National Technoløgy Initiative

TECHNOLOGICAL SOVEREIGNTY MODEL

2025

TABLE OF CONTENTS

TECHNOLOGICAL SOVEREIGNTY CHALLENGES

METHODS FOR IDENTIFYING KEY TECHNOLOGIES (1/2)

National strategies

- Are based on approaches crested in the 1970-1990s (TRL, Gartner Magic Quadrant, etc.)
- Create lists of technologies without assessing their impact on achieving technological sovereignty
- Are based on unilateral promotion of interests in foreign markets
- Do not provide a basis for the implementation of equal partnership and international programs to achieve technological sovereignty

USA

List of critical and new technologies – a too for shaping the strategy of technological competitiveness and national security:

- Advanced computing techniques
- New engineering materials
- Gas turbine engine technologies
- Advanced networked management of semsors and signatures
- Modern production
- Artificial intelligence
- Biotechnologies
- Production and storage of clean energy
- Privacy, data protection and cybersecurity technologies
- Energy
- Highly automated systems and robotics
- Human-machine interfaces
- Hypersonic technologies
- Integrated communications and networking technologies
- Location, navigation and time technologies
- Quantum Information and assistive technologies
- Semiconductors and microelectronics
- Space technologies and systems

Source:

https://clck.ru/3JfJAs

EUROPEAN UNION

Strategic Technology Platform of 11 programs across three targeted investment areas:

1. Digital technologies and high-tech innovations
2. Clean and resource-efficient technologies
3. Biotechnologies

Previously announced technology initiatives:

- Advanced materials for industrial leadership
- Zero Emissions Industry
- Search, processing of critical raw materials and materials (lithium, cobalt, nickel, gallium, raw boron, titanium, tungsten), ensuring supply chain security
- Microelectronics (new generation chips)
- Closed-loop economy
- Secure satellite communications for critical infrastructure and motion control of autonomous spacecraft (high-speed satellite Internet, mobile broadband satellite communications, satellite networks for computing and the Internet of Things)

Source:

https://strategic-technologies.europa.eu/index_en

CHINA

Fourteenth Five-Year Plan for National Economic and Social Development of the PRC and Long-Term Goals Forecast for 2035

S&T Priorities:

- Информационные технологии нового поколения
- New generation information technologies
- Biotechnologies
- New and hydrogen energy
- New materials
- Quantum Informatics
- Genetic technologies
- Development of maritime airspace and outer space
- Energy saving
- Comprehensive design of integrated transportation systems
- Renewable energy sources (increasing share in total energy sources)
- Environmental technologies that promote economic development

Source:

https://www.gov.cn/xinwen/2021-03/13/content_5592681.htm

TECHNOLOGICAL SOVEREIGNTY CHALLENGES

METHODS FOR IDENTIFYING KEY TECHNOLOGIES (2/2)

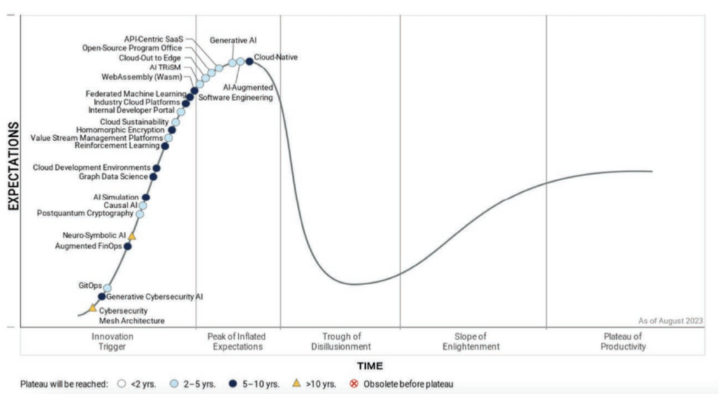
International think tanks

- Meet the interests of investors, business objectives and product strategies of big companies
- Use a marketing-driven approach in promoting technologies
- Do not provide a unified framework for achieving technological sovereignty at the international level

Large-scale marketing campaigns

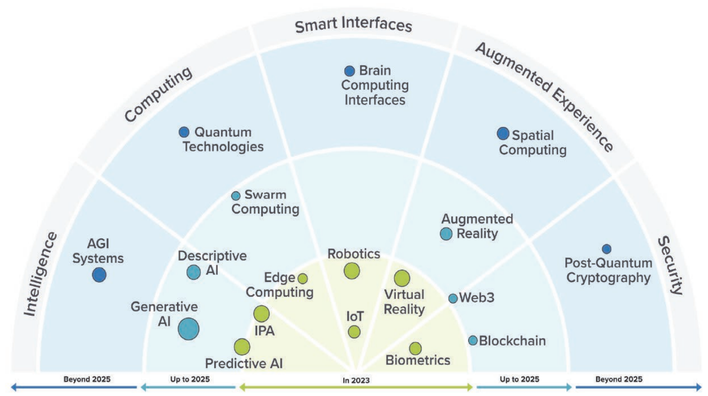
- Industry 4.0 (Germany)
- Metaverse (Meta*)
- One Belt, One Road (China)

Russia
(according to the classifier of the Ministry of Education and Science of Russia, Ministry of Economic Development of Russia, ministry of Industry and Trade of Russia) uncritically uses outdated approaches oriented to a different economic structure



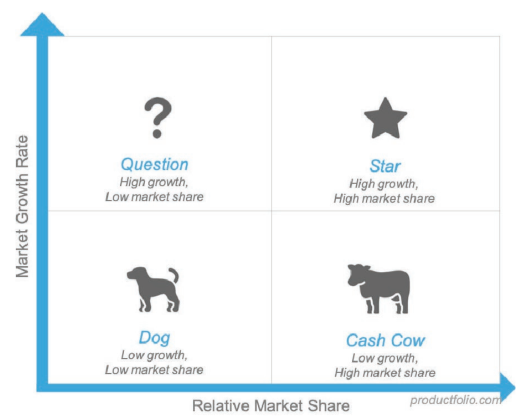
GARTNER curve

A marketing tool for technology promotion, reflecting investors' attention and the level of technology adoption at different stages of the product life cycle



IDC RADAR **(INTERNATIONAL DATA CORPORATION)**

Assessment of technology maturity and the number of organizations planning to adopt the technology in the short, medium and long term



BCG "MATRIX"

A marketing tool for analyzing business products in 1970, relevant to the previous wave of globalization and focused on getting maximum market share for companies

What might the Russian method look like?

1. Focused on technological sovereignty
2. Focused on critical and end-to-end technologies
3. Clear, transparent and attractive for friendly countries

* Prohibited in the Russian Federation

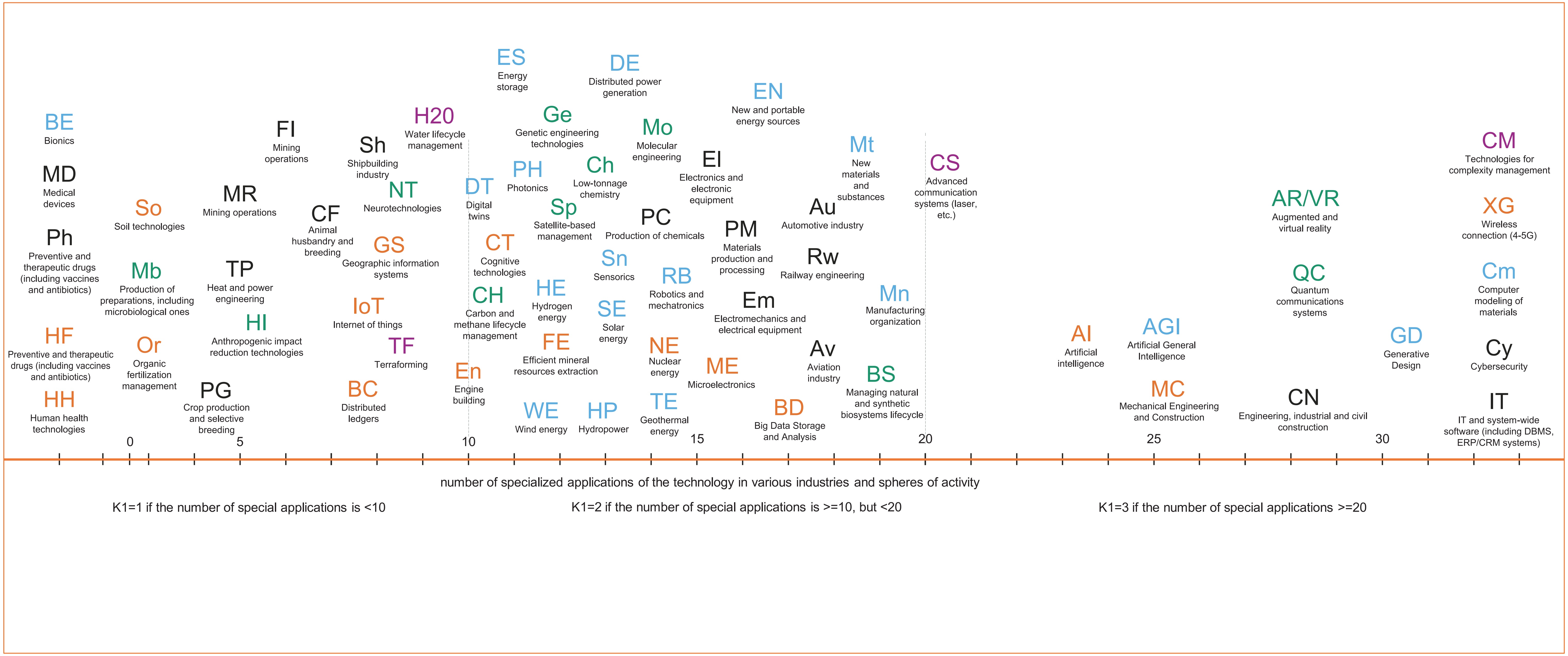
TECHNOLOGICAL SOVEREIGNTY CHALLENGES

TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (1/6)

W1
0.3
WEIGHT

K1. "Valence" (degree of "End-to-end ability")

Is calculated on an estimate of the number of specialized applications of a technology in industries END-TO-END ABILITY = N(applications). The highest K1 score is assigned to the technology that has the most specialized applications.

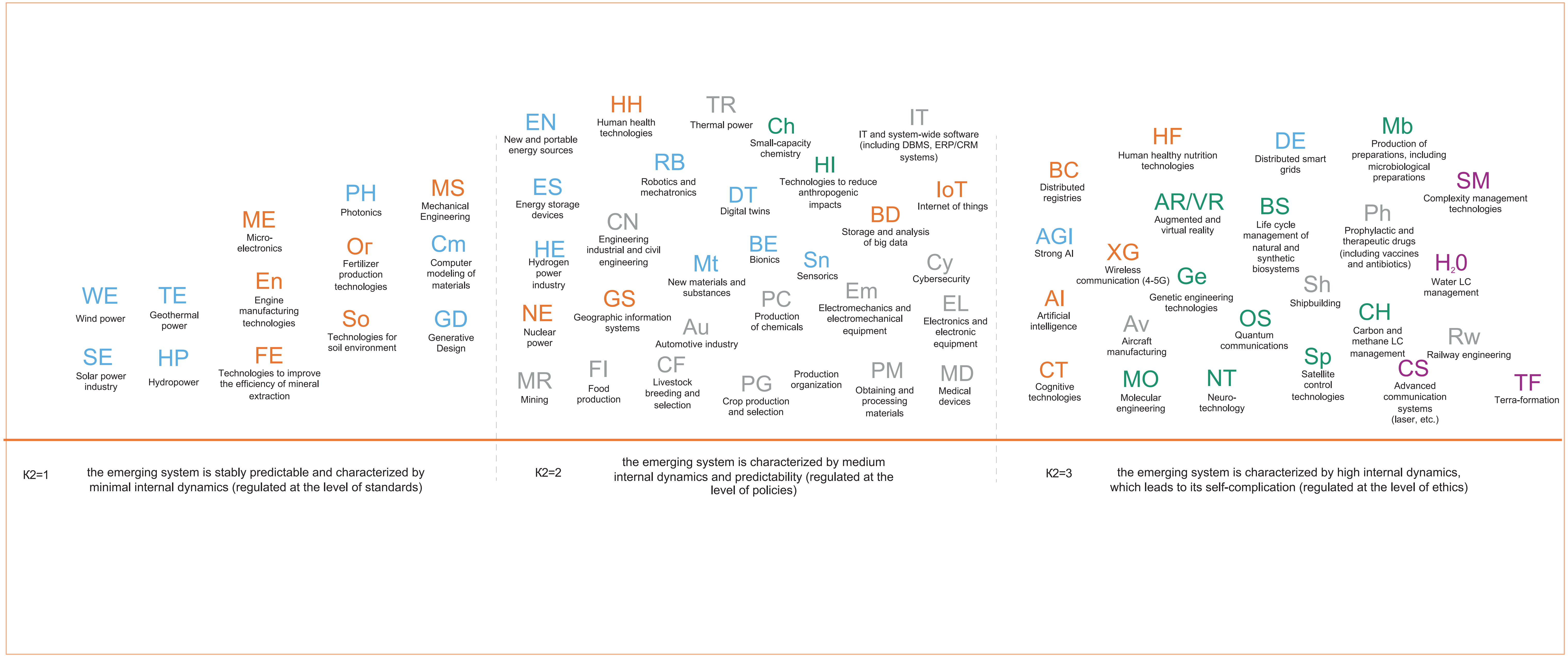


TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (2/6)

W2
0.2
WEIGHT

K2. Degree of complexity of the technology in terms of managing complexity

Is calculated by expert opinion on the complexity of the implemented systems and degree of necessary regulation. The highest K2 score is given to the technology that produces the most complex systems.



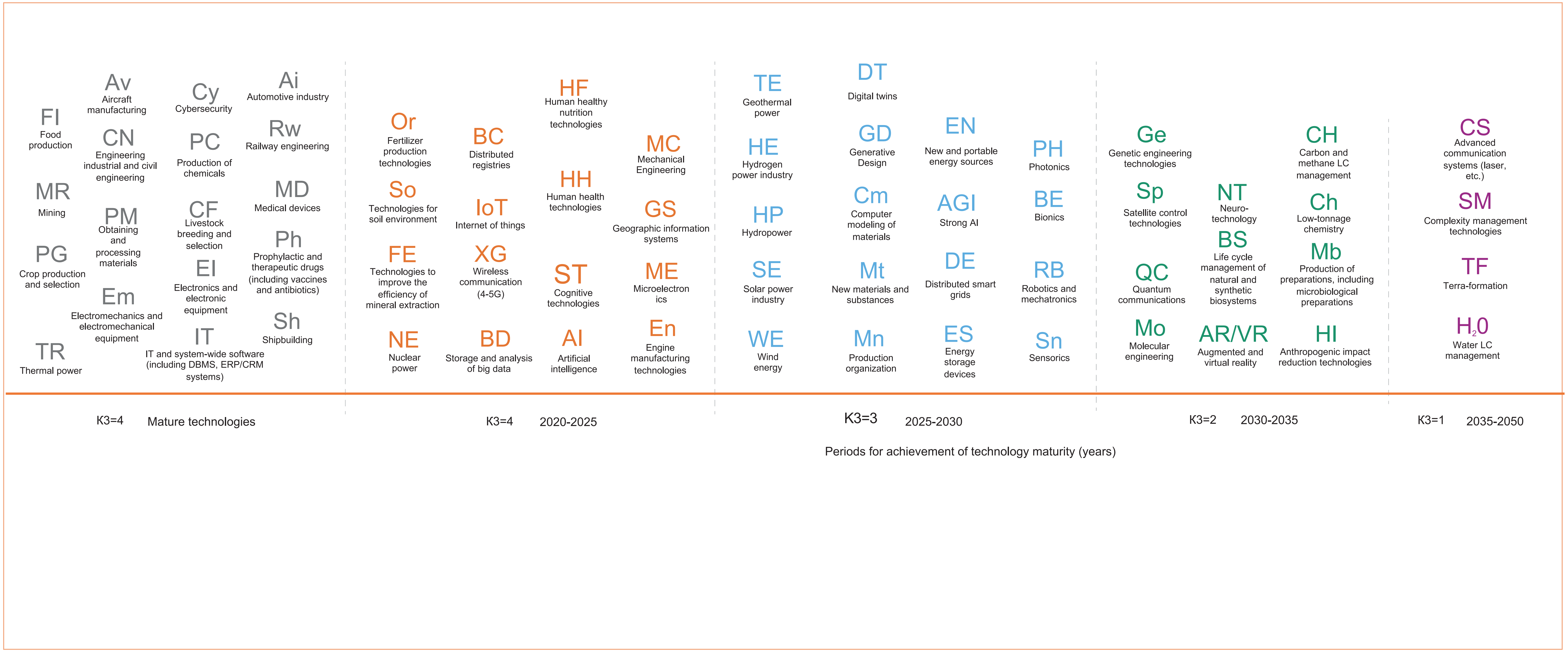
TECHNOLOGICAL SOVEREIGNTY CHALLENGES

TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (3/6)

W3
0.2
WEIGHT

K3. Maturity period

Is calculated according to the market research on the technology package readiness performed by analytical agencies. The highest score for the K3 indicator is assigned to the most mature technology, because at the time of calculation it can have the greatest impact on the achievement of technical sovereignty.

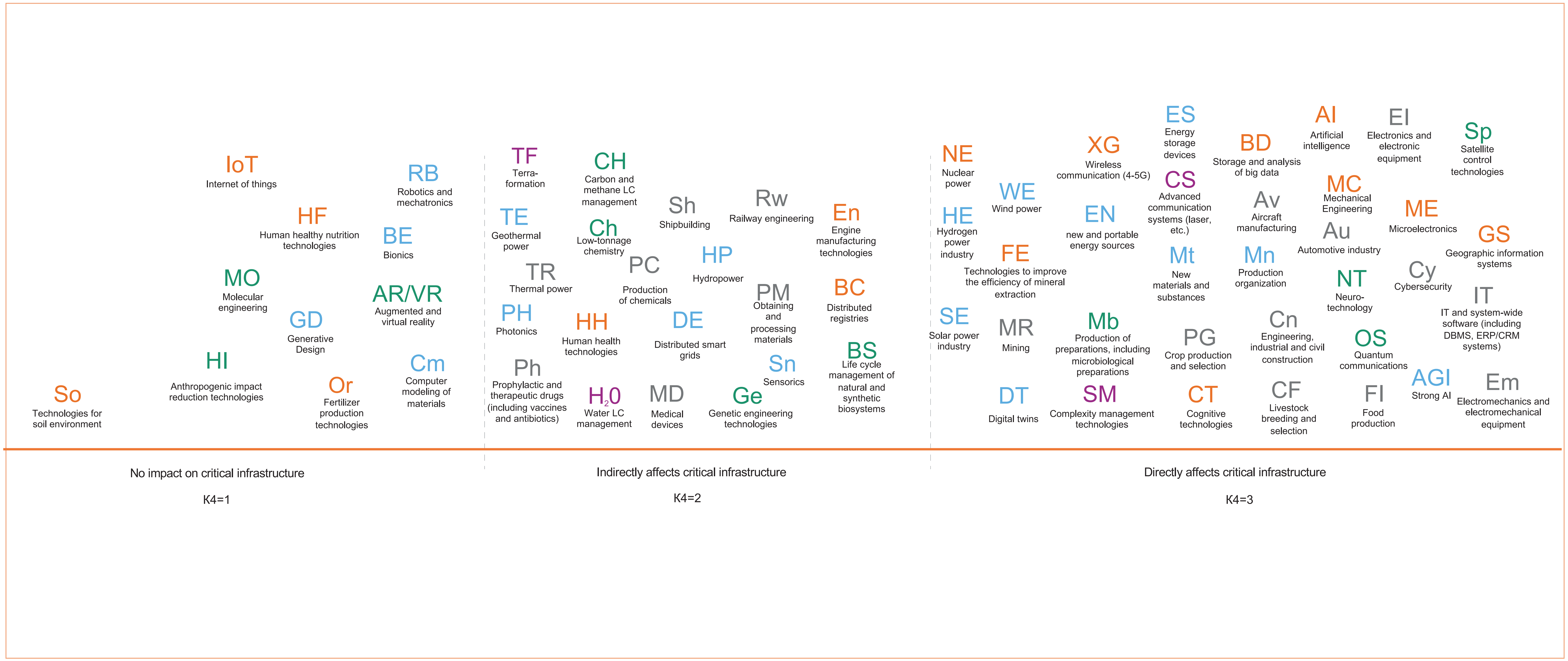


TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (4/6)

W4
0.2
WEIGHT

K4. Degree of impact on critical infrastructure

Is calculated based on expert opinion on degree of impact the technology has on the state's critical infrastructure. The highest K4 score is assigned to a technology that has a direct impact on a country/state's CI.

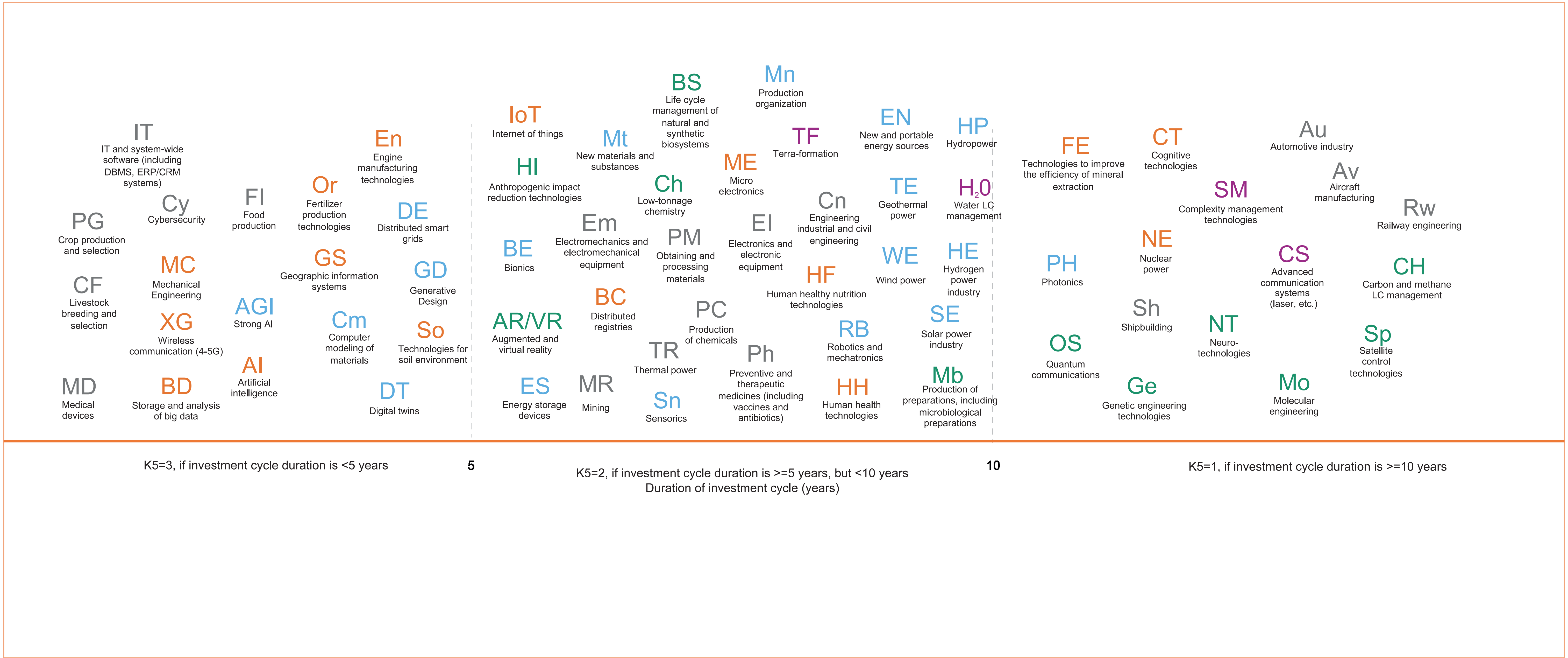


TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (5/6)

W5
0.1
WEIGHT

K5. Length of the technology investment cycle

Is calculated on the basis of analytical studies of agencies on the payback period of technology projects. The highest score for the K5 indicator is assigned to the technology with the shortest investment cycle, since its implementation can most quickly produce a positive economic effect.



TECHNOLOGY ASSESSMENT CRITERIA AND SOVEREIGNTY IMPACT ANALYSIS (6/6)

TS. Comprehensive assessment of the technology's impact on sovereignty

To be calculated as a weighted average as per K1-K5 criteria.
The highest score (2 or more) means that the technology has a direct impact on sovereignty and should be developed first.

$$TS = K1 \times W1 + K2 \times W2 + K3 \times W3 + K4 \times W4 + K5 \times W5$$

0		1		2	
	No impact on technological sovereignty		Indirectly affects technological sovereignty		Direct impact on technological sovereignty

TECHNOLOGICAL SOVEREIGNTY CHALLENGES

"PERIODIC TABLE" OF TECHNOLOGIES (1/2)

SECOND EDITION
2024-05-12

The estimate is made for the horizon 2020–2030 and may dynamically change in the future

The evaluation of technology indices by scales is of expert character and is given to illustrate end-to-end technologies that have the greatest impact on technological sovereignty

"Valence" (degree of "end-to-end ability" / "penetrability") of the technology: 0 – 10 – 20

Cn [2,9] Engineering, industrial and civil construction COMPLEXITY 2 CRIT 3 INVEST 2	**IT** [3,0] IT and system-wide software (including DBMS, ERP/CRM-systems) COMPLEXITY 2 CRIT 3 INVEST 3	**Cy** [3,0] Cybersecurity COMPLEXITY 2 CRIT 3 INVEST 3	**XG** [3,2] Wireless connection (4 -5G) COMPLEXITY 3 CRIT 3 INVEST 3	**MC** [2,8] Mechanical Engineering and construction COMPLEXITY 1 CRIT 3 INVEST 3	**AI** [3,2] Artificial intelligence COMPLEXITY 3 CRIT 3 INVEST 3
	El [2,6] Electronics and electronic equipment COMPLEXITY 2 CRIT 3 INVEST 2	**Au** [2,5] Automotive industry COMPLEXITY 2 CRIT 3 INVEST 1	**BD** [2,7] Big Data Storage and Analysis COMPLEXITY 2 CRIT 3 INVEST 3	**Me** [2,4] Micro-electronics COMPLEXITY 1 CRIT 3 INVEST 2	**DT** [2,5] Digital twins DIFFICULTY 2 CRIT 3 INVEST 3
	Em [2,6] Electromechanics and electrical equipment COMPLEXITY 2 CRIT 3 INVEST 2	**Av** [2,7] Aviation industry COMPLEXITY 3 CRIT 3 INVEST 1	**FE** [2,3] Efficient mineral resources extraction COMPLEXITY 1 CRIT 3 INVEST 1	**En** [2,3] Engine building COMPLEXITY 1 CRIT 2 INVEST 3	**ES** [2,4] Energy storage COMPLEXITY 2 CRIT 3 INVEST 2
PM [2,4] Materials production and processing COMPLEXITY 2 CRIT 2 INVEST 2	**PS** [2,4] Production of chemicals and solutions COMPLEXITY 2 CRIT 2 INVEST 2	**Rw** [2,5] Railway engineering COMPLEXITY 3 CRIT 2 INVEST 1	**NE** [2,5] Nuclear energy COMPLEXITY 2 CRIT 3 INVEST 1	**CT** [2,7] Cognitive technologies COMPLEXITY 3 CRIT 3 INVEST 1	**HE** [2,4] Hydrogen energy COMPLEXITY 2 CRIT 3 INVEST 2
	CF [2,4] Animal husbandry and breeding COMPLEXITY 2 CRIT 3 INVEST 3	**Sh** [2,2] Shipbuilding industry COMPLEXITY 3 CRIT 2 INVEST 1	**BC** [2,3] Distributed ledgers COMPLEXITY 3 CRIT 2 INVEST 2	**GS** [2,4] Geographic information systems COMPLEXITY 2 CRIT 3 INVEST 3	**HP** [2,3] Hydropower COMPLEXITY 1 CRIT 2 INVEST 2
PG [2,4] Crop production and selective breeding COMPLEXITY 2 CRIT 3 INVEST 3	**TP** [2,1] Heat and power engineering COMPLEXITY 2 CRIT 2 INVEST 2	**Ph** [2,3] Preventive and therapeutic drugs (including vaccines and antibiotics) COMPLEXITY 3 CRIT 2 INVEST 1	**Or** [2,0] Organic fertilization management COMPLEXITY 2 CRIT 1 INVEST 3	**So** [2,0] Soil technologies COMPLEXITY 2 CRIT 1 INVEST 3	**SE** [2,2] Solar energy COMPLEXITY 1 CRIT 3 INVEST 2
MR [2,3] Mining operations COMPLEXITY 2 CRIT 3 INVEST 2	**FI** [2,4] Food processing COMPLEXITY 2 CRIT 2 INVEST 2	**MD** [2,2] Medical devices COMPLEXITY 2 CRIT 2 INVEST 3	**HF** [2,1] Healthy human nutrition solutions COMPLEXITY 3 CRIT 1 INVEST 2	**HH** [2,1] Human health technologies COMPLEXITY 2 CRIT 2 INVEST 2	

Mature technologies — 2020 — 2023 — 2025 — 2028

2020-2025 — 2025-2030

TECHNOLOGICAL SOVEREIGNTY CHALLENGES

"PERIODIC TABLE" OF TECHNOLOGIES (2/2)

AGI ●●● [3,0] Artificial General Intelligence COMPLEXITY 3 CRIT 3 INVEST 3	**AR/VR** ● [2,3] Augmented and virtual reality COMPLEXITY 3 CRIT 1 INVEST 2	**QC** ● [2,6] Quantum communications systems COMPLEXITY 3 CRIT 3 INVEST 1	**CM** ● [2,4] Technologies for complexity management COMPLEXITY 3 CRIT 3 INVEST 1
Mn ● [2,4] Manufacturing organization DIFFICULTY 2 CRIT 3 INVEST 2	**Mt** ● [2,4] New materials and substances COMPLEXITY 2 CRIT 3 INVEST 2	**BS** ●●● [2,2] Managing natural and synthetic biosystems lifecycle COMPLEXITY 3 CRIT 2 INVEST 2	**CS** ● [2,4] Advanced communication systems (laser, etc.) COMPLEXITY 3 CRIT 3 INVEST 1
Sn ● [2,2] Sensorics COMPLEXITY 2 CRIT 2 INVEST 2	**Ge** ● [2,1] Genetic engineering technologies COMPLEXITY 3 CRIT 2 INVEST 1	**Sp** ● [2,3] Sattelite-based management COMPLEXITY 3 CRIT 3 INVEST 1	
DE ●●● [2,5] Distributed power generation COMPLEXITY 3 CRIT 2 INVEST 3	**Ch** ●● [2,0] Low-tonnage chemistry COMPLEXITY 2 CRIT 2 INVEST 2		
TE ● [2,0] Geothermal energy COMPLEXITY 1 CRIT 2 INVEST 2	**NT** ● [2,0] Neurotechnologies COMPLEXITY 3 CRIT 3 INVEST 1	**CH** ●● [2,1] Carbon and methane lifecycle management COMPLEXITY 3 CRIT 2 INVEST 1	**H_20** ●● [2,0] Water lifecycle management COMPLEXITY 3 CRIT 2 INVEST 2
WE ● [2,2] Wind energy COMPLEXITY 1 CRIT 3 INVEST 2			**TF** ●● [2,0] Terraforming COMPLEXITY 3 CRIT 2 INVEST 2
	Mb ● [2,1] Production of preparations, including microbiological ones COMPLEXITY 3 CRIT 3 INVEST 2		

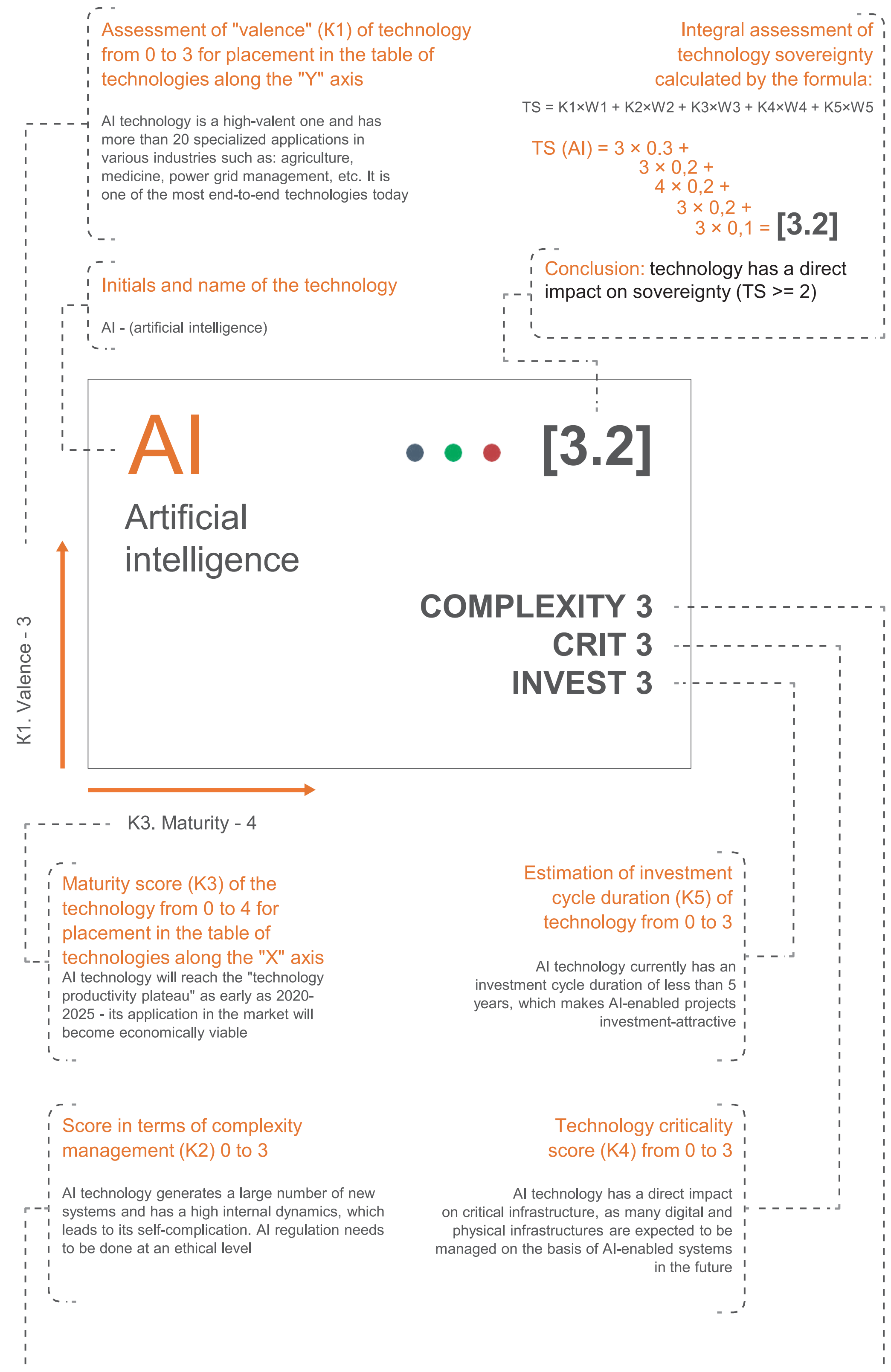
The period for achievement of technology maturity

2028 — 2030 — 2033 — 2035 — 2050

2025-2030 — 2030-2035 — 2035-2050

Maturity period

Example of a cell of a "periodic table" of technologies



The use of technology has an impact:

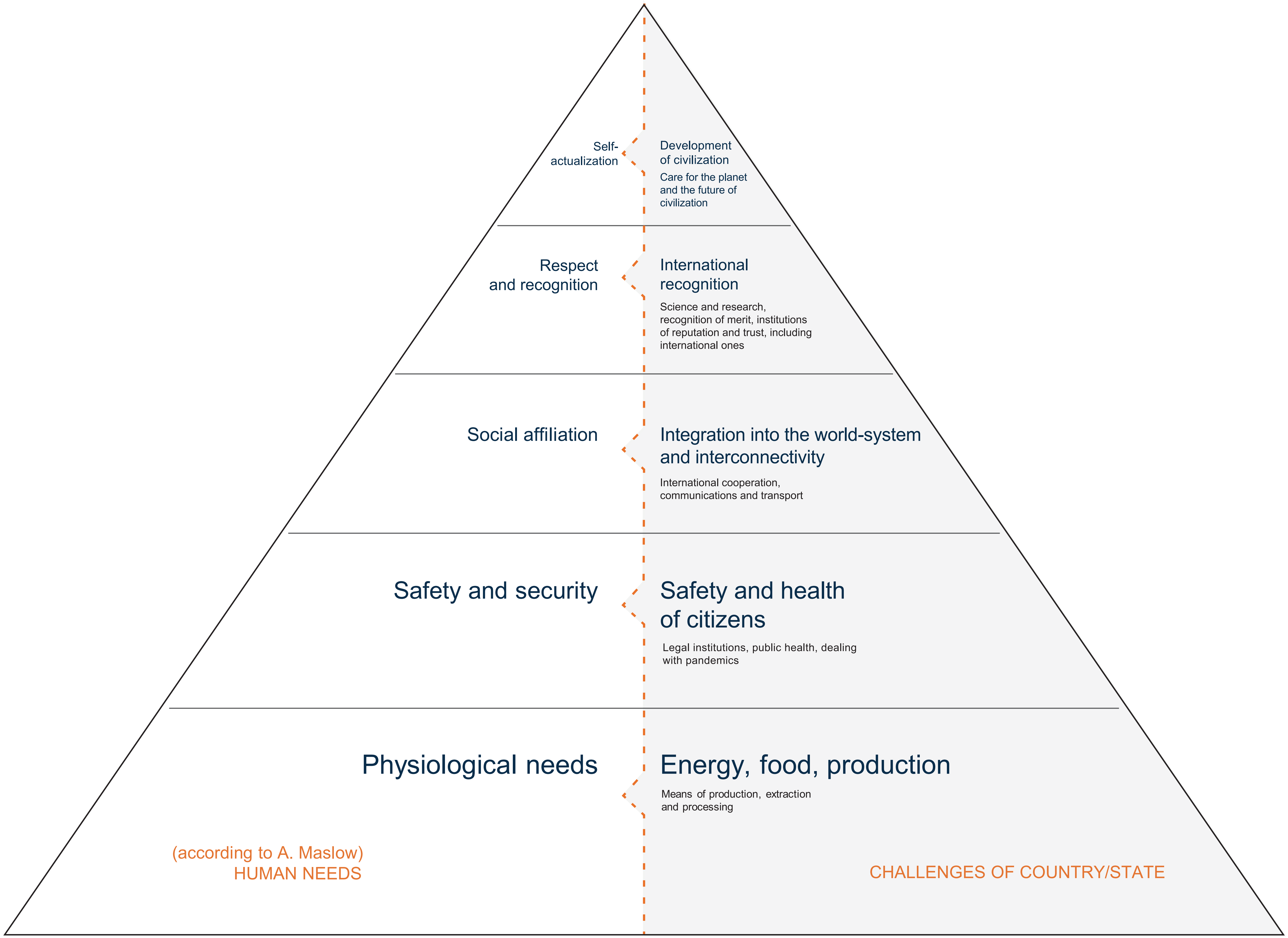
- ● on energy
- ● on space on
- ● person

The period for achievement of technology maturity:

- AI 2020-2025
- HE 2025-2030
- QC 2030-2035
- CS 2035-2050
- MR Mature technologies

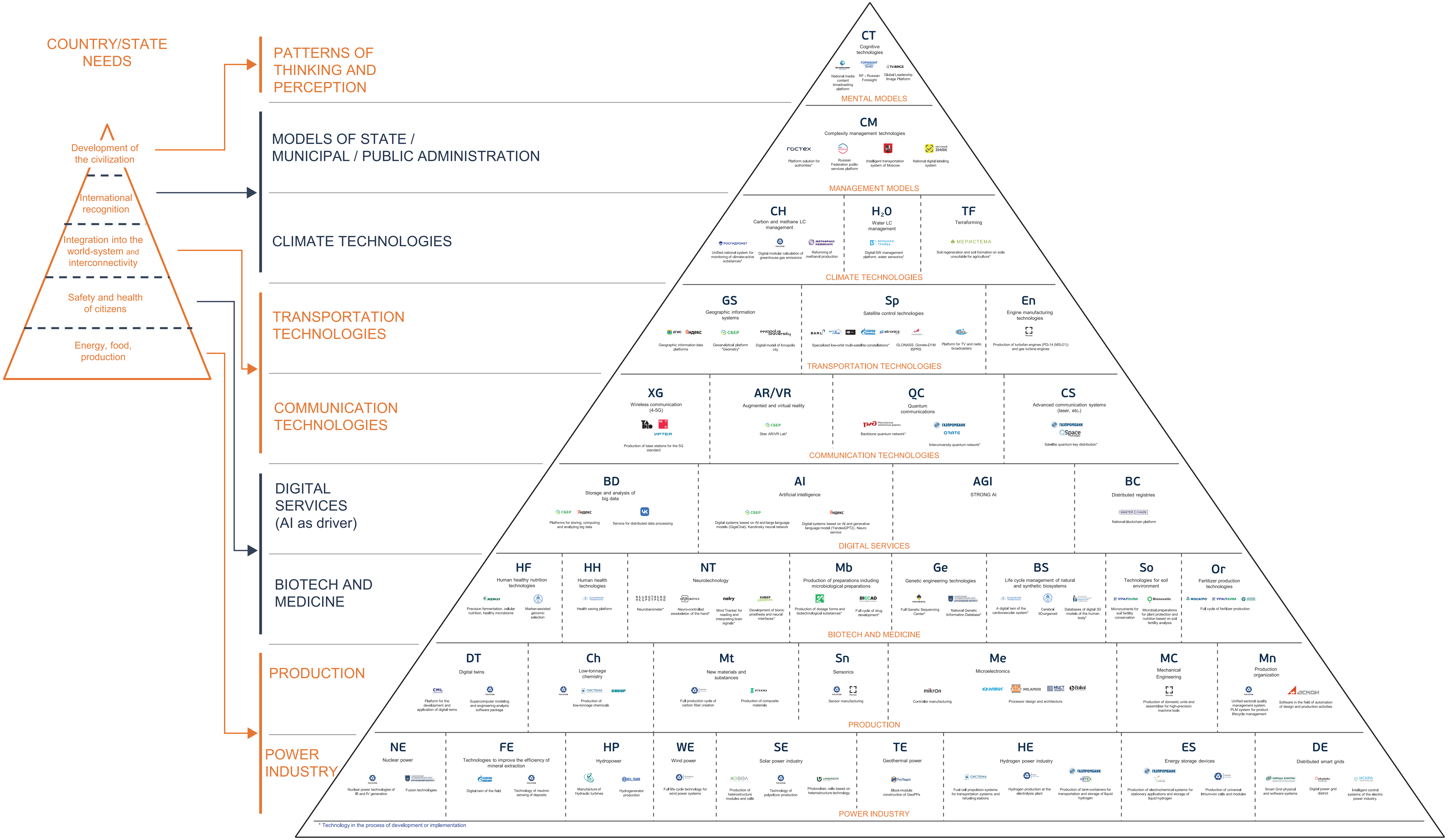
TECHNOLOGICAL SOVEREIGNTY MODEL

MASLOW'S HIERARCHY OF NEEDS AND THE GOALS OF THE STATE



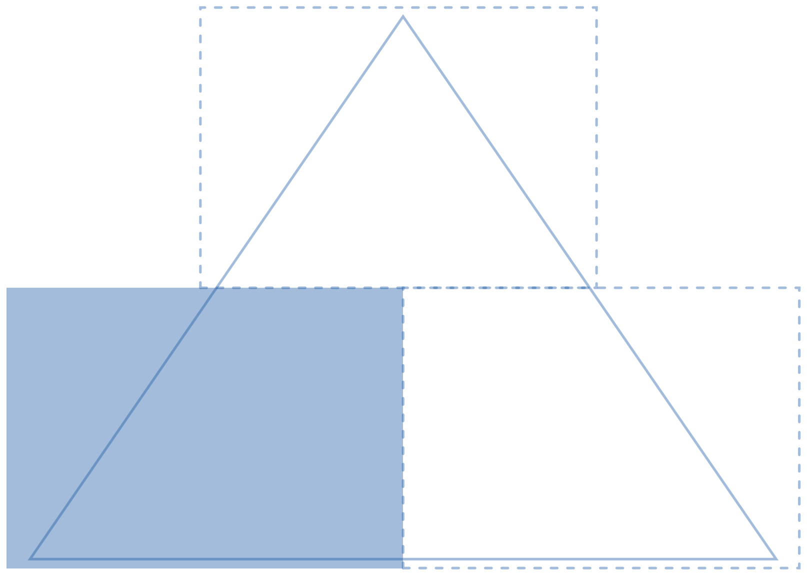
TECHNOLOGICAL SOVEREIGNTY MODEL

RUSSIAN COMPANIES AND PROJECTS (1/4)



TECHNOLOGICAL SOVEREIGNTY MODEL

RUSSIAN COMPANIES AND PROJECTS (2/4)



DIGITAL SERVICES

BD
Storage and analysis of big data

- Platforms for storing, computing and analyzing big data
- Service for distributed data processing

AI
Artificial intelligence

- Digital systems based on AI and large language models (GigaChat). Kandinsky neural network
- Digital systems based on AI and generative language model (YandexGPT2). Neuro service

BIOTECH AND MEDICINE

HF
Human healthy nutrition technologies

- Precision fermentation, cellular nutrition, healthy microbiome
- Marker-assisted genomic selection

HH
Human health technologies

- Health saving platform

NT
Neurotechnology

- Neurobarometer*
- Neuro-controlled exoskeleton of the hand*
- Mind Tracker for reading and interpreting brain signals*
- Development of bionic prosthesis and neural interfaces*

Mb
Production of preparations including microbiological preparations

- Production of dosage forms and biotechnological substances*
- Full cycle of drug development*

PRODUCTION

DT
Digital twins

- Platform for the development and application of digital twins
- Supercomputer modeling and engineering analysis software package

Ch
Low-tonnage chemistry

- Production of low-tonnage chemicals

Mt
New materials and substances

- Full production cycle of carbon fiber creation
- Production of composite materials

Sn
Sensorics

- Sensor manufacturing

POWER INDUSTRY

NE
Nuclear power

- Nuclear power technologies of III and IV generation
- Fusion technologies

FE
Technologies to improve the efficiency of mineral extraction

- Digital twin of the field
- Technology of neutron sensing of deposits

HP
Hydropower

- Manufacture of Hydraulic turbines
- Hydrogenerator production

WE
Wind power

- Full life cycle technology for wind power systems

SE
Solar power industry

- Production of heterostructure modules and cells
- Technology of polysilicon production
- Photovoltaic cells based on heterostructure technology

* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

RUSSIAN COMPANIES AND PROJECTS (3/4)

DIGITAL SERVICES

AGI
STRONG AI

BC
Distributed registries
- National blockchain platform

BIOTECH AND MEDICINE

Ge
Genetic engineering technologies
- Full Genetic Sequencing Center*
- National Genetic Information Database*

BS
Life cycle management of natural and synthetic biosystems
- A digital twin of the cardiovascular system*
- Cerebral 3D-organoid
- Databases of digital 3D models of the human body*

So
Technologies for soil environment
- Micronutrients for soil fertility conservation
- Microbial preparations for plant protection and nutrition based on soil fertility analysis

Or
Fertilizer production technologies
- Full cycle of fertilizer production

PRODUCTION

Me
Microelectronics
- Controller manufacturing
- Processor design and architecture

MC
Mechanical Engineering
- Production of domestic units and assemblies for high-precision machine tools

Mn
Production organization
- Unified sectoral quality management system. PLM system for product lifecycle management
- Software in the field of automation of design and production activities

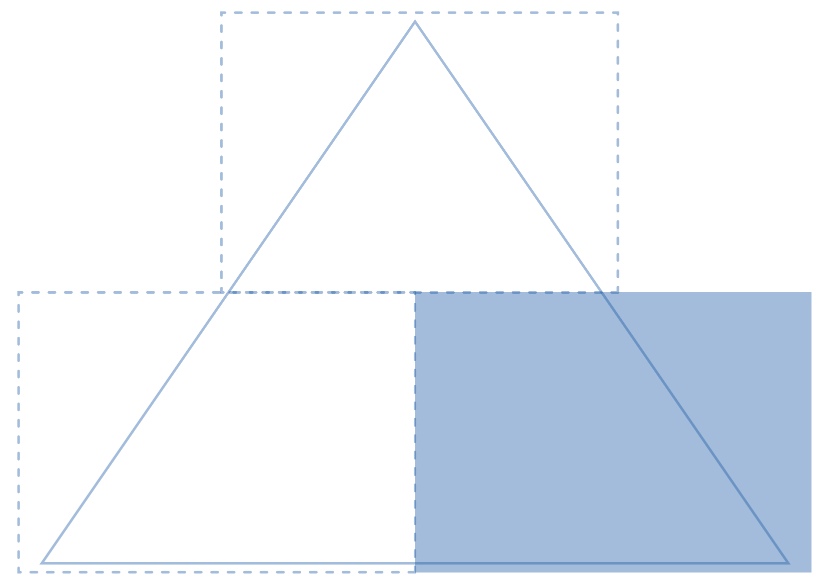
POWER INDUSTRY

TE
Geothermal power
- Block-module construction of GeoPPs

HE
Hydrogen power industry
- Fuel cell propulsion systems for transportation systems and refueling stations
- Hydrogen production at the electrolysis plant
- Production of tank-containers for transportation and storage of liquid hydrogen

ES
Energy storage devices
- Production of electrochemical systems for stationary applications and storage of liquid hydrogen
- Production of universal lithium-ion cells and modules

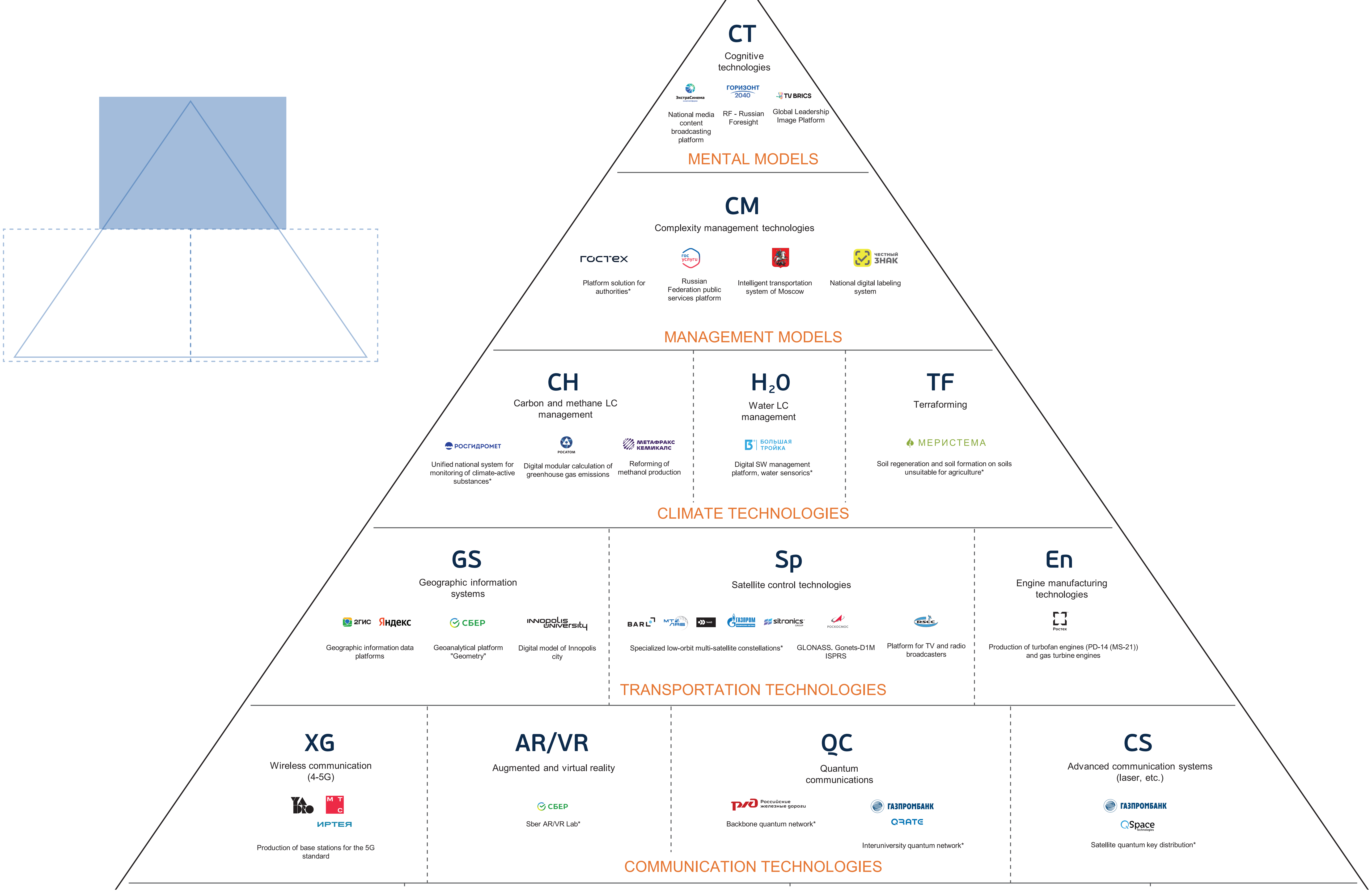
DE
Distributed smart grids
- Smart Grid physical and software systems
- Digital power grid district
- Intelligent control systems of the electric power industry.



* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

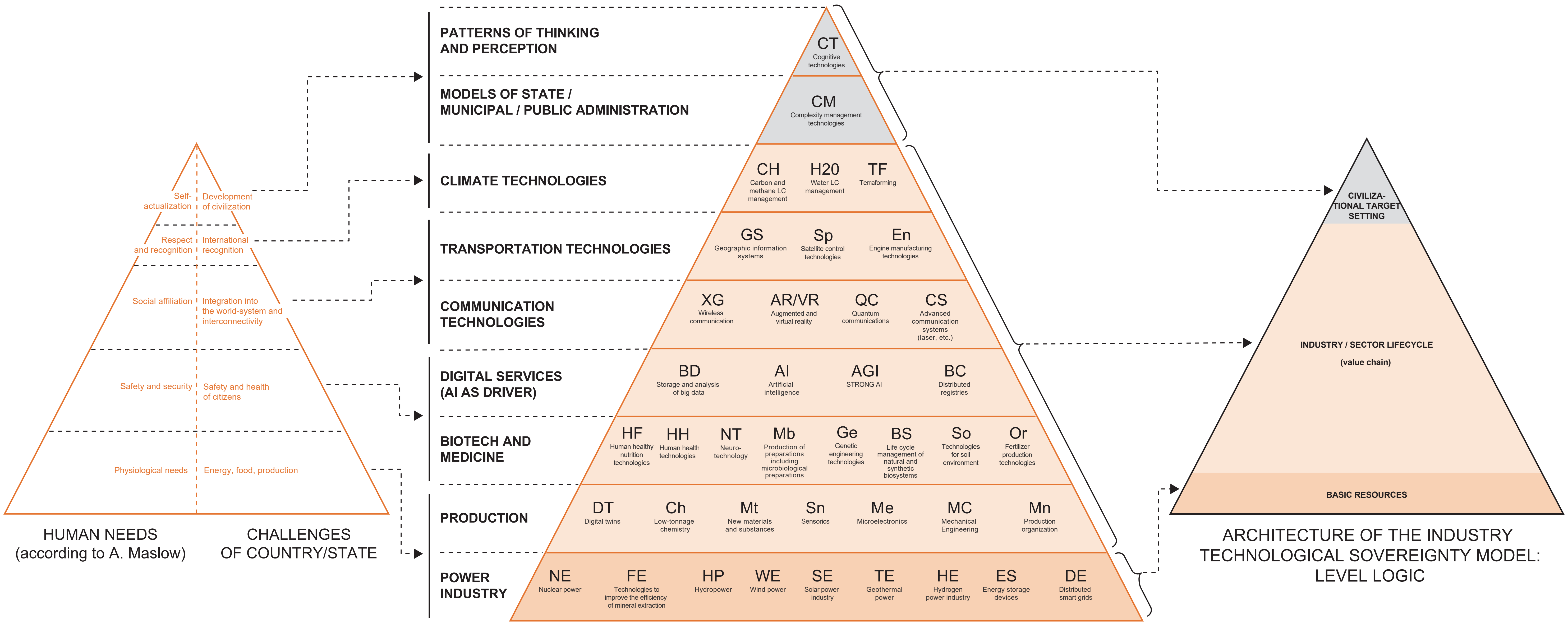
RUSSIAN COMPANIES AND PROJECTS (4/4)



* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

APPROACHES TO COMPLETING THE TECHNOLOGICAL SOVEREIGNTY CHALLENGES



THE TECHNOLOGICAL SOVEREIGNTY MODEL

At each level of the pyramid of state objectives are placed technologies that will have a significant impact on technological sovereignty in the horizon of 2030-2036. The technologies are structured into nine groups, forming the **Model of Technological Sovereignty of the State.**

To build sovereignty, the state must hold the "keys" to technology - advanced basic science and education programmes, advanced standards, and widespread adoption of artificial intelligence and new materials.

These "keys" reside in centres of competence - leading technology companies developing cutting-edge products and platforms.

The state technological sovereignty model is decomposed into a more detailed set of industry technological sovereignty models:

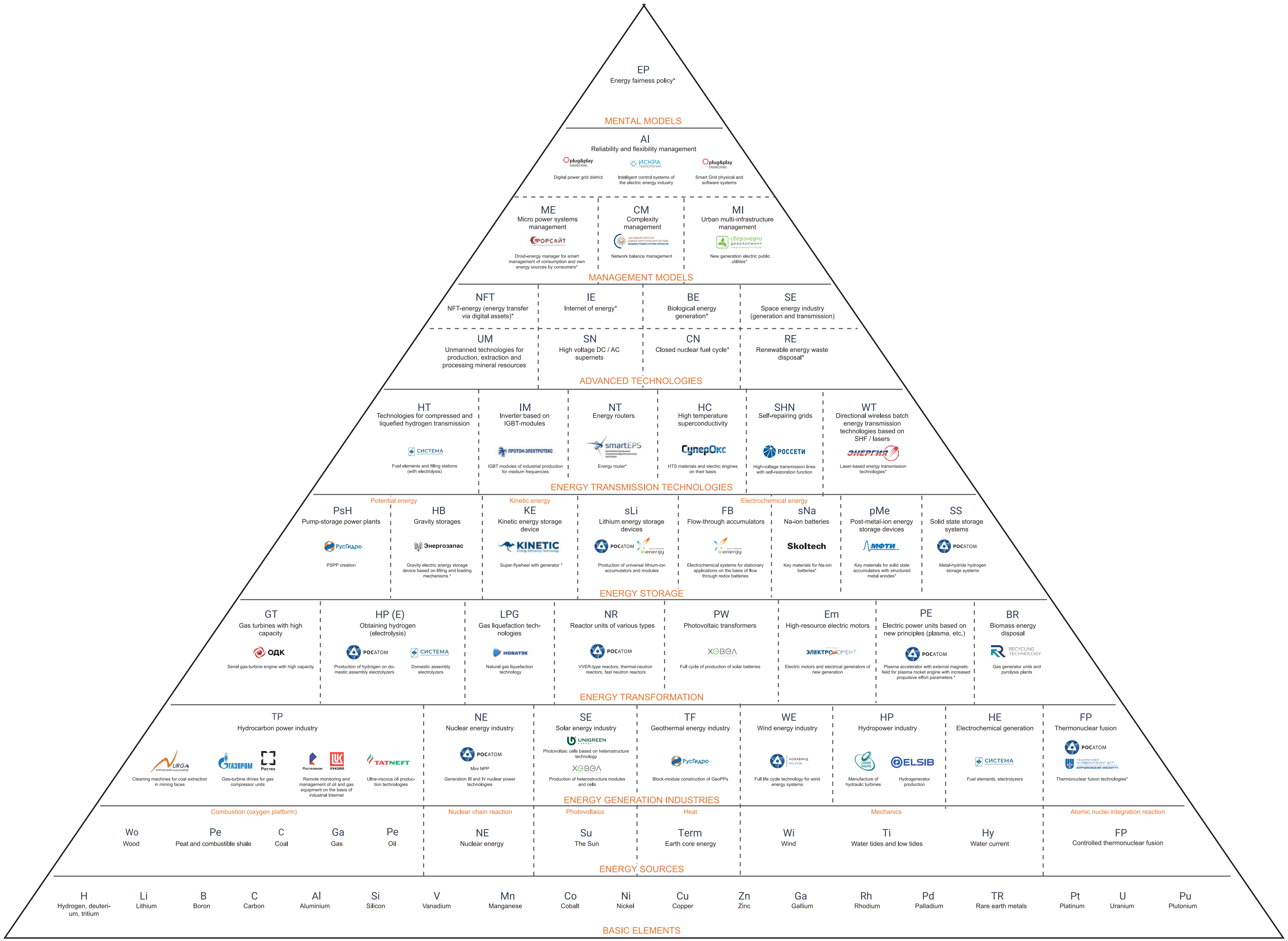
- for technologies of a certain level (e.g. energy level)
- for technologies of a certain domain (e.g. extraction efficiency technologies)

The definition of levels of the industry model of technological sovereignty is based on the pyramid of basic human needs and goals of the state, and it is possible to distinguish 3 macro-levels:

- CIVILIZATIONAL TARGET SETTING
- INDUSTRY/SECTOR LIFE CYCLE
- BASIC RESOURCES

TECHNOLOGICAL SOVEREIGNTY MODEL

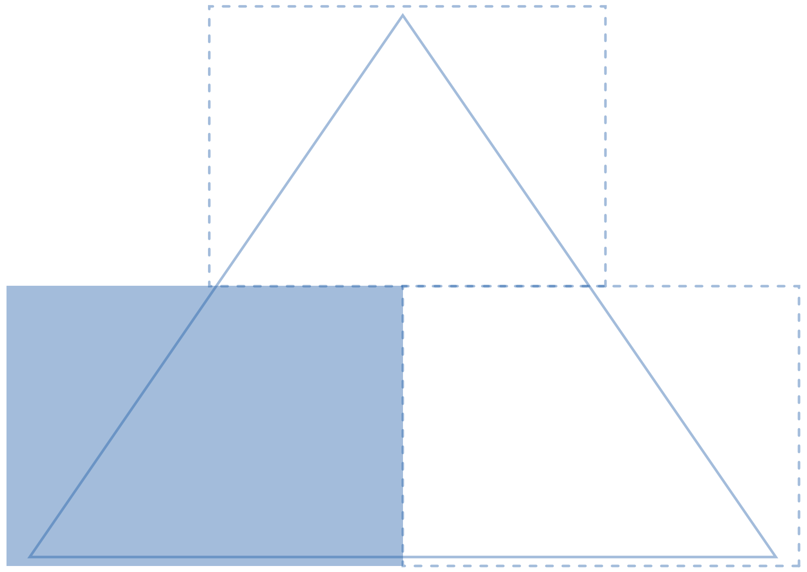
ENERGY (1/4)



* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

ENERGY (2/4)



ENERGY STORAGE

Potential energy

PsH
Pump-storage power plants
PSPP creation

HB
Gravity storages
Gravity electric energy storage device based on lifting and loading mechanisms *

Kinetic energy

KE
Kinetic energy storage device
Super-flywheel with generator *

sLi
Lithium energy storage devices
Production of universal lithium-ion accumulators and modules

ENERGY TRANSFORMATION

GT
Gas turbines with high capacity
Serial gas-turbine engine with high capacity

HP (E)
Obtaining hydrogen (electrolysis)
Production of hydrogen on domestic assembly electrolyzers
Domestic assembly electrolyzers

LPG
Gas liquefaction technologies
Natural gas liquefaction technology

NR
Reactor units of various types
VVER-type reactors, thermal-neutron reactors, fast neutron reactors

ENERGY GENERATION INDUSTRIES

TP
Hydrocarbon power industry
Cleaning machines for coal extraction in mining faces
Gas-turbine drives for gas compressor units
Remote monitoring and management of oil and gas equipment on the basis of industrial Internet
Ultra-viscous oil production technologies

NE
Nuclear energy industry
Mini NPP
Generation III and IV nuclear power technologies

SE
Solar energy industry
Photovoltaic cells based on heterostructure technology
Production of heterostructure modules and cells

ENERGY SOURCES

Combustion (oxygen platform)

Wo	Pe	C	Ga	Pe
Wood	Peat and combustible shale	Coal	Gas	Oil

Nuclear chain reaction

NE
Nuclear energy

Photovoltaics

Su
The Sun

BASIC ELEMENTS

H	Li	B	C	Al	Si	V	Mn	Co	Ni
Hydrogen, deuterium, tritium	Lithium	Boron	Carbon	Aluminium	Silicon	Vanadium	Manganese	Cobalt	Nickel

* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

ENERGY (3/4)

ENERGY STORAGE

Electrochemical energy

FB — Flow-through accumulators
inenergy
Electrochemical systems for stationary applications on the basis of flow through redox batteries

sNa — Na-ion batteries
Skoltech
Key materials for Na-ion batteries*

pMe — Post-metal-ion energy storage devices
МФТИ
Key materials for solid state accumulators with structured metal anodes*

SS — Solid state storage systems
РОСАТОМ
Metal-hydride hydrogen storage systems

ENERGY TRANSFORMATION

PW — Photovoltaic transformers
ХЕВЕЛ
Full cycle of production of solar batteries

Em — High-resource electric motors
ЭЛЕКТРОМОМЕНТ
Electric motors and electrical generators of new generation

PE — Electric power units based on new principles (plasma, etc.)
РОСАТОМ
Plasma accelerator with external magnetic field for plasma rocket engine with increased propulsive effort parameters *

BR — Biomass energy disposal
RECYCLING TECHNOLOGY
Gas generator units and pyrolysis plants

ENERGY GENERATION INDUSTRIES

TF — Geothermal energy industry
РусГидро
Block-module construction of GeoPPs

WE — Wind energy industry
НОВАВИНД РОСАТОМ
Full life cycle technology for wind energy systems

HP — Hydropower industry
Силовые машины
Manufacture of hydraulic turbines
ELSIB
Hydrogenerator production

HE — Electrochemical generation
СИСТЕМА
Fuel elements, electrolyzers

FP — Thermonuclear fusion
РОСАТОМ
Национальный исследовательский центр «Курчатовский институт»
Thermonuclear fusion technologies*

ENERGY SOURCES

Heat

Term — Earth core energy

Mechanics

Wi — Wind

Ti — Water tides and low tides

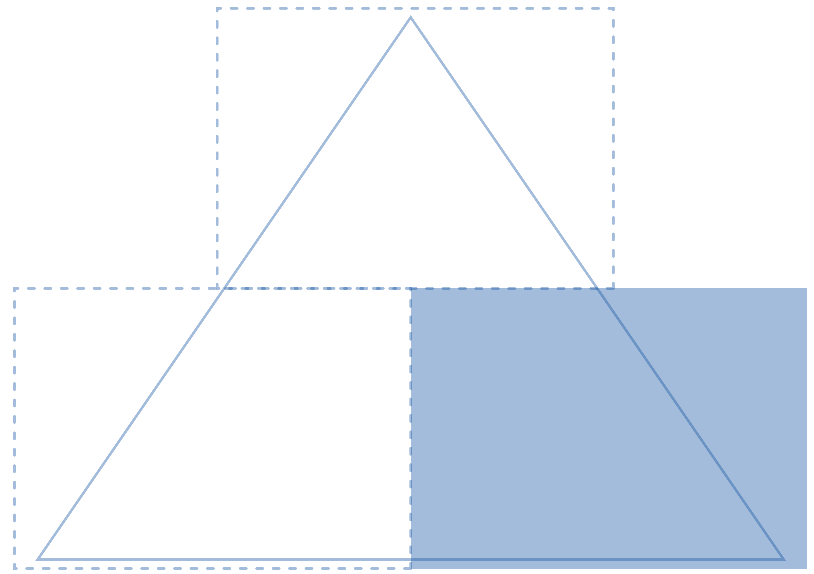
Hy — Water current

Atomic nuclei integration reaction

FP — Controlled thermonuclear fusion

BASIC ELEMENTS

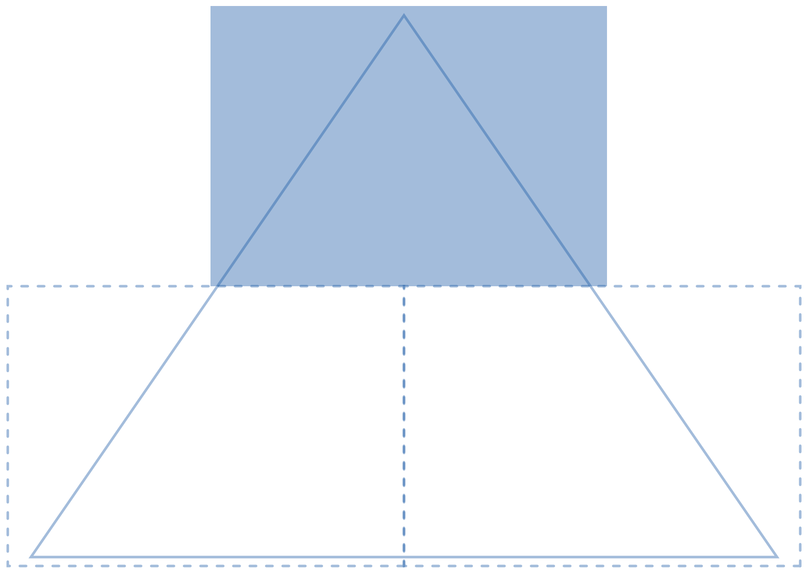
Cu	Zn	Ga	Rh	Pd	TR	Pt	U	Pu
Copper	Zinc	Gallium	Rhodium	Palladium	Rare earth metals	Platinum	Uranium	Plutonium



* Technology in the process of development or implementation

TECHNOLOGICAL SOVEREIGNTY MODEL

ENERGY (4/4)



EP
Energy fairness policy*

MENTAL MODELS

AI
Reliability and flexibility management

- plug&play ENGINEERING — Digital power grid district
- ИСКРА ТЕХНОЛОГИИ — Intelligent control systems of the electric energy industry
- plug&play ENGINEERING — Smart Grid physical and software systems

ME
Micro power systems management
ФОРСАЙТ — Droid-energy manager for smart management of consumption and own energy sources by consumers*

CM
Complexity management
СИСТЕМНЫЙ ОПЕРАТОР ЕДИНОЙ ЭНЕРГЕТИЧЕСКОЙ СИСТЕМЫ / RUSSIAN POWER SYSTEM OPERATOR — Network balance management

MI
Urban multi-infrastructure management
сберэнерго девелопмент — New generation electric public utilities*

MANAGEMENT MODELS

NFT
NFT-energy (energy transfer via digital assets)*

IE
Internet of energy*

BE
Biological energy generation*

SE
Space energy industry (generation and transmission)

UM
Unmanned technologies for production, extraction and processing mineral resources

SN
High voltage DC / AC supernets

CN
Closed nuclear fuel cycle*

RE
Renewable energy waste disposal*

ADVANCED TECHNOLOGIES

HT
Technologies for compressed and liquefied hydrogen transmission
СИСТЕМА — Fuel elements and filling stations (with electrolysis)

IM
Inverter based on IGBT-modules
ПРОТОН-ЭЛЕКТРОТЕКС — IGBT modules of industrial production for medium frequencies

NT
Energy routers
smartEPS интеллектуальные электроэнергетические системы — Energy router*

HC
High temperature superconductivity
СуперОкс — HTS materials and electric engines on their basis

SHN
Self-repairing grids
РОССЕТИ — High-voltage transmission lines with self-restoration function

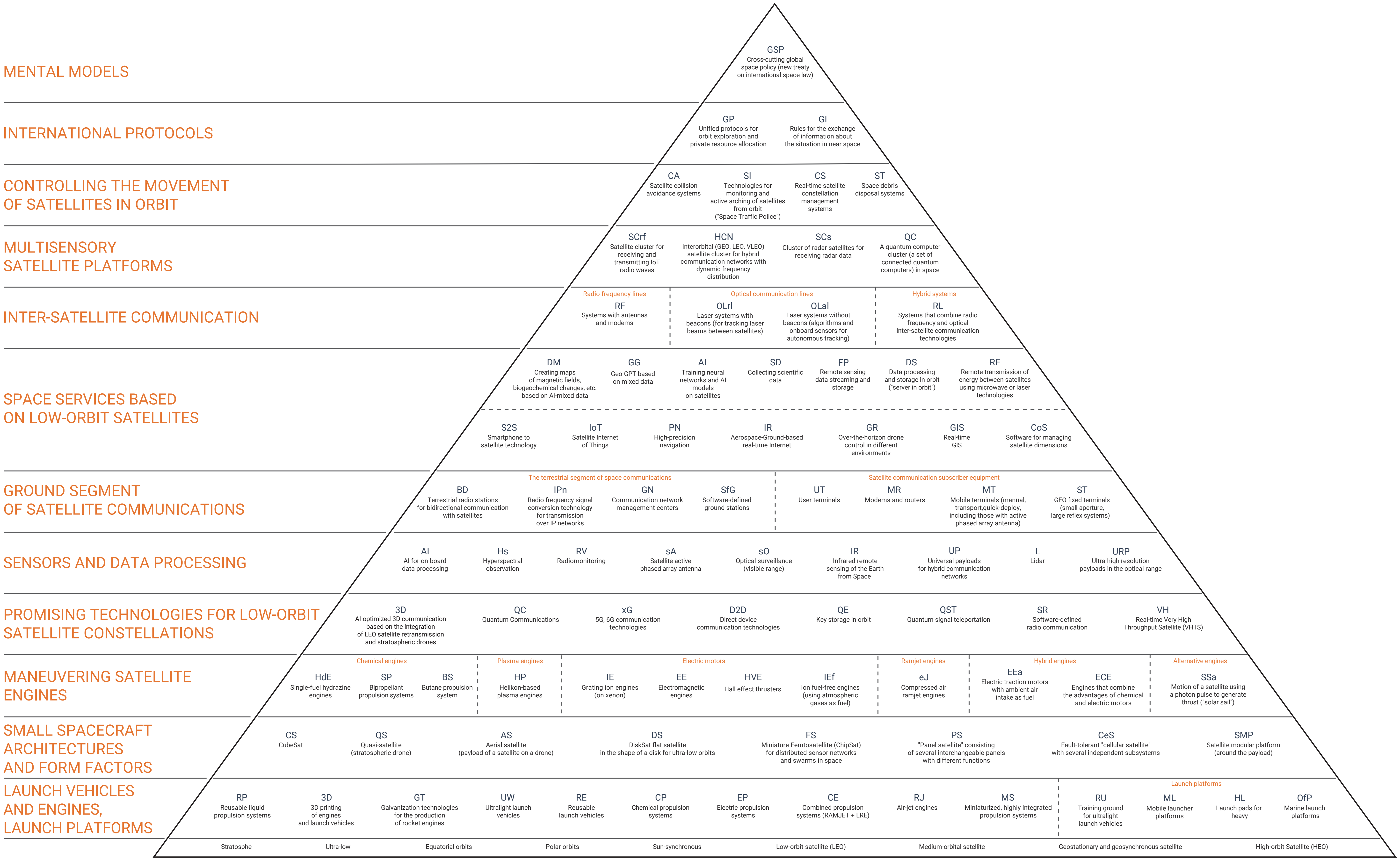
WT
Directional wireless batch energy transmission technologies based on SHF / lasers
ЭНЕРГИЯ — Laser-based energy transmission technologies*

ENERGY TRANSMISSION TECHNOLOGIES

* Technology in the process of development or implementation

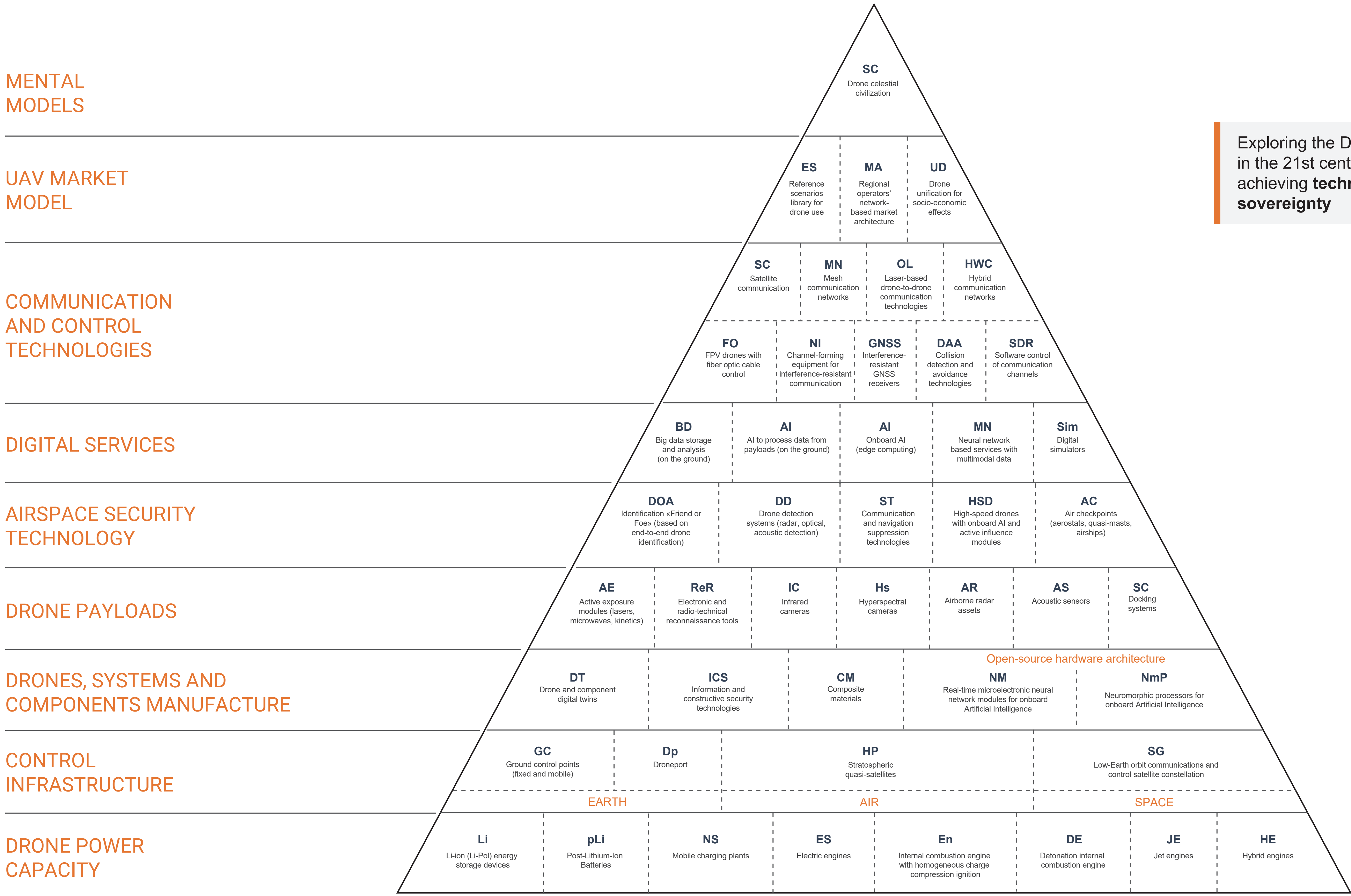
TECHNOLOGICAL SOVEREIGNTY MODEL

PERSPECTIVE SPACE TECHNOLOGIES AND SERVICES



TECHNOLOGICAL SOVEREIGNTY MODEL

DRONES AND NEAR SPACE (VER. 2.0)



Exploring the Digital Sky in the 21st century requires achieving **technological sovereignty**

TECHNOLOGICAL SOVEREIGNTY MODEL

TECHNOLOGY OWNERSHIP ASSESSMENT SCALE

TECHNOLOGY "KEY" OWNERSHIP

- In-house ontology and development core, ability to manage product generations
- Control of basic resources for technology development
- Concentration of competencies and scale of cooperation

TECHNOLOGY OWNERSHIP LEVELS

KEY

- Developed network of research centers, laboratories and institutes actively operating in this field
- Availability of significant scientific achievements recognized on national and international level (e.g. breakthrough technologies, unique procedures, high-efficiency solutions)
- High patent activity: large number of registered patents, includingones in international registers, with a wide range of application

CHANCE

- Sovereign platforms based on this technology have been established or are being developed to ensure scalability of its application
- Leading Russian companies possess advanced products and centers of excellence
- Forward-looking preparation programs have been launched

CRISIS

- Absence of systematic considerable efforts in this technological field. The gap is widening

! Minimum sufficient technological sovereignty (TS) level – possession of technology "keys" required for the development and serial manufacture of a sovereign product.

TECHNOLOGY DEVELOPMENT FACTORS

VALUE	1. SCIENCE	2. EQUIPMENT	3. NEW MATERIALS	4. DIGITALIZATION	5. PERSONNEL
3 points	• Developed network of research centers, laboratories and institutes actively operating in this field. • Availability of significant scientific achievements recognized on national and international level (e.g. breakthrough technologies, unique procedures, high-efficiency solutions). • High patent activity: large number of registered patents, including ones in international registers, with a wide range of application. • High publishing activity: regular publications in top-rated scientific journals, reports at top-level conferences, high citation rate of papers.	• Modern advanced equipment. • High performance and reliability. • Equipment manufacture localization >= 90%.	• Full cycle of material development and manufacture (from raw materials to finished product). • Unique materials with patent protection. • Active introduction into the industry. • Export of materials to global markets.	• In-house AI-platforms and algorithms (e.g. generative AI, computer vision). • Digital solutions are integrated into key industries. • Export of digital products.	• The demand for technology specialists is completely met. • Developed system of specializations: Bachelor's program, Master's program, postgraduate program, as well as intermediate vocational education programs. • Availability of competent teachers and experts providing a high training level. Continuous updating of academic programs according to the current technology requirements and trends.
2 points	• Availability of several research centers or scientific organizations involved in the development of the technology (not more than 1-3 centers). • There are individual domestic scientific developments, but their scale and significance are substantially inferior to global equivalents. • The dynamics of growth in the number of studies (patents, publications) is poor, with no notable progress in recent years.	• Basic equipment requiring modernization to meet the modern technology requirements. • Import dependency. • Equipment manufacture localization level >25%<90%.	• Limited manufacture of materials (raw material import dependency). • There are engineering developments, but no scaling. • Implementation in pilot projects.	• Implementation of adapted foreign solutions. • Local digital services (e.g. for the public sector). • Dependency on foreign algorithms.	• There is a shortage of specialists (more than 70% of the demand is not met), but the situation is gradually improving. • There are academic disciplines or courses related to the technology, but their coverage and depth are not sufficient for complete training of staff. • In the long term (5–10 years), an improvement in the shortage of staff is expected due to graduation of specialized program students.
1 point	• Complete absence of specialized research centers, laboratories or institutes involved in the development of the technology. • No recorded scientific achievements by domestic scientists in this field. • No patents related to the technology listed in national or international registers.	• No domestic equipment for manufacture according to the technology or complete import dependency	• Total dependence on imported materials. • No in-house development. • The use of out-of-date analogs.	• No in-house AI solutions. • Use of foreign platforms without adaptation. • Lack of digital infrastructure	• Critical shortage of specialists in this technology (over 90% of the demand is not met). • Absence or highly limited number of academic disciplines, courses or programs related to the technology in question. • No specializations in universities or colleges. • Critical shortage of specialists results in dependency on foreign staff or technologies.

TECHNOLOGICAL SOVEREIGNTY MODEL

ARCHITECTURE OF THE TECHNOLOGICAL SOVEREIGNTY MODEL BY INDUSTRY

house development lines provide this

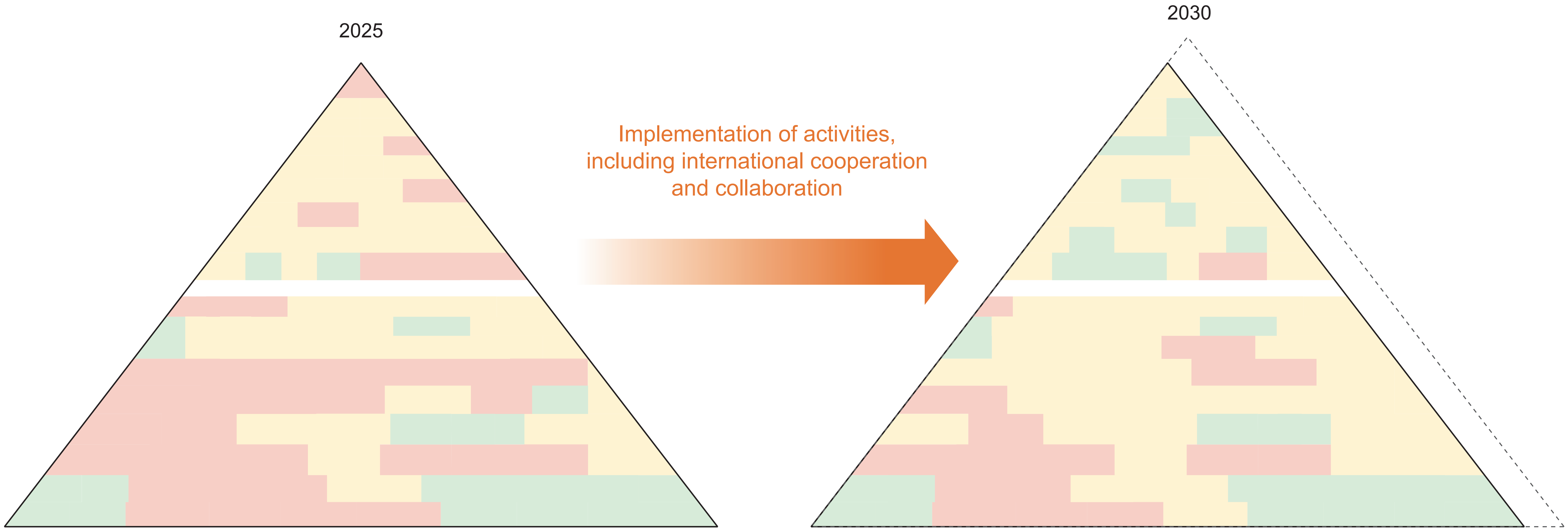
The government in collaboration with industry-leading companies is developing a roadmap to achieve the target level of technological advancement. The roadmap contains activities focused on development of key factors:

- **Science** is stimulating creation of the new generations of technologies.
- **Equipment** is essential for implementing of technologies.
- **Materials** (including modern materials).
- **Digitalization**.
- **Staff** required both currently and in the long-term perspective (2030–2050).

THREE TECHNOLOGY OWNERSHIP LEVELS

KEY	– In-house development lines provide this technology for 2-3 succeeding generations – Sovereign solutions based on this technology are demanded in global markets – Russian solutions and approaches form the international technological standards
CHANCE	– Sovereign platforms have been or are being created on the basis of this technology, which allow for scaling its application – Leading Russian companies possess advanced products and competence centers – Early preparation programs have been deployed
CRISIS	– Absence of systematic considerable efforts in this technological field. The gap is widening

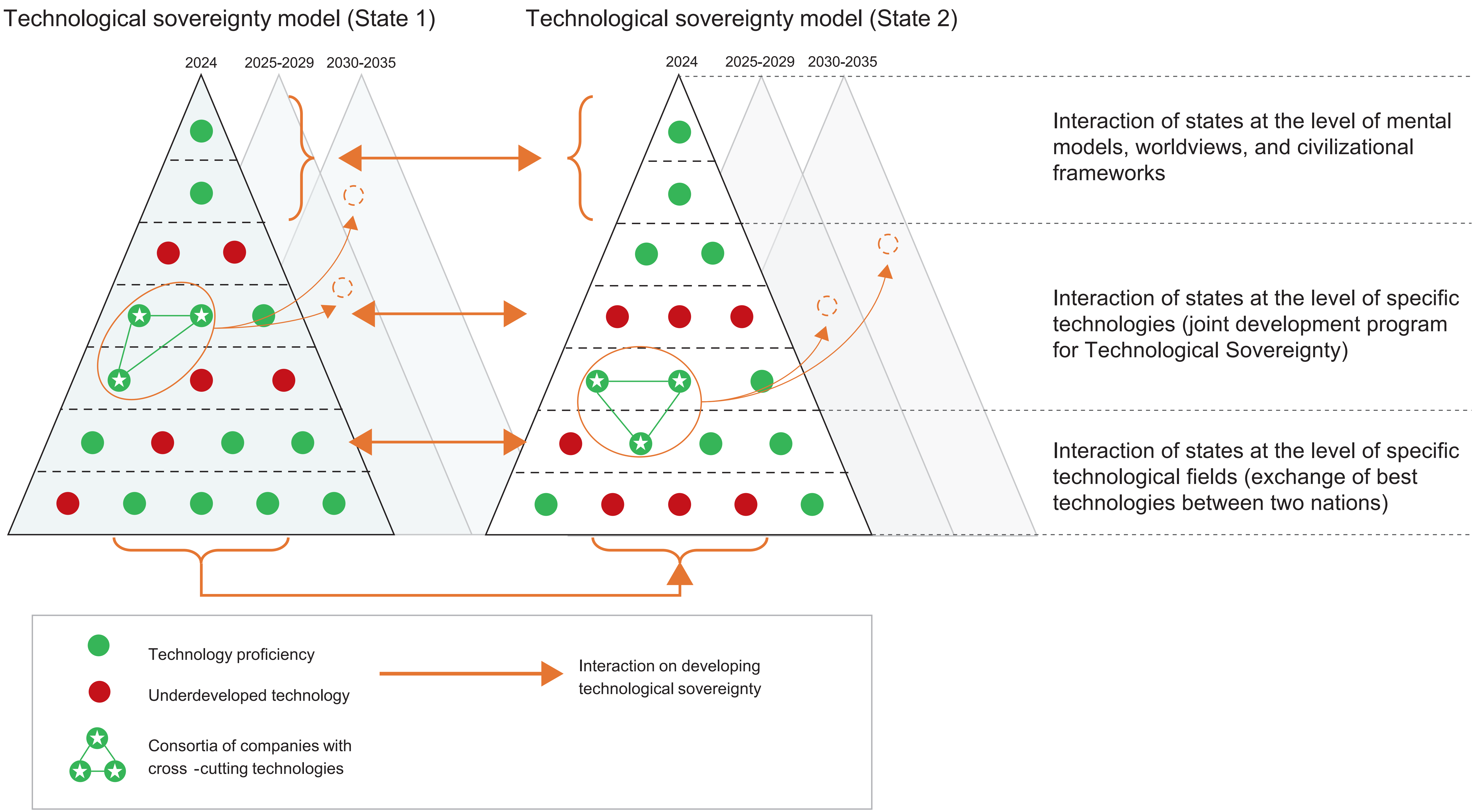
! Minimum sufficient technological sovereignty (TS) level – possession of technology 'keys' required for the developmentand serial manufacture of a sovereign product



Illustrative example

TECHNOLOGICAL SOVEREIGNTY MODEL

INTERNATIONAL COOPERATION ON DEVELOPING TECHNOLOGICAL SOVEREIGNTY



more on
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