



GEELY
吉利控股集团

Electric Vehicles - How Charging Times Drive Voltage Choices

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2019.11

Agenda

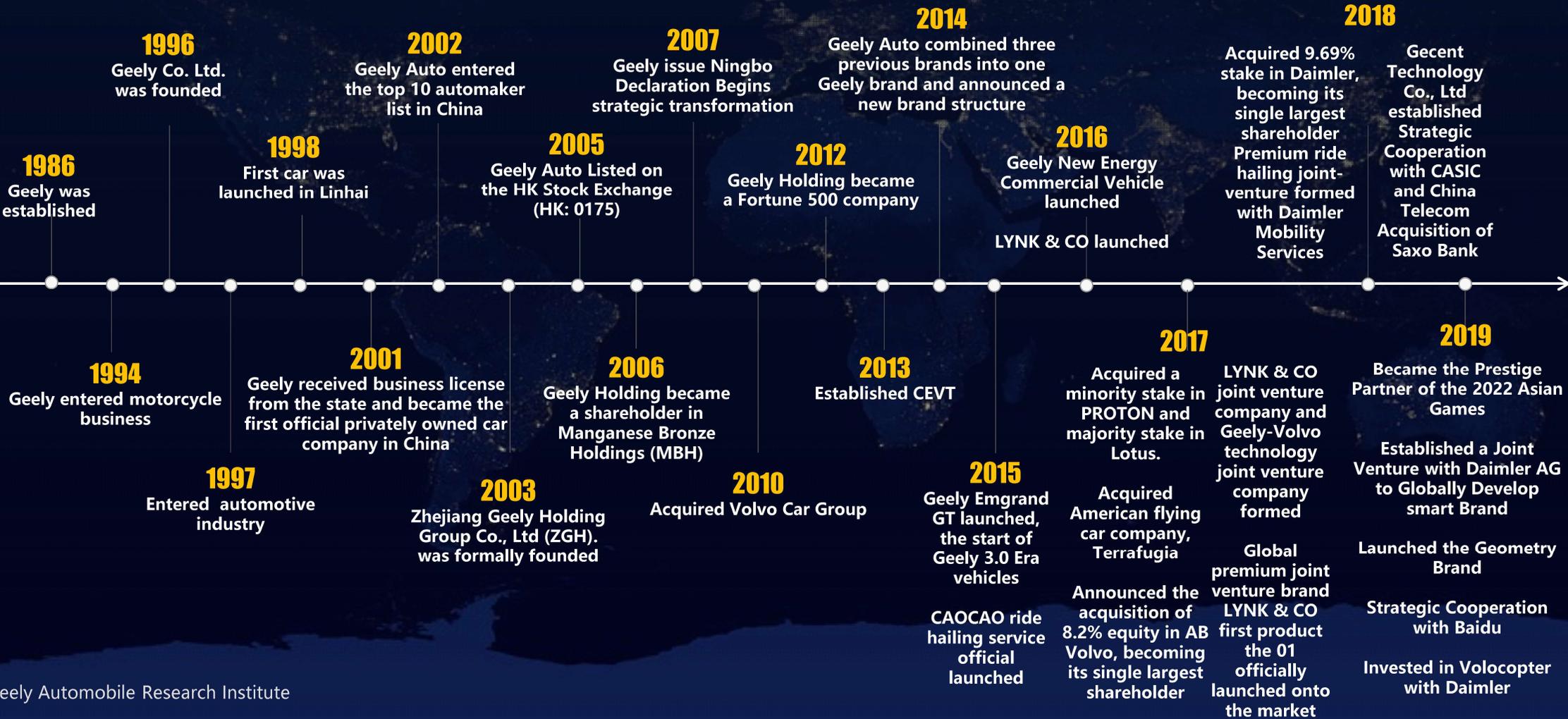
- 1. Geely Group**
- 2. Three steps towards EV acceptance**
- 3. Next step on the Journey?**



01

About Geely

Development History of Geely Group



2020 Strategy of Geely Auto



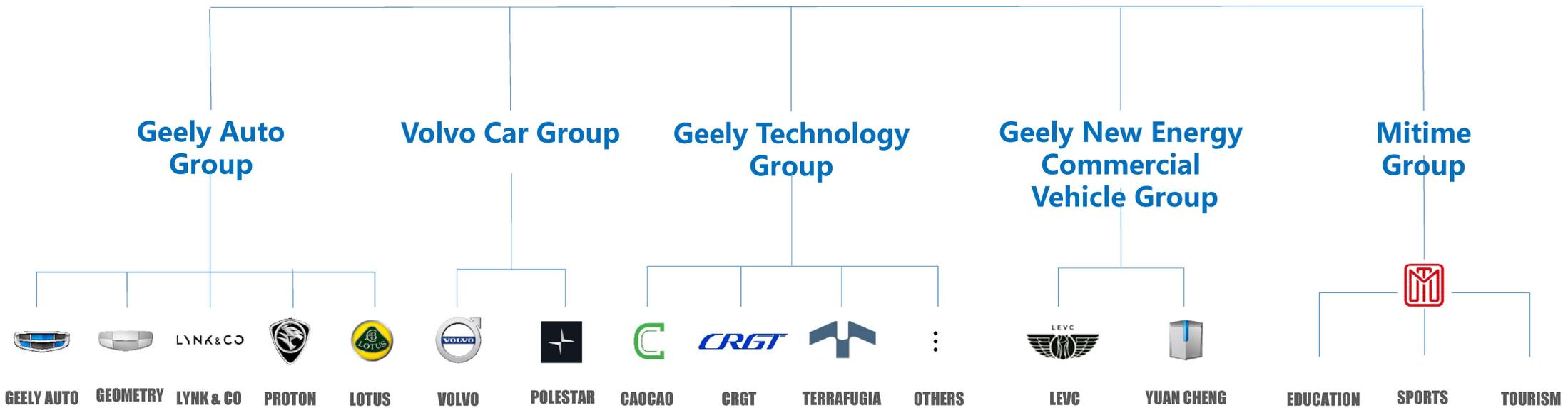
Production and Sales Volume of
2 Million by 2020 |

World **Top10** Automakers |

The Most Competitive and
Respectable Chinese Auto Brand

Group Structure of Geely

GEELY Zhejiang Geely Holding Group



Hot products

> Bo Yue <

The monthly sales of Bo Yue, one of the most popular models in Geely, combines Chinese cultural elements and international fashion trends in appearance and its smart intelligences just like intelligent safety, intelligent driving, intelligent comfort, and intelligent interconnection all lead the new trend of SUV.



> Bin Yue <

Binyue was launched on October 31, 2018. As the first SUV based on the BMA basic module architecture, it's also a global strategic model for young consumers with high-appearance, high-performance and high-intelligence.



> Borui GE <

Borui GE, a new hybrid flagship model of the "Blue Geely Action" strategy, combines Geely's iNTEC technology. GE represents Grand Evolution, Genius Efficient and Geely Elite.



Hot products

> LYNK & CO 01 <

LYNK&CO was built on the CMA (Compact Modular Architecture) which was jointly developed by Geely Auto and Volvo Cars with Volvo Cars in the leading position. 01 is the first vehicle of LYNK&CO, launched on November 28, 2017.



> LYNK & CO 03 <

LYNK&CO 03 was launched in Japan on October 19, 2018, with 6 models 3 styles. It is the first sedan under the CMA architecture. Its speed, power and appearance made it the lead of sport sedans.



> LYNK & CO 02 <

Lynk&Co 02 was launched in Amsterdam on March 26, 2018. It was based on the CMA basic module architecture, positioning high energy SUV coupe. Lync&Co 02 has received more than 10,000 online orders in 11 days since it officially launched its pre-sale at 20:02 on May 20, with an average order of less than 2 minutes.



New Products

Xing Yue

High-order sports SUV
First vehicle of Geely Auto on CMA
Launched in China on May 10, 2019



星越



几何A

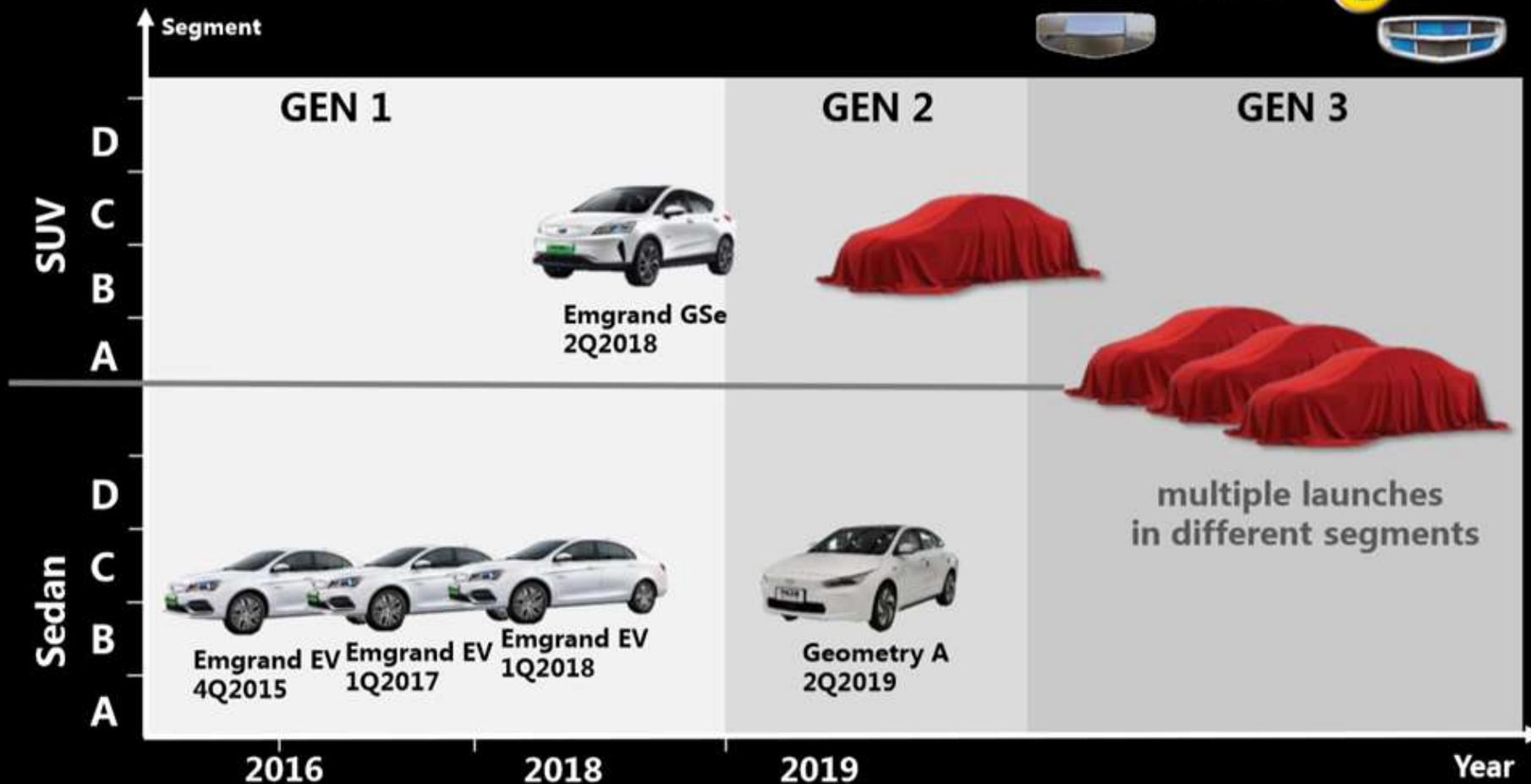
GEOMETRY | A

The best electric car in the Eastern Hemisphere
Launched in Singapore on April 11, 2019
New EV brand of Geely Auto Group

Geely Electric Vehicle introductions

□ GEN 3 represents all new BEV architecture

LYNK & CO



R&D Studios



Hangzhou, China



Ningbo, China



Gothenburg, Sweden



Coventry, UK



FRANKFURT, GERMANY

Over 20,000 researchers

R&D Strategy



Product Platform Strategy

Geely will focus on 5 platforms and launch over 30 new products by 2020.



Safety Strategy

Safety strategy is based on the “people-oriented” concept and intensive study of traffic and accidents, applying “safety identification circle” to provide all-round protection to drivers.



Energy Diversity Strategy

Geely officially released the “Geely Blue Action” on 18 November 2015. NEV is planned to account for over 90% of the total sale by 2020.



Intelligent Technology Strategy

Geely has laid out its technology development route as the core of “Intelligent connectivity” and “intelligent driving”, which will be the core strategy for Geely in the coming decade.

New Energy Power System Geely Intelligent Power Four Technological Pathways

Pure Electric

- Cao Cao has more than several hundred million kilometers of stable operation
- 450Km endurance, up to 500Km by year 2020
- The new generation of pure electric modular architecture

Hybrid

- MHEV
- HEV
- PHEV

Alternative Fuels

- 22% energy consumption
- 74% pollutant reduction
- 73% carbon emission reduction
- 4 methanol power development, 14 methanol cars

Hydrogen Fuel Cell

- Realizing the "0" Emission in the Future
- Realizing the first Mass production Model in 2025



02

Three steps for EV

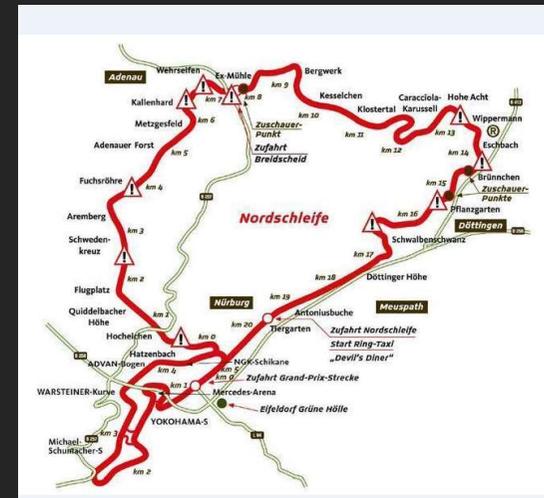
Key aspects to achieve customer acceptance

1. Attributes, performance driving feel etc..
2. Cost of the vehicle, total cost of ownership
3. Convenience of using the vehicle, mainly charging



Key aspects to achieve customer acceptance: Performance

➤ Porsche Taycan enters the sports car market...



Taycan Nurburgring: 7min 42s

Key aspects to achieve customer acceptance: Cost

- **Economy of scale is needed. Pure electric platforms are being established**
 - **Geely PMA**
 - **VW MEB**
 - **....**
- **Component prices are coming down.**
 - **Battery prices have been reduced dramatically**
 - **Integration of power electronics, e-motors and mechanical parts are increasing**
 - **Auxillaries such as Heat pumps, cables, connectors etc..**

Key aspects to achieve customer acceptance: Cost

Example of customer propositions...



KIA KONA EV
150kW/392Nm
39.2kWh/64kWh
Sales in Europe starting @ €34,000



Geely Geometry-A
120kW/250Nm
51.9kWh/61.9kWh
Sales for China Market: €19,500 ~ €24,700



VW ID.3
150kW, 310Nm
45kWh/58kWh/77kWh
Sales starting below €30,000

Key aspects to achieve customer acceptance: Convenience..

Range & Charging..

Premium experience?

- 1. Easy to charge**
- 2. Sufficient range**

Assumption highway driving:

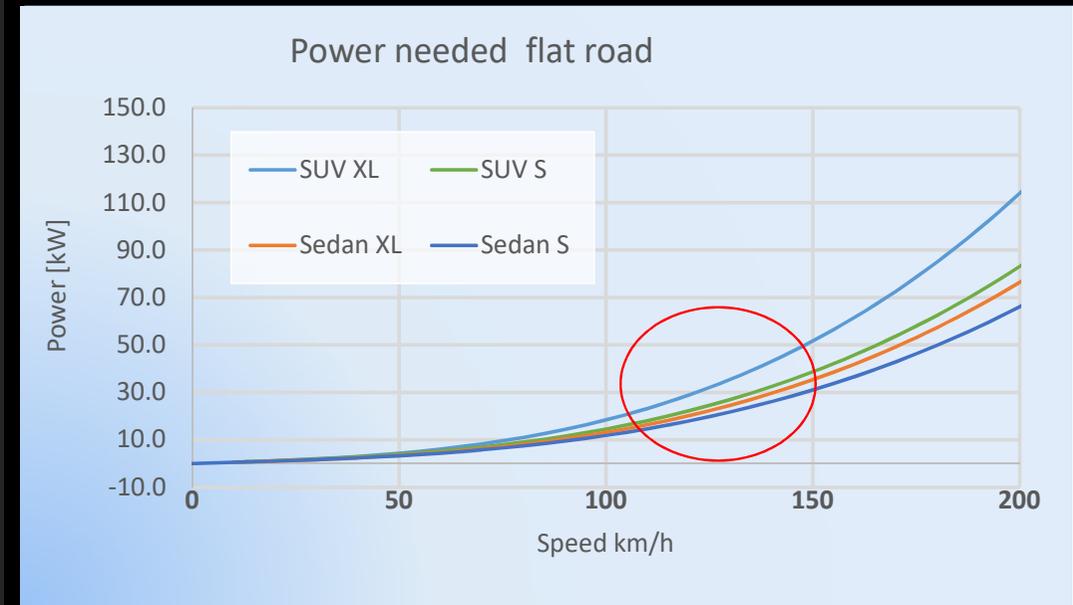
- Drive three – four hours.**
- Recharge during restroom / lunch stop . 20 – 40 min**



Key aspects to achieve customer acceptance: Convenience..

Range, 3-4 hours highway

- Power up to 50kW for high speed large SUV
- 30kW D-size SUV → 100 – 120kWh usable battery energy
- 20 min charging requires average charging power of 300 – 360kW



Key aspects to achieve customer acceptance: Convenience..

Charging 120kWh...

- **High power charging stations capable of 350-400kW**
- **1000V & 500A limitations**
- **Currents limited by cable size**

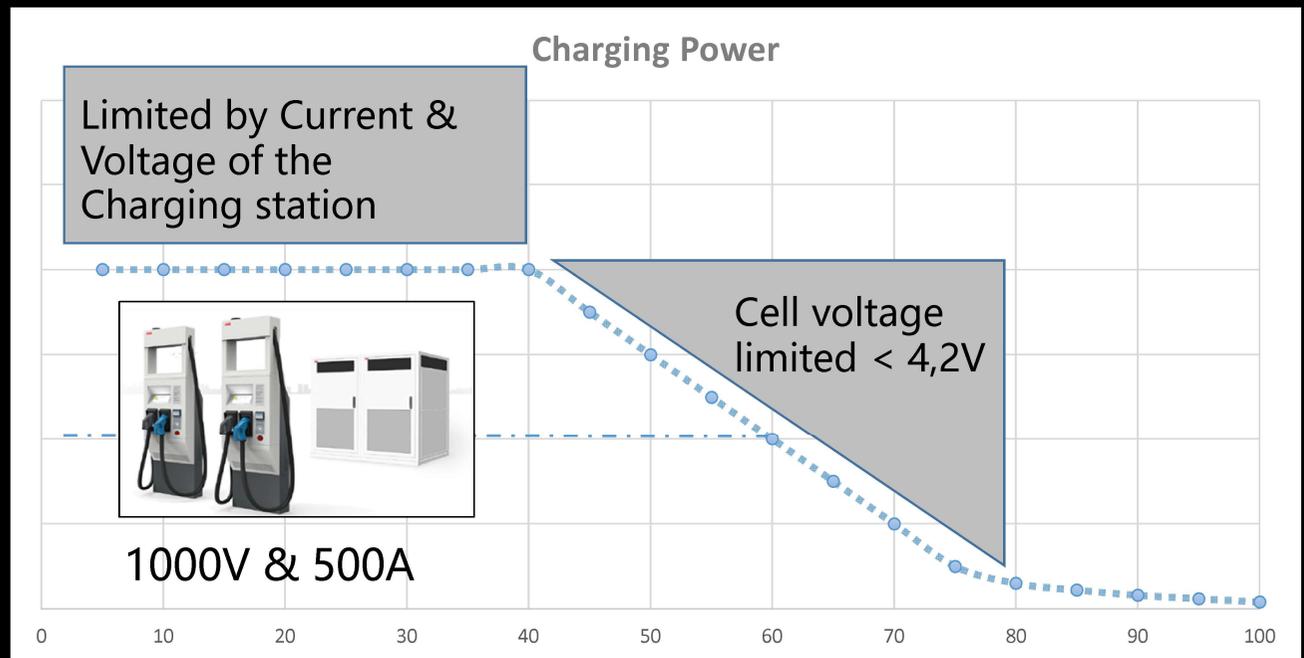


! Power = Voltage x Current

Key aspects to achieve customer acceptance: Convenience..

Charging 120kWh...

- Initial charging limited by current
- Cell damage limit voltage across the cell
- Last part of charging limited as the cell reach maximum voltage
- Due to the low charging during 80-100%SOC it is only realistic that 0-80% charging is considered



Key aspects to achieve customer acceptance: Convenience..

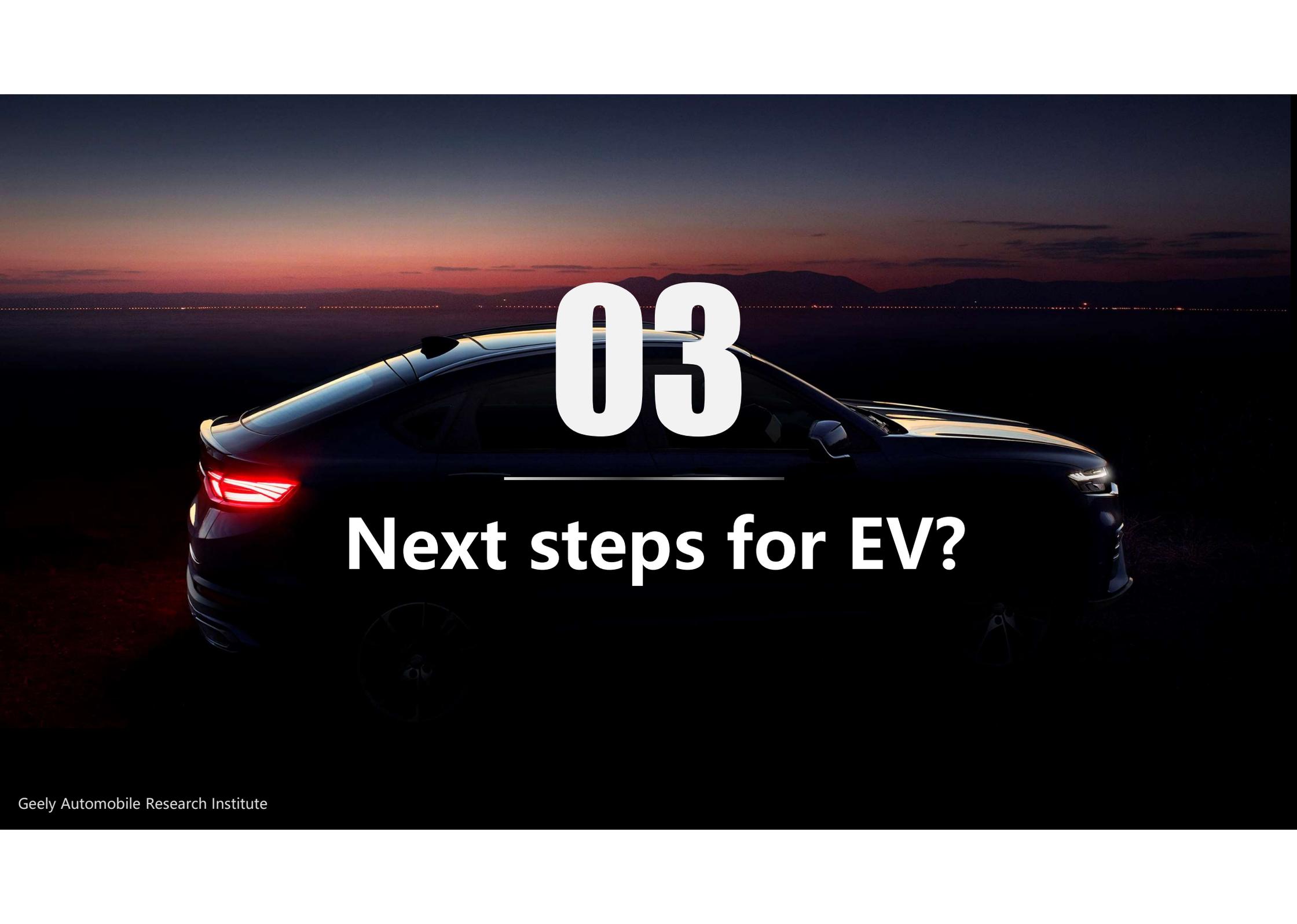
Charging 120kWh...

What do we need to solve?

- **0- 80% can be fast charging!**
- **200-300kW average charging possible ... we need 120kWh??**

Heat losses!

- **Power ... $P = I^2 \times R$... Very high current lead to heating around 20kW with the DCIR we have on batteries today. This is ten times the heater you have in the garage today..**

A dark blue car is shown from a rear three-quarter view at night. The car's rear lights are illuminated, casting a red glow. The background features a sunset or twilight sky with a gradient from orange to dark blue, and distant city lights or lights on a horizon line. The car is positioned in the lower half of the frame, with the text '03' and 'Next steps for EV?' overlaid on it.

03

Next steps for EV?

Key aspects to achieve customer acceptance

- 1. Attributes, performance driving feel etc..** ✓ **OK!**
- 2. Cost of the vehicle** ✓ **OK?**
- 3. Convenience of using the vehicle, mainly charging** ➤ **NOK**
 - **Energy density must increase to allow longer journeys**
 - **We need higher voltage, above 800V for charging larger vehicles**
 - **Even with higher voltage we need lower internal resistance of the battery to deal with heat losses**

A final word on EV market sales...

Per Gillbrandt:

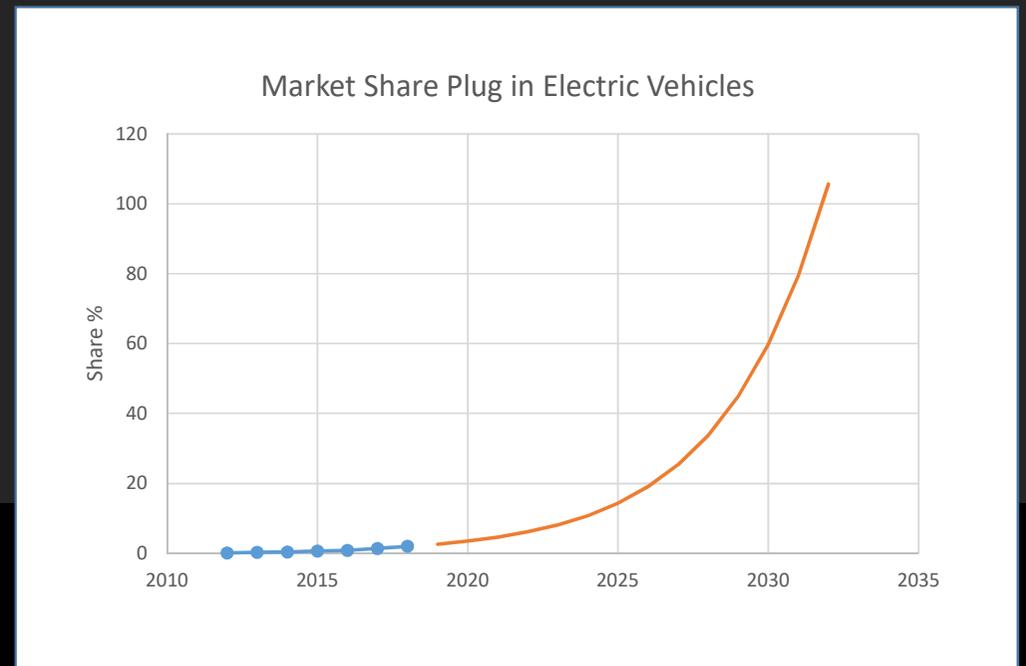
“Den som inte ser bakåt när man ser framåt måste se upp”

“If you don't watch the past when looking into the future you have to watch out”

Therefore...

my prediction of EV growth rate

30% growth per year





GEELY
吉利控股集团

THANKS