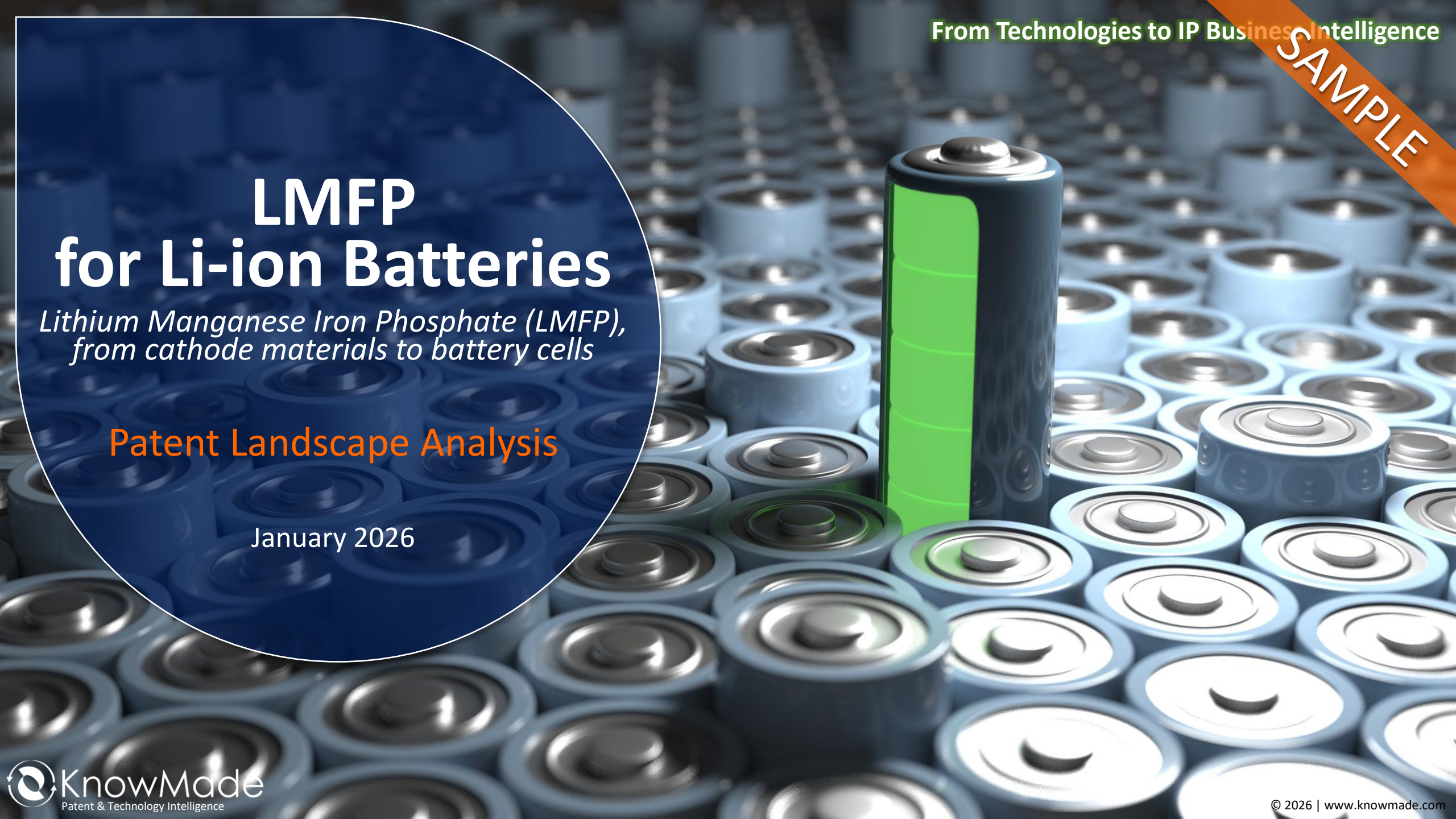
LMFP for Li-ion Batteries

Lithium Manganese Iron Phosphate (LMFP), from cathode materials to battery cells

Patent Landscape Analysis

January 2026



KnowMade
Patent & Technology Intelligence

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ONE-HOUR PRESENTATION

The author of the report is available to address any questions you may have.

A **one-hour online presentation** of the report is included with your purchase. This session offers the opportunity for a direct interaction with the author, including a presentation of the results and a dedicated Q&A session.

Feel free to contact the author to schedule a meeting.

Contact us

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MAIN PATENT ASSIGNEES MENTIONED IN THE REPORT

INDUSTRIALS

CATL, LG Chem/LG Energy Solutions, Samsung, Dynanonic, BYD, EVE Energy, Murata/Sony, ATL, Guoxuan High Tech Power Energy/Gotion, SVOLT, Toyota, Taiheiyo Cement, Toshiba, Sumitomo Chemical/Tanaka Chemical, Tinci Materials Technology, Envision/AESC, Global Graphene, COSMX/COSLIGHT, Sumitomo Metal Mining, Sunwoda, General Motors, Rongbay Technology, HydroQuébec, Reliance New Energy/Lithium Werks, Epsilon Carbon/Johnson Matthey, and more.

R&D LABORATORIES

SEL, Kyushu University, AIST, Tokyo Metropolotan University, Central South University, Institute of Physics, Tsinghua University, Beijing Institute of Technology, Hanyang University, UNIST, KAIST, RIST, KERI, CEA, CNRS, Fraunhofer, Université de Montréal, University of Chicago, University of Michigan, Lockheed Martin/UT-Battelle, and more.

INTRODUCTION

Key information on LMFP

Lithium Manganese Iron Phosphate (LMFP) is a promising emerging cathode material for lithium-ion batteries. Derived from LFP, it retains key advantages (structural stability, safety, low cost, relatively good cycle life) while offering a 10–20% higher energy density thanks to manganese substitution. LMFP still faces challenges such as low electronic conductivity, slow lithium-ion diffusion, and performance degradation linked to Mn^{3+}. Current research focuses on chemo-physical modifications to overcome these limitations and enable large-scale commercialization. **LMFP** developments are mainly led by major Chinese battery manufacturers, with new North American companies also advancing LMFP technology for EV and ESS applications.

Strength

- **Higher energy density than LFP**
- Lower cost per kWh than NMC
- **Abundance and low cost of Mn**
- Higher voltage
- Better low temperature performance than LFP
- High thermal stability and safety
- High voltage platform
- Leverage existing LFP manufacturing processes and infrastructure

Weakness

- Reduced calendar and cycle life compared to LFP, due to the Jahn-Teller distortion of Mn and metal dissolution into electrolyte.
- **Poor electrical conductivity lithium-ion diffusion**
- Like LFP, SOC estimation is challenging
- Dual voltage plateau worsens cell consistency, causing mileage data fluctuations in BMS
- Limited compaction at cathode electrode level

Opportunity

- **Mid-to-Long Range EVs**
- Heavy-duty vehicles (trucks and buses)
- Blend cathode with NCM for high-voltage batteries
- Potential to replace LFP in EV applications
- Improvements similar to LFP

Threat

- Lack of industry standardization causes product inconsistencies
- Scaling challenges
- Advanced modifications required for LMFP increase process complexity
- **Underdeveloped supply chain**
- Supply Chain geographically concentrated in China especially for Mn precursor

Research focus

- Improve electrical conductivity, lithium-ion diffusion and stability (overcome JanT distortion and metal dissolution) thanks to:
  - Nanostructuring and morphology control (nanosizing, spherical/microspheres, nanorods, nanoplates, crystal orientation control)
  - Surface coating (carbon and/or non-carbon materials (ion-conductive materials, metal oxides/phosphates, other cathode materials)
  - Ion-doping at Li site (Na, K, Mg)
  - Ion-doping ant Mn/Fe site (Mg, Y, V, Co, Ni, Cr, Zn, Nb)
  - Anionic doping (B, P, F)
  - Composition and structure design (gradient surface layer).
- Develop green synthesis routes (Hydrothermal, Solvent-free mechanochemical, Direct regeneration recycling, Microwave-assisted synthesis, etc.)

INTRODUCTION

Comparison of battery performances in function of their technologies

Performance Metrics for Key Battery Chemistries	Lithium Ion								Sodium ion	Lithium Metal	Solid State	Lithium Sulfur
Cathode / Anode	High Voltage LCO / Gr	NMC / Gr	NCA / Gr	LFP / Gr	LMFP / Gr	LMO / Gr	High Voltage LNMO / Gr	High Ni / Majority Silicon	NaMOx / Hard Carbon	High Ni / Lithium Metal	High Ni / Lithium Metal	Sulfur / Lithium Metal
Gravimetric Energy Density Wh/kg (cell level)	180-200	250-300	250-280	160-205	190-230	100-150	150-165	325-350	130-160	400-450	300-450	300-500
Volumetric Energy Density Wh/L (cell level)	400-700	650-800	600-750	250-400	400-580	300-400	400-650	750-1000 +	150-300	700-1000	700-900	450-650
Cycle Life (C/2+ rate) (>80%)	750	1500	1000	3000	2000	500	750	500	6000	400	500	300
Calender aging (Qual)	Avg	Avg	Avg	Good	Avg	Low	Poor	Low	Avg	Avg	-	Avg
Self Discharge (%/Month)	1.00%	0.25%	2.50%	0.50%	1.00%	2.00%	-	5.00%	0.20%	-	-	1.00%
Charge Rate Capability (Qual)	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Good	Avg	Low	Low	Avg
Discharge Rate Capability (Qual)	Good	Avg	Avg	Avg	Avg	Good	Avg	Good	**Avg	Avg	Avg	Avg
Safety (Active Materials)	Avg	Low	Low	Avg	Avg	Avg	Low	Low	Good	Poor	**Poor	**Avg
Possible Form Factors and Challenges	No Issue	No Issue	No Issue	No Issue	No Issue	No Issue	No Issue	*High Swelling*	No Issue	handling issues	Manufacturing Challenges	No Issue
Nominal Voltage (V) Voltage Range (V)	3.6 (3.0 - 4.5)	3.7 (2.5 - 4.3)	3.6 (3.0-4.3)	3.2 (2.5 - 3.65)	3.7 (2.75 - 4.0)	3.8 (3 - 4.3)	4.7 (3.0 - 5.0)	3.5 (2.5 - 4.2)	3.1-3.7 (1.5 - 4.2)	3.7 (2.5 - 4.2)	3.7 (2.5 - 4.2)	2.1 (1.5 - 3)
Cathode Specific Capacity (mAh/g)	274	215	200	170	160	148	147	215	170	215	215	1675
High Temperature Operation (60C+)(Qual)	Low	Avg	Low	Good	Good	Low	Low	Avg	Good	Low	**Low	Good
Low Temperature Operation (10C-)(Qual)	Poor	Good	Good	Poor	Avg	Avg	Avg	Good	Poor	Low	**Low	Poor
Recycle Value (Li, Co, Ni, Cu) for Cost/Effort	Good	Avg	Avg	Low	Low	Low	Avg	Avg	Poor	**Avg	**Avg	Low

Best 5
Good 4
Avg 3
Low 2
Poor 1

* Cell design and components other than the cathode can make a very large difference in cell performance metrics
* Marker [-] indicates no spec sheet available to make judgement.
Ratings marked with "**"are based on published data but have no commercial cells
For more details and sources, please visit: Battery Talk: Battery Application Break Down 1/01/2025 (Version 3.0)

BATTERY REPORT 2024 VF VOLTA FOUNDATION

INTRODUCTION

LMFP Manufacturing processes (1/2)

The synthesis of Lithium Manganese Iron Phosphate cathode materials generally relies on two broad categories: **solid-phase methods and liquid-phase methods**. These methods are often combined with necessary high-temperature sintering or carbon coating steps to optimize the material's performance

Process	Description	Advantages	Challenges
Solid-Phase synthesis (SSS)	The solid-phase method involves the direct mixing of solid precursors (containing lithium, iron, manganese, and phosphorus) followed by high-temperature calcination. Mixing methods are mainly planetary ball milling or spray drying. Calcination is usually a two-step heating process: first, pre-sintering (300–500 °C) to decompose organic material, followed by sintering at elevated temperatures (600–850 °C) to enhance crystallization and promote olivine-type crystal growth.	Most mature, simplest, and most suitable process for large-scale industrial production due to its relative simplicity and high yield	The process is limited by diffusion kinetics, requires high temperatures and long processing times, which can lead to particle aggregation and non-uniform particle size distribution.
Hydrothermal and Solvothermal Methods	These methods conduct chemical reactions in a closed system under high temperature and pressure conditions, with the solvent being water (hydrothermal) or an organic solvent (solvothermal). Raw materials are dissolved in the solvent and held in a high-pressure reactor to complete the chemical reaction.	The hydrothermal method is a viable commercial route for olivine production. It offers control over material morphology, nanoscale particle size, Fe/Mn repartition and crystal structure. It typically requires lower reaction temperatures and less energy consumption compared to SSS.	Requires specialized equipment (autoclaves) capable of withstanding high pressures, which complicates industrial scale-up. Post-treatment may be necessary due to atomic misalignments.
Co-precipitation	This method achieves mixing at the atomic level by simultaneously precipitating metal ions (Mn^{2+}, Fe^{2+}, PO_4^{3-}) from a solution by adjusting the pH and other conditions. The precursor mixture is precipitated, separated, washed, and then subjected to calcination. It can be combined with spray drying and high-temperature sintering.	Uses inexpensive and available raw materials. The process is relatively simple and suitable for industrial application.	Difficult to control the crystallization process and requires ensuring a homogeneous distribution of Mn and Fe to avoid phase separation
Sol-gel	The sol-gel method involves hydrolyzing and condensing metal alkoxides or inorganic metal salts in a liquid phase to form a sol-gel system, followed by drying and high-temperature treatment. A sol-gel system is formed, then slowly polymerized into a 3D spatial network structure (gel), dried to obtain a gel-like precursor, and finally subjected to high-temperature treatment to get the final product.	Facilitates the uniform introduction of multiple metal ions. The resulting materials typically have a high specific surface area, uniform crystal size, and high purity. It allows for controllable particle size (~100 nm) and is suitable for forming thin films and coatings.	The process is complex, involves lengthy drying and processing cycles, and uses expensive raw materials, making it generally unsuitable for industrial mass production. Poor reproducibility can occur.

INTRODUCTION

LMFP Manufacturing processes (2/2)

Process	Description	Advantages	Challenges
Molten-State Synthesis (MSS)	This method involves the synthesis of the material in a molten state. MSS is used for the dry preparation of LMFP. The process involves melting precursors, which may be followed by grinding (milling) of the resulting ingot.	Recognized for its potential in large-scale production of olivine materials via molten ingot synthesis.	A major drawback is its high energy consumption and the requirement for a long grinding process of the prepared ingot.
Mechano chemical Method	Involves mixing precursors via high-energy mechanical activation, sometimes combined with sintering steps	A widely studied approach. Enables the production of nanoparticles, often leading to uniform structures. Mechanochemical activation followed by calcination can yield materials with excellent cycle performance.	The properties of the resulting LMFP can show variations depending on whether mechanochemical or solvothermal methods were used.
Temperature-Programmed Calcination	A simple, specific solid-state strategy developed to in-situ synthesize (M-LMFP) materials with innovative carbon coating and phase doping structures (Fe2P and amorphous Li4P2O7). It relies only on the carbon and Fe-containing components derived directly from the raw materials to form beneficial secondary phases.	This method achieves surface modifications without introducing additional reducing gases or cumbersome processes. It is an extremely scalable strategy for large-scale production.	An imbalance in the ratio of the generated doping phases (Fe2P and amorphous Li4P2O7) can be detrimental to cycling stability, potentially hindering Li + transport due to chemical inhomogeneity
Ionothermal Processes	The synthesis involves multiple types of ionic liquids, often followed by high-energy dry ball milling and high-temperature treatment.	Primarily recognized for fundamental research. Can potentially regulate crystal morphology. The use of ionic liquids can create specific synthesis environments.	Emerging method for LMFP synthesis.
Two-Phase Mixing Strategy	Involves synthesizing LMFP and then physically blending it with other materials, such as NCM or LFP, to improve energy density and safety, although this requires high uniformity during blending. Strategies range from simple physical mixing during slurry preparation to sophisticated interface enhancement methods. Structural modification can involve adding LMFP as a coating or skeletal structure to other materials.	Combine advantages of different cathode active materials. Achieves a more balanced performance profile, combining the high energy density of layered oxides with the intrinsic safety and long cycle life of olivine phosphates. LMFP blending improves the safety and stability of layered oxides (NCM) by protecting against degradation and dissolution.	Homogeneity is a major challenge due to the significant differences in physical properties (e.g., particle size or density) between the constituent materials. The performance of the blend can be limited by the degradation of the less stable component (e.g., NCM). Complexity arises from the need to optimize the ratio and interface of the mixed materials.

INTRODUCTION

Scope of the report

This report provides a detailed picture of the patent landscape related to **LMFP: from cathode materials to battery cells**. We have selected and analyzed more than **16,800+ patents and patent applications** published **worldwide** up to **July 2025**, representing more than **7,810 patent families** (inventions) relevant to the scope of this report.

LMFP: From cathode materials to battery cells

Included: Lithium metal batteries and Li-ion batteries / Excluded: Other solid-state batteries (Li-S battery, Li-Air battery, Na-ion battery, Mg-ion battery, etc.)

VALUE CHAIN SEGMENTS

- Precursor materials
- Cathode materials
- Electrodes
- Battery cells
- Battery packs
- Manufacturing equipments
- Recycling
- Charging technologies

LMFP MATERIALS

- Clear reference to LMFP
- General reference to Lithium metal phosphate cathode material which can include LMFP
- General reference to Lithium metal phosphate cathode material which does not include LMFP
- Focus on LMFP
- LMFP in a list of cathode materials

TYPE OF MATERIALS

- Non composite
- Core-shell
- Composite without a shell

Included in the study

Excluded of the study

INTRODUCTION

Found the right information in the report

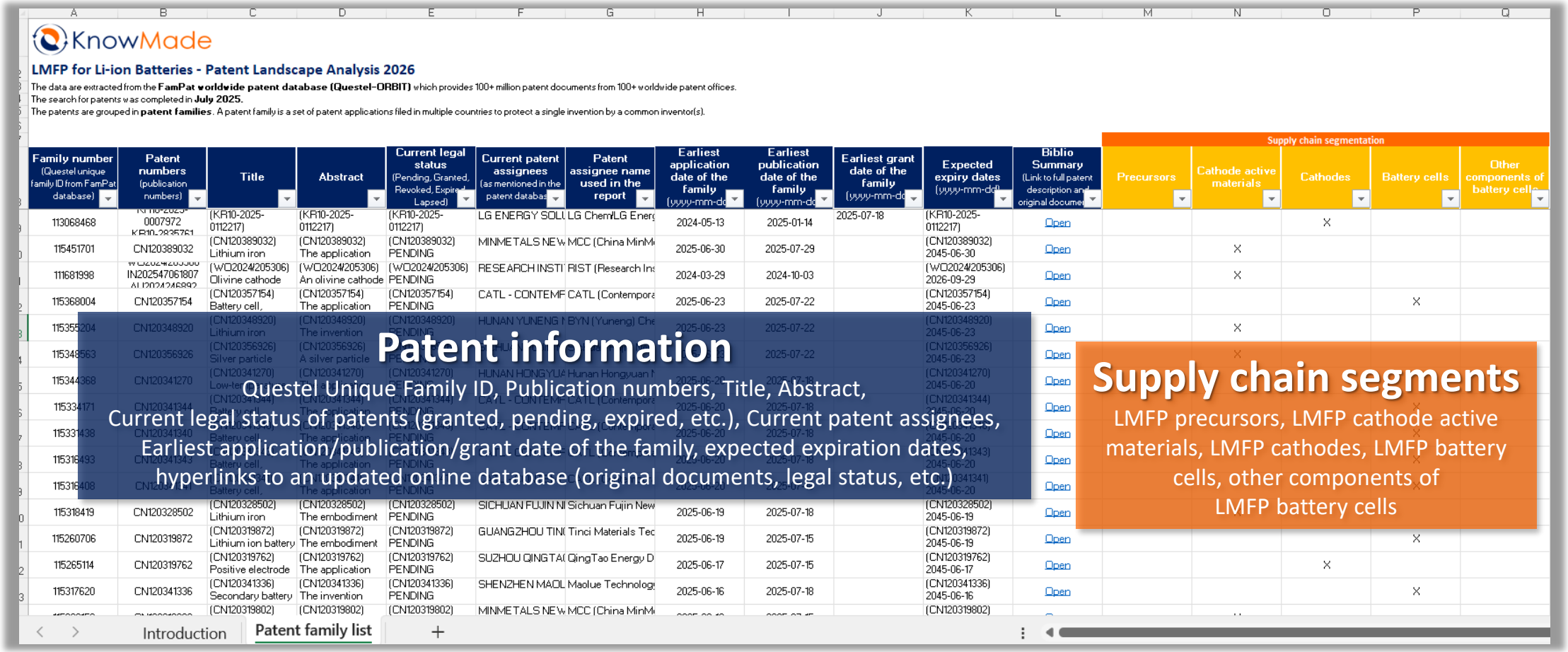
Report sections ↓ | Your concern → | Information you get ↘

	TECHNOLOGY *For R&D teams, engineers, scientists*	IP *For IP teams, patent attorneys*	MARKET *For executives, business developers*	PLAYER *Zoom in a competitor / partner*
PATENT LANDSCAPE OVERVIEW • **Ranking of players** (enforceability, current activity, geo/tech coverage, prior-art contribution, etc.) • **Patent filings dynamics per player** • **IP collaborations** (co-filings, IPR transfers) • **Patent litigation/oppositions**	Innovators	Main patent owners IP risks/opportunities	Ecosystem (competitors, newcomers, partners, clients) Main trends IP vs Market	IP position vs Market position Player relationships (collaborations/ dependencies)
SEGMENTS ANALYSIS • **Patent filings dynamics per segment** • **IP leaders per segment** (enforceability, current activity, blocking potential) • **Key patents per segment** • **Recent patenting activity per segment**	Technology trends Technology mapping	Blocking players IP risks/opportunities in each segment (FTO, litigation, licensing)	Benchmarking Markets of interest Future developments	IP position and level of investment in each segment Key IP developments
IP PROFILE OF KEY PLAYERS • **Patent portfolio summary** (portfolio size, IP activity evolution, patents legal status, geo/tech coverage, strengths/weaknesses, etc.) • **Key patents** • **Recent patenting activity**	Current R&D activities Technology roadmap	Blocking patents Geo/Tech coverage Link between patents and products	Future products Potential partners Potential targets	R&D investment level Key inventions Current IP activities Strengths / Weaknesses

INTRODUCTION

Excel patent database

With the present report is provided an extensive **Excel database with the 7,810+ patent families** (inventions) analyzed in this study. This useful patent database allows for multicriteria searches and includes patent publication numbers, **hyperlinks to an updated online database** (original documents, legal status, etc.), priority date, title, abstract, patent assignees, patent's current legal status, and **segments** (precursor, cathode active material, cathodes, battery cells, other components of battery cells).



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LMFP for Li-ion Batteries - Patent Landscape Analysis 2026

The data are extracted from the **FamPat worldwide patent database (Questel-ORBIT)** which provides 100+ million patent documents from 100+ worldwide patent offices.
The search for patents was completed in **July 2025**.
The patents are grouped in **patent families**. A patent family is a set of patent applications filed in multiple countries to protect a single invention by a common inventor(s).

Family number (Questel unique family ID from FamPat database)	Patent numbers (publication numbers)	Title	Abstract	Current legal status (Pending, Granted, Revoked, Expired, Lapsed)	Current patent assignees (as mentioned in the patent database)	Patent assignee name used in the report	Earliest application date of the family (yyyy-mm-dd)	Earliest publication date of the family (yyyy-mm-dd)	Earliest grant date of the family (yyyy-mm-dd)	Expected expiry dates (yyyy-mm-dd)	Biblio Summary (Link to full patent description and original documents)	Supply chain segmentation: Precursors	Cathode active materials	Cathodes	Battery cells	Other components of battery cells
113068468	KR10-2025-0007972 KR10-2835761	(KR10-2025-0112217)	(KR10-2025-0112217)	(KR10-2025-0112217)	LG ENERGY SOLU	LG Chem/LG Energ	2024-05-13	2025-01-14	2025-07-18	(KR10-2025-0112217)	Open			X		
115451701	CN120389032	(CN120389032) Lithium iron	(CN120389032) The application	(CN120389032) PENDING	MINMETALS NEW	MCC (China MinM	2025-06-30	2025-07-29		(CN120389032) 2045-06-30	Open		X			
111681998	WO2024205306 IN202547061807 AU2024246892	(WO2024/205306) Olivine cathode	(WO2024/205306) An olivine cathode	(WO2024/205306) PENDING	RESEARCH INSTI	RIST (Research Ins	2024-03-29	2024-10-03		(WO2024/205306) 2026-09-29	Open		X			
115368004	CN120357154	(CN120357154) Battery cell,	(CN120357154) The application	(CN120357154) PENDING	CATL - CONTEMP	CATL (Contempora	2025-06-23	2025-07-22		(CN120357154) 2045-06-23	Open				X	
115355204	CN120348920	(CN120348920) Lithium iron	(CN120348920) The invention	(CN120348920) PENDING	HUNAN YUNENG	BYN (Yuneng) Che	2025-06-23	2025-07-22		(CN120348920) 2045-06-23	Open		X			
115348563	CN120356926	(CN120356926) Silver particle	(CN120356926) A silver particle	PENDING				2025-07-22		(CN120356926) 2045-06-23	Open					
115344368	CN120341270	(CN120341270) Low-te	(CN120341270)	(CN120341270)	HUNAN HONGYUA	Hunan Hongyuan M	2025-06-20	2025-07-18		(CN120341270) 2045-06-20	Open					
115334171	CN120341344	(CN120341344) Battery cell,	The application	PENDING	CATL - CONTEMP	CATL (Contempora	2025-06-20	2025-07-18		(CN120341344) 2045-06-20	Open				X	
115331438	CN120341340	Battery cell,	The application	PENDING			2025-06-20	2025-07-18		2045-06-20	Open				X	
115316493	CN120341343	Battery cell,	The application	PENDING			2025-06-20	2025-07-18		(CN120341343) 2045-06-20	Open				X	
115316408	CN120341341	Battery cell,	The application	PENDING			2025-06-20	2025-07-18		(CN120341341) 2045-06-20	Open				X	
115318419	CN120328502	(CN120328502) Lithium iron	(CN120328502) The embodiment	(CN120328502) PENDING	SICHUAN FUJIN NI	Sichuan Fujin New	2025-06-19	2025-07-18		(CN120328502) 2045-06-19	Open					
115260706	CN120319872	(CN120319872) Lithium ion battery	(CN120319872) The embodiment	(CN120319872) PENDING	GUANGZHOU TIN	Tinci Materials Tec	2025-06-19	2025-07-15		(CN120319872) 2045-06-19	Open				X	
115265114	CN120319762	(CN120319762) Positive electrode	(CN120319762) The application	(CN120319762) PENDING	SUZHOU QINGTA	QingTao Energy D	2025-06-17	2025-07-15		(CN120319762) 2045-06-17	Open			X		
115317620	CN120341336	(CN120341336) Secondary battery	(CN120341336) The invention	(CN120341336) PENDING	SHENZHEN MAOL	Maolue Technolog	2025-06-16	2025-07-18		(CN120341336) 2045-06-16	Open				X	
		(CN120319802)	(CN120319802)	(CN120319802)	MINMETALS NEW	MCC (China MinM				(CN120319802)						

Introduction | Patent family list | +

Patent information

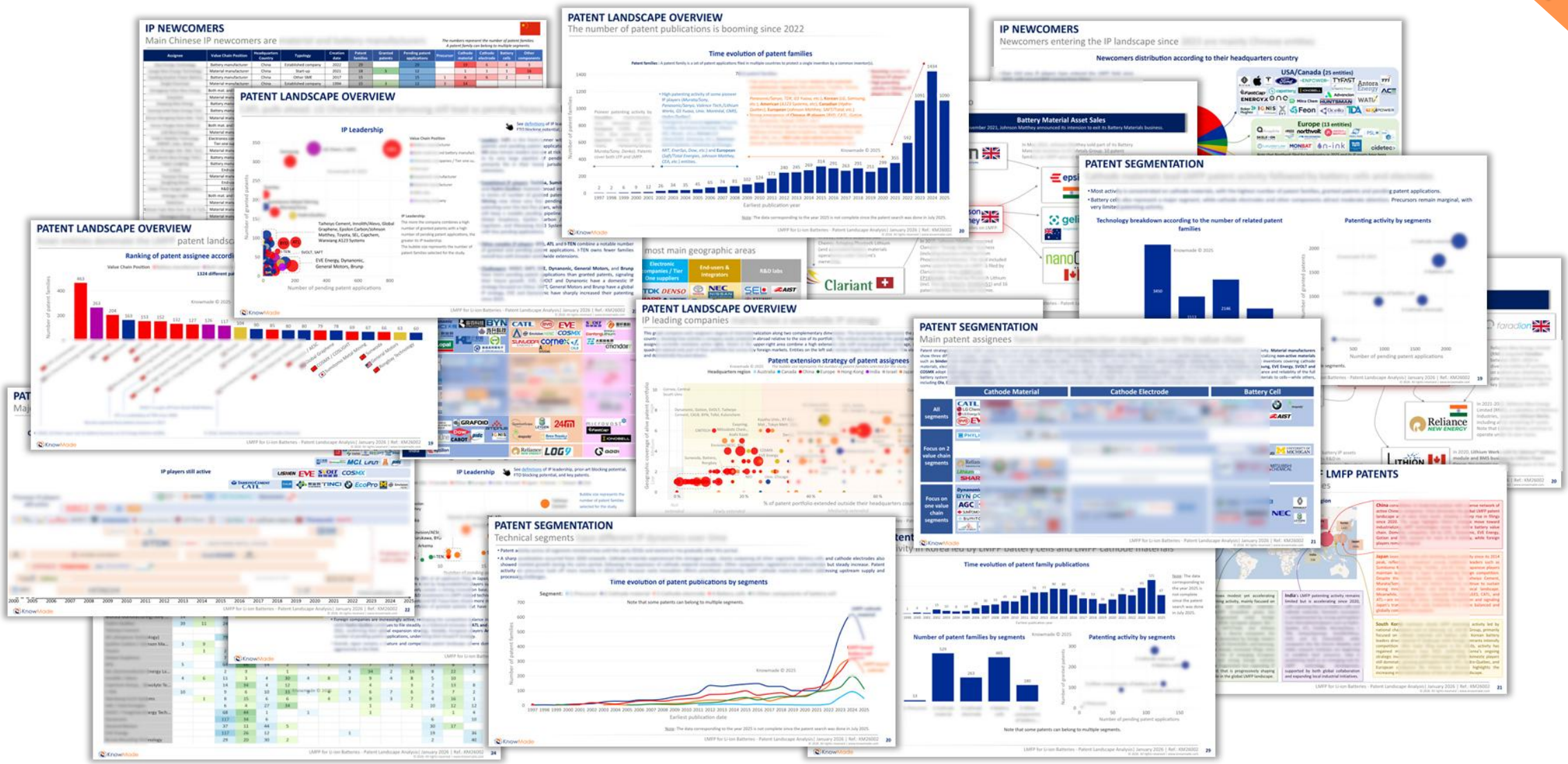
Questel Unique Family ID, Publication numbers, Title, Abstract, Current legal status of patents (granted, pending, expired, etc.), Current patent assignees, Earliest application/publication/grant date of the family, expected expiration dates, hyperlinks to an updated online database (original documents, legal status, etc.)

Supply chain segments

LMFP precursors, LMFP cathode active materials, LMFP cathodes, LMFP battery cells, other components of LMFP battery cells

Patent Landscape Overview

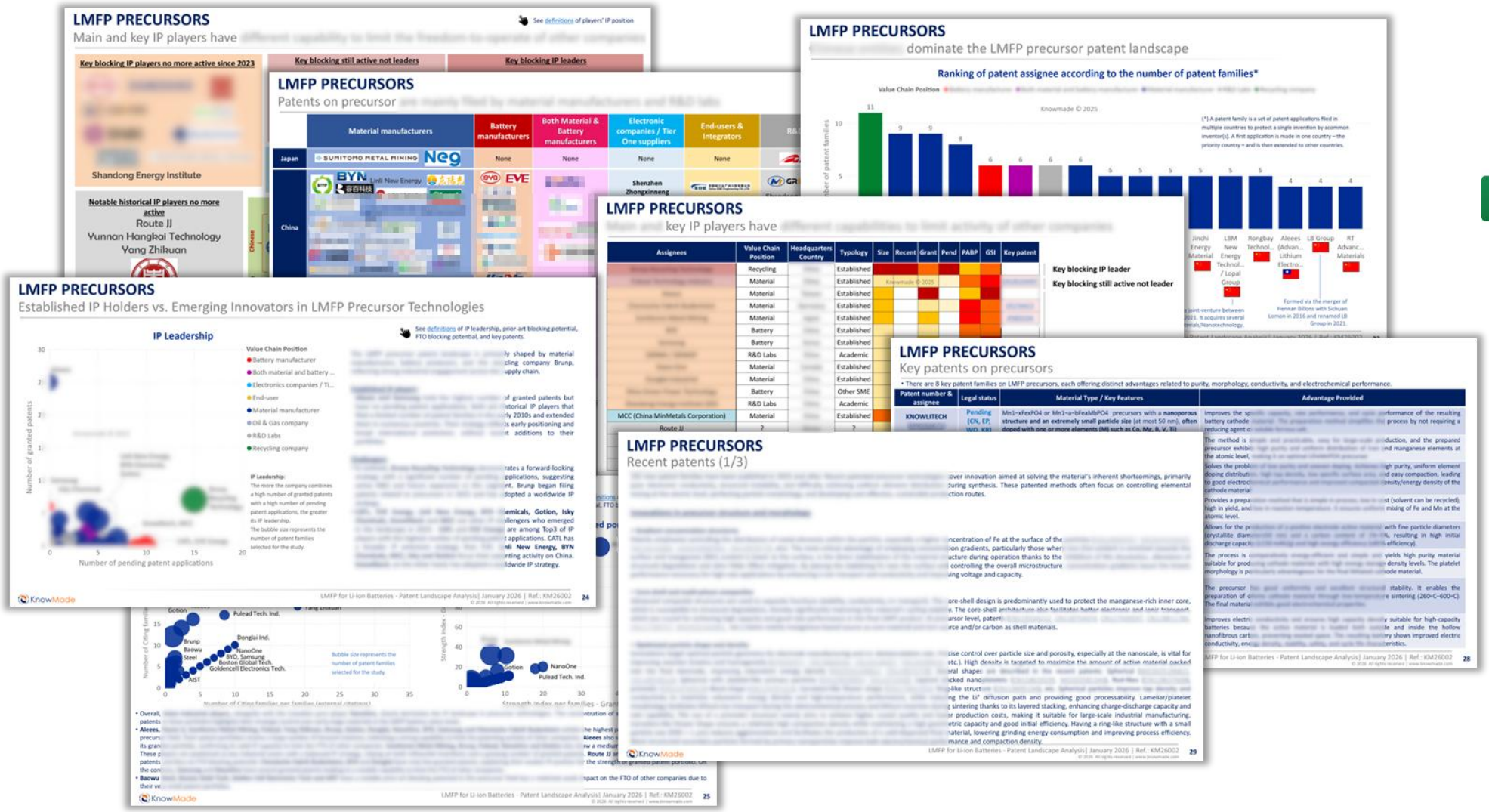
General trends, IP leaders, new entrants, IP strategies, IP collaborations



Patents on LMFP Precursors

Main patent assignees, newcomers, key players, key patents, notable recent patents

SAMPLE

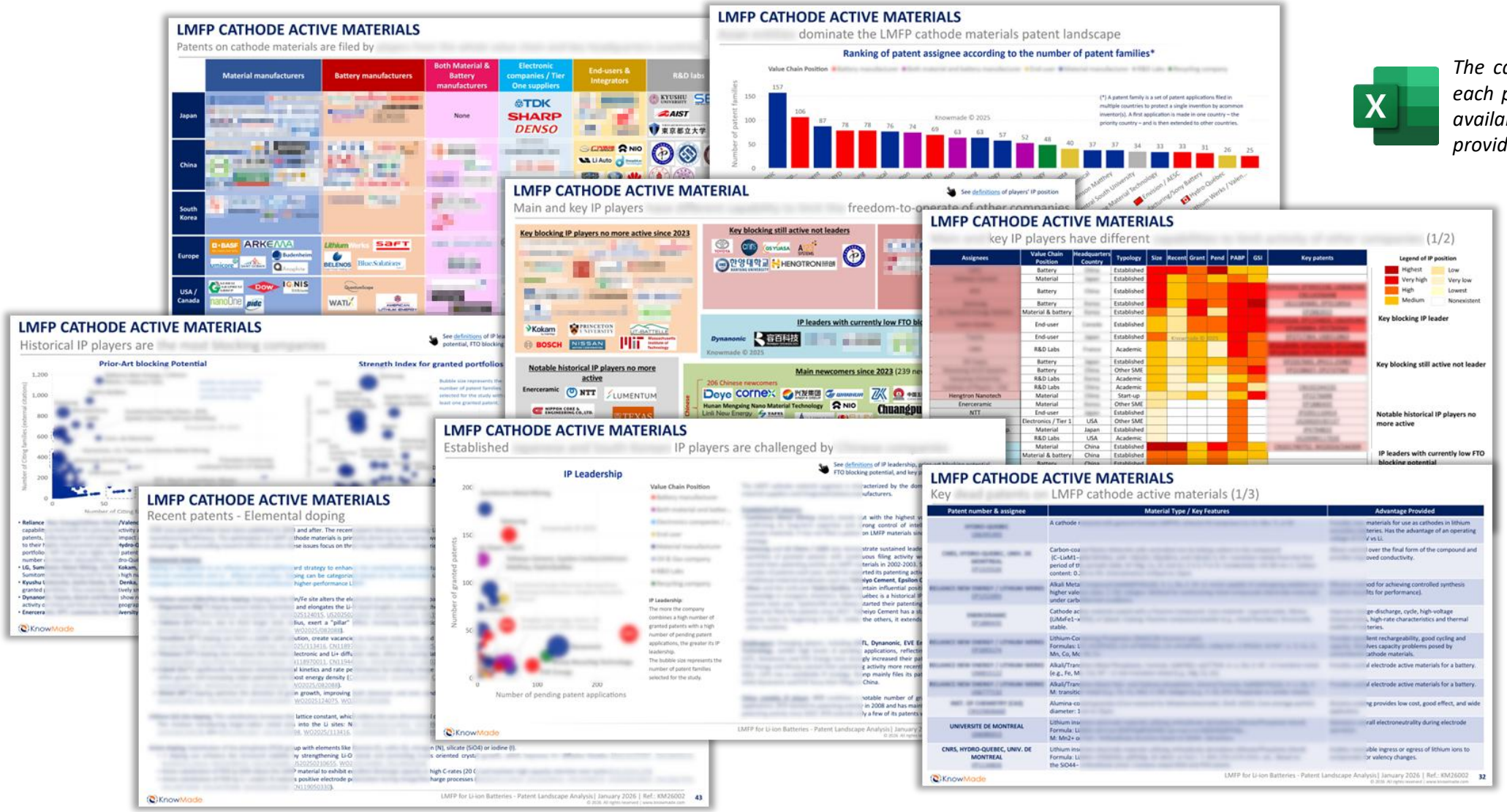


The categories to which each patent belongs are available in the Excel file provided with the report

Patents on LMFP Cathode Materials

Main patent assignees, newcomers, key players, key patents, notable recent patents

SAMPLE

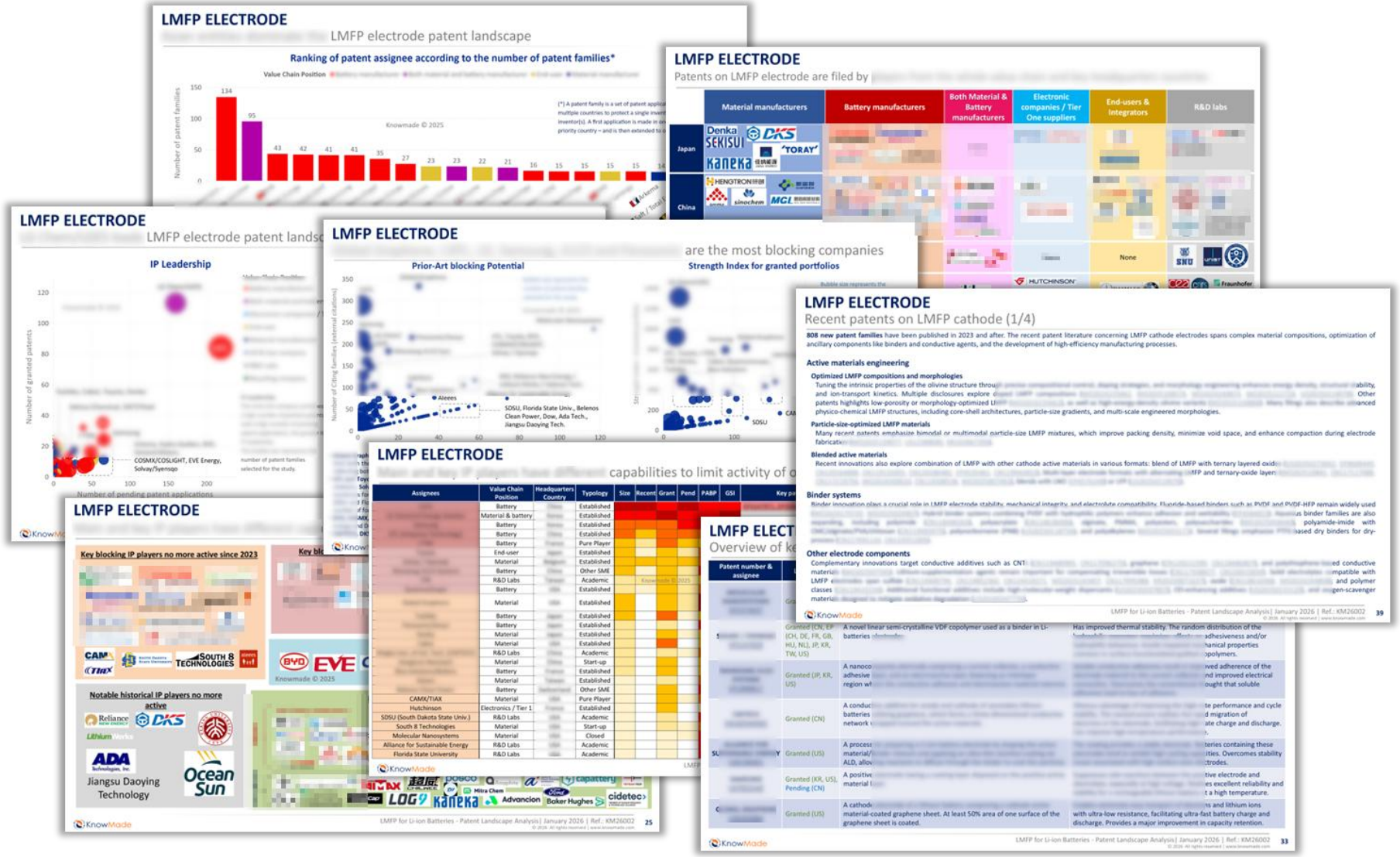


The categories to which each patent belongs are available in the Excel file provided with the report

Patents on LMFP Electrode

Main patent assignees, newcomers, key players, key patents, notable recent patents

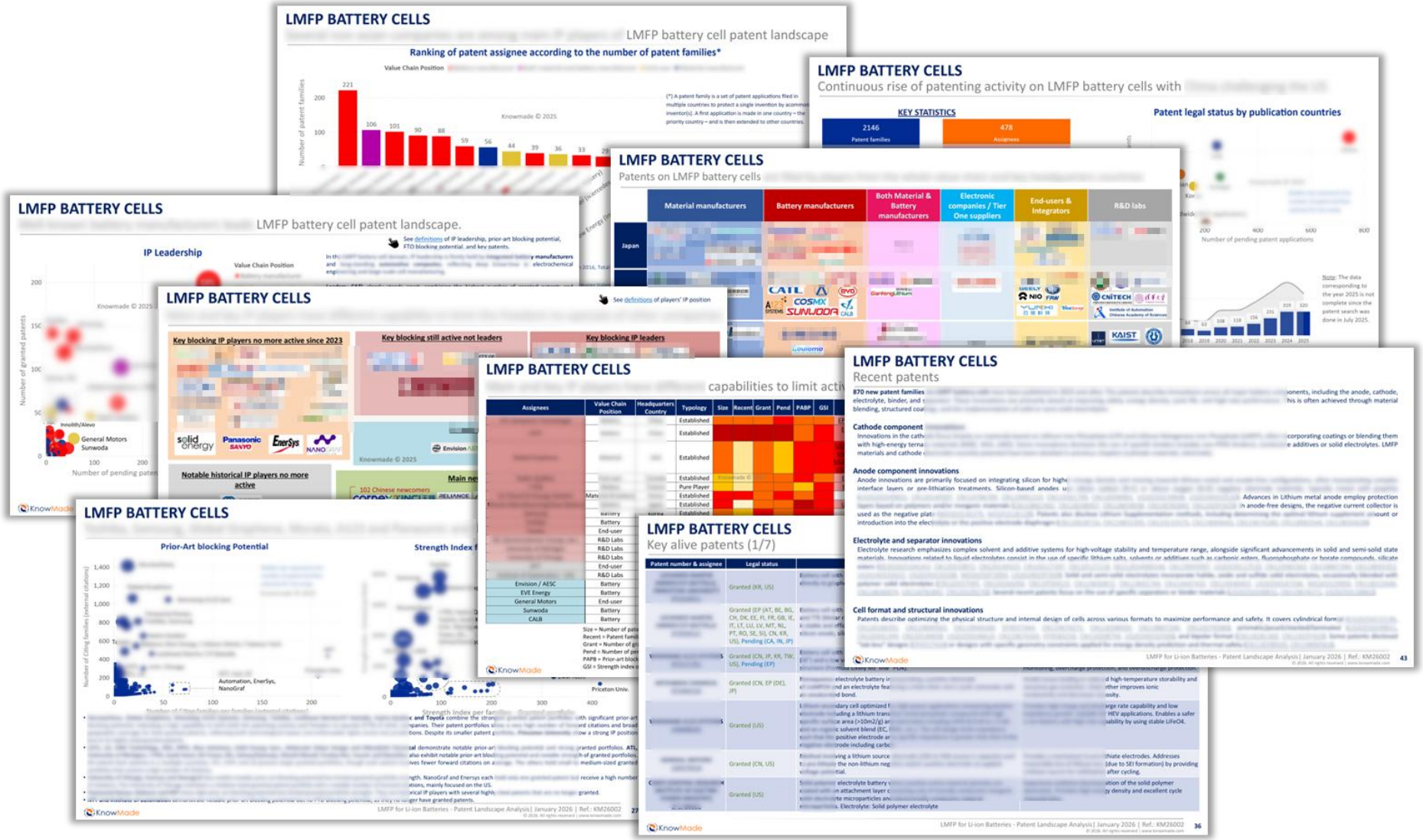
SAMPLE



The categories to which each patent belongs are available in the Excel file provided with the report

Patents on LMFP Battery Cells

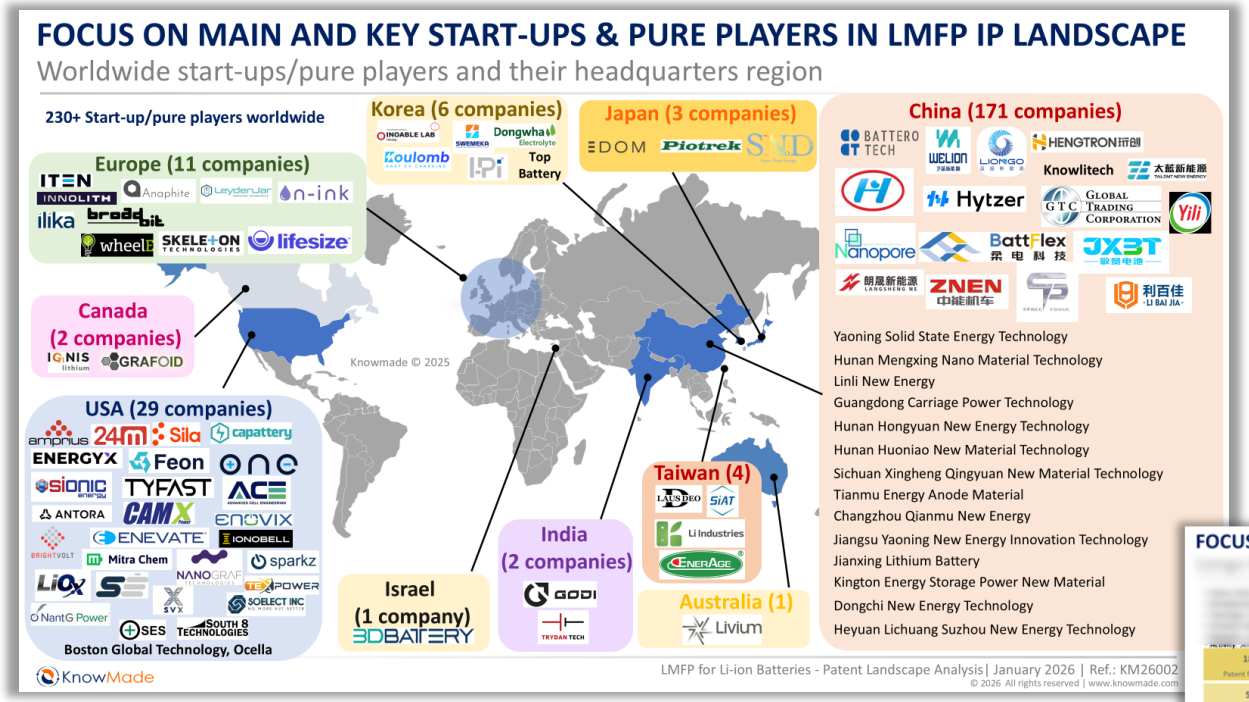
Main patent assignees, newcomers, key players, key patents, notable recent patents

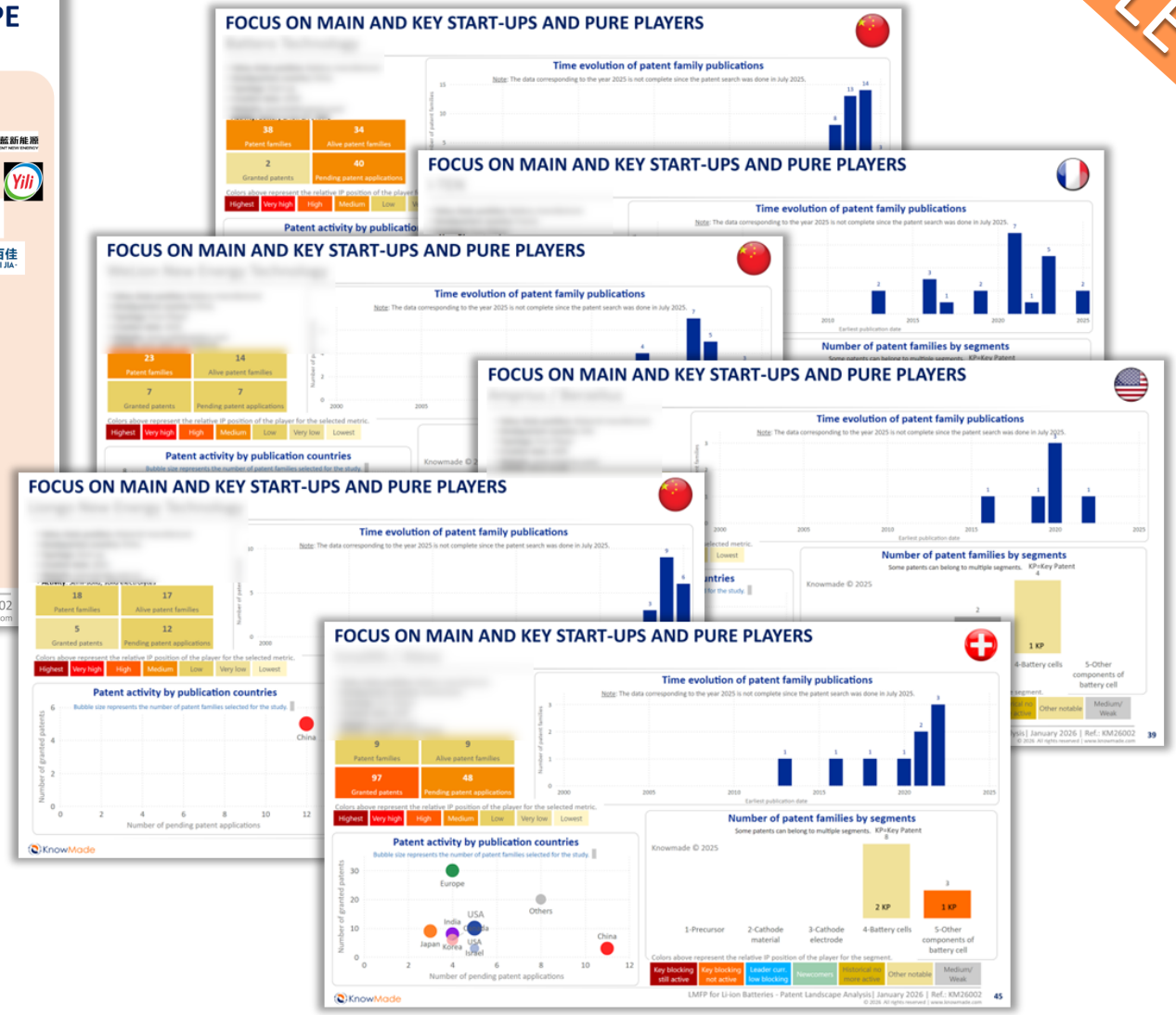


The categories to which each patent belongs are available in the Excel file provided with the report

Start-ups & Pure Players

IP dynamics, level of patent activity, geographical & technical coverage, IP strengths, and potential for reinforcement



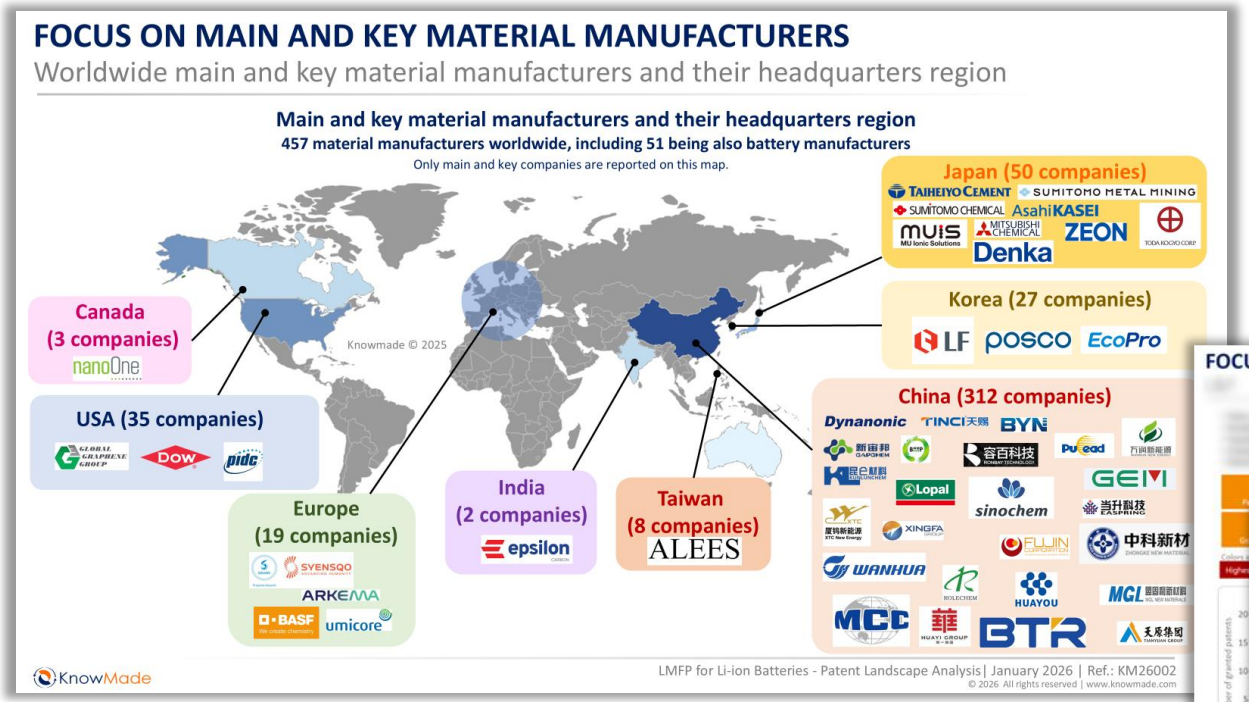


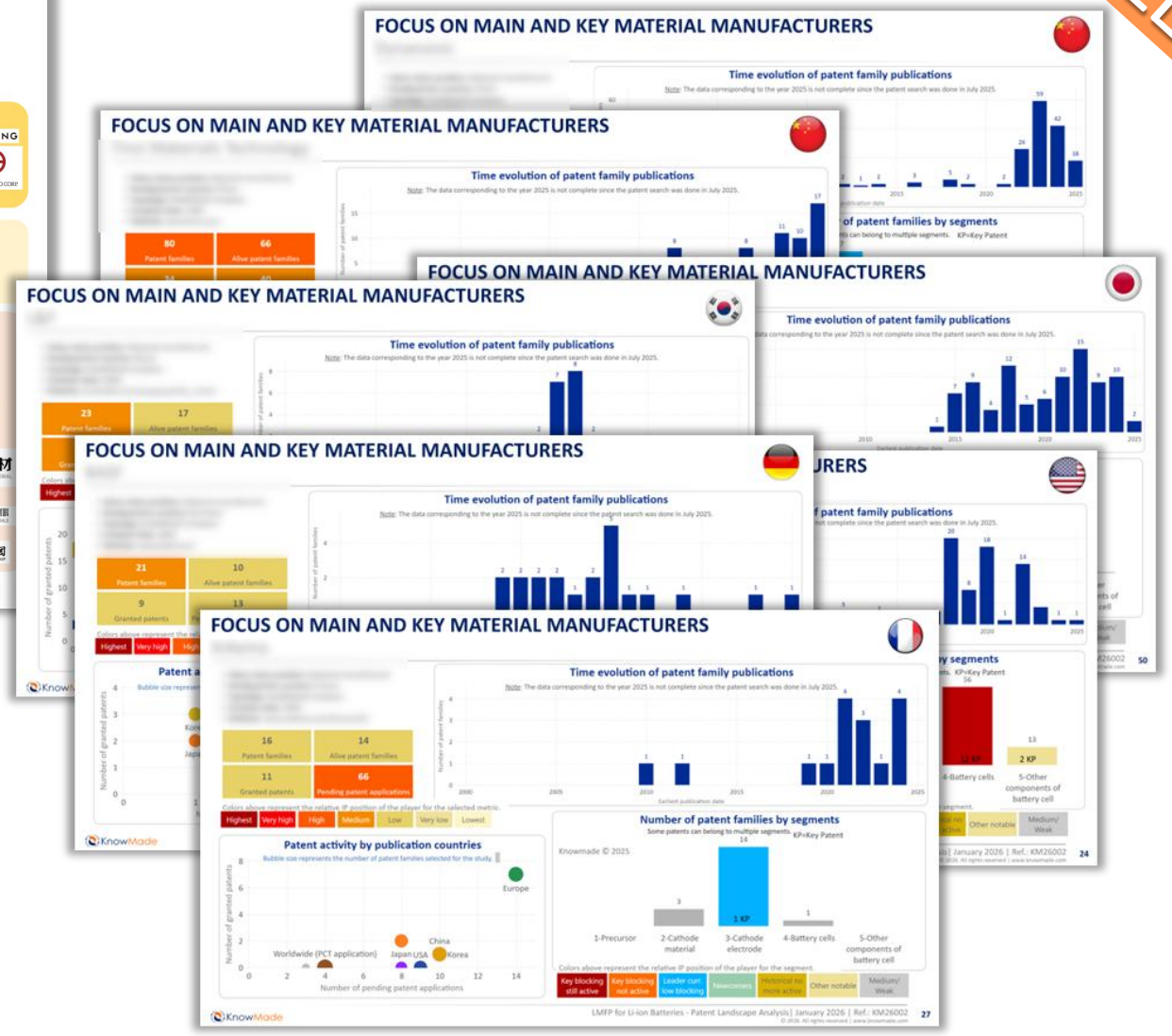
IP profile of 15+ start-ups & pure players:

Amprius/Berzelius, Ignis Lithium, I-TEN, Innolith/Alevo, Battero Technology, WeLion New Energy Technology, Liongo New Energy Technology, Hengtron Nanotech, Chongqing Tailan New Energy, Haopeng New Energy, Zhongke Shenlan Huize New Energy, Yaoning Solid State Energy Technology, Hunan Mengxing Nano Material Technology, Linli New Energy, Tianmu Energy Anode Material, Knowlitech.

Material Manufacturers & Recycling Companies

IP dynamics, level of patent activity, geographical & technical coverage, IP strengths, and potential for reinforcement



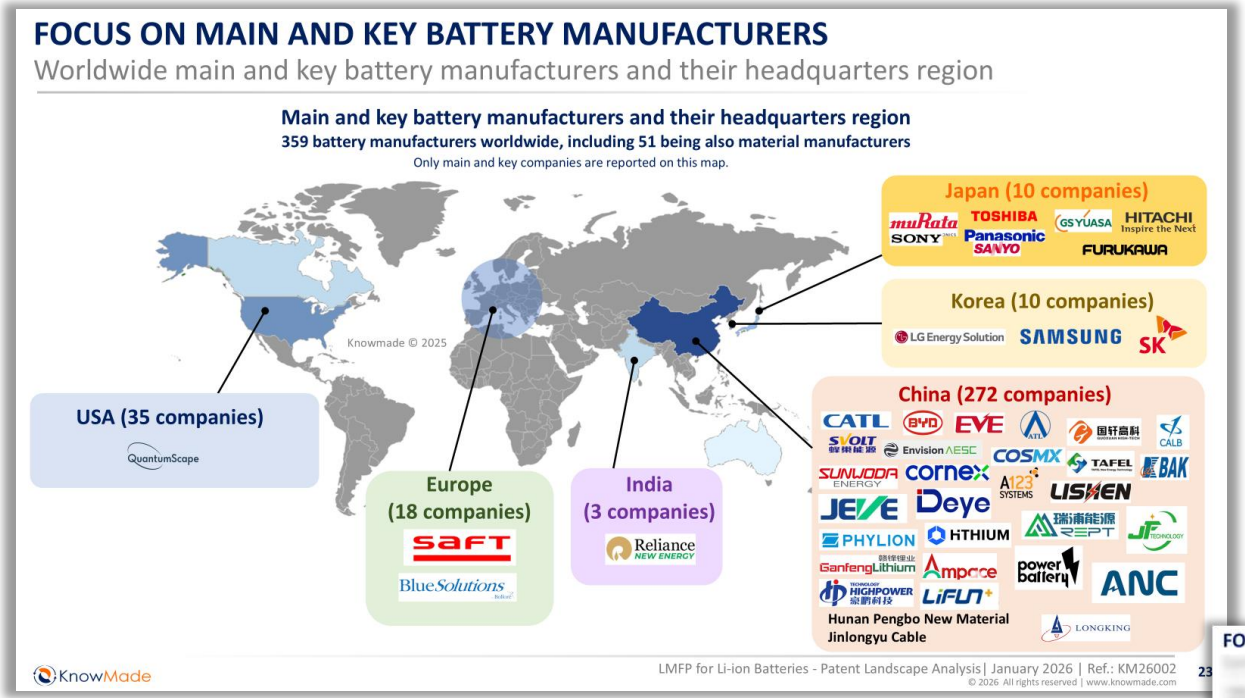


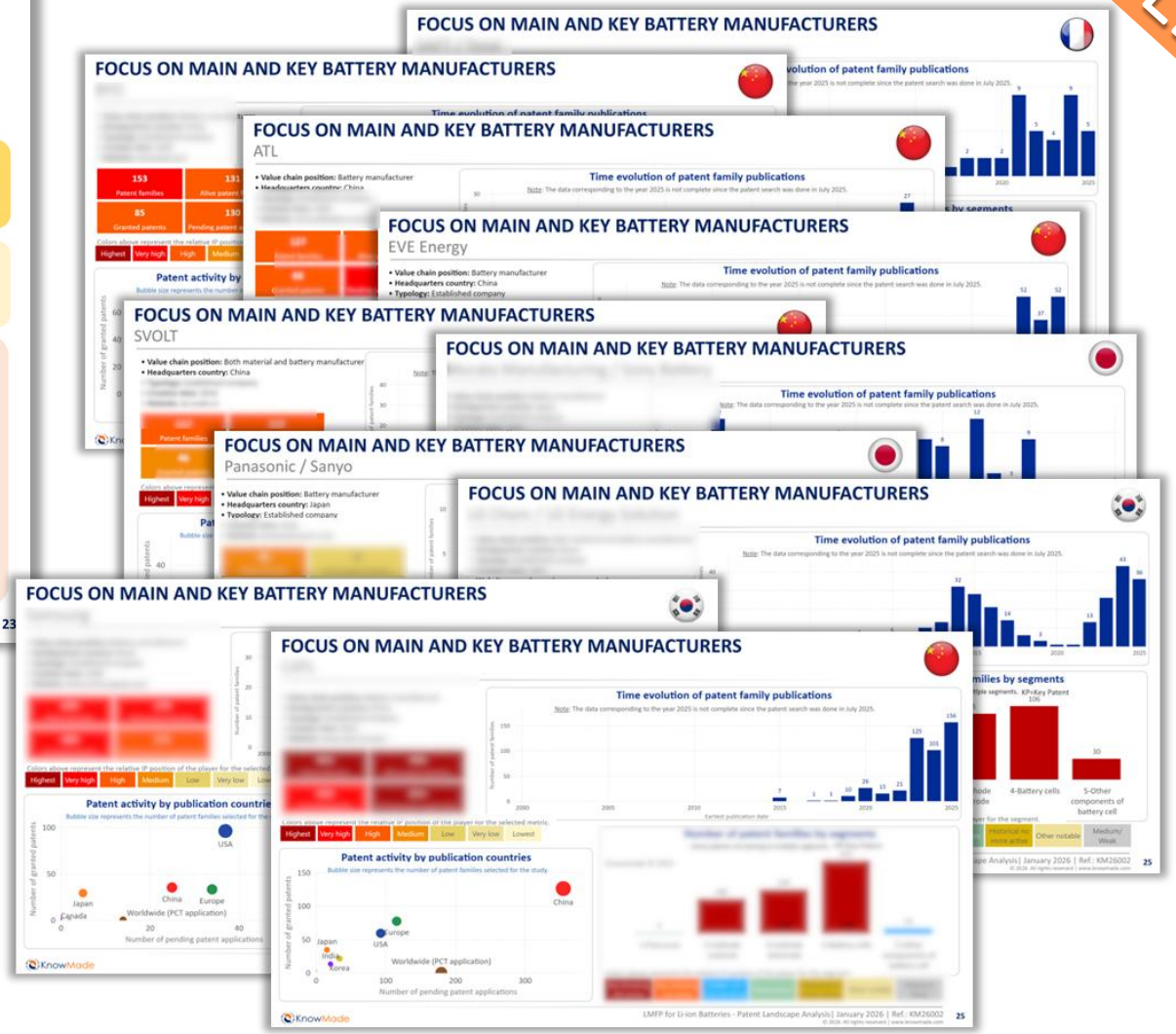
IP profile of 45+ material manufacturers and recycling companies:

Taiheiyo Cement, Sumitomo Chemical/Tanaka Chemical, Sumitomo Metal Mining, Asahi Kasei, MU Ionic Solutions, Mitsubishi Chemical, Denka, Toda Kogyo, Zeon, L&F, Posco, EcoPro, Global Graphene, Dow, PIDC (Pacific Industrial Development Corporation), Nano One, BASF, Solvay/Syensqo, Umicore, Arkema, Epsilon Carbon/Johnson Matthey, Aleees (Advanced Lithium Electrochemistry), Brunp Recycling Technology, Dynanonic, Tinci Materials Technology, Rongbay Technology, Capchem Group/Novolyte Technologies, BYN (Yuneng) Chemical, Easpring Material Technology, Kulunchem, LBM New Energy Technology/Lopal Group, Pulead Technology Industry, Sinochem, GEM, and more

Battery Manufacturers

IP dynamics, level of patent activity, geographical & technical coverage, IP strengths, and potential for reinforcement



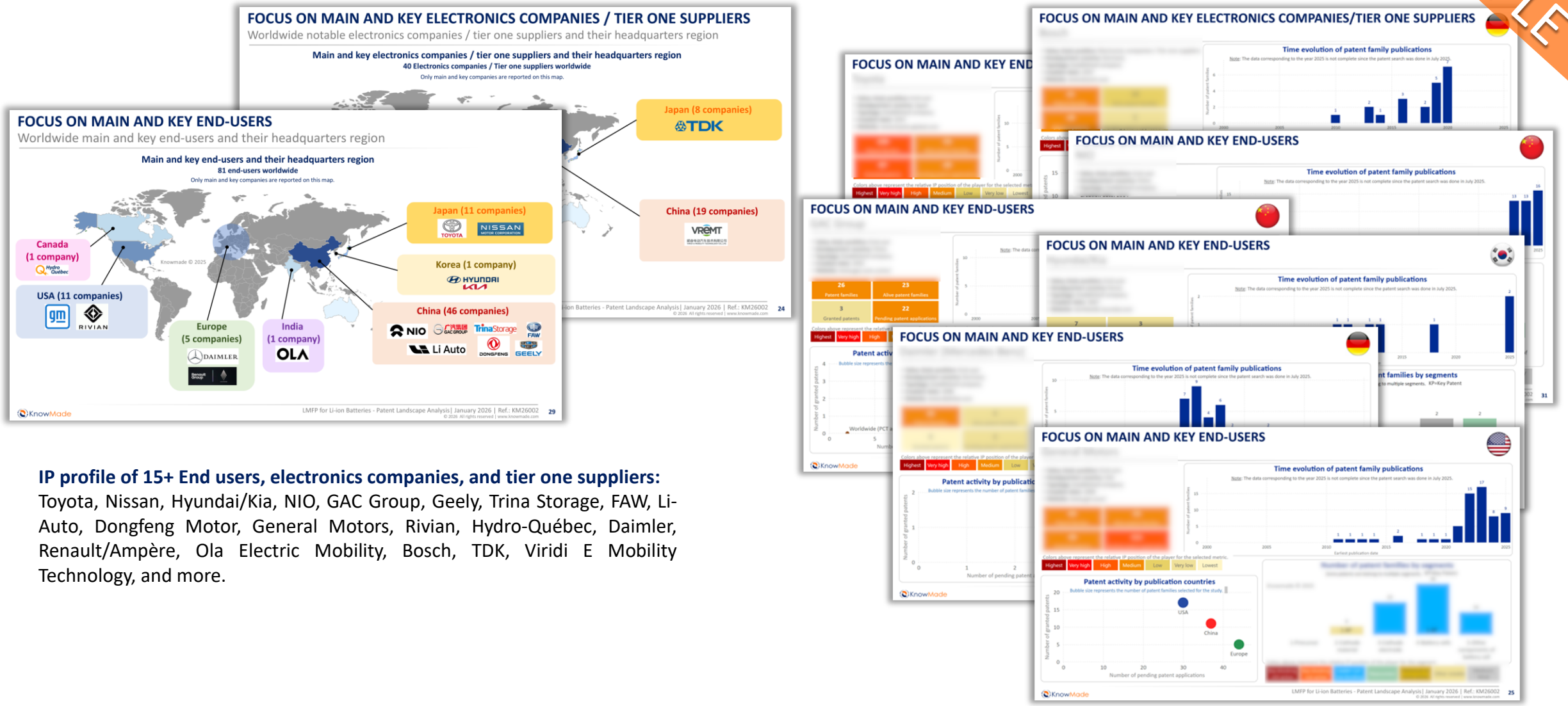


IP profile of 45+ battery manufacturers:

LG Chem/LG Energy Solution, Samsung, SK Group, Murata Manufacturing/Sony Battery, Toshiba, Panasonic/Sanyo, GS Yuasa, Hitachi, Furukawa, CATL, BYD, EVE Energy, ATL, SVOLT, Gotion/Guoxuan High Tech Power Energy, Envison/AESC, COSMX/COSLIGHT, Sunwoda, Cornex New Energy, CALB (China Aviation Lithium Battery), Wanxiang A123 Systems, Tafel New Energy Technology/Zenergy, JEVE (Tianjin EV Energy), Deyi Energy Technology, Lishen, Phylion, Hithium Energy Storage Technology, Ganfeng Lithium, REPT Energy, Ampace, Reliance New Energy (Incl. Lithium Werks/Valence Tech.), Quantumscape, SAFT, Blue Solutions, and more.

End users, electronics companies, and tier one suppliers

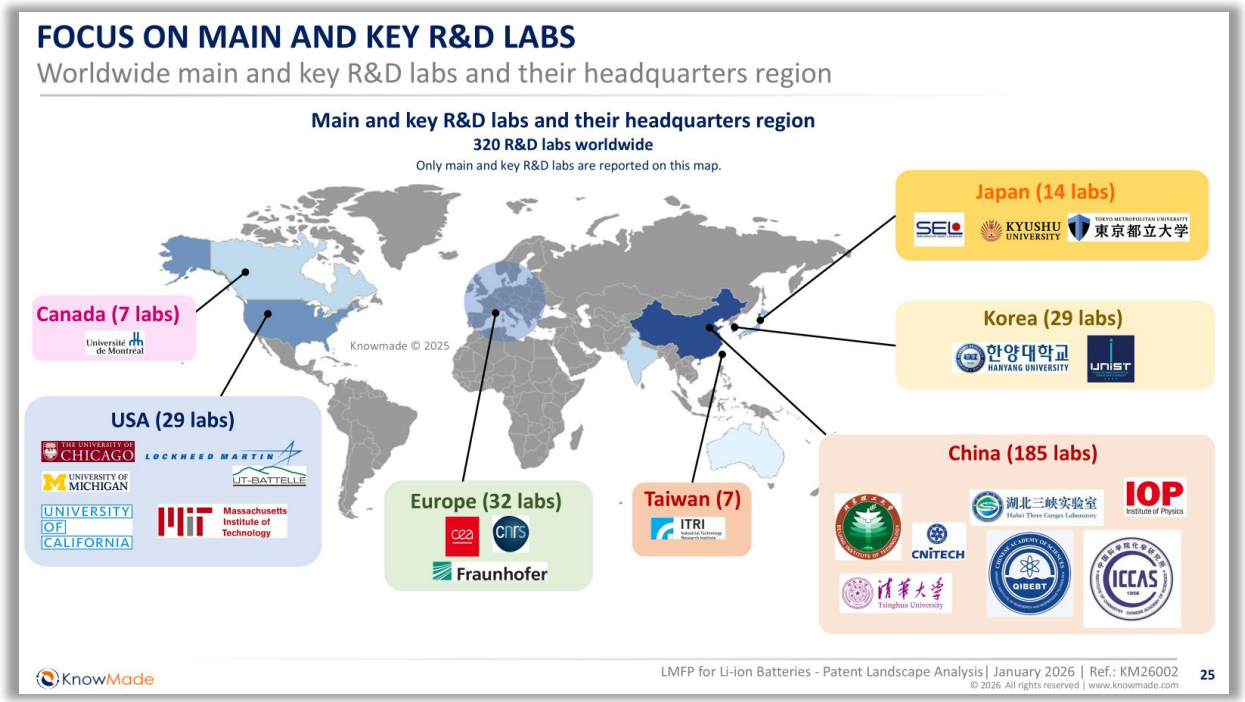
IP dynamics, level of patent activity, geographical & technical coverage, IP strengths, and potential for reinforcement



IP profile of 15+ End users, electronics companies, and tier one suppliers:
Toyota, Nissan, Hyundai/Kia, NIO, GAC Group, Geely, Trina Storage, FAW, Li-Auto, Dongfeng Motor, General Motors, Rivian, Hydro-Québec, Daimler, Renault/Ampère, Ola Electric Mobility, Bosch, TDK, Viridi E Mobility Technology, and more.

R&D Labs

IP dynamics, level of patent activity, geographical & technical coverage, IP strengths, and potential for reinforcement



IP profile of 20+ R&D Labs:

Hanyang University, UNIST (Ulsan National Institute of Science & Technology), SEL, Kyushu University, Tokyo Metropolitan University, University of Chicago, Lockheed Martin Energy/UT-Battelle, University of Michigan, University of California, MIT (Massachusetts Institute of Technology), Université de Montréal, CEA, CNRS, Fraunhofer, ITRI (Industrial Technology Research Institute), Beijing Institute of Technology, Tsinghua University, Institute of Physics (CAS), Institute of Chemistry (CAS), Ningbo Institute of Industrial Technology (CNITECH), Qingdao Institute of Bioenergy and Bioprocess Technology (CAS), Hubei Three Gorges Laboratory.

ORDER FORM

LMFP for Li-ion Batteries

Patent Landscape Analysis – January 2026

Ref.:KM26002

SHIP TO
Name (Mr/Ms/Dr/Pr):
_____
Job Title:
_____
Company:
_____
Address:
_____
City:
_____
State:
_____
Postcode/Zip:
_____
Country:
_____
VAT ID Number for EU members:
_____
Tel:
_____
Email:
_____
Date:
_____

PAYMENT METHODS

Check

To pay your invoice using a check, please mail your check to the following address**:**

KnowMade S.A.R.L.
2405 route des Dolines, Le Drakkar,
06560 Valbonne Sophia Antipolis
FRANCE

Money Transfer

To pay your invoice using a bank money wire transfer please contact your bank to complete this process. Here is the information that you will need to submit the payment:

Payee: KnowMade S.A.R.L.
Bank: Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var, France
IBAN: FR76 1460 7003 6360 6214 5695 139
BIC/SWIFT: CCBPFRPPMAR

Paypal

In order to pay your invoice via PAYPAL, you must first register at www.paypal.com. Then you can send money to the KnowMade S.A.R.L. by entering our E-mail address contact@knowmade.fr as the recipient and entering the invoice amount.

RETURN ORDER BY

E-mail: contact@knowmade.fr
Mail: KnowMade S.A.R.L., 2405 route des Dolines, Le Drakkar, 06560 Valbonne Sophia Antipolis, FRANCE

PRODUCT ORDER

☐ **4,990 EUR – Multi user license***

For price in dollars, please use the day's exchange rate.
For French customer, add 20% for VAT.
All reports are delivered electronically in pdf format at payment reception.

**The report can be shared with the employees of the company purchasing the report. Subsidiaries and joint-ventures are excluded. Please be aware that the report is watermarked on each page, with the name of the recipient and the organization (the name mentioned in the PO). This watermark also reaffirms that report sharing is not allowed.*

I hereby accept Knowmade's Terms and Conditions of Sale
Signature:

Terms and Conditions of Sales

DEFINITIONS

"Acceptance": Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions "I hereby accept Knowmade's Terms and Conditions of Sale".

"Buyer": Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

"Contracting Parties" or "Parties": The Seller on the one hand and the Buyer on the other hand.

"Intellectual Property Rights" ("IPR") means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

"License": For the reports and databases, 2 different licenses are proposed. The buyer has to choose one license:

1. One user license: a single individual at the company can use the report.
2. Corporate license: the report can be used by unlimited users within the company. Subsidiaries and joint ventures are not included.

"Products": Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

"Seller": Based in Sophia Antipolis (France headquarters), Knowmade is a technology intelligence company specialized in the research and analysis of scientific and technical information. We provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

1. SCOPE

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. Any additional, different, or conflicting terms and conditions in any other documents issued by the buyer at any time are hereby objected to by the seller, shall be wholly inapplicable to any sale made hereunder and shall not be binding in any way on the seller.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions "I hereby accept Knowmade's Terms and Conditions of Sale". This results in acceptance by the Buyer.

1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer's address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

2. MAILING OF THE PRODUCTS

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or
- within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

2.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 The mailing is operated through electronic means either by email via the sales department. If the Product's electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer's risk.

3. PRICE, INVOICING AND PAYMENT

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to Knowmade, PayPal or by electronic transfer to the following account:

Banque Populaire Méditerranée, CAP 3000 Quartier du lac, 06700 St Laurent du Var, France
BIC or SWIFT code: CCBPFRPPMAR
IBAN: : FR76 1460 7003 6360 6214 5695 139

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

4. LIABILITIES

4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.

4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

5. FORCE MAJEURE

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

6. PROTECTION OF THE SELLER'S IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

- Information storage and retrieval systems;
- Recordings and re-transmittals over any network (including any local area network);
- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
- Posting any Product to any other online service (including bulletin boards or the Internet);
- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

7. TERMINATION

7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

8. MISCELLANEOUS

All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

9. GOVERNING LAW AND JURISDICTION

9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Grasse, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.

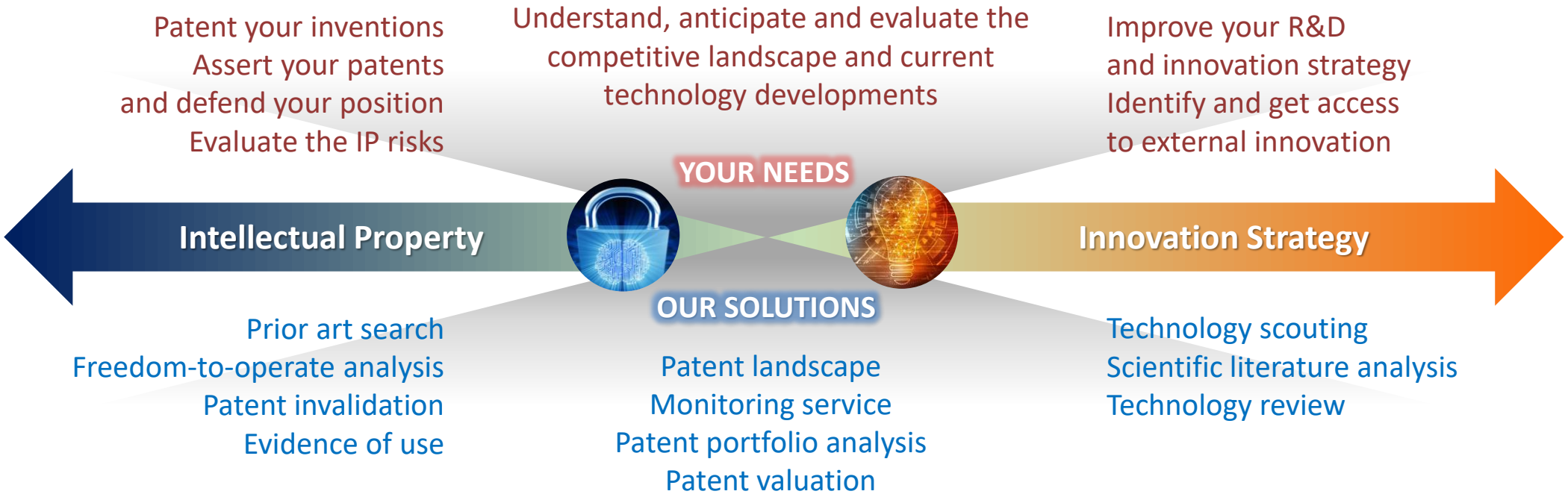
KNOWMADE

Patent and Technology Intelligence

KNOWMADE PURPOSE

Turning **patent** and **scientific data** into **actionable insights** to support **decision-making** in **R&D**, **innovation**, **investment**, and **intellectual property**.

Competitive landscape | Technology trends | Opportunities / Risks | R&D and IP strategy

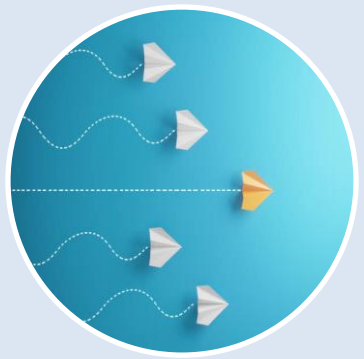


WHAT INFORMATION CAN YOU GET ?

INTELLECTUAL PROPERTY

For IP teams,
patent attorneys

- Risks and opportunities (FTO, litigations, licensing)
- Key patents
- Link between patents and products



TECHNOLOGY

For R&D teams,
engineers, scientists

- R&D activities
- Technological roadmap
- Position on the supply chain

MARKET

For executives,
business developers

- Identify competitors
- Compare IP with market position
- Evaluate the level of investment
- Future products & target markets

KNOWMADE OFFER

CUSTOM SERVICES
(Tailor-made analysis)

To meet your needs and budget/lead time constraints

- Specific and dedicated report.
- Prior-art search, literature review, patent landscape, freedom-to-operate, patent valuation, IP due diligence, technology scouting, monitoring service, etc.

Format
- PDF file with analyses.
- Excel file with data.
- Access to the analyst.

REPORTS
(multi-client product)

To understand the competitive landscape and explore the emerging ecosystems and new technologies

- Stand alone report
- Patent landscape.
- Overview on IP dynamics, trends and players.
- Competitor, technology and strategy analysis.
- Benchmark of patent portfolios.
- Key IP players & key patents.

Format
- PDF file with analyses.
- Excel file with patent data.

MONITORS
(multi-client product)

To track the latest R&D developments and IP activities, and to be sensitive to weak signals

- Annual subscription
- Patent monitoring service.
- Quarterly updated patent data and technology trends.
- Current R&D and IP activities.
- Early detect weak signals, opportunities and risks.
- Open discussion with analyst.

Format
- PDF file with analyses.
- Excel file with patent data.
- Direct access to the analyst.

INSIGHTS
(free article & webinar)

To get unique information about industry and technology

- Analyst point of view about industry news (product release, M&A, start-up, fund-raising, etc.) from a patent perspective.

Format
- Knowmade website

MAIN FIELDS OF EXPERTISE

SEMICONDUCTORS

- Materials & Substrates
- Power electronics
- RF & Wireless datacom
- MEMS, Sensing & Imaging
- Photonics, Lighting & Display
- Memory
- Packaging

HEALTHCARE

- New therapeutic tools
- Medical diagnostics
- Medical devices and imaging
- Drug discovery and delivery

ENERGY

- Batteries
- Fuel-cells
- Solar PV
- Power management

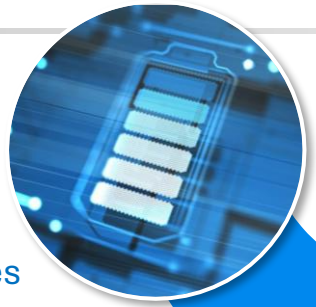
AGRI-FOOD

- Food processing & formulation
- Vegan food
- Next-gen packaging
- Microbiology

ENERGY
Expertise

Energy storage devices

- Batteries
- Fuel cells
- Supercapacitors
- Primary & Secondary devices
- Thin film & Microdevices
- Cylindrical, prismatic, pouch



Whole supply chain

- Active Materials
- Battery electrodes, electrolytes, separators
- Fuel cell electrodes, membranes, catalysts, gas diffusion layer, bipolar plates, electrolytes
- Battery cells / Fuel cells
- Battery packs / Fuel cell stacks
- Manufacturing & Recycling

Energy

from materials and cells to modules and systems

Key technologies

Li-ion batteries

- LTO, Li-metal, silicon anodes
- NMC, NCA, LNMO, LFP cathodes
- Solid electrolytes

Post Li-ion batteries

- Na-ion
- Li-S
- Mg-ion
- Al-ion
- Ca-ion
- Zn-ion
- F-ion
- Li-air

Fuel cells

- PEMFC
- SOFC
- MCFC
- PAFC
- AFC

All applications

- Automotive (BEV, FCEV)
- Consumer electronics
- Stationary energy storage

Power Management & Control

- Power electronics
- BMS
- Thermal management

KnowMade
Patent & Technology Intelligence

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06560 Sophia Antipolis, France

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contact@knowmade.fr