WIRELESS POWER

CONSORTIUM

Medium Power Work Group

Ebike Wireless Charging

Proposal for standardization

&

Draft Commercial Requirements

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Contents

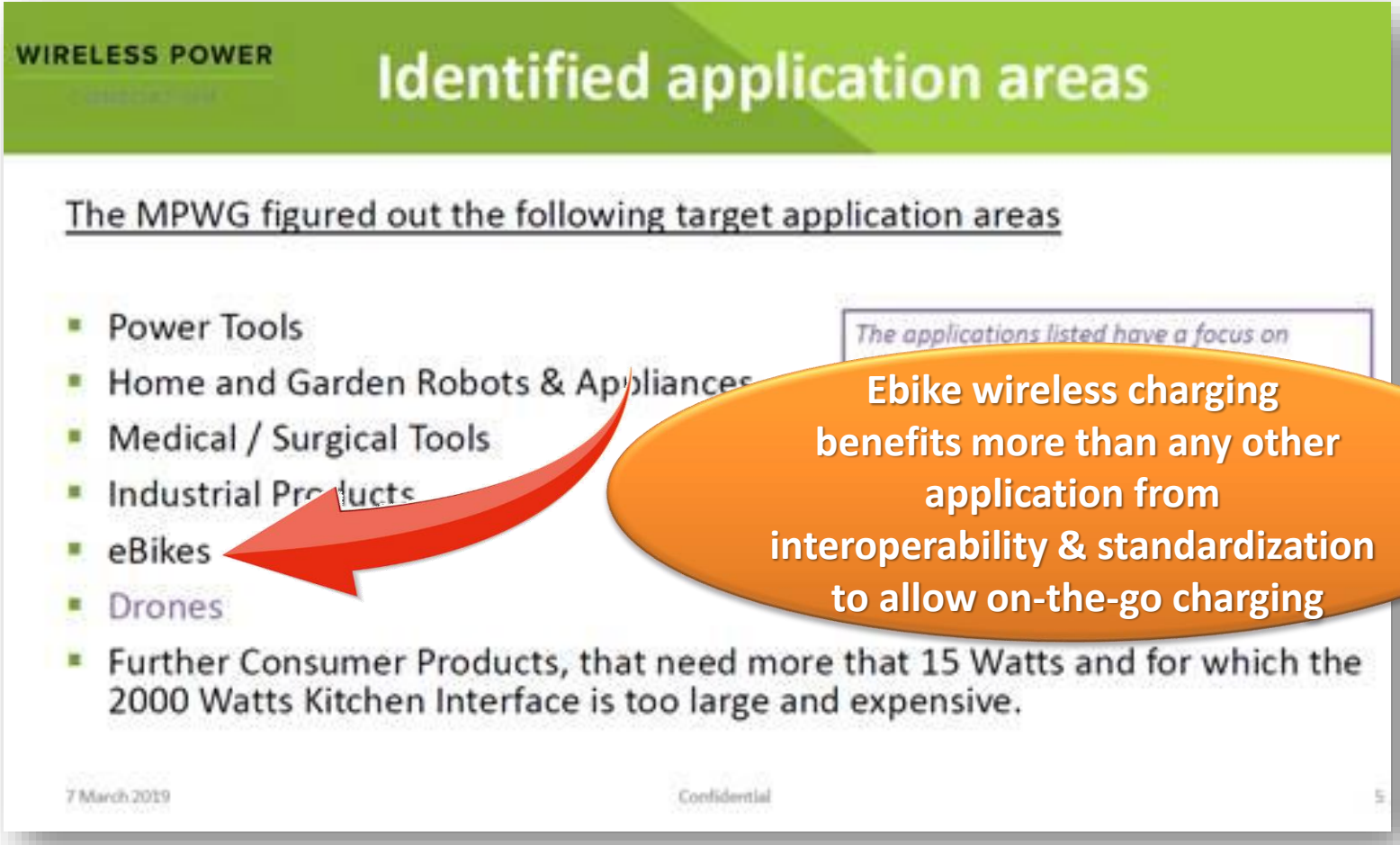
Introduction

- Ebike companies/tech-suppliers highly interested in ***standardized*** wireless charging.
- ***Why now*** and not before? Because time-is-right
  - Market growing fast with CAGR of ~10% to >40B$ in 2026
  - Increasing green/sustainability awareness, environmental consciousness
  - On-the-go charging extends range without bigger batteries
  - Proprietary charging becoming a negative differentiator (different plugs)
  - Growing awareness of lifestyle diseases.
  - E-mobility is hotter than ever before.
- Plus a growing market of ***Light Electronic Vehicles*** (LEV) with similar requirements.
- WPC Medium power standardization has provided a ***solid basis.***

LEV market growing factor 2 between 2019 and 2026 to >40B$ or ~40Munits

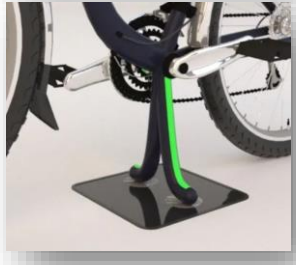
segway unveils jurassic park gyrosphere 'transport pod' ahead of CES 2020

Aligned with Medium Power Commercial Requirements



Prior Work on wireless Ebike charging

- The idea of wireless charging of Ebike is ***not new*** at all
- Many initiatives, but ***no standardization***
  - https://www.rubinolab.com/wireless-battery-charger/
  - https://tech.nikkeibp.co.jp/dm/english/NEWS_EN/20150305/407471/
  - https://smartcitieselectronics.com/charge-e-bikes-batteries-wirelessly-says-wurth-elektronik/
  - https://cyclingindustry.news/wireless-charging-for-electric-bikes-on-the-horizon/
  - And many more…..
- So why no standardized wireless charging so far?
  - Too much focus on form-factor
  - Assumption that Ebike charging is city/government driven
    - Standards are industry-driven. They are part of a business case
  - Easy to make a working prototype!
    - Complexity is ALL using same basic technology BEFORE designing the application



Forget formfactor
Standardize the basics
and start simple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KING-METER

- E-bike wireless charging station
- Bicycle docking station
- Software of management
- GPS Lock & Bluetooth Lock
- Mob APP

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ZONECHARGE

Electric bicycle solution

Electric bicycles are the easiest means of transportation for humans. This electric bicycle solution is based on the concept of "energy saving and emission reduction, green travel". It adopts wireless power supply technology, which makes the battery and charging equipment have no physical contact, sealed, waterproof, dustproof and moisture-proof, maintenance-free, and can be charged immediately, safe and convenient. The sharing of electric bicycle industry is difficult to charge, exposed contacts, and high operating costs.

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Park, Charge & Go

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Fesla Charge

Some of the Benifits

User Experience

It's based on a park, charge and go experience, providing its users a fast and happy fueling experience. No need for an adaptor!

Range Anxiety

Designed for a mass-role out to be placed on strategic locations in a city, campus, office parks and your local coffee company.

Keep it organized

Place bicycles in cities in a structured way. Less inconvenience due to bicycles lying around.

Vandalism Resistant

The tile is mounted in the ground and is made of robust materials that limit the chances of acting vandalism. No tripping over wires.

Durability

Using power transfer by means of magnetic coupling have their entire electric circuits sealed from moisture. No need for wires that can break or fail due to corrosion.

City scape

The tile is placed in the ground providing a minimal impact to the cityscape. It could coexi with existing locking mechanisms or bike racks required.

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Many other Light Electric Vehicles (LEVs)

D-fly's dragonfly hyperscooter features aerospace-grade aluminum

yamaha reveals latest edition of its three-wheeled electric scooter

harley-davidson electric scooter concept races towards production

segway unveils jurassic park gyrosphere 'transport pod' ahead of CES 2020

Much bigger LEV market with same battery charging requirement as Ebike

What can wireless charging do for E-bikes

- **Wireless charging benefits:**
  - Remove exposed contacts
  - Facilitate new form factors
  - Enable charging in public places
  - Freedom of (high) charging power in a safe way

ONE interface that is rugged, weather resistant and fits any formfactor

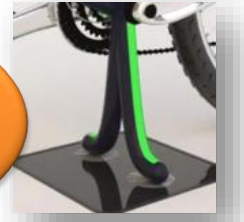
- **Wireless charging standardization:**
  - No need to carry your own proprietary charger
  - On-the-go charging needs a standard charging interface
  - Interoperability allows chargers from different vendors to charge your battery
  - On-the-go charging by charging-ecosystem with standardized vandal-proof interface
  - Enable new businesses (“charging as service” like “free WIFI”)
  - Charging-technology-supply-market standardization drives down cost

Why do we need a standard?

1. Many different and impressive designs/form-factors have been published already

- Confirming market interest
- But no uniformity in the underlying "electronics"
- Making it difficult to source basic technology
  → "reinvent the wheel" over and over again

General understanding that Ebike wireless charging represents a valid business case. Time to align!!

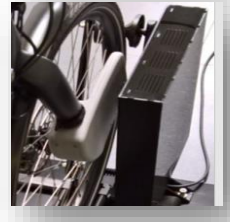


2. Parties not talking to each-other to exchange solutions/problems

- Formfactor is seen as most important, no common performance agreed
  - Electronics are "boring" & "invisible" → No business-case focus, yet the MOST important!
- Interoperability is not looked at, creating a lock-in (need) of TX and RX
- Important technical issues (FOD!!) are not tackled. It is only half-a-solution

3. If we believe in city-infrastructure, then ANY bike needs to work with it

- Cities will not allow a non-standardized technology.
  - Need ability to chose from multiple suppliers
- Public Ebike market growing but ***public*** charging needs to work on ***private*** bikes



Keep it simple ! Don't over-standarize

- **What to standardize?**

  Define the ***minimum possible technical items*** to allow wireless charging (charging TX and RX ***module***)

  – Required charging power level at RX output

  – Coil diameter for TX and RX

  – Charging distance range

  – Misalignment range

  – FOD

Engage with Ebike companies, Ebike drive train suppliers and battery makers to agree on minimum set of requirements

- **What to NOT standardize?**

  DO **NOT** standardize mechanical form-factors of how the TX and RX module are embedded in the design

  – See examples on next pages on HOW the modules can be integrated in frame and/or charge

  – Examples are food-for-thought only. ***Should NOT be mandated*** as part of a certified design

- **Keep maximum overlap with already standardized concept in Medium Power**

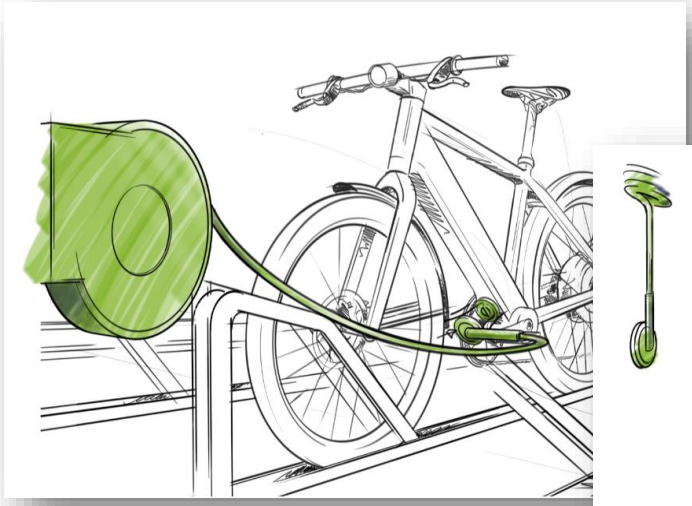
Basics: “BIG Version” of Qi charging as a start

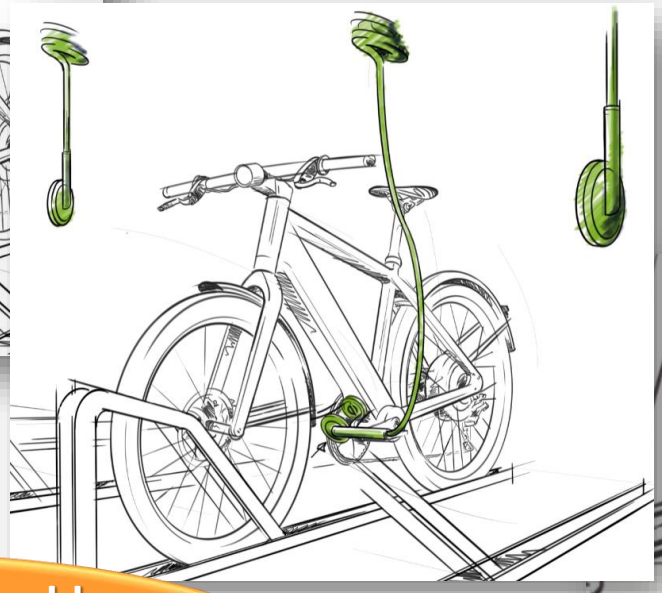
5 - 20 Watt

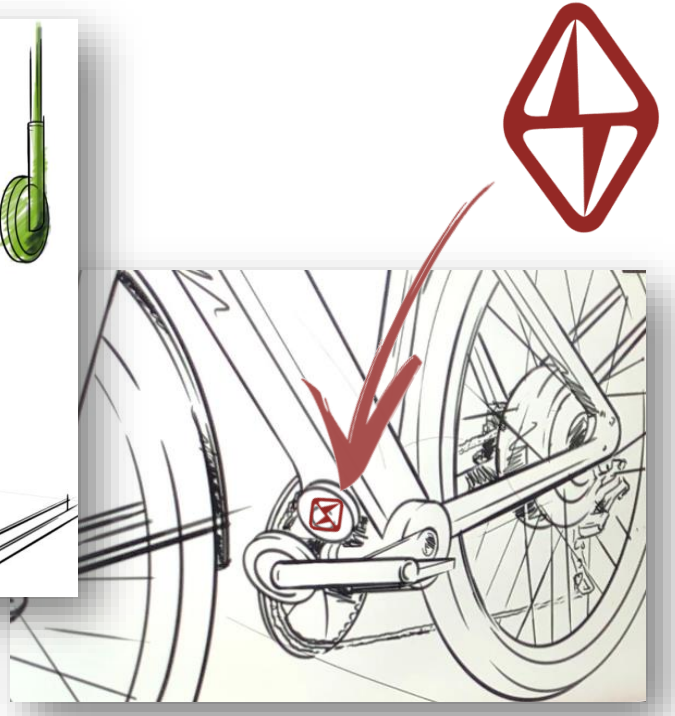
100 - 500 Watt*

*1 hour on-the-go charging of 500Wh battery

Or hookup the charger to the Ebike battery/frame



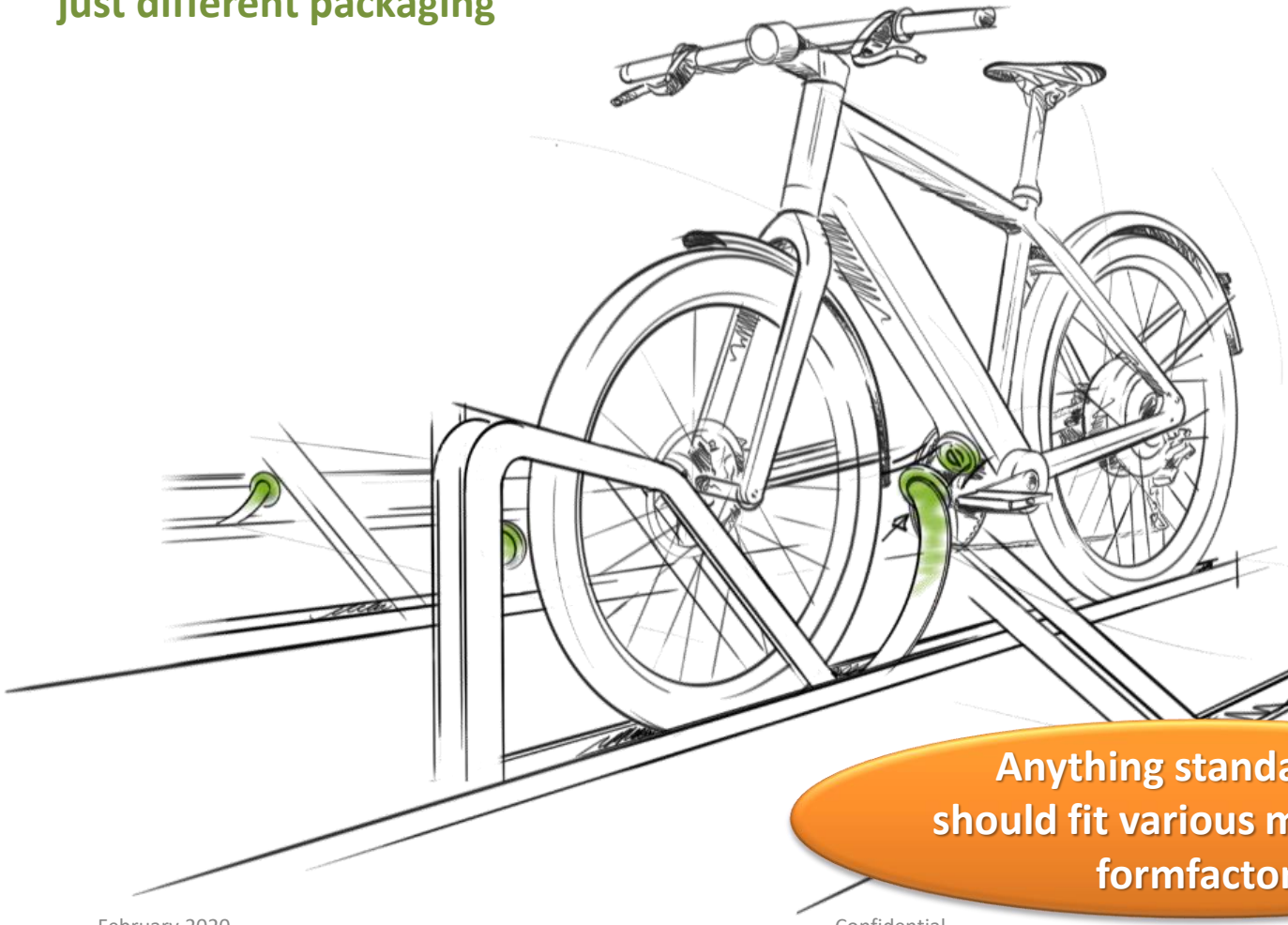




Bike interface preferably attached to the “triangle” to avoid moving (outside) wires

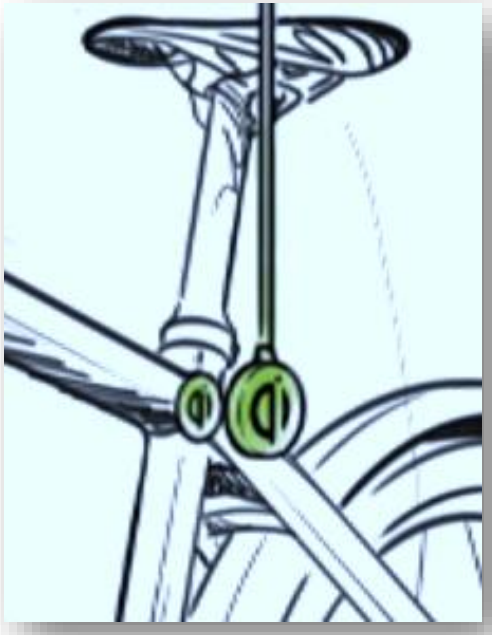
Many options, using same electronics

just different packaging



Anything standardized should fit various mechanical formfactors

Many options, using same electronics
just different packaging



Anything standardized should fit various mechanical formfactors

Standardization – Must-haves & Optionals

1. Wireless charging interface from transmitter to receiver

- Similar like Qi charging of smartphones
- Still different power levels are possible
- Receiver charging interface can be
  - part-of or built-into the (removable) battery
  - part of the design of the bike
- Transmitter and receiver modules are standardized (multi-sourced)
- All standardized batteries (logo-bearing) work with any standardized charger

Must-haves will set the boundary conditions for many different formfactors (not the other way around)

2. Optionally

A. Wireless power transfer from battery to bike
  - Avoid metal contacts between battery and bike
  - At the cost of efficiency & range

B. Standardized mechanical interface to enable eco-system of public chargers

Draft Requirements – To be detailed

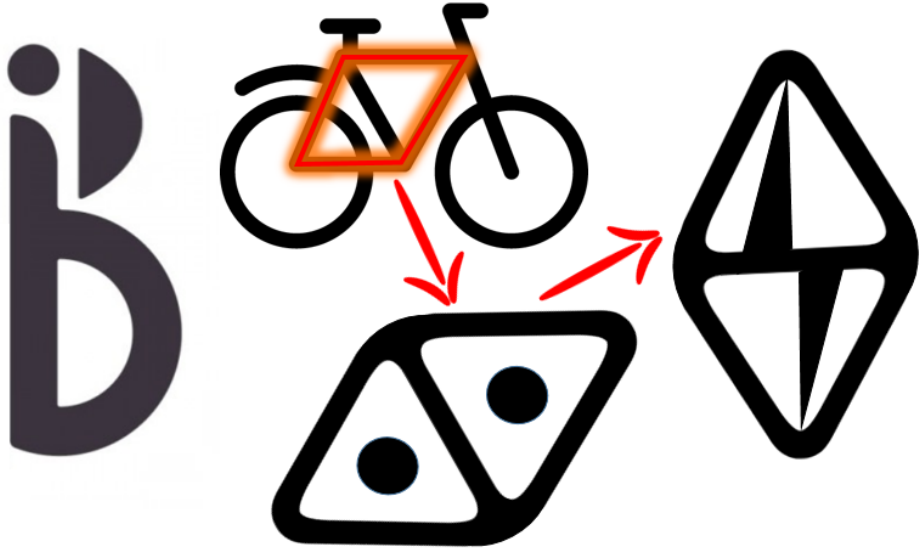
Final specifications will be a compromise between power, size, distance, cost

- **Technical Requirements**
  - **Receiver** minimum charging level: 100W
    - Optionally support up to 500W
  - **Public transmitters** to support 500W charging level
    - 500W fo to 1-2hours on-the-go charging time for a ~500Wh battery
  - **Coil diameter** for transmitter and receiver: ~70mm
  - **Charging Distance (Z)**: 1cm – 4 cm. Maximum freedom for mechanical design
  - **XY misalignment**: <0.5cm (at which power transfer loss <25%)
  - **Foreign object detection** and/or temperature warning/shutdown
  - **TX/RX coil alignment support** (optical, mechanical, magnetic)
  - **Attachment support** of TX to RX coil especially for vertical positioning
- **Commercial Requirements (500W charging capability)**
  - **Cost of TX electronics** from AC to coil: <8$ excluding packaging
  - **Cost of RX electronics** from coil to battery: <4$ for 100W, <6$ for 500W.
    - excluding power control circuits already available in battery for wired charging

Compatibility and logo

- **Compatibility with Medium Power standard**
  - The Ebike wireless charging standard defines a narrow subset of existing medium power standardized elements, PLUS some additional Ebike specific elements as needed
- **Logo needed for market adoption**
  - Some quick examples/sketches

Ebike wireless charging logo Creates visibility for users and indicates compatability



Next steps

1. Check interest of (tier-1) Ebike companies to jointly define requirements. For example
   - Shimano
   - PON
   - Accell
   - …….
2. Same for Ebike drive train suppliers
   - Shimano
   - Bosch
   - Brose
   - Yamaha
   - Simplon
   - Bafang
   - Kingmeter
   - …..
3. Same for Wireless Charging Technology Suppliers
   - Zonecharge
   - Chushantech
   - Primax
   - ….
4. Same for Ebike battery suppliers

All initial partners we talked to recognize the need and and eager to join forces

Thank you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