Thailand Board of Investment Automotive Online Briefing

LUMEN THAILAND LTD

Lumen Group

- The Lumen Group is headquartered in Australia and we manufacture and supply Automotive components globally.
- Our Markets include OEM's, Motor Sport, Parts & Accessories and the Aftermarket.
- Our customers are global OEM's, Tier 1 and Tier 2's

- Our core product groups include Electrical, Electronic and Plastics components. This includes Lumen Freedom, a new company that is solely focused on the designing and manufacturing Wireless Charging systems for electric vehicle (WEVC)*

Locations

- We have around 700 employees in 8 global locations*

Lumen North America
Engineering, Manufacturing & Sales

Lumen Europe
Engineering, Warehousing, Sales & Graphics

Lumen China
Sales

Lumen Taiwan
Manufacturing & Sales

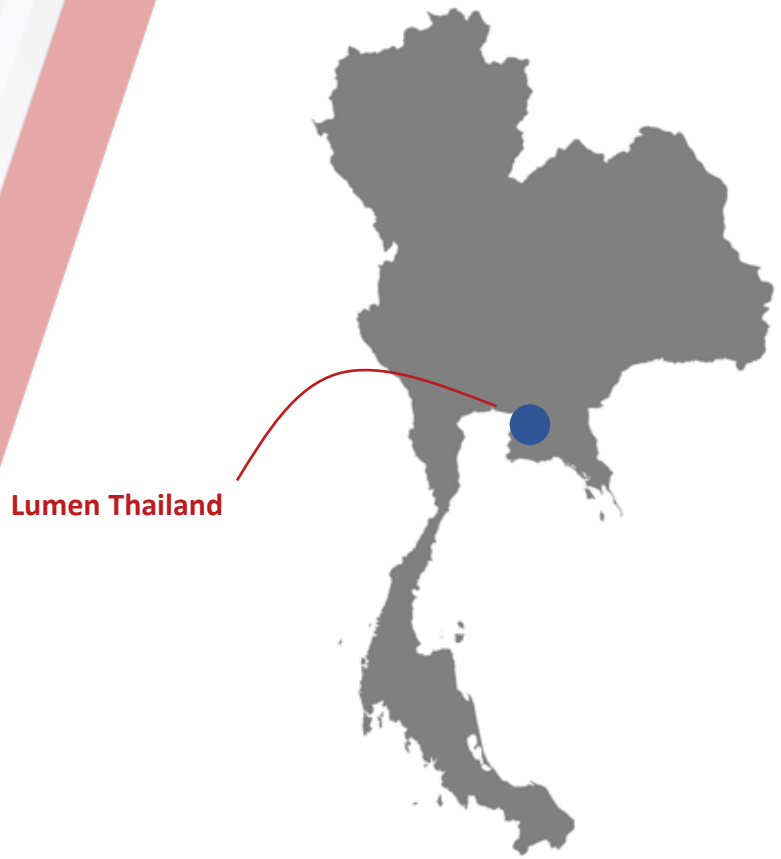
Lumen Thailand
Engineering, Manufacturing & Sales

Lumen New Zealand
Sales

Lumen South Africa
Engineering, Manufacturing & Sales

Lumen Australia & Lumen Freedom
Head Office

Our Location



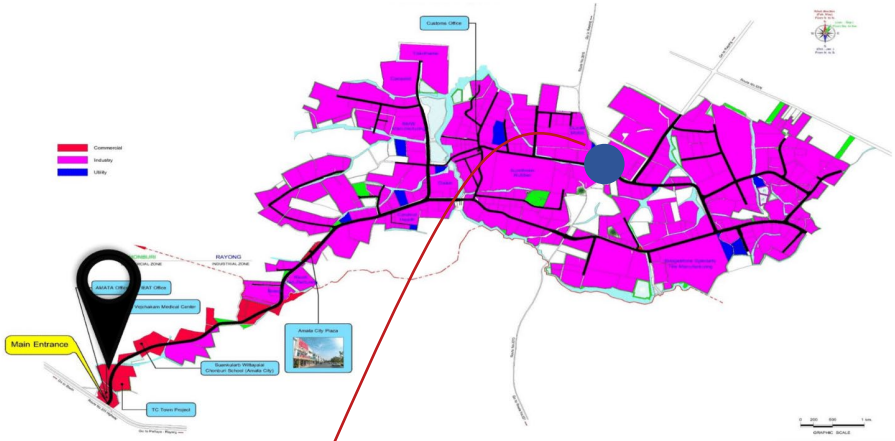
Distances to important locations

AMATA
POSSIBILITIES HAPPEN

distance from AMATA CITY CHONBURI		distance from AMATA CITY RAYONG
57 km	Bangkok (Bangna – Trad Km.1)	114 km
42 km	Suvarnabhumi International Airport	99 km
85 km	Don Muang International Airport	142 km
81 km	U Tapao Airport	42 km
46 km	Laem Chabang Seaport	27 km
96 km	Map Ta Phut Deep Seaport	48 km
67 km	Klong Teoy Port (Bangkok)	120 km
5 km	Chonburi City	52 km
35 km	Sriracha City	29 km
68 km	Pattaya City	36 km
103 km	Rayong City	53 km

AMATA
POSSIBILITIES HAPPEN

Amata City Rayong Master Plan



Lumen Thailand

LUMEN

What we do

Established in 2014 with the help and guidance of BOI*

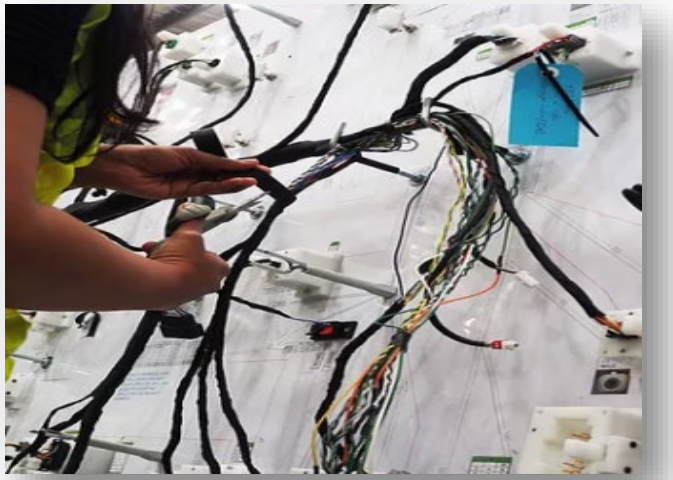
Production Harnesses, Plastic and Electronic Assembly*

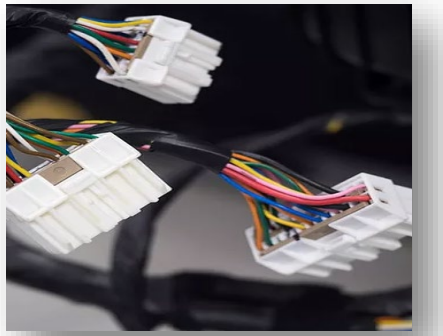
This year we opened our new two storey purpose built facility*

High Voltage Cables and WEVC Production expansion*

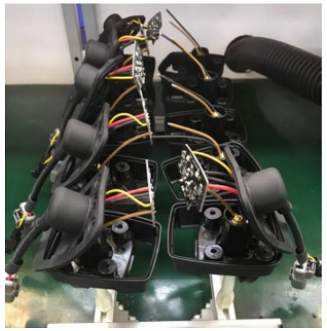
Strategic Manufacturing and Export Hub for Asia, Australia and North America*

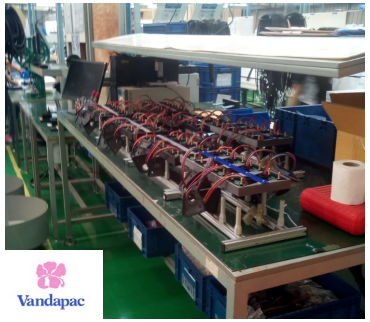
Custom wiring assemblies





Plastic & Electronic Assemblies





Why Thailand

Original Decision to Invest in Thailand

Leading Automotive production base in Southeast Asia enabling increased sales and production opportunities in domestic and export markets

ASEAN member enabling access to the Free Trade Agreements established by AFTA

Developed and Stable Infrastructure enabling Lumen establishment of a global export hub.

Access to a highly skill labor force across many disciplines from Management to Engineering right through the production personnel*

Geographic location situated in the heart of Asia promoting trading opportunities with India and China.

Confidence in the Social, Legal and Financial Systems in Thailand

Why Thailand

Reasons we continue Invest

Investment and growth strategies of Lumen and the Thailand Government EV Policies are aligned. The Policy are heavily focused on EV adoption and production*

IP and Patent protection in Thailand is recognizes and they respects the international rules like the Paris Convention and The Patent Co-operation Treaty*

Skilled and talented engineering pool is allowing us to establish a Research and Development center*

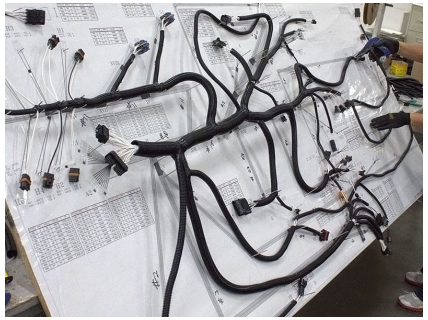
An engaged work force that takes every opportunity and challenge head on.

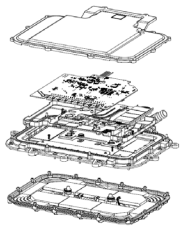
Consistent support from BOI team, both in Sydney and BKK, with application process and any questions Lumen has had along the way.

BOI Applications & Expansion Plan

Current facility production

Lumen Thailand
Wiring Harness
Electronic Assembly
Established 2014

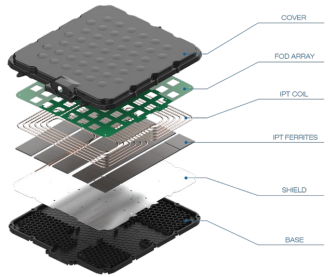


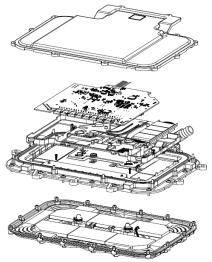


Stage 1
WEVC R&D Centre
WEVC Assembly

Stage 2
EV High Voltage Harness Production

Stage 3
SMT Automotive Electronics
SMT WEVC Electronics





Stage 4
WEVC Production
WEVC Assembly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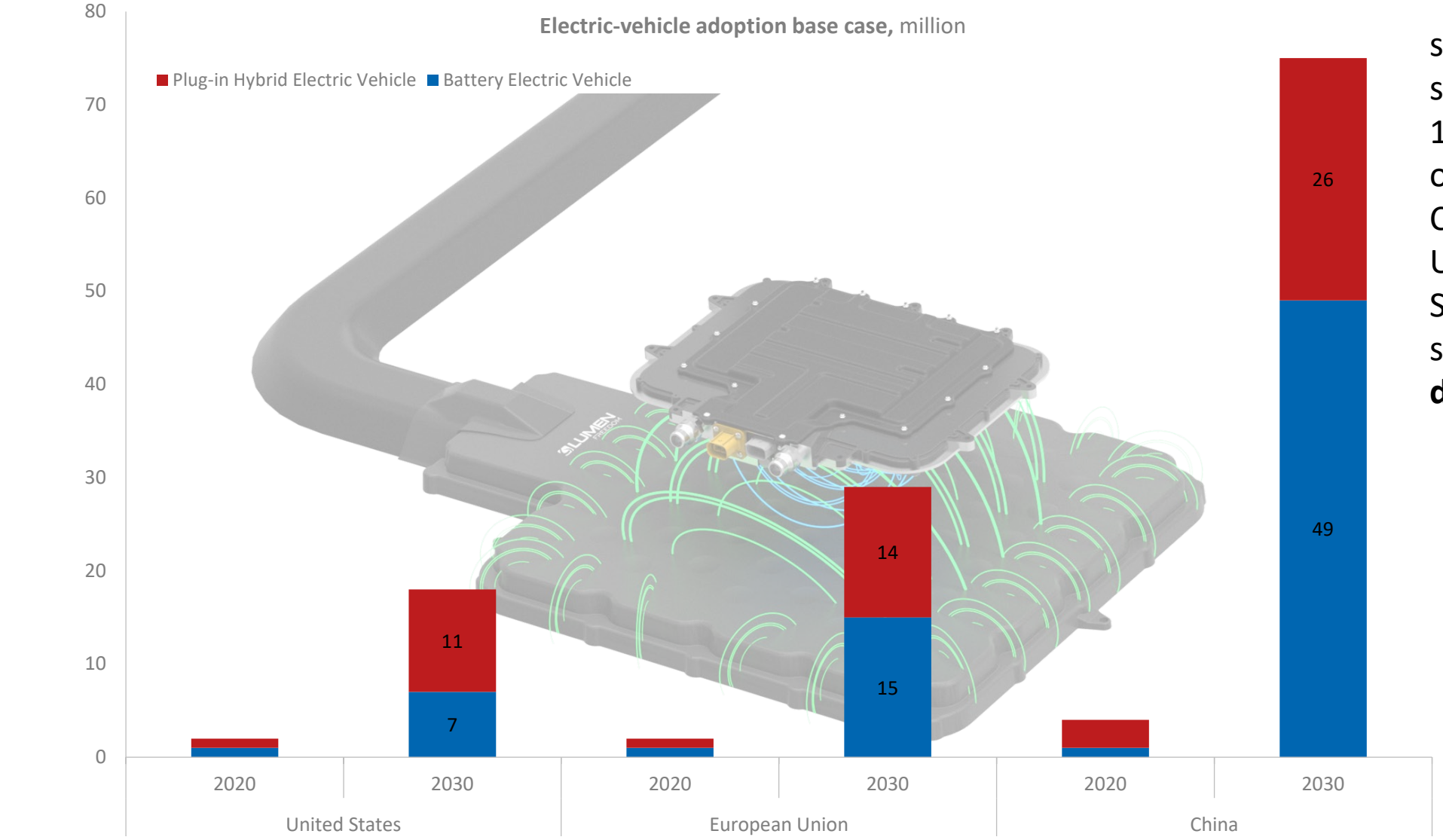
STOP


LUMEN
FREEDOM
Leading the Charge...
THAILAND
BOARD OF
INVESTMENT
Online Briefing Automotive Industry – 29 July 2021
The rise of EV technology: the Automotive Industry transition to a zero-emission future

Increasing Adoption of EVs

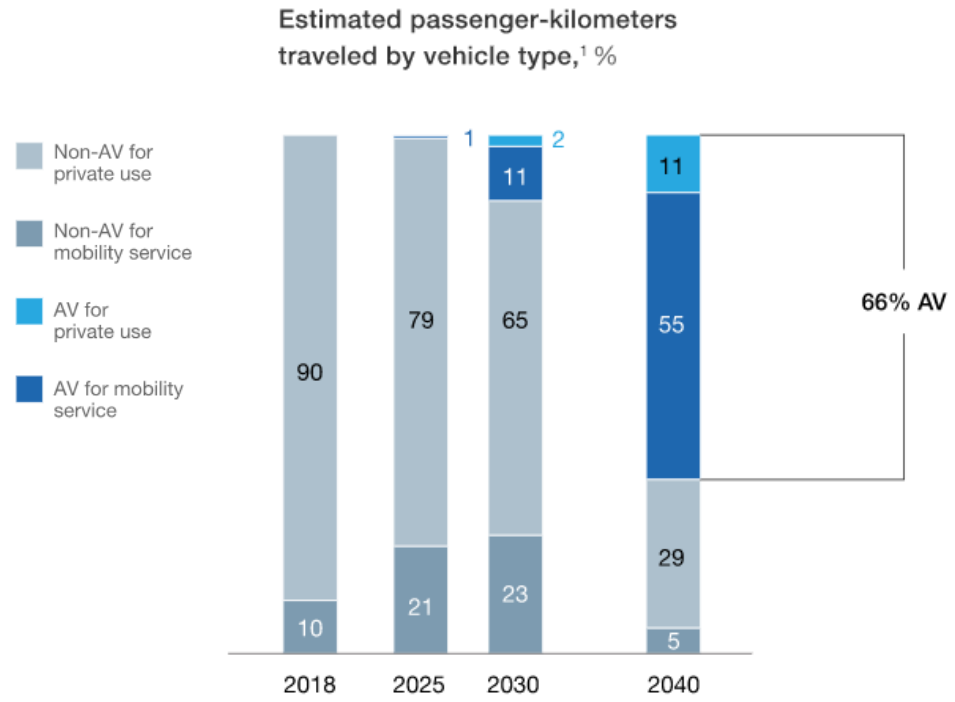


"McKinsey's base-case scenario for EV adoption suggests approximately 120 million EVs could be on the road by 2030 in China, the European Union, and the United States. The aggressive-case scenario could see that **double**."

Source: McKinsey&Company

The Driverless Revolution

Autonomous vehicles (AV) will travel about 66 percent of total passenger-kilometers in 2040.

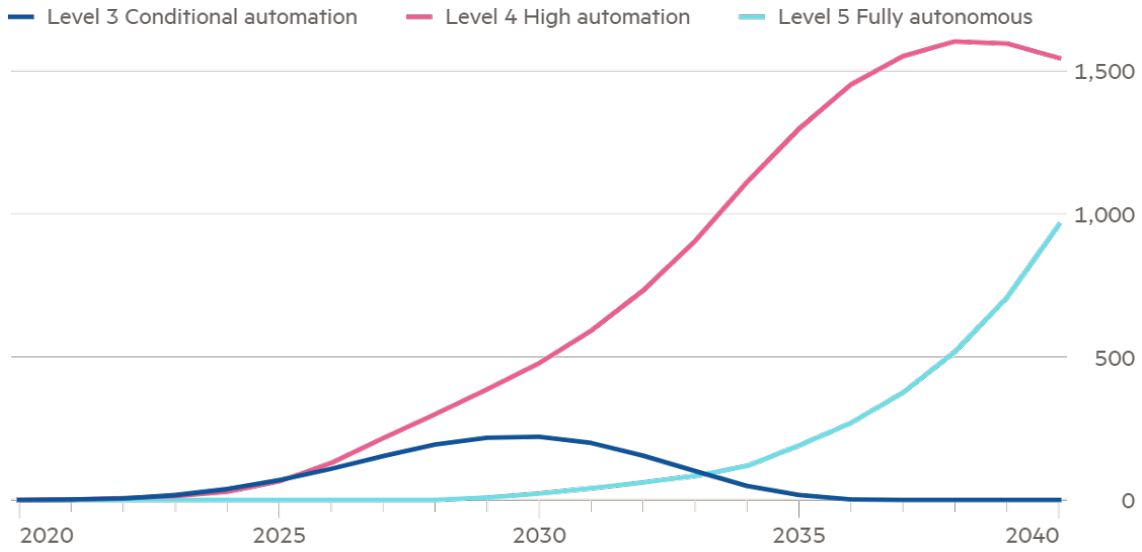


[1]Baseline scenario.
[2]Figures may not sum, because of rounding.

Source: McKinsey&Company

Projected value of the driverless market

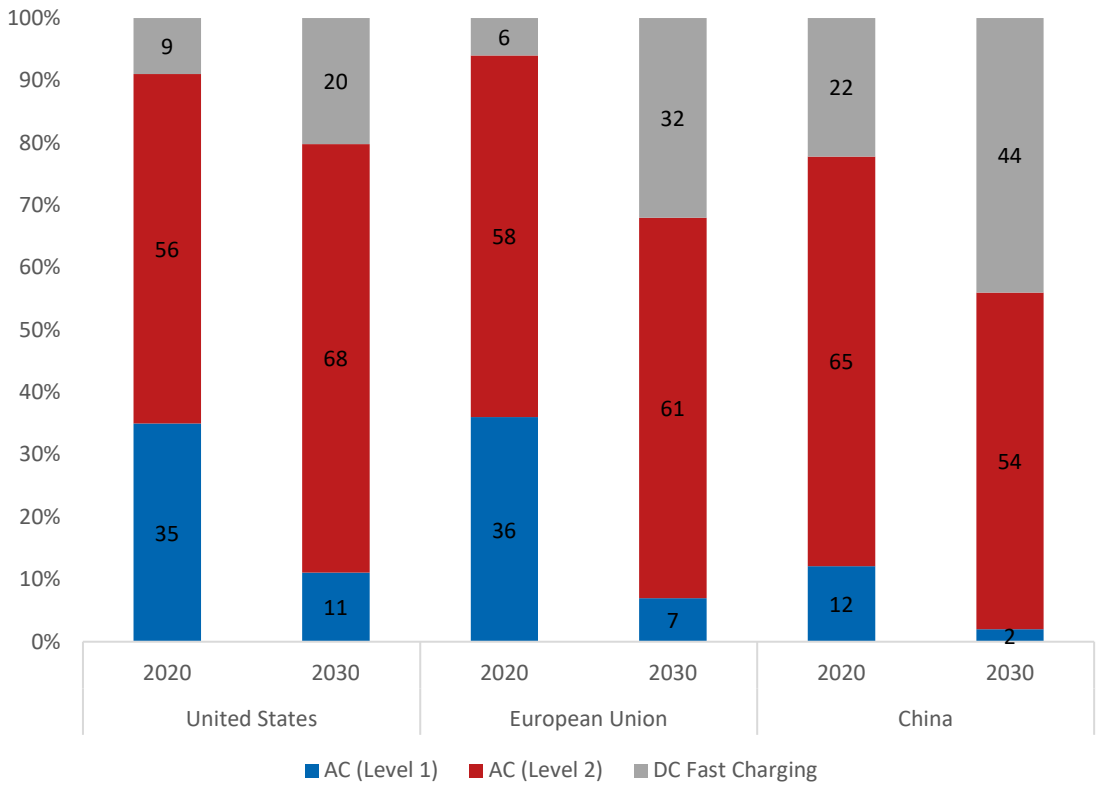
Worldwide autonomous car and robotaxi market ($bn)



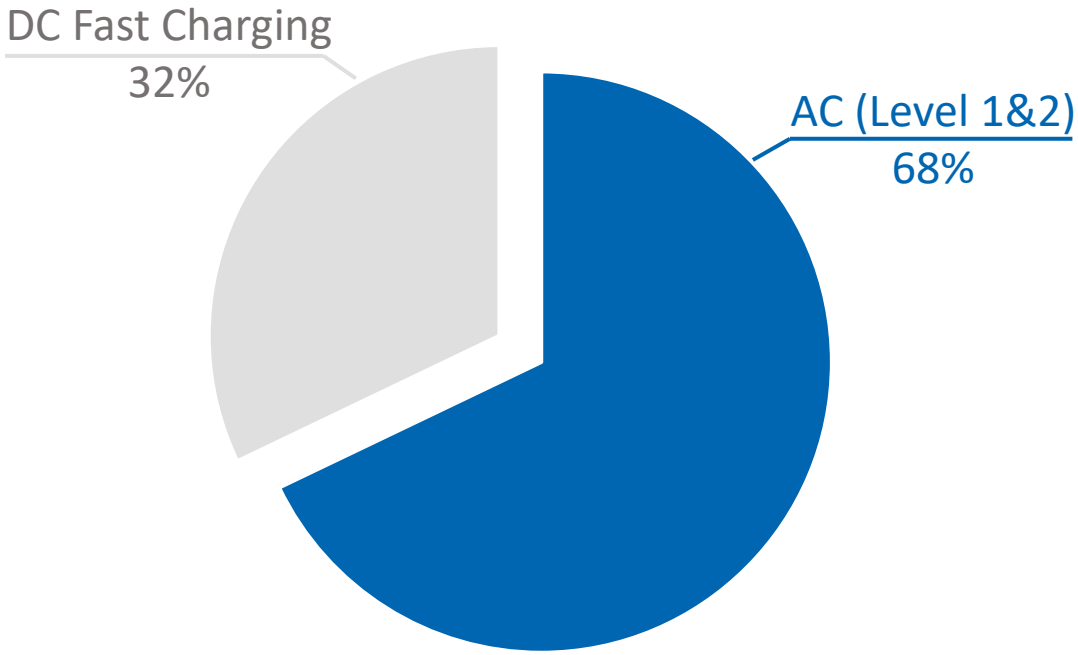
Source: IDTechEx

Charger Demand

Energy demand by charging technology,
% of kWh, home-centred scenario



Level 1 and Level 2 charging will likely remain the dominant source of charging energy demand



- AC level 1 & 2 power will remain the dominant charging technology through 2030 – mostly taking place at homes, workplaces.
- DCFC will likely play a much larger role in China, which requires more public-charging infrastructure.

Source: McKinsey&Company

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"Simply park and charge without the need for plug-in cables or adaptors."

Overview of Societal Trends Driving Adoption of EVs

Global urbanisation

Mega cities are forecast to grow from 10 today to **40 by 2030**

(Urban Mobility report, CEBR 2017)

Infrastructure strain

As cities grow there is huge pressure on **public** and **private** transport **infrastructure**

Health costs

Urban outdoor air pollution causes **1.3m deaths** worldwide per year

(World Health Organisation estimate)

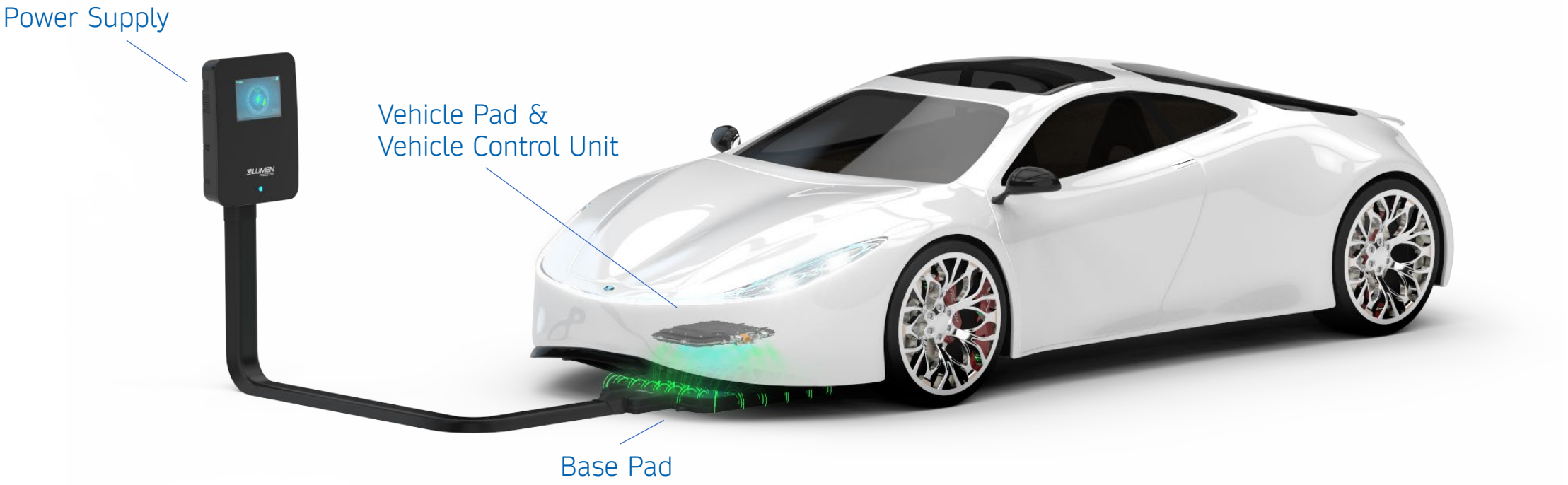
Air pollution

Legislation and **fines** for pollution continue to evolve

(Environment Protection Agency, EC)

LUMEN FREEDOM

Wireless Charging System Elements



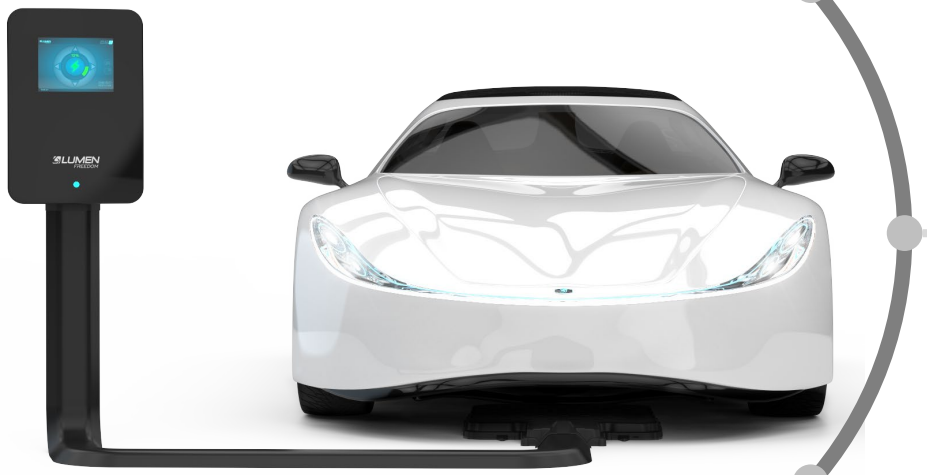
Ground Assembly – Power Supply & Base Pad

- Power supply is single or three phase AC input
- Generates high frequency AC current in the base pad
- Current magnitude is controllable

Vehicle Assembly – Vehicle Pad & Vehicle Control Unit

- Receives power from base pad
- Rectifies AC to DC
- Performs system controls
- Interfaces with car electronics

Technical Benefits



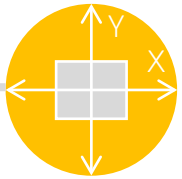
EFFICIENT

Power transfer is as efficient as a tethered charging system; >90% end-to-end efficiency

CONVENIENT

From parking to charging is simple, effortless & convenient process - perfect for autonomous vehicles

TOLERANT OF MISALIGNMENT



There is no need to have the coils perfectly aligned – the system accommodates the most inaccurate of parkers

INCONSPICUOUS

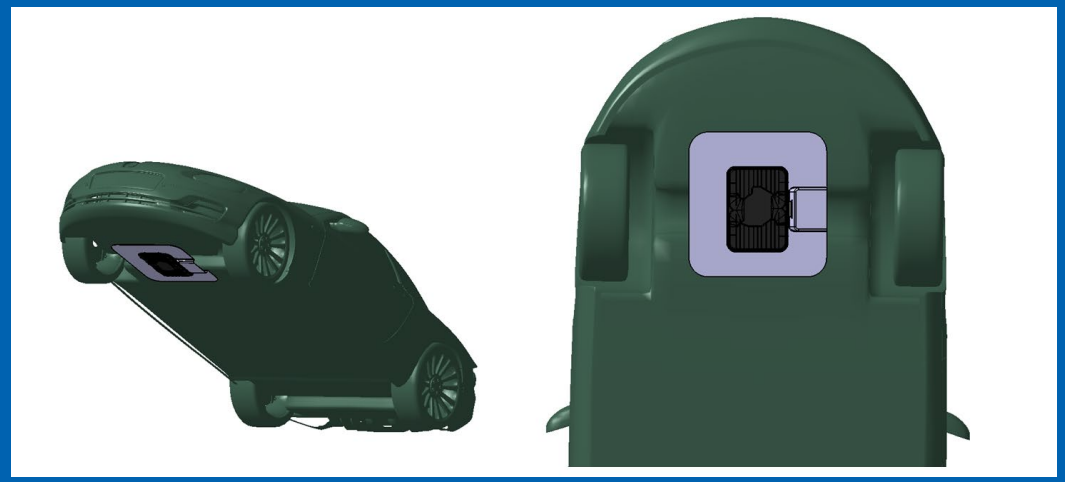
The system can transfer power even when the ground assembly is submerged beneath asphalt & concrete – snow & ice present no problems

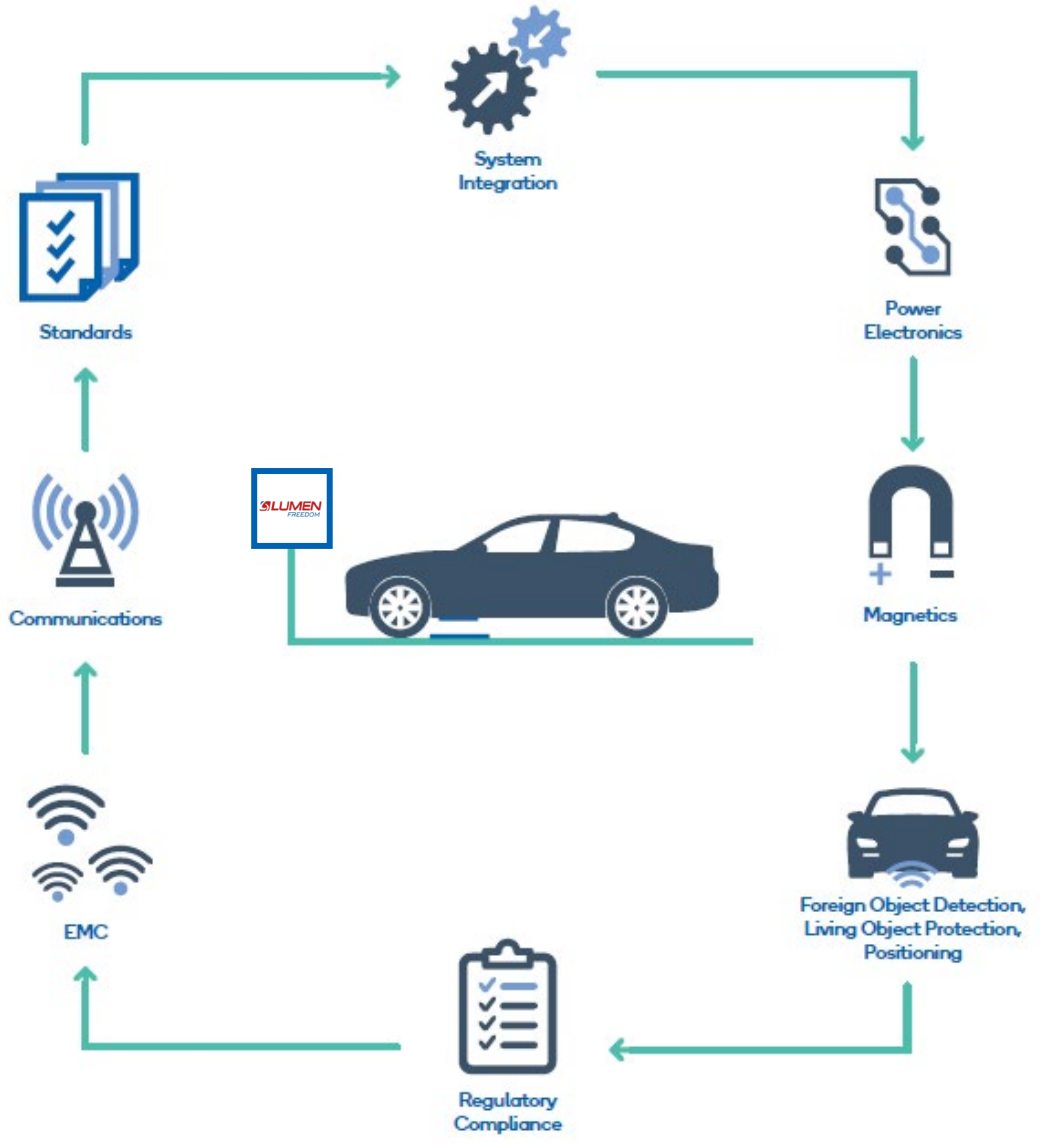
SEMI-DYNAMIC & DYNAMIC

Charging whilst on the move removes the fear associated with range anxiety on long journeys, allowing seamless relaxed travelling

Design Approach

Lumen Freedom's ongoing collaboration with automotive partners allows fit-for-purpose, relevant technology. Lumen Freedom's complete engineering approach covers system design, testing and simulation, along with vehicle integration.





Technology Roadmap

Dynamic Wireless Charging

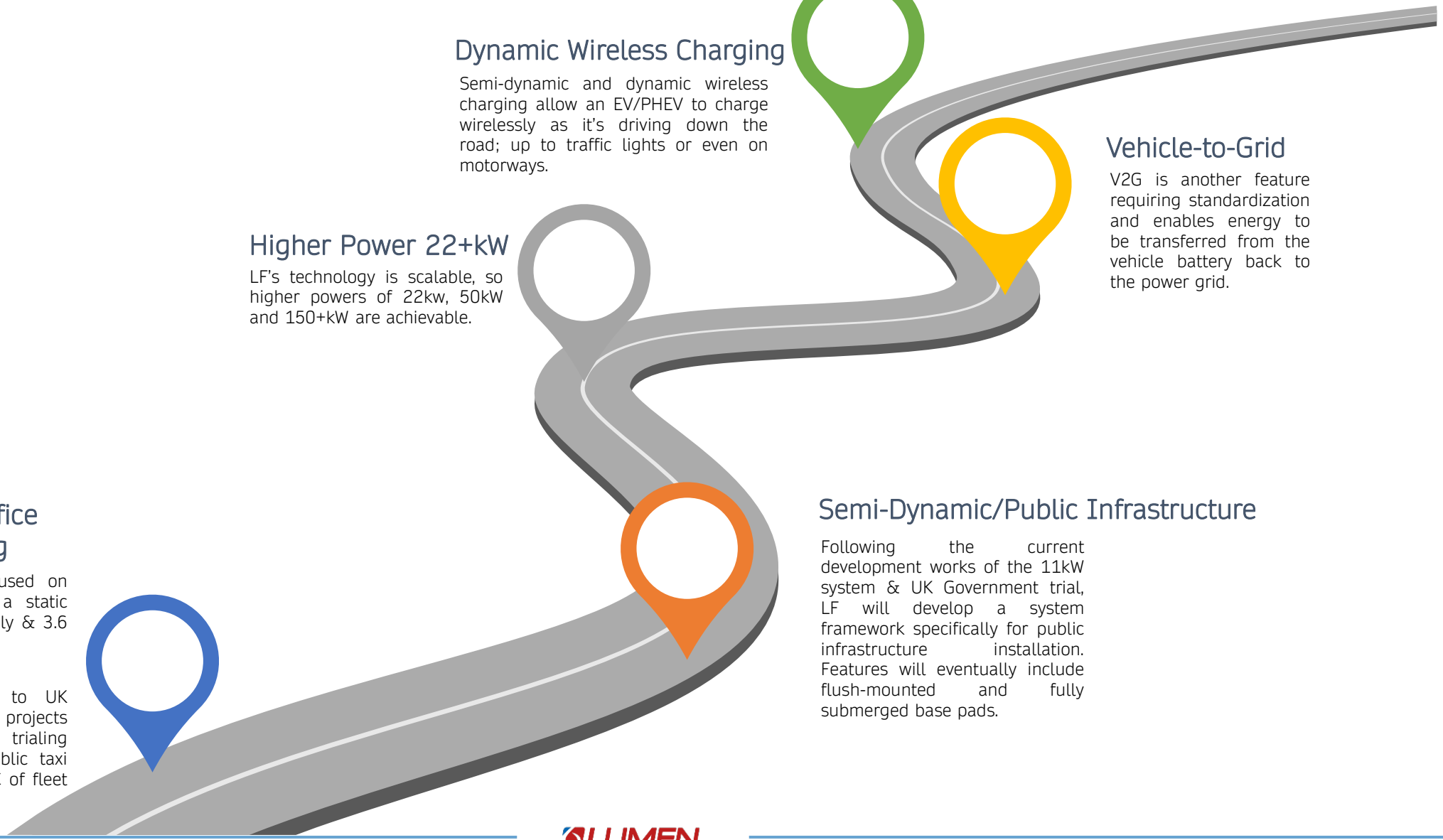
Semi-dynamic and dynamic wireless charging allow an EV/PHEV to charge wirelessly as it's driving down the road; up to traffic lights or even on motorways.

Vehicle-to-Grid

V2G is another feature requiring standardization and enables energy to be transferred from the vehicle battery back to the power grid.

Higher Power 22+kW

LF's technology is scalable, so higher powers of 22kw, 50kW and 150+kW are achievable.



11kW WEVC – Residential/Office Static Charging

LF are currently focused on the development of a static 11kW Ground Assembly & 3.6 to 11kW Vehicle Pads.

LF are a supplier to UK Government funded projects (WiCET & AMiCc) trialing 11kW WEVC at a public taxi rank, and 11kW WEVC of fleet commercial vehicles.

Semi-Dynamic/Public Infrastructure

Following the current development works of the 11kW system & UK Government trial, LF will develop a system framework specifically for public infrastructure installation. Features will eventually include flush-mounted and fully submerged base pads.

Technology Roadmap

Lumen Freedom WEVC technology supports semi-dynamic charging, for applications such as taxi ranks, to dynamic charging - charging lanes on a motorway.

Wireless charging is crucial for autonomous vehicles in the future...

There are two paths for such vehicles:

(i) At the end of a journey or busy period, they will go to a home/depot to be charged – where static wireless charging will be crucial.

(ii) They're constantly on the move, picking up people from various points – where a road network with semi-dynamic and dynamic charging capability will be crucial.

In either instance, autonomous vehicles should not have to be physically plugged in...


SEMI-DYNAMIC CHARGING
STATIC CHARGING
SEMI-DYNAMIC CHARGING
STATIC CHARGING
DYNAMIC CHARGING
Share Ride
LUMEN FREEDOM
Share Ride
ECO
DRIVE THRU
LUMEN
WIRELESS CHARGING AREA
Sub - Station
Imagine the Future

Leading the Charge...

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