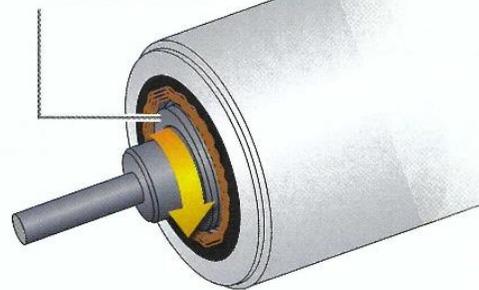
1つのモータのロータ部とステータ部が同一方向同時回転する
世界初の画期的構造。云わばWロータモータまたは回転
ステータモータとも呼べるモータである。

Innovative Structure: Rotor and Stator rotate in the Same Direction
byname; "Double Rotor Motor" / "Rotating Stator Motor"



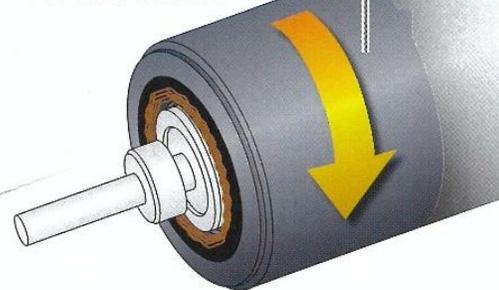
1 通常走行時
Normal Travelling

ロータ回転
Rotate Rotor



2 回生 (減速→停止) 時
Regeneration (Slowdown/stop)

ステータ回転
Rotate Stator



3 再発進時
Restarting

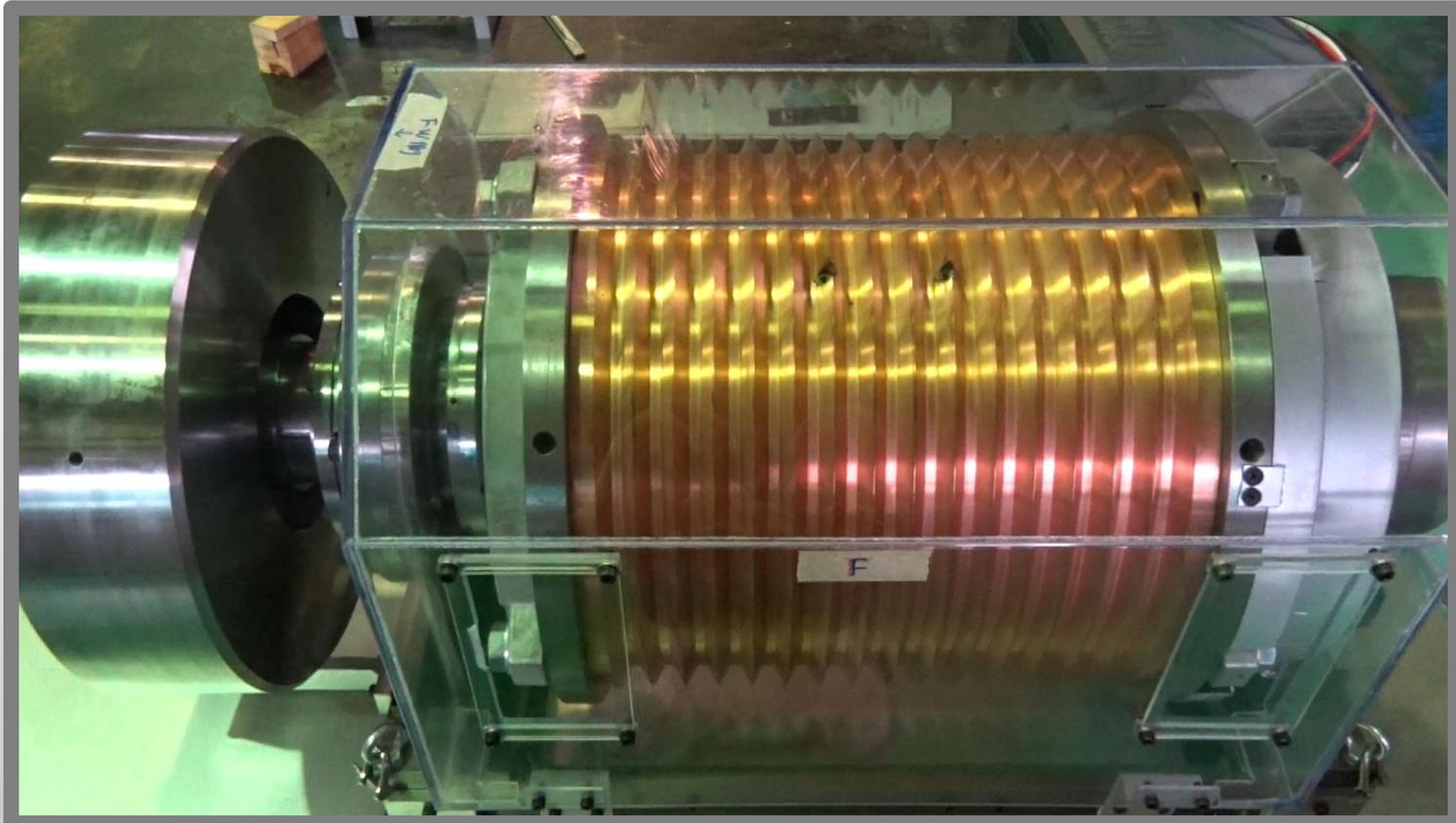
Rotor + Stator Rotate
ロータ&ステータ
同一方向同時回転
in the Same Direction



運動エネルギー蓄積機能
Accumulating Kinetic Energy

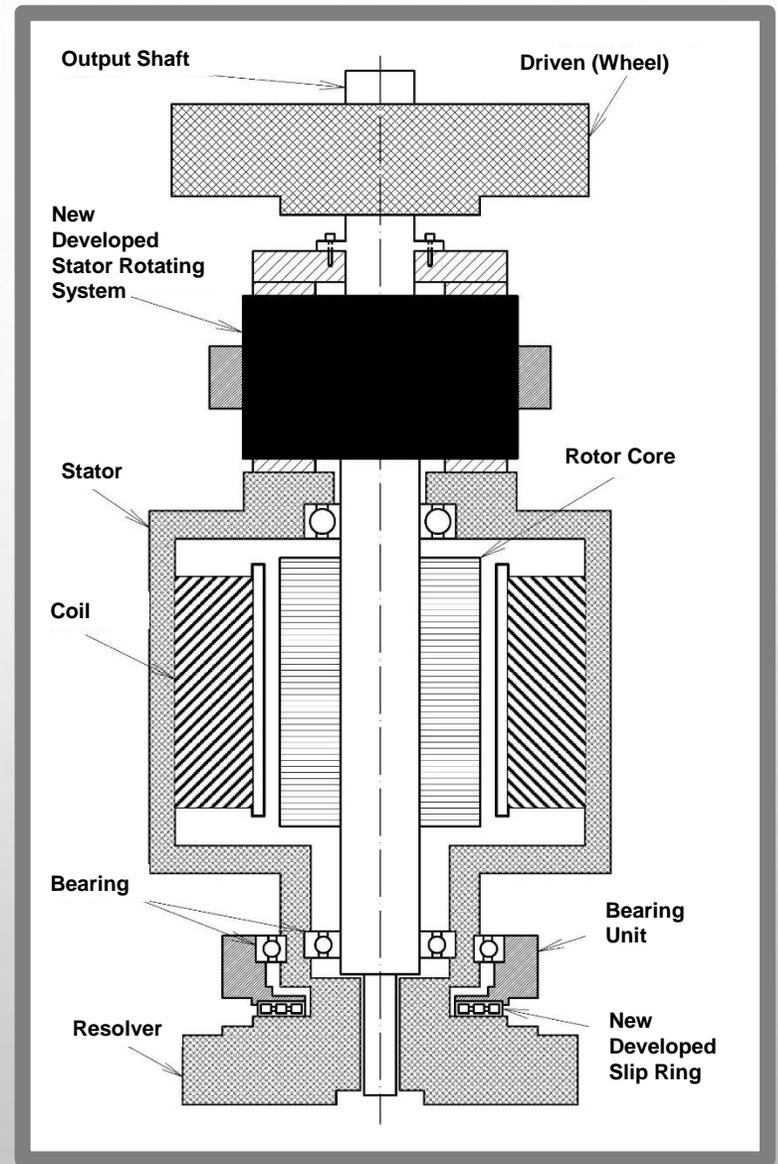
高効率回生機能
High Efficiency Regeneration

逆起電力リアクタンス減少機能
Reduce Counter Electromotive Force Reactance



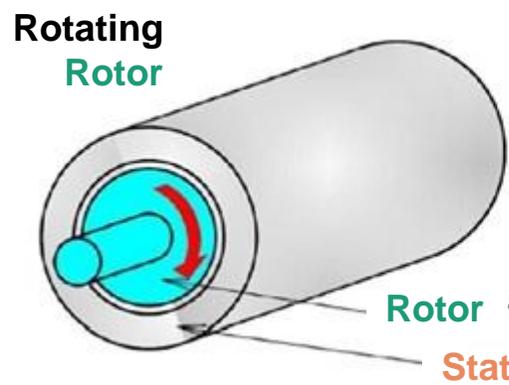
● Original Mitsubishi Electric SF-PR-22
in-house Modification into K&E system
Specifications

- Composite Output: $45\text{Kw} + 155\text{Kw} = 200\text{Kw}$ (Theoretical value)
- Motor Weight: 150Kg
- Stator Rotating Speed: Max. 6,000rpm

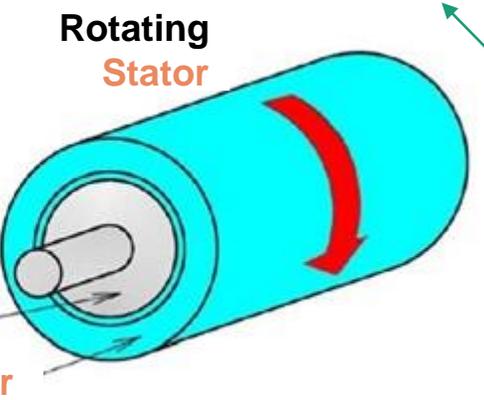


● Enable High Efficiency by using a stator as a Flywheel to store regenerative kinetic energy by breaking, and combined output when restarting

1. Traveling (Power Running)



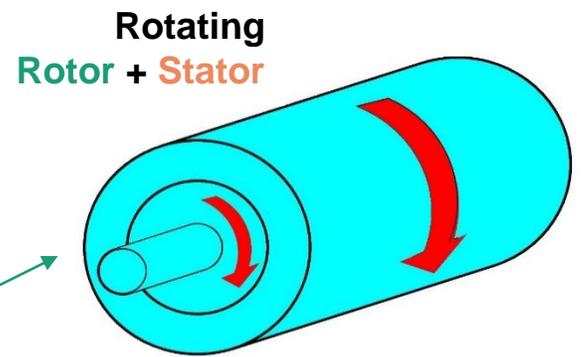
2. Breaking (Regeneration)



Regeneration

- by using a stator as a flywheel
- Stator receive power generation reaction force by Rotor/Stator electromagnetic force

3. Restarting

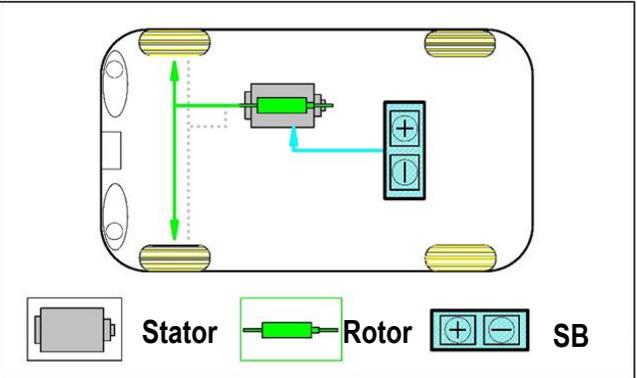


Restarting

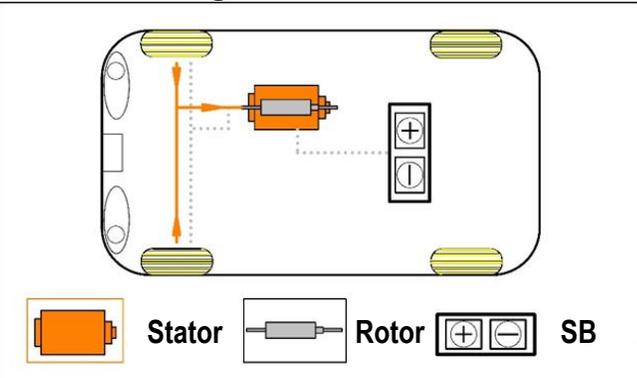
- High torque from high-speed rotating magnetic field
- Reduce back electromotive force by rotor and stator rotate in the same direction simultaneously

Prevent reverse rotating by One-way Crutch

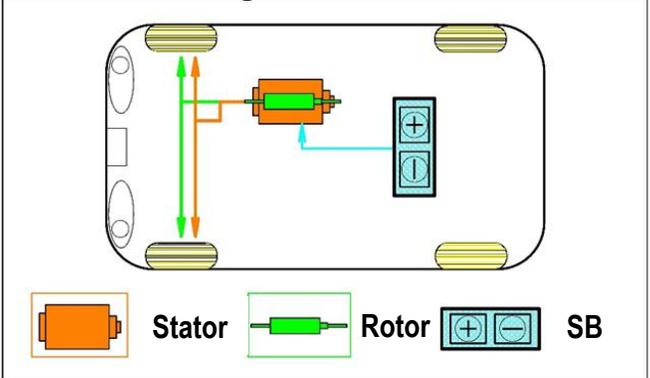
① <Starting-up ~ Travelling>



② <Breaking>



③ <Restarting>



1. Features

- More than double the output of a battery of the same capacity (using the current generated by the rotating magnetic field)
- PM motor, weak field control not required, shows improved efficiency (relative magnetic flux speed decreases during stator rotation)
- Drive/regenerative currents can be suppressed, improving battery life and size
- Significantly improved power consumption during city driving (Potential to enable double EV driving range depending on the control method)

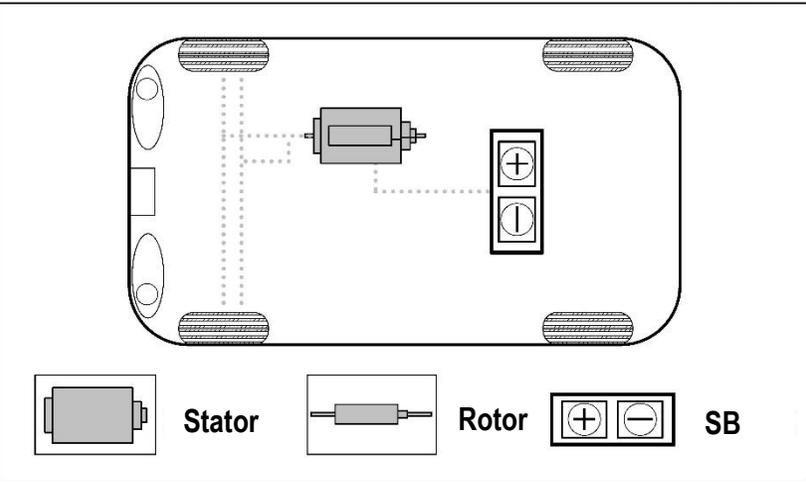
2. Expected Benefits

"The characteristics are like a motor with a built-in large-capacity capacitor, and it is suitable for EVs with large battery capacity constraints, such as small cars, city delivery vehicles, and buses"

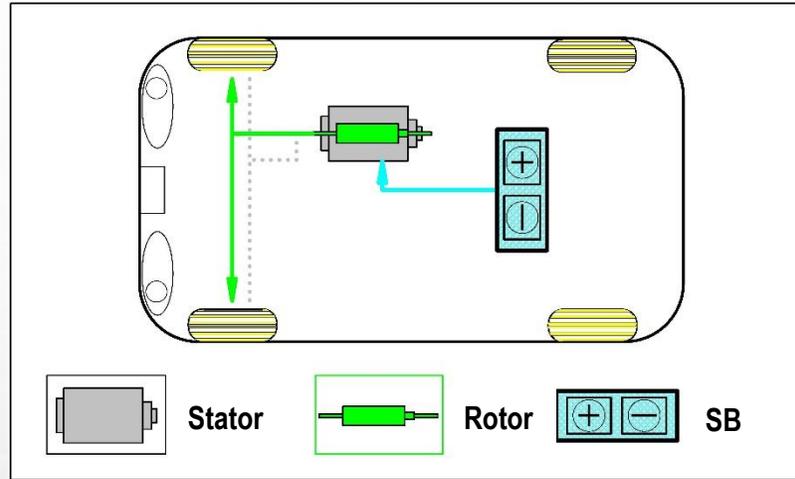
- Easing conditions of Battery (location, size, ampacity)
- Enable to double the output when restarting
- Enable drive like Li-ion batteries even with lead-acid or NiMH batteries
- Enable drive like high-voltage batteries by combined current even at low voltage

【K&E Power Motor Operation Status】

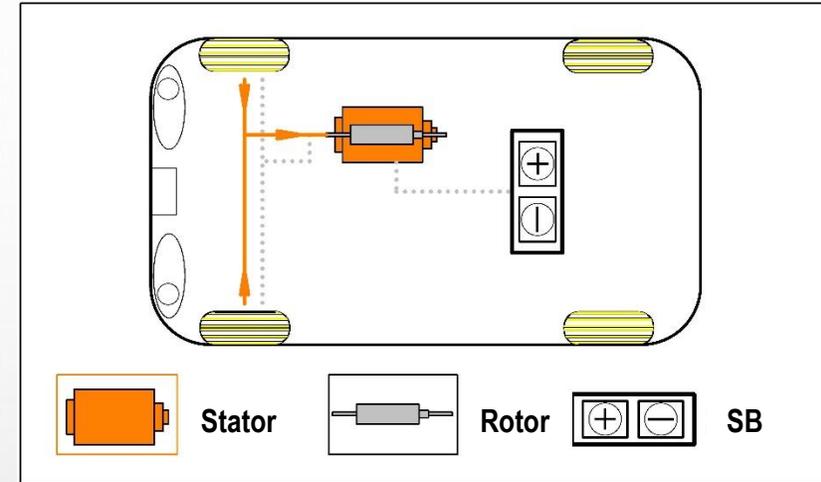
① <Parking State> *1



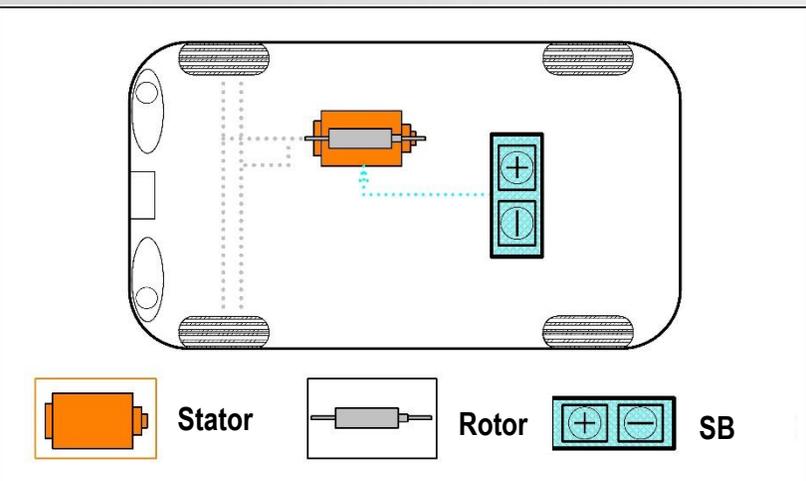
② <Starting-up>



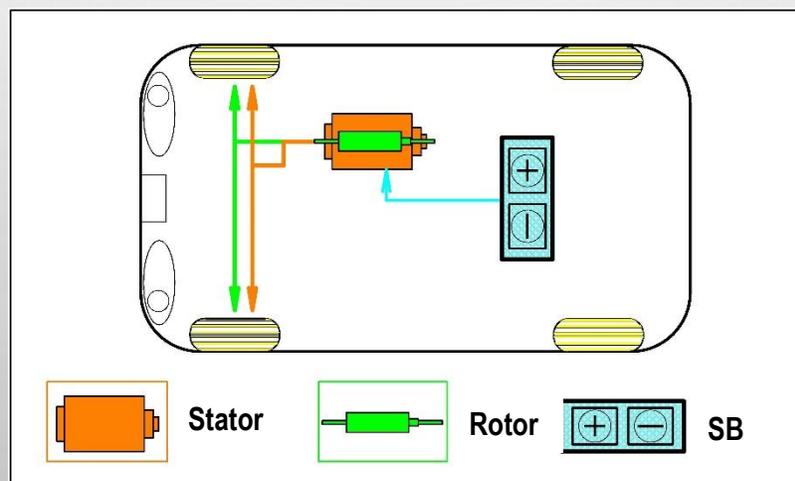
③ <Regenerative Breaking>



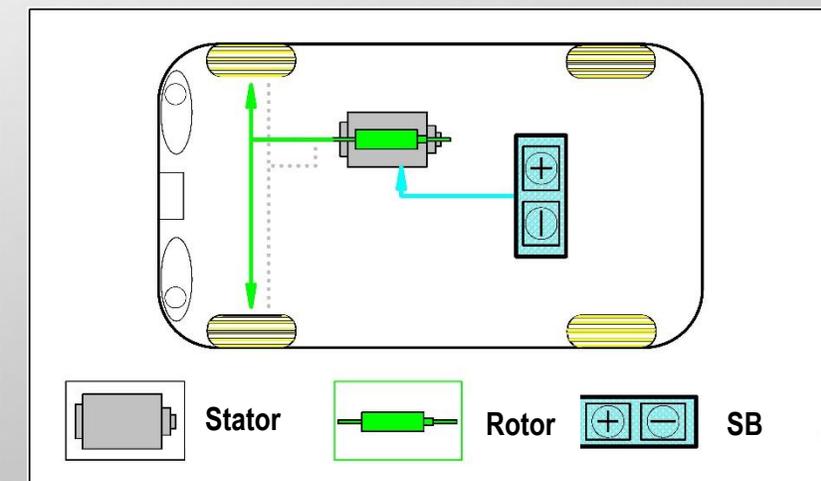
④ <Stopping/Idling>



⑤ <Restarting>



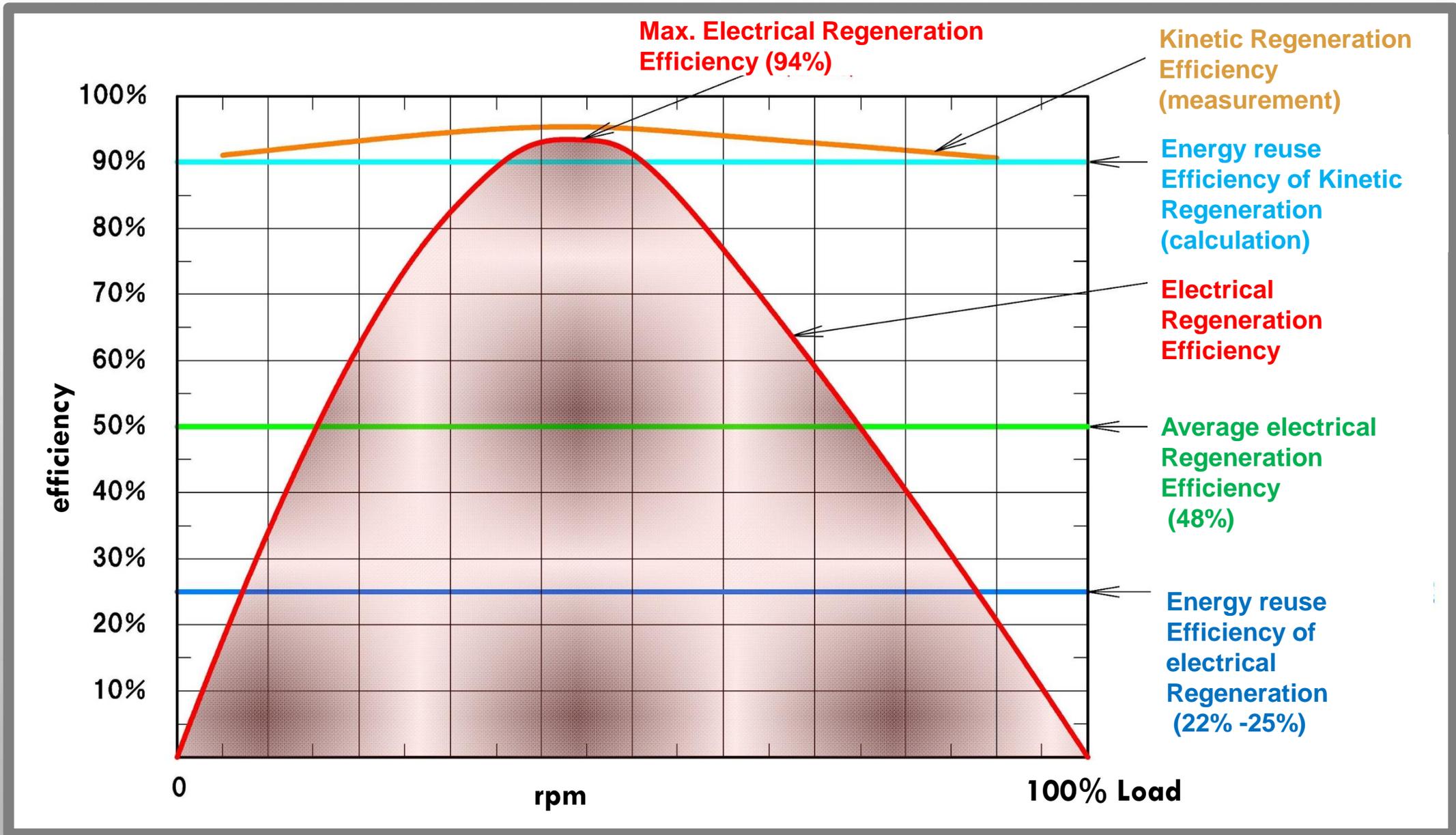
⑥ <Constant Speed Travelling>



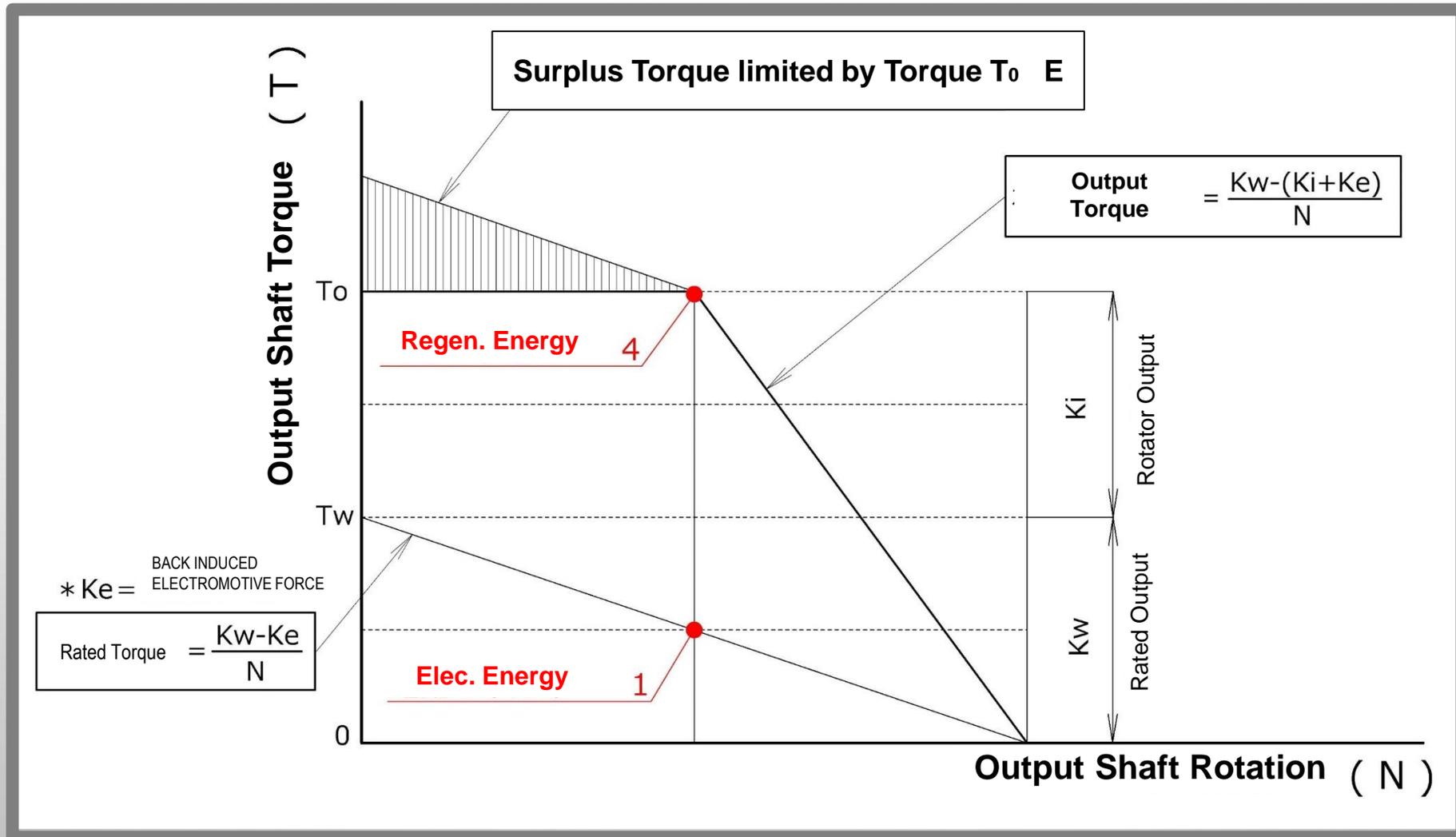
*1 by supplying battery power to ① <Parking State> enable to enter ④ <Stopping/Idling> status

SB: Secondary Battery

[Kinetic vs Electrical Regeneration Efficiency]



[Theoretical N-T Chart]



*1 Surplus torque compensate equivalent electricity to motor power generated by coil. As a result, enable to reduce power supply from the battery