





# Ukraine in the Global Innovation Dimension Report 2007-2017

Legal partner:





Ukrainians have strong technical competencies and necessary skill sets needed to develop disruptive technologies. Such skills are increasingly important for today's businesses and societies as well as those of the future.

As the global demand for R&D and IT specialists grows, an increasing number of leading international companies, including some of the best innovators in the world, are cooperating with engineers, inventors and developers from Ukraine on various research projects, as well as investing in Ukrainian tech startups and companies.

For the first time, we have conducted an analysis of the competencies and the international cooperation efforts of Ukrainian inventors based on objective data and not solely on experts' opinions.

We analyzed patents Ukrainian citizens have obtained during the last 11 years, from 2007 until 2017, both in Ukraine and abroad, as well as patents obtained by non-residents in Ukraine during the same time period. Additionally, the international scientific publications of Ukrainian authors and co-authors were analyzed since 2007, based on Web of Science data, the most respectful source of this type of data internationally. In total, our analysis was carried out on over 200,000 different publications. This is without taking into consideration the publications related to other countries, which we used for comparison of the level of innovation activity and strategy in different technological areas.

We are pleased to share this data, respective analytics, patent and scientific publications' themescapes with you. It is our hope that this report will help you understand Ukraine and the strengths and technical competencies of Ukrainians, as well as provide new insights and inspiration for your business.

We hope you enjoy it!



Over the next 30 years, we'll encounter some of the greatest transitions that any generation has ever had to face. Technological disruption is already affecting every part of our lives...every business, every industry, every society...even what it means to be "human." These changes show no signs of slowing down; in fact, they're accelerating rapidly.

If ever there was a place going through radical transformation at the center stage of global politics, Ukraine is one.

For all of us at Singularity University, this is a country we want to support, learn from, and also help be a part of the global expansion of awareness of how technology really can be a fundamental driver for creating a future of abundance, one where we can transcend some of the crazy, nonsensical development barriers and get back to focusing on the big problems.

Singularity University was founded on the premise that the world's greatest problems are the world's greatest opportunities.

I deeply believe that Ukraine has all the necessary ingredients to tackle its biggest challenges and earn its rightful place as one of the global leaders in exponential technologies .

For all of us at SingularityU Kyiv, this report signifies another important milestone on the way to creating a future of prosperity for Ukraine and its citizens.

Ukraine is changing, and in true spirit of Singularity University, we'd like you to join us on our journey from inspiration to impact.



#### Max Yakover

#### **CEO and Managing Partner of UNIT.City Innovation park**

During the last 5 years, Ukraine has already made its voice heard and became established on the global IT arena: with more than 130,000 developers in the country, the industry is growing by an average of 20% each year. During 2017 alone, our IT companies received a total of \$265 million of investments and since 2007, more than 140,000(!) patents have been registered in Ukraine. All this points to the fact that we have high goals and global ambitions.

But in order for Ukraine to become a real, global innovation hub, for technology to be born and nurtured on our territory and the talent to not leave its borders - a bigger effort is needed.

Ukraine needs an entrepreneurial ecosystem that will support and help innovators in every aspect. We also need solid infrastructure in order to enable early stage inventions to turn into products. We aim to help entrepreneurs access markets and financing, accelerators and mentors and to introduce them to companies that have already gone through this thorny path, in an active search for innovation.

Understanding the importance of creating such an environment - in 2017 we opened UNIT.City. A place where talents can launch their startups faster and easier, find investment, international partners and collaborate with corporations. Our goal is to build one of the biggest innovation parks in Central and Eastern Europe and become the leader in the space.

The task of this Report is to show which industries are the most promising in Ukraine, where innovations are already vigorously developing, and where there are opportunities for growth. This is a vital message to the international community about how much potential Ukrainian talent really has. This is the signal to the international community - that now is the best time to come to Ukraine.



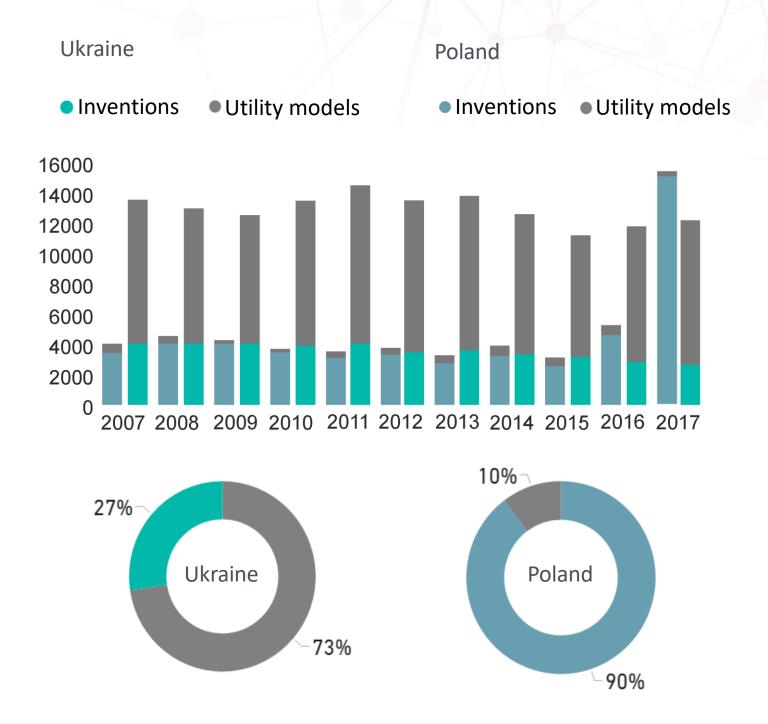
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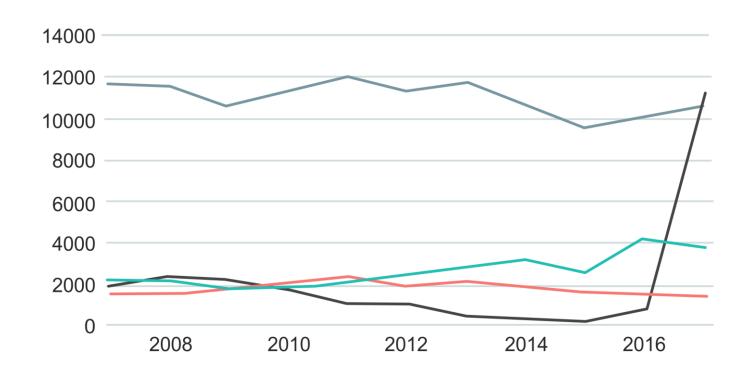
### NUMBER OF INVENTIONS AND UTILITY MODELS REGISTERED IN UKRAINE AND IN POLAND



Ukraine has a high number of patents and utility models registered during the 2007-2017 period, well above its GDP per capita ratings.



#### SHARE OF RESIDENTS AND NON-RESIDENTS IN PATENTING IN UKRAINE AND IN POLAND



Ukraine

Residents

Non-residents

Poland

Residents

Non-residents

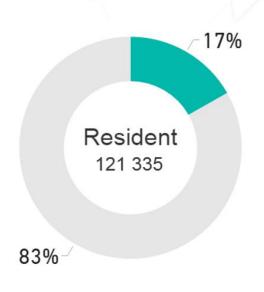
The level of patenting activity in Ukraine, generally remains stable for both residents and non-residents\*, although the share of non-residents has seen a slight decrease since 2013.

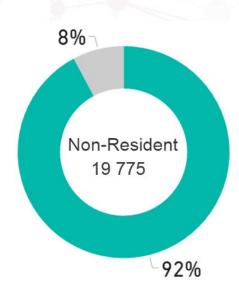
Non-residents obtained 11,221 patents in Poland in 2017 – almost the same number of patents, as such applicants obtained in Poland from 2007-2016.

\*As grants to non-residents. In this Report we define grants based on applications which were first filed in other countries (respectively, non-residents in Poland or Ukraine in these graphs).



### PATENTS REGISTERED IN UKRAINE DURING 2007-2017





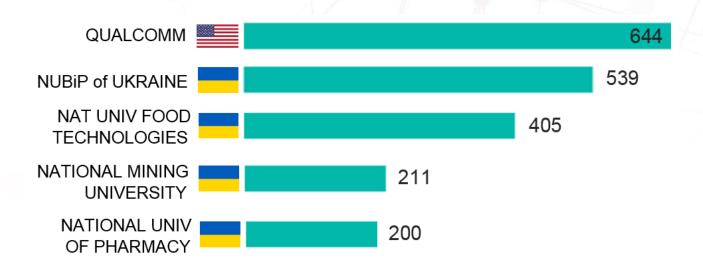
- Inventions
- Utility Models

Ukrainian residents obtain a remarkably high number of utility models, one of the highest in the world. The main reason for this is a simpler, cheaper and faster procedure required to obtain them. On the other hand, utility models provide a shorter term of legal protection - 10 years, instead of 20. In a majority of the cases, they are related to less important objects of protection, which must be novel, but are not required to be not obvious to experts in the field (as are inventions).





### TOP INVENTION PATENTS OWNERS IN UKRAINE



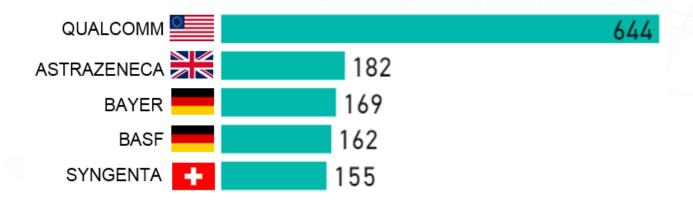
One of the most important drivers of innovation and development activity within the country is the opportunity to commercialize intellectual property. Being the subjects that generate significant amounts of inventions, universities, as expected, are the biggest patent holders in Ukraine. At the same time, such impressive amount of IP assets for a long time was not properly commercialized due to lack of funding and poor commercialization strategies. In recent years we see positive changes in legislation that enable universities creating spin-offs and university based startups, which will allow them raising funds for further development, find partners or clients in Ukraine and abroad. This model is successfully exploited in the US and a row of European countries, so we expect increased cooperation of foreign investors, technology companies and Ukrainian universities in this regard, which should significantly incentivize commercialization and patent activity in Ukraine in general.

Natalia Pakhomovska, DLA Piper Ukraine





### TOP NON-RESIDENT INVENTION PATENTS OWNERS IN UKRAINE

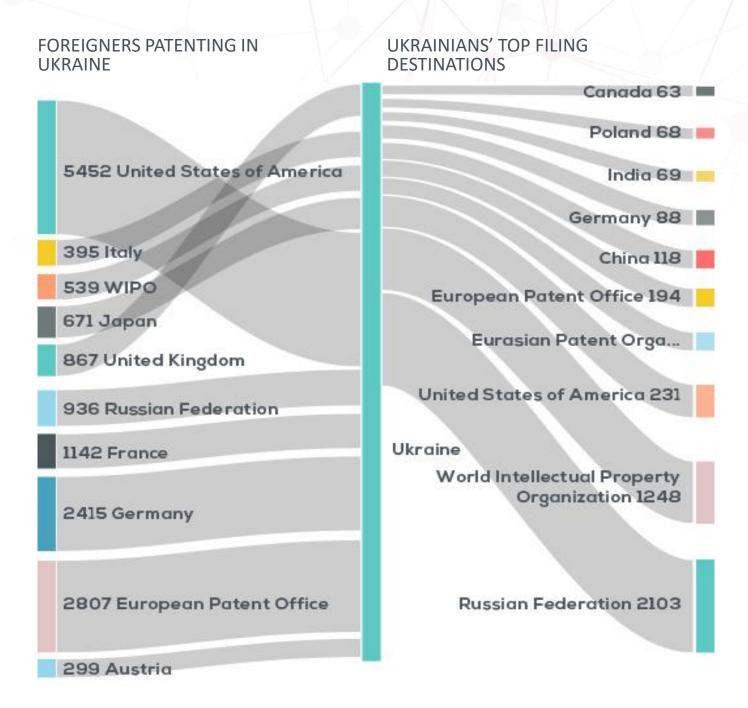


The pace of technology development nowadays is significantly faster than legislative reforms are introduced. The number of IP disputes in Ukraine increases from year to year and they become more complicated as technology develops. The need of highly qualified judges that specialize in intellectual property has led to creation of Supreme court on intellectual property matters. This IP specialized judicial body is expected to start functioning by the end of 2018 and we anticipate that it should significantly increase enforceability of IP rights within Ukraine, which should lead to overall increase in patent activity both of residents and foreign companies.

Natalia Pakhomovska, DLA Piper Ukraine



### INTERNATIONAL PATENTING IN UKRAINE



The left part of this graph shows the number of patents granted in Ukraine in relation to the number of inventions, which were first filed in a given country (US, Germany, European Patent Office etc).

The right part of the graph shows the number of patent applications and grants filed in a given country, after they were filed in Ukraine.



### KEY CLASSES OF UKRAINIAN PATENTING ABROAD WITH PRIORITY IN UKRAINE\*

Civil engineering		420
Pharmaceuticals		360
Medical or veterinary science		330
Metallurgy		322
Transport		310
Packing, Storing		272
Thermal processes and apparatus		267
Agriculture and Forestry		223
Separation of solid materials		177
Computer Technology		152
Earth or rock drilling		142
Inogranic chemistry		126
E-commerce*		114

<sup>\*</sup>based on patents for inventions, utility models and patent applications

This graph shows the key classes, in accordance with international patent classification, of patenting by Ukrainian inventors abroad. It is based on patents and applications which were first filed in Ukraine, in other words, with priority in Ukraine.

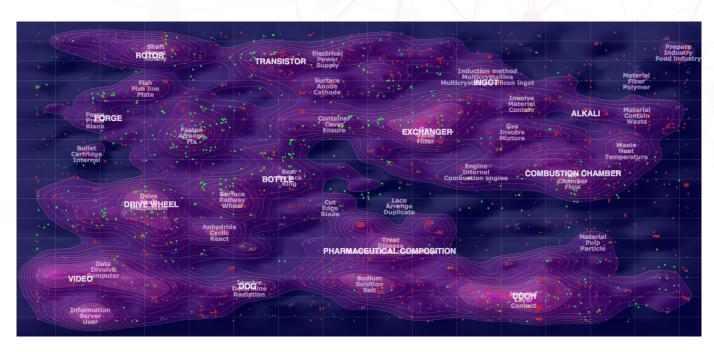
Interestingly enough, these classes substantially differ from those that are defined based on a set of patents and applications, which were filed with Ukrainian inventors in other jurisdictions without first applying for them in Ukraine. This is demonstrated in respective graphs and themescapes further in the Report.

For example, it is more common for inventors working in the Computer Technology field to file patents only in other jurisdictions, without filing them in Ukraine.

Both data sets: applications in other countries, with priority in Ukraine, and those filed only in foreign jurisdictions, can be considered as a good representation of the most developed competencies of Ukrainian inventors.



### PATENT THEMESCAPE OF UKRAINIAN PATENTING ABROAD WITH PRIORITY IN UKRAINE



UTILITY MODELS



Key terms by the number of documents in which they are mentioned

Melt	Salt	Disease	Pharmaceutical	Sodium	Rotor	Digital	Network
204	194	158	157	156	155	138	125
	Heat		=5 /	-50		200	
Video	Exchanger	Medicinal	Ingot	Game	Server	Wireless	Software
108	100	97	93	92	88	85	84

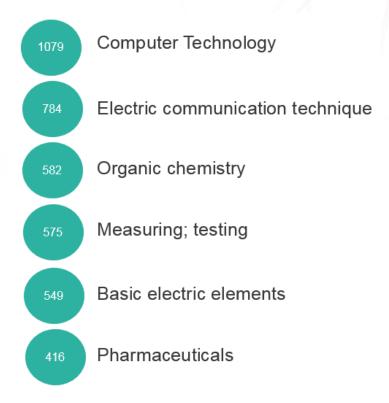
Patent Themescape map demonstrates the main topics of patents applied by Ukrainians in foreign patent offices after filing such applications in Ukraine. There is a quantitative advantage of inventions over utility models in Ukrainian patenting abroad. The key topics include Pharmaceutical Composition, Heat Exchanger (mostly related to industrial applications), Combustion Chamber, Video and data processing, Cooh (carboxylic acid based products). Topics with a large number of utility models include Fasteners and Fixers, Transistor, Bottle, Drive Wheel.

<sup>\*\*</sup>based on 4906 patents and applications



### KEY CLASSES OF PATENTING ABROAD WITH UKRAINIAN INVENTORS

Patenting Abroad, Filed only in foreign jurisdictions, without priority in Ukraine\*\*



<sup>\*</sup>based on patents for inventions, utility models and patent applications

The analysis of the results of Ukrainian inventors' activity in other countries, based on applications which were filed only in other jurisdictions, without filing them in Ukraine, were obtained by searching all Derwent Innovation collections by authors' nationality (UA), excluding documents with UA priority, which were analyzed previously in this Report.

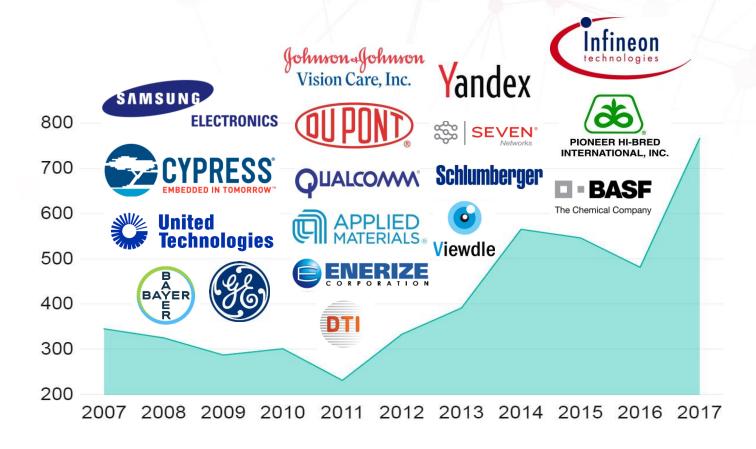
The results include patents, applications and utility models of 3 main groups:

- Ukrainian inventors filing with international companies and research institutions;
- Ukrainian inventors filing from their foreign companies (most important startups with patents and applications can be found in this data set);
  - Ukrainian inventors filing only in other jurisdictions as natural persons.

<sup>\*\*</sup>with Ukrainian inventors/co-inventors filed only in foreign jurisdictions



### DYNAMICS OF PATENTING ABROAD WITH UKRAINIAN INVENTORS



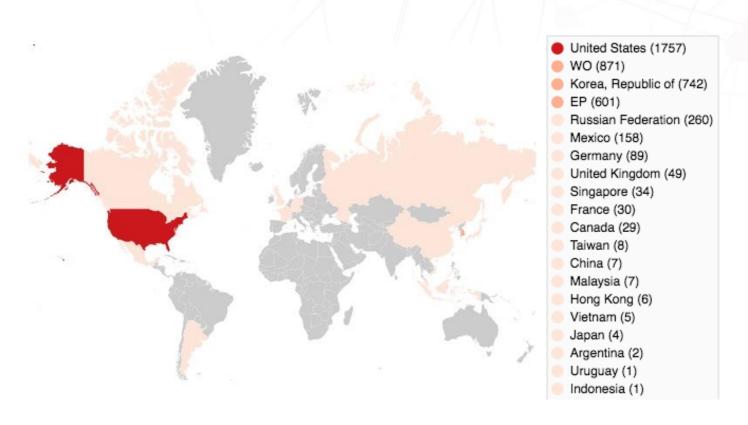
<sup>\*</sup>based on 4633 patents and applications, applied only in foreign jurisdictions

As we discovered from the results of the search for the UA inventors in other countries, they increasingly cooperate with and develop new inventions for many leading international companies (some of them are listed in the above graph).

This category of patents and applications — which were filed only in other jurisdictions — is also the fastest growing of all 3: those filed in Ukraine, filed in other countries with priority in Ukraine, and filed in other countries without filing them in Ukraine.



### GEOGRAPHICAL DISTRIBUTION OF PATENTS FILED WITH UKRAINIAN INVENTORS ABROAD\*



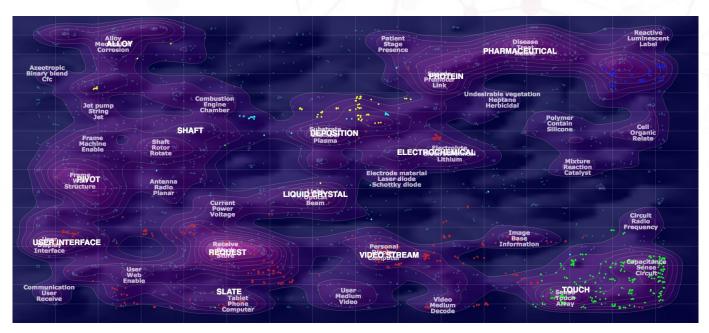
<sup>\*</sup>based on 4633 patents and applications, filed only in foreign jurisdictions, identified by authors from Ukraine

The above graph also shows a big difference in the geography of Ukrainian inventors' patenting activity, filing only in other jurisdictions, compared to Ukrainians filing in other jurisdictions after initially filing in Ukraine (presented in the page "International patenting in Ukraine" of this Report).

And respectively, different target markets for commercialization of such inventions.



### THEMESCAPE OF PATENTS FILED WITH UA INVENTORS ONLY IN FOREIGN JURISDICTIONS



Key terms by the number of documents

\*based on 4633 patents/app, filed only in foreign jurisdictions

Alkyl	Capacitance	Capacitive	Request	Disease	Aryl	Notebook	Halo
278	256	244	229	218	195	184	176
Message	Notebook Computer	Deposition	Pharmaceutical Composition	Cytostatic	Client	Cancer	Cycloalkyl
170	165	159	145	144	144	137	117

#### **SAMPLE COMPANIES**

UNITED TECHNOLOGIES CORP

SAMSUNG ELECTRONICS CO LTD

CYPRESS SEMICONDUCTOR CORP

BAYER CROPSCIENCE AG

GEN ELECTRIC

This Thematic Landscape demonstrates the key topics of inventions filed with UA inventors in other countries, without priority in Ukraine.

We highlighted the documents filed in cooperation with several selected foreign companies, to reveal the subject of their research cooperation with UA inventors.

Samsung has the highest number of joint patents with UA inventors, likely due to the fact that Samsung has a large R&D center in Ukraine.



### **EXAMPLE OF UKRAINIAN STARTUP ACQUISITION: VIEWDLE**

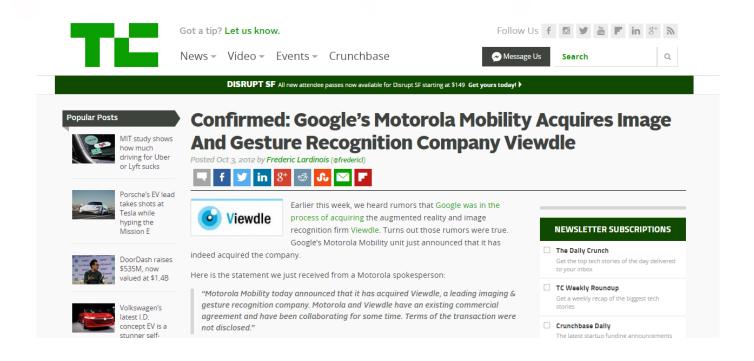
Was Sold to Google for over \$30 million in 2012

Viewdle patent statistics 10 DWPI families

38 patents and applications:

Applications: 27 records

Patents: 11 records



As we analyzed patent DBs, most of the Ukrainian startups, which successfully attracted considerable amounts of international investments, have patents in prestigious jurisdictions, such as US, EU, China and others.





#### **EXAMPLE OF STARTUP ACQUISITION: VIEWDLE**



A patent portfolio should be viewed as an asset of the business that may be used for different activities. For example, a patent portfolio may be used offensively (to sue a third party for infringement), defensively (to establish a position in a market), as a negotiation tool (to provide comfort to a customer) or to increase the overall value of the technology company. For a start-up or smaller technology company, the focus should not be suing third parties for infringement since the costs of patent litigation can be astronomical.

It is often challenging for start-ups and smaller technology companies to incentivize their engineers to spend the time to prepare and file a patent application. One option to incentivize engineers is to provide an award (cash or stock or recognition) when a patent application is filed and then a larger award (cash or stock or recognition) when a patent has been issued. Another option is to have a patent wall at the company on which a plaque is placed when a patent issues. Finally, it is often an excellent idea for the company to have a patent committee that regularly meets, assesses new ideas and manages the process to file a patent application with a patent attorney.

Timothy Lohse, DLA Piper USA, Silicon Valley



### **EXAMPLE OF UKRAINIAN STARTUP ACQUISITION: LOOKSERY**

Was Sold to Snapchat for \$150 million in 2015



AVATAR MERGER SUB II, subsidiary company of SNAP INC and SNAP INC owns 19 patents (6 DWPI families) related to Looksery: 4 patents for inventions, 15 applications

US20150195491A1
Background
modification in video
conferencing





US9576190B2 Emotion recognition in video conferencing



US20150193718A1 Emotion recognition for workforce analytics

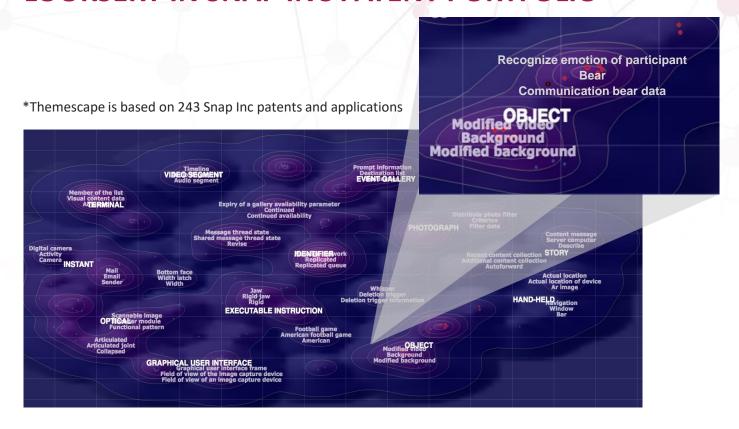


https://www.corporationwiki.com/p/2rzstf/avatar-merger-sub-ii-llc





#### LOOKSERY IN SNAP INC PATENT PORTFOLIO



For start-ups or smaller technology companies, like Viewdle or Looksery, a patent portfolio can be essential in enhancing the value of the technology company as evidenced by the sale valuations for both Viewdle and Looksery. Note that a patent portfolio generally means multiple patent families that ideally protect different features or aspects of the technology company's product like the background modification in video conferencing and the emotion recognition in video conferencing patents of Looksery.

In one example, a small technology company in the United States (5-10 employees) sold products for electrostatic discharge protection for semiconductor related companies. The company made excellent products and were very innovative (filing upwards of 40 U.S. patents for their different products). The company was eventually purchased, for a significant amount, by a large public company in the electrostatic discharge protection industry. The large public company analyzed the patent portfolio of the small technology company and realized that the patent portfolio covered a number of yet to be commercialized product of the large public company.

Timothy Lohse, DLA Piper USA, Silicon Valley



### TOP CLASSES OF NON-RESIDENTS' PATENTING IN UKRAINE

5181	Pharmaceuticals
4367	Organic chemistry
1220	Biocidal, pest repellant, pest attractant or plant growth
540	Mutation or genetic engineering
517	Wireless communication networks
455	Transmission of digital information
411	Tabacco; cigars; cigarettes; smoker's requisites
252	Manufacture of iron or steel
181	New plants

During the last 11 years (2007-2017) non-residents obtained almost half of the patents for inventions in Ukraine, from the total number of the patents for inventions registered by the Ukrainian patent office.

The most developed topics of their patenting activity are presented in the graph above.

Topics such as 'Biocidal, pest repellent, pest attractant or plant growth', 'Mutation or genetic engineering' and 'New plants', can be related to the general topic 'Agriculture'.

Respectively, Pharmaceuticals and solutions for Agriculture are the most important categories of non-residents' patenting activity in Ukraine.



### TOP NON-RESIDENT PATENT OWNERS IN UKRAINE

	QUALCOMMINC		World leader in 3G and next-generation mobile technologies
Himme .	ASTRAZENECA AB	•	Global, science-led biopharmaceutical business
allila	BAYER CROPSCIENCE AG	•	Crop protection products
alithia	BASFSE	•	Innovative technologies development in agriculture
	SYNGENTA PARTICIPATIONS AG	•	Pharmaceutical companies
.III	SMS SIEMAG AG	•	Crop protection products and seeds development
nlilin	JANSSEN PHARMACEUTICA NV	•	Plant supplier to the metallurgical industry
Inc.	BASF AG	•	Crop protection products
aldma	BOEHRINGER INGELHEIM INT	•	International pharmaceutical group
I	SERVIER LAB		Global, research-driven pharmaceutical company
	PHILIP MORRIS PRODUCTS SA	•	Global tobacco company
	DOW AGROSCIENCES LLC	•	Provides innovative technologies for crop protection
	JAPAN TOBACCO INC	•	Global tobacco company

The graphs on the left, indicate the number of patents respective companies obtained in Ukraine each year from 2007 till 2017.



### TOP 10 NON-RESIDENT PATENT OWNERS BEFORE AND AFTER 2013



- 149 QUALCOMM INC
  - 88 PHILIP MORRIS PRODUCTS SA
- 70 DOW AGROSCIENCES LLC
- 66 BASF SE
- 56 SYNGENTA PARTICIPATIONS AG
- 47 BAYER IP GMBH
- 46 NESTEC SA
- 42 BOEHRINGER INGELHEIM INT
- 36 NOVARTIS AG
- 31 BRITISH AMERICAN TOBACCO CO

#### 2007-2012

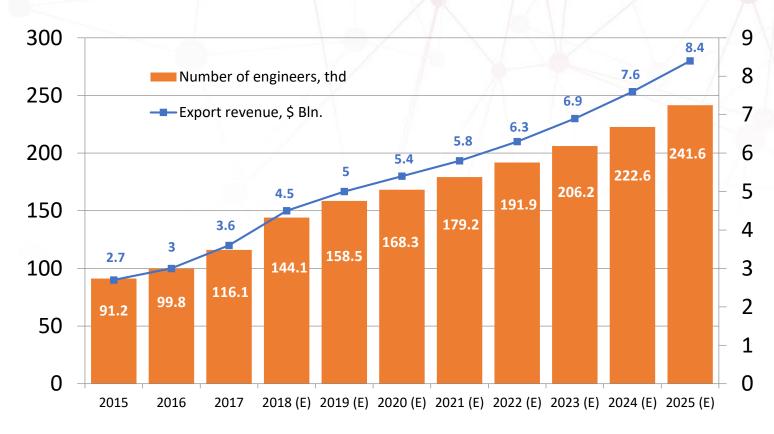
- 494 QUALCOMM INC
- 161 ASTRAZENECA AB
- 141 BASF AG
- 140 SMS SIEMAG AG
- 139 BAYER CROPSCIENCE AG
- 129 JANSSEN PHARMACEUTICA NV
- 99 SYNGENTA PARTICIPATIONS AG
- 97 SERVIER LAB
- 96 BASF SE
- 94 BOEHRINGER INGELHEIM INT

The graph shows Top 10 non-residents by the number of patents obtained in 2007-2012 and in 2013-2017 in Ukraine. This comparison shows how the patenting activity of non-resident companies developed, and who obtained the highest number of patents in Ukraine.





#### **KEY FACTS ABOUT IT INDUSTRY OF UKRAINE**



Source: Ukrainian IT Industry performance overview, PwC 2017

#### INTERNATIONAL RECOGNITION



18 Ukraine based IT-companies are in The Global Outsourcing 100



5 Ukraine based IT-companies are in GSA UK Top Performer Index 2018



5 Ukraine based IT-companies are in Inc. 500 Europe as fastest growing businesses

#### SELECTED CLIENTS OF UKRAINE'S IT-INDUSTRY



SAMSUNG







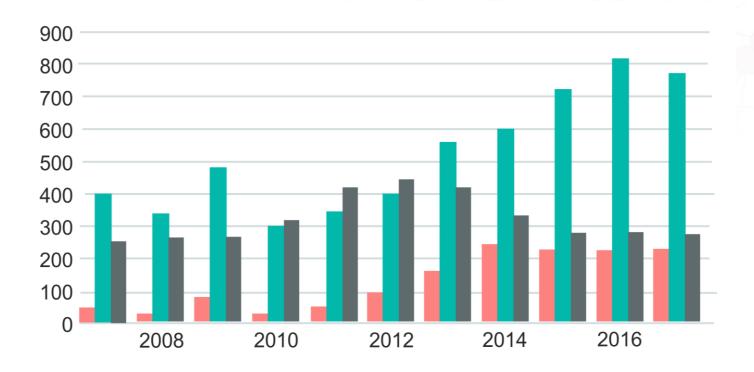






#### IT RESEARCH ACTIVITY

#### PATENTING AND SCIENTIFIC PUBLICATIONS



- Patents obtained in Ukraine
- International scientific publications based on Web of Science data
- Patents and applications with Ukrainian inventors/co-inventors filed in foreign jurisdictions without priority in Ukraine

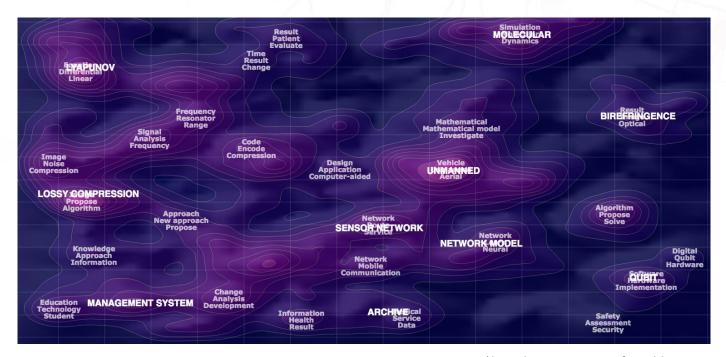
Ukraine has over 130 thousands of qualified IT engineers and is a highly ranked IT outsourcer. The forecast of IT Industry Development by 2020 according to National Innovation Projects State Company is:

≈ 4,5 % contribution of IT industry to Ukraine's GDP

> 5,1 bln. Ukrainian IT export



# INTERNATIONAL PUBLICATIONS ON COMPUTER SCIENCE BY UKRAINIAN AUTHORS, 2007-2017 THEMESCAPE



\*based on 5217 scientific publications

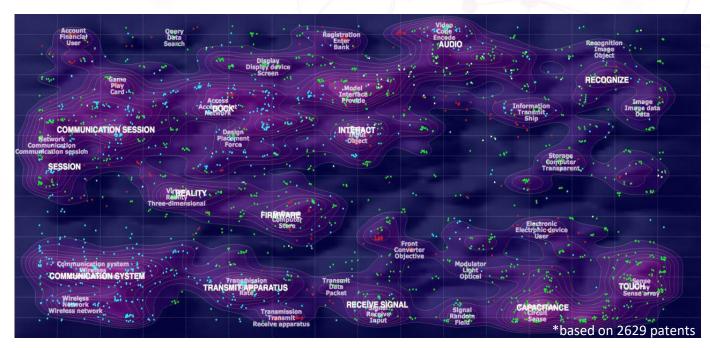
#### Key terms by the number of documents in which they are mentioned

Data	Algorithm	Parameter	Network	Information	Solution	Image	Simulation	Technology	Signal	Quality	Support
1098	911	771	751	740	584	556	541	481	456	440	313
										Communic	
Linear	Equation	Neural	Service	Noise	Energy	Management	Frequency	Nonlinear	Resource	ation	Architecture
302	297	277	253	251	250	249	237	230	225	218	217

Important topics developed in Computer science publications by Ukrainian researchers, as demonstrated in this Themescape, are Unmanned Aerial Vehicles, Lossy compression algorithms (for data compression), Sensor Networks, Neural network models, IT Project management system, Qubit (quantum computing), Simulation of Molecular Dynamics.



### IT AND TELECOMMUNICATION PATENTS' THEMESCAPE



ABROAD, WITH PRIORITY IN UKRAINE

UA INVENTORS,
FILED ONLY ABROAD

FROM ABROAD TO UKRAINE

#### Key terms by the number of documents in which they are mentioned

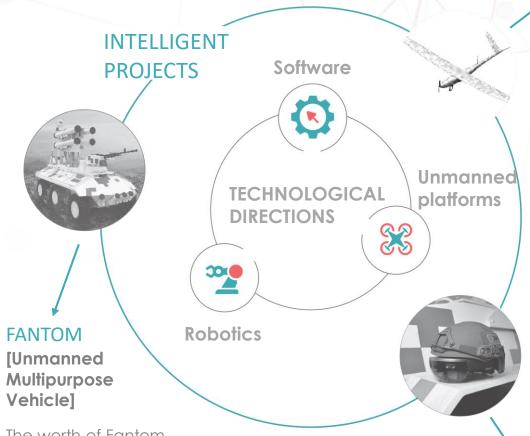
Communication	Wireless	Transmission	Image	Video	Sense	Touch	Communication System
400	261	195	191	184	175	165	154
Caman	Canaditiva	Cinquit	0.000	Canasitanas	Compan	Wireless Communication	Flacture de
Sensor	Capacitive	Circuit	Array	Capacitance	Screen	System	Electrode
154	133	127	126	117	112	72	70

Most developed technological topics in IT and telecommunications are represented in the patent Themescape above. Main focus of patents applied by Ukrainians in foreign countries with priority in Ukraine include Capacitance Circuit, Sense array, Display device etc. Patents with Ukrainian inventors/co-inventors filed only in foreign jurisdictions relate to Financial Account User, Registration (Bank), Transmit and Receive apparatus. Main clusters for foreign patents in Ukraine are Communication System and Communication Session, Design Placement, Dock – Network Access, Video Code.





#### **ADVANCED DEFTECH SOLUTIONS**



### SPARROW LE [Unmanned Aerial System]

Sparrow is designed to determine the Coordinates of the enemy and air surveillance with an online broadcast at a distance of up to 20 km and maximal flight altitude of 5000m. Due to small dimensions and used materials it remains invisible for both visual observation and radar systems.

The worth of Fantom is that it is able to protect soldier's life and minimize human presence in dangerous places, conduct reconnaissance operations and reduce physical load for military personnel during military, rescue and reconnaissance ground operations.

#### **LIMPIDARMOR**

[Helmet-mounted circular review system with augmented reality glasses]

LimpidArmor is designed to be used by either crews of armoured vehicles or crews of mining and construction vehicles to increase review area and accuracy of maneuvering

Ukraine is one of the top 10 exporters of defense related products in the world, and these competences are enhanced by the strong IT sector of the country. Surprisingly, startup spirit is infecting this rather conservative industry as well, driven by <a href="www.ukrinnovate.com">www.ukrinnovate.com</a>, the first private platform for development and promotion of defense technologies.

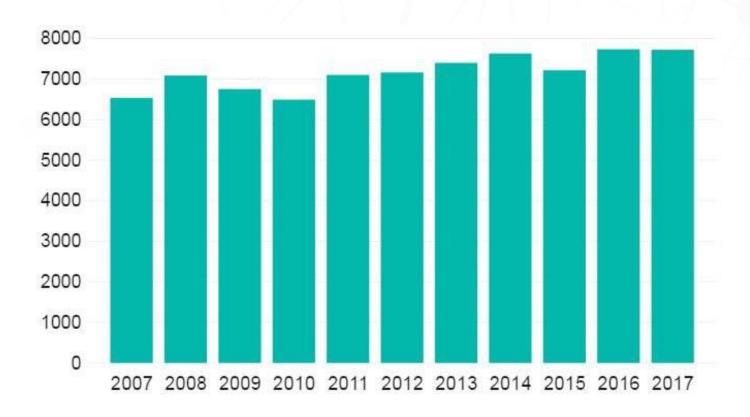


\*Analysis of scientific publications, topics etc is based on **Web of Science** Data





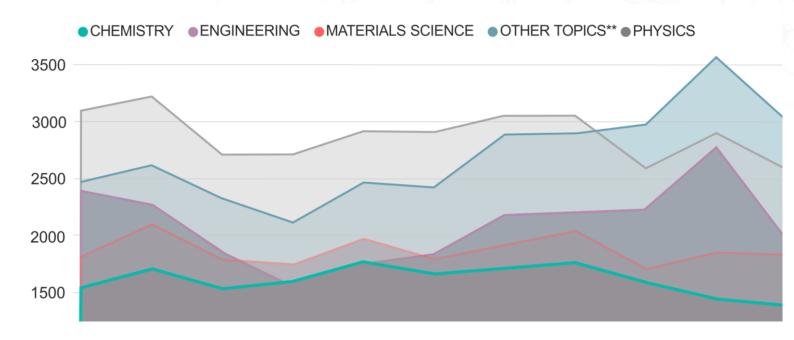
## INTERNATIONAL SCIENTIFIC PUBLICATIONS BY UKRAINIAN AUTHORS AND COAUTHORS\*



<sup>\*</sup>This graph and further analysis of scientific publications, topics etc is based on **Web of Science** Data.



### DYNAMICS OF MAIN TOPICS OF UKRAINIAN SCIENTIFIC PUBLICATIONS\*



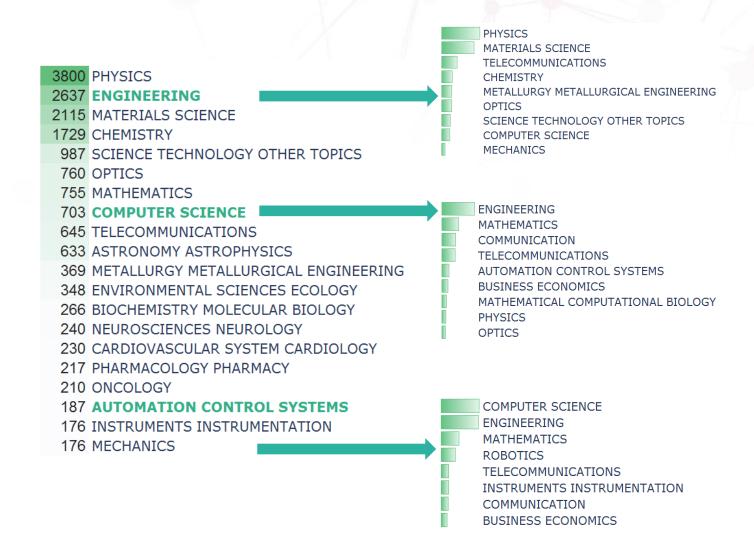
<sup>\*</sup>based on Web of Science Data

The graph shows the most developed scientific research topics in Ukraine, based on the number of respective, international scientific publications in accordance with Web of Science data and classification.

<sup>\*\*</sup>other topics include science technology, optics, mathematics, computer science, telecommunications, astronomy astrophysics



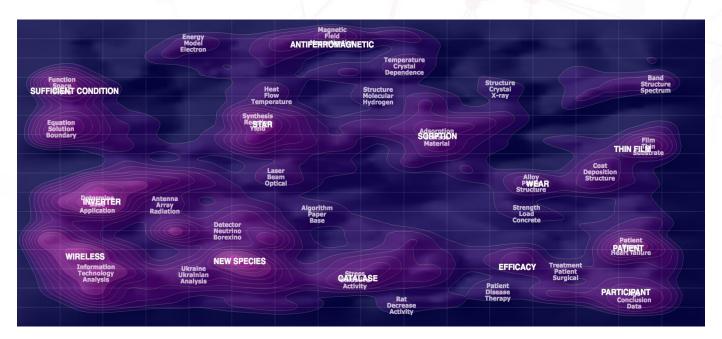
### TOPICS OF UKRAINIAN SCIENTIFIC PUBLICATIONS, 2016-2017



Depending on their content, articles can be classified in Web of Science by several subjects. We conducted a more detailed analysis of the topics developed by Ukrainian researchers during 2016-2017 and their interrelations, as presented in this graph.



### THEMESCAPE OF UKRAINIAN SCIENTIFIC PUBLICATIONS, 2016-2017



\*based on 15000 scientific publications

#### Key terms by the number of publications in which they are mentioned

Patient	Ukraine	Species	Diffraction	Alloy	Disease	Risk	Management
754	652	608	544	418	392	343	319
Clinical	Powder	Gene	European	Service	Steel	Drug	Cancer
307	307	281	280	266	265	257	248

Themescape demonstrates the most developed topics of international scientific publications by Ukrainian authors and co-authors in 2016-2017. Main topics are Magnetic field and properties, Inverter applications, Wireless technology, Adsorption materials, New Species, Sufficient condition (Mathematical functions), Patient Heart Failure and Treatment Efficiency.



THE NETHERLANDS

UKRAINE

AGRICULTURAL LAND

1,9 mn ha

42 mn ha

AGRICULTURAL EXPORT, 2017

€91.7 billion

COUNTRY'S TOTAL PATENT GRANTS\*

51732

40008

AGRICULTURAL PATENT GRANTS\*

5548

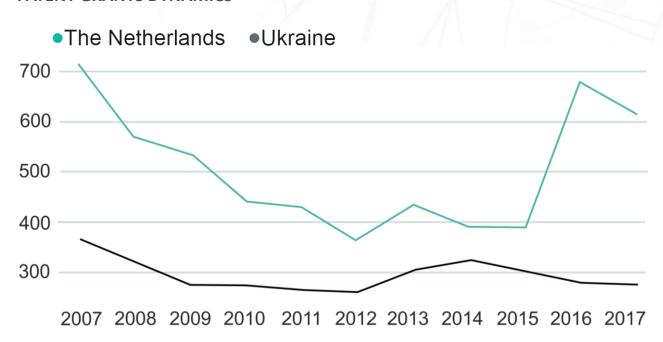
3240

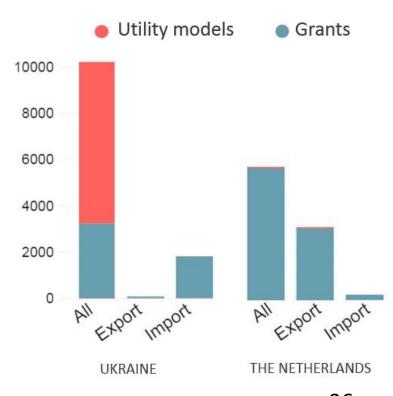
\*During 2007-2017 period



# COMPARISON OF PATENTING DYNAMICS IN AGRICULTURE

#### PATENT GRANTS DYNAMICS



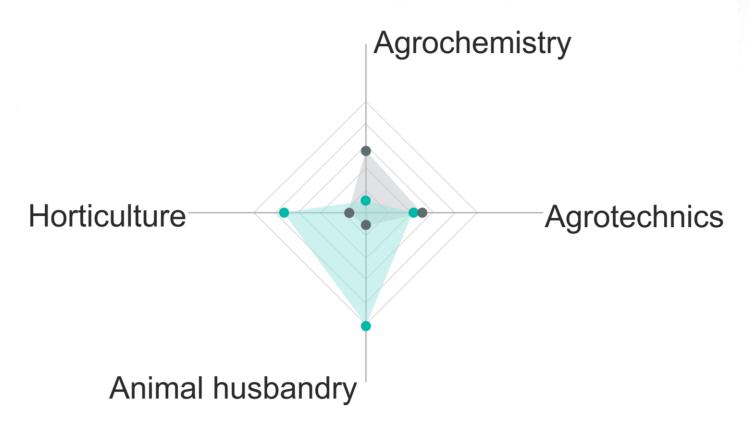


Ukraine has immense potential in agriculture, but so far the growth in the sector has been mainly driven by its vast natural and resources imported technologies. As the example of **Netherlands** the proves, innovations can substantially productivity increase profitability of the agricultural sector. The differences between the countries can be seen in the amount of imported/exported general level inventions, activity and topics of research.



# COMPARISON BY AGRICULTURAL SUB-SECTORS, BASED ON GRANTED PATENTS

The NetherlandsUkraine

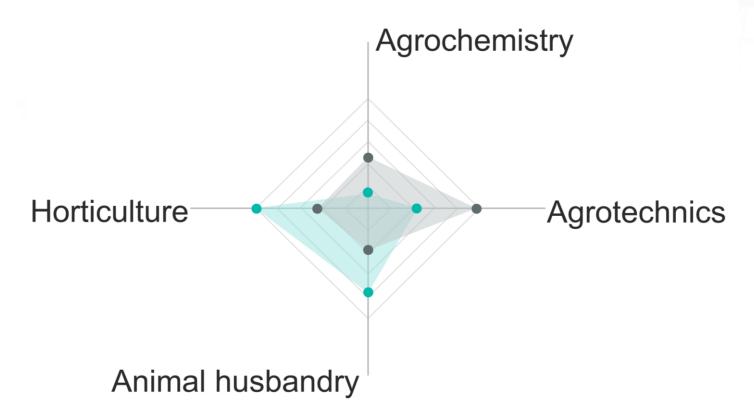


The classification of inventions registered in Ukraine and in the Netherlands, by agricultural sub-sectors, shows substantial differences in countries' focus. Most inventions in Ukraine are related to agrochemical solutions and agrotechnics. It is important to note, that about 60% of these inventions belong to non-residents, which protect their exclusive rights to sell the respective goods and technologies in a rapidly growing Ukrainian market.



# COMPARISON OF PATENT APPLICATIONS, PATENTS FOR INVENTIONS AND UTILITY MODELS BY AGRICULTURAL SUB-SECTORS

The NetherlandsUkraine



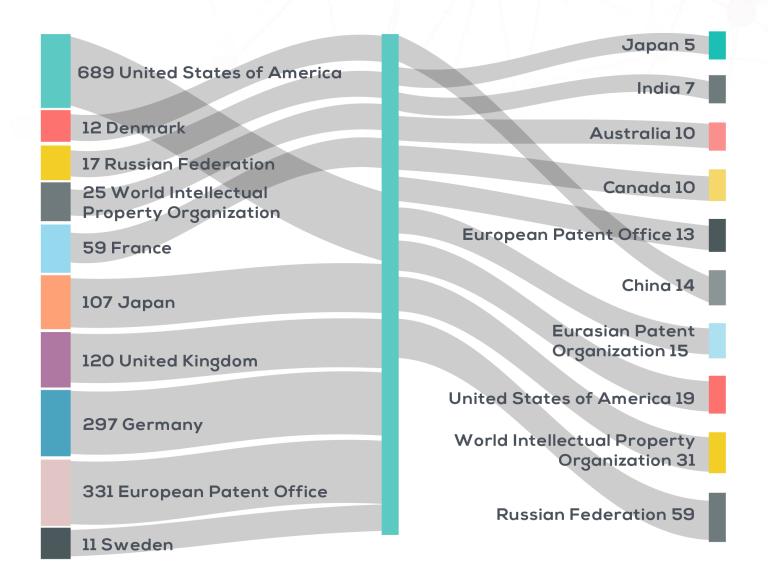
In the same classification, but including patent applications filed in the Netherlands and Utility models registered in Ukraine, shows a different picture. The reason being, as has already been shown earlier in this Report, that Utility models are highly popular in Ukraine for IP protection. 70-80% of all documents obtained by the residents of Ukraine are Utility models. Respectively, when we take Utility models into consideration, we discover that they are mostly related to Agrotechnics, Animal Husbandry and Horticulture (including new plants).



# INTERNATIONAL PATENT COOPERATION IN AGRICULTURE IN UKRAINE

FOREIGNERS PATENTING IN UKRAINE

UKRAINIANS' TOP FILING DESTINATIONS

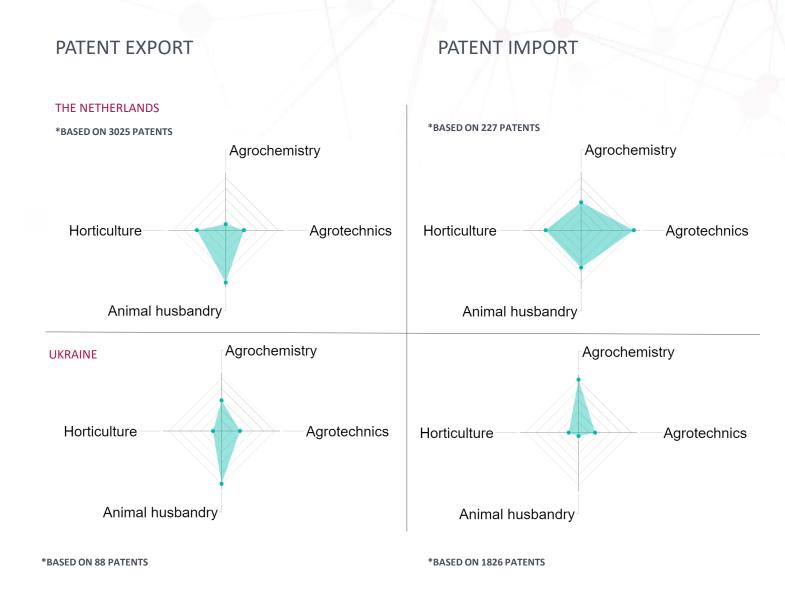


The left part of this graph shows the number of patents granted in Ukraine in relation to inventions, which were first filed in a given country (US, EP etc).

The right part of the graph shows the number of patent grants and patent applications filed in the given countries, after they were filed in Ukraine.



### PATENTS' EXPORT AND IMPORT BY AGRICULTURAL SUB-SECTORS



The classification of inventions and further division of patents obtained during 2007-2017 in both countries by "Import"/"Export" criteria, provide additional details on innovation activity in the countries. Specifically, that strong competencies of the Netherlands in Horticulture and Animal Husbandry, directly result in a high number of respective patents obtained in other countries.

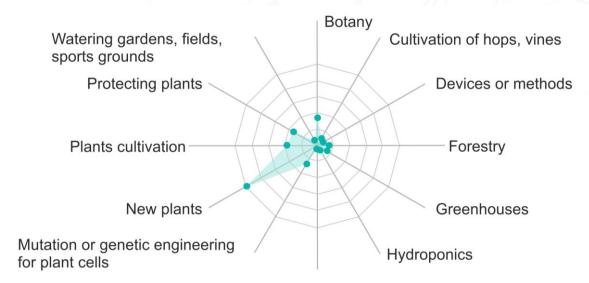
On the other hand, we can see that a high number of Agrochemical patents in Ukraine, is driven by the activity of foreign companies in Ukraine.



# DIRECTIONS OF PATENTING ACTIVITY IN HORTICULTURE

### **UKRAINE**

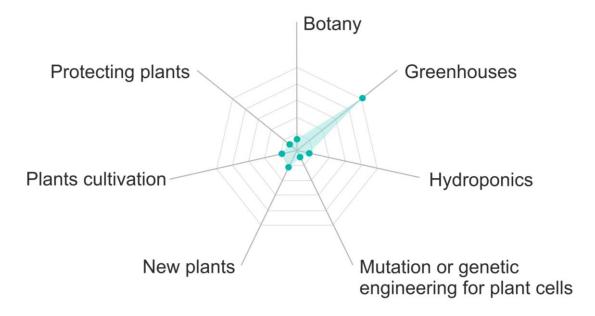
\*BASED ON 1822 PATENTS



Measuring or testing processes involving enzymes

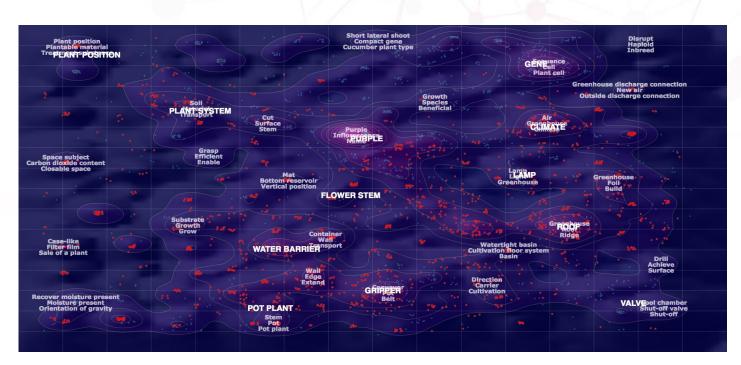
### THE NETHERLANDS

\*BASED ON 1986 PATENTS





# PATENT THEMESCAPE OF NETHERLANDS IN HORTICULTURE



GREENHOUSES

\*based on 3260 patents and applications

#### Key terms by the number of documents in which they are mentioned

Sequence	Gene	Tissue	Marker	Phalaenopsis	Tissue Culture	Genome	Seq Id
269	245	241	186	185	170	161	155
Specification	Trait	White	Genetic	Progeny	Derive	Plant Cell	Seq Id No
144	138	134	132	130	129	128	128

The most developed topic of horticulture related patents in the Netherlands is 'Greenhouse'. As it is shown in the patent Themescape above, the most developed subtopics in Greenhouses are Greenhouse Climate, Water barrier, Pot plant, Plant system, Plant position, Gripper, Lamp light in greenhouse, Shut-off valve, Greenhouse roof.



# PATENT OWNERS IN HORTICULTURE, THE NETHERLANDS

2%

### **TOP 5 PATENT OWNERS**



Market leader in young orchid plants



AgBiotech company for higher crop yield & quality



Design and manufacture of horticultural machinery and complete production lines for greenhouses



Leading company in breeding, production and sales of vegetable seeds



Develop new vegetable varieties and sell the seeds produced from them all over the world

98%

Universities

Companies and Individual owners

The Netherlands – mainly companies, which are commercial producers of agricultural products invest in their own research and register new inventions to their names.



# PATENT OWNERS IN HORTICULTURE, UKRAINE

41%

### **TOP 5 PATENT OWNERS**



Ukrainian National University of Bio-resources and Nature Exploitation



**Donetsk National University** 



Poltava State Agrarian Academy



Donetsk Botanic Gardens of NAS of Ukraine



Institute of Bioenergy Crops and Sugar Beet of NAAN

59%

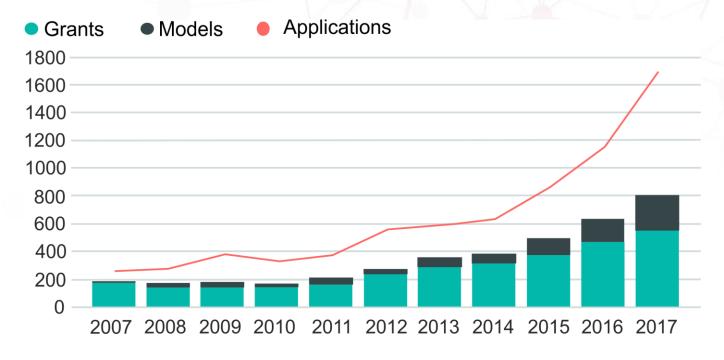
Universities

Companies and Individual owners

Ukraine – mainly Universities and individual patents owners. Previously in the majority of cases, Ukrainian agricultural holdings imported new technologies and only in recent years has this situation started to change. As the bigger players start to invest in startups and infrastructure projects, they aim to develop innovations for their businesses and to own them.



# EXPONENTIAL TECHNOLOGIES IN AGRICULTURE WORLDWIDE



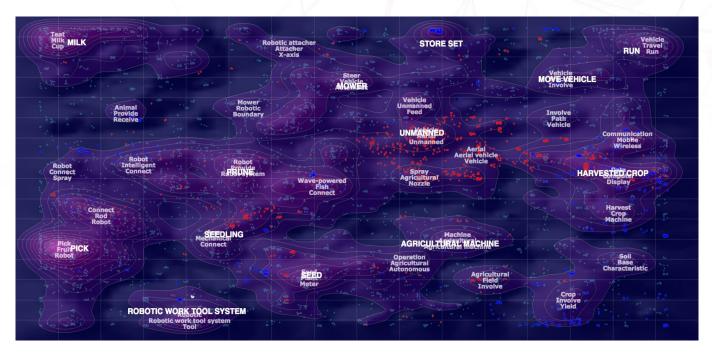
Total Count of Patent Grants, Applications and utility Models of Exponential Technologies in Agriculture, by types

Robotics for Agriculture	Automatic pilot	Drones
	3074 Precision agriculture	800 Al
5322	2492	698

The data presented in the graphs above, is based on the global patent search and on IPC classes related to technologies, which are considered to be the key drivers of further development of the agriculture sector.



# PATENT THEMESCAPE ON ARTIFICIAL INTELLIGENCE AND UNMANNED AERIAL VEHICLES IN AGRICULTURE



\*based on 10979 patents and applications





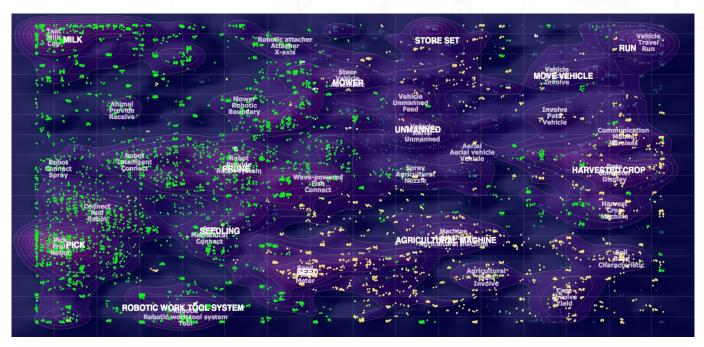
### Key terms by the number of documents in which they are mentioned

Milk	Pick	Fruit	Mower	Teat	Dairy	Cow	Cup	Work Vehicle	Robot Arm
865	651	543	492	487	485	462	395	224	214
Lawn				Dairy	Robotic		Unmanned Aerial		
Mower	Milk Robot	Teat Cup	Planter	Livestock	Attacher	Attacher	Vehicle	Stall	Parlor
204	192	191	182	178	176	176	145	145	135

The relations between Unmanned aerial vehicles (red) and Artificial intelligence technologies (blue) are presented in the Themescape above. Patents related to Unmanned aerial vehicles are concentrated in such topics as Agricultural Spray Nozzle, Aerial vehicle, Seedling, while patents on Artificial intelligence are distributed across Crop yield, Harvest crop machine, Store set. These both technologies converge in Harvested crop topic (crop analysis).



# PATENT THEMESCAPE ON ROBOTICS FOR AGRICULTURE AND PRECISION FARMING TECHNOLOGIES



\*based on 10979 patents and applications

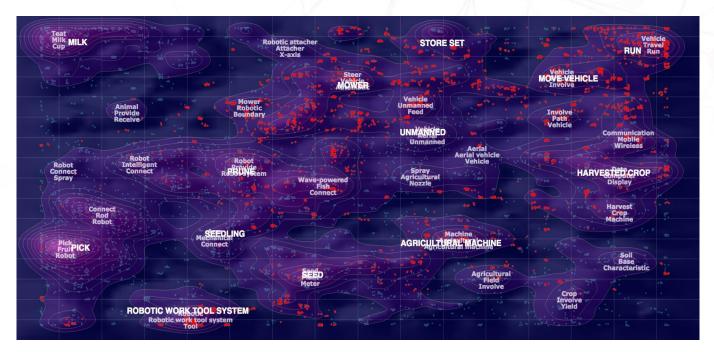
ROBOTICS FOR AGRICULTURE

PRECISION AGRICULTURE

The relations between robotics for agriculture (green) and precision farming technologies (yellow) are presented in the Themescape above. Patents related to robotics in agriculture are distributed across such topics as Automation of milk production (Milk Cup), Harvesting fruits (Pick Fruit Robot), Autonomous Robot systems, Robotic work tool system etc. Patents on precision agriculture are concentrated in Agricultural machine, Vehicle Control and Positioning (Move vehicle), Harvested crop, Store set, Vehicle travel run, Unmanned aerial vehicle, Soil base characteristics etc.



### PATENT THEMESCAPE ON AUTOMATIC CONTROL SYSTEMS IN AGRICULTURE



\*based on 10979 patents

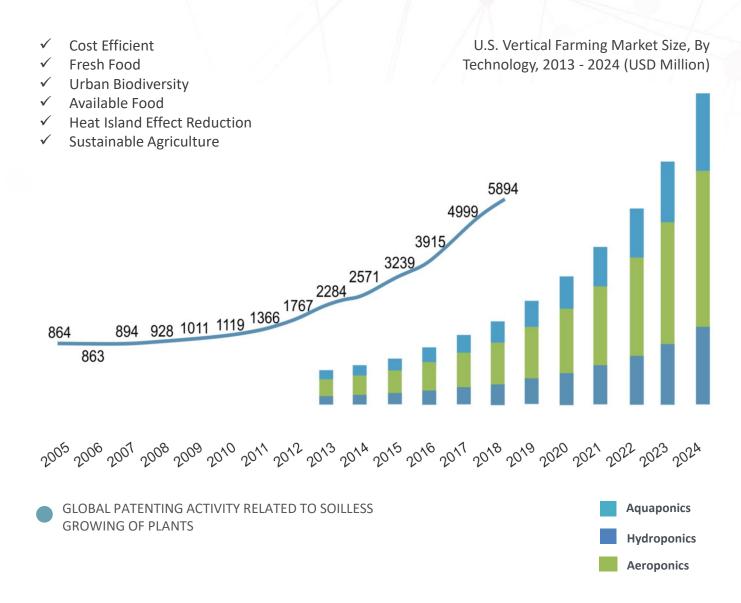
### AUTOMATIC CONTROL SYSTEMS IN AGRICULTURE

The patent Themescape focuses on solutions related to automatic control systems that are used in agriculture. Patents are represented in the Themescape by dots, and their number and concentration illustrates the level of technology development. Closer distance between the dots indicate a commonality of respective patents. Areas with lighter color demonstrate higher patenting activity in a certain technological area.

Robotics is the earliest direction that started to develop in agriculture. It has a high number of patents that cover such topics as: Milk, Prune, Seedling, Pick and Robotic work tool system. Automatic control systems are rapidly developing in the field of agriculture, while patents on Artificial intelligence in agriculture started to develop later, compared to other technologies, but are quickly catching up with other tech in number of inventions and in variety of applications.



# VERTICAL FARMS – ONE OF THE BEST EXAMPLES OF AGRICULTURE AND IT SYMBIOSIS



Strong growth of vertical farms related inventions and markets represent both the opportunity and the threat to Ukraine. On the one hand with strong IT and agricultural industry, Ukrainian companies have good chances to develop successful solutions and businesses in this field. On the other hand, vertical farms, as their investment and operating costs decrease, can allow local production of food in some of the export markets, which are important for Ukrainian producers.





### **UKRAINIAN AGRITECH STARTUPS**



http://agritech.unit.city/

Global trends show that agriculture needs to be more efficient and effective to yield more harvest from the same areas of fertile land. Vertical farming, precision agriculture, agricultural robots and drones, automation and Internet of Things (IoT) in agriculture are now becoming more common. Being an agricultural country, Ukraine becomes an active participant in agriculture innovations too. While the biggest patent holders in agriculture are still Ukrainian universities, there are more and more Ukrainian agritech startups that specialize on drone based sensing systems (Agrieye, Skyglyph), drone based crop protection (Kray Technologies), agriculture automation (Greenbe) and precision farming solutions (Monada, Craft Scanner). With development of agritech startups in Ukraine, it is also expected that in the nearest future patent export in the field of agrotechnics will exceed patent import.

Natalia Pakhomovska, DLA Piper Ukraine



# **EXAMPLES OF UKRAINIAN AGRICULTURAL STARTUPS**

### **IN UKRAINE**



Source: <a href="http://greenbe.com.ua/">http://greenbe.com.ua/</a>

### Greenbe

Easy way to measure and to monitor key soil parameters, make predictions, receive notifications for optimal irrigation process

### **Kray Technologies**

An easy-to-use, efficient and affordable solution, which solves the crop protection problems faced by farmers all over the world.

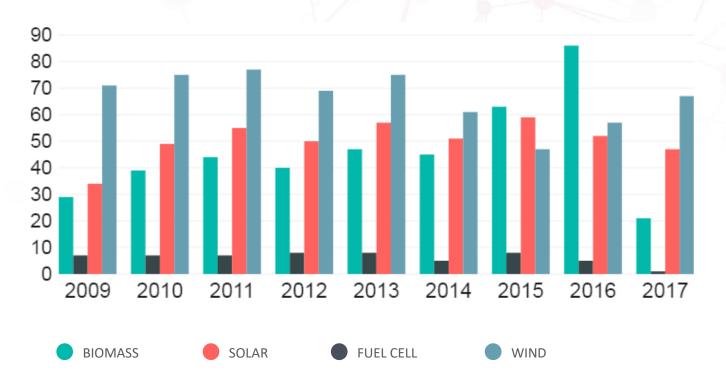


Source: http://kray.technology/





# RENEWABLE ENERGY PATENTING IN UKRAINE, BY TYPES



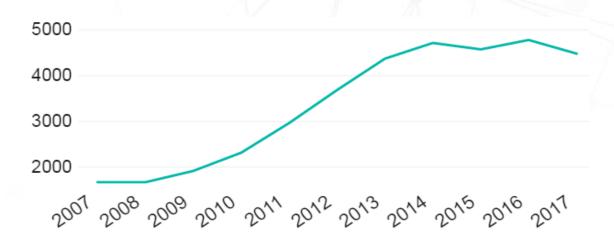
Renewable energy development in Ukraine is strategically important for the country, as it can open the way to its real energy and, respectively, political independence. As well as allow higher cost efficiency of agricultural and industrial production.

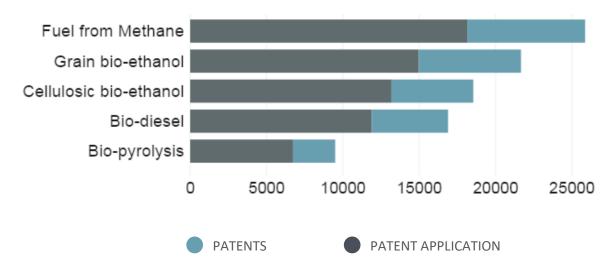
Driven by the rising costs of natural gas and oil for the local consumers, due to substantial devaluation of the local currency, there is a growing interest to energy generation from renewable energy sources (RES). One of the main sources of RES in Ukraine is biomass, which is a natural consequence of strong agricultural sector and vast natural resources of the country. Further, depending on the region, there are favorable conditions for development of wind and solar energy generation.

Although least numerable in the graph above, there are some strong and competitive inventions related to electro-chemical generation of electricity using fuel cells, which can substantially increase the efficiency of the electrical power generation in Ukraine, when they are industrially implemented.



## BIOENERGY, GLOBAL PATENTING TREND



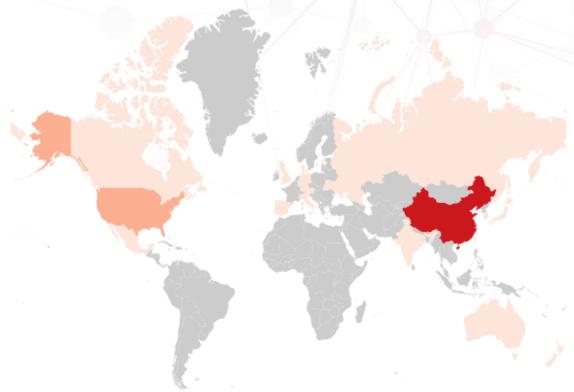


There is a growing number of inventions related to energy generation from biomass internationally, as shown in the graph above. It proves the attractiveness of this technological area and its strategic importance. This interest is substantially driven by the fact that such energy generation can be carbon neutral and thus contribute to measures against climate change.

We organized all the patents and applications from this set of results, based on IPC classes related to types of biofuel, as presented in the graph above.



# GEOGRAPHICAL DISTRIBUTION OF WIND ENERGY RELATED PATENTS



\*Based on patents for Inventions and Utility Models

- China (21002)
- United State (7526)
- EP (4087)
- Korea, Republic of (3956)
- Japan (3652)
- Spain (2826)
- Denmark (2227)
- Germany (2155)
- Russian Federation (1600)
- Australia (1169)

- Taiwan (1135)
- Canada (1088)
- Ukraine (661)
- Austria (613)
- New Zealand (499)
- India (422)
- United Kingdom (389)
- Portugal (377)
- Italy (364)
- Mexico (364)

Another especially important renewable energy source for Ukraine, is Wind Power, as it can provide flexible, decentralized energy generation. We conducted further research on Wind energy inventions based on a comparison with that of Denmark.

Denmark is one of the leaders in Wind Energy related patents for inventions and utility models, as well as in their practical implementation – achieving 43,4 % of energy generation from wind of the country's total consumption in 2017.



# PATENTING DYNAMICS OF WIND ENERGY RELATED PATENTS



<sup>\*</sup>Wind energy production as a percentage of total electricity Consumption 2007 – 2017.

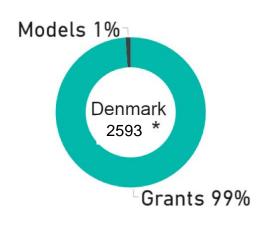
In 2016, electric power generation by wind power stations, produced 0,8% of total energy generation in continental Ukraine.

The dynamics of patenting in Denmark, as well as respective percentages of their energy generation by wind power stations are presented in the graph above.

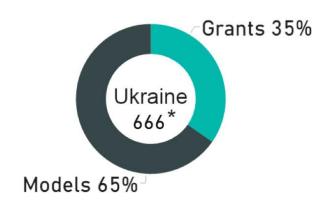
http://www.windpower.org/en/knowledge/statistics/the\_danish\_market.html



# PATENTING DYNAMICS OF WIND ENERGY RELATED PATENTS



DENMARK 2016: INSTALLED WIND POWER GENERATION CAPACITY WAS 5229 MW



UKRAINE 2016: INSTALLED WIND POWER GENERATION CAPACITY WAS 426,2 MW

http://www.windpower.org/en/knowledge/statistics/the\_danish\_market.html http://uwea.com.ua/uploads/docs/uwea 2016 report ua web open.pdf

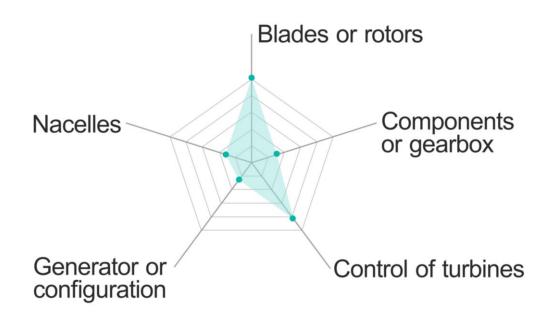


# STRUCTURE OF WIND ENERGY RELATED PATENTS IN DENMARK\*

#### PATENTING DIRECTIONS BY IPC

	Rotation axis substantially parallel to the air
1776	flow entering the rotor
1307	Controlling wind motors
816	Adaptations of wind motors for special use
	Details, components or accessories not
472	provided for in groups
	Assembly, mounting or commissioning of
228	wind motors;

#### PATENTING DIRECTIONS BY CPC



<sup>\*</sup>by priority country

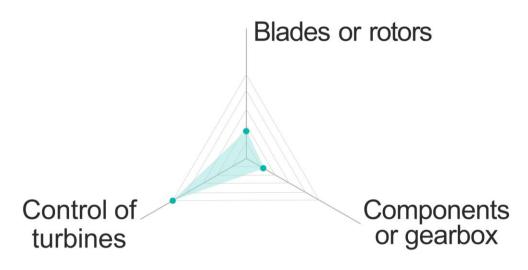


# STRUCTURE OF WIND ENERGY RELATED PATENTS IN UKRAINE\*

#### PATENTING DIRECTIONS BY IPC

	Rotation axis substantially perpendicular to the air flow
266	entering the rotor
207	Adaptations of wind motors for special use
	Rotation axis substantially parallel to the air flow entering
161	the rotor
158	Controlling wind motors
56	Other wind motors

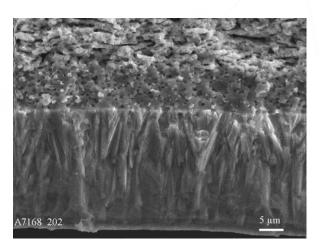
### PATENTING DIRECTIONS BY CPC



<sup>\*</sup>by priority country



# EXAMPLES OF UKRAINIAN STARTUPS IN RENEWABLE ENERGY GENERATION



Source: Innolytics Group Research

### Solid Oxide Fuel Cells

Ukrainian scientists achieved the remarkably high quality of Solid Oxide Fuel Cells (SOFC) structure and efficiency (photo on the left) and are looking for the partners to commercialize the technology. SOFC allow almost 2 times more efficient electricity generation comparing to traditional electromechanical methods.

### **Sirocco Energy**

Sirocco Energy panel - is a new linear wind generator for distributed energy production. In contrast to horizontal and vertical wind turbines, Sirocco's wind panels undergo translational motion rather than rotational motion.



Source: https://www.sirocco.energy







# PHARMACEUTICALS: PATENT STATISTICS IN UKRAINE

Pharmaceutical patents in Ukraine comprise\*:

- 10,3 % of all patents
- 17,2 % of all inventions
- almost 1/3 of all patents filed by non-residents



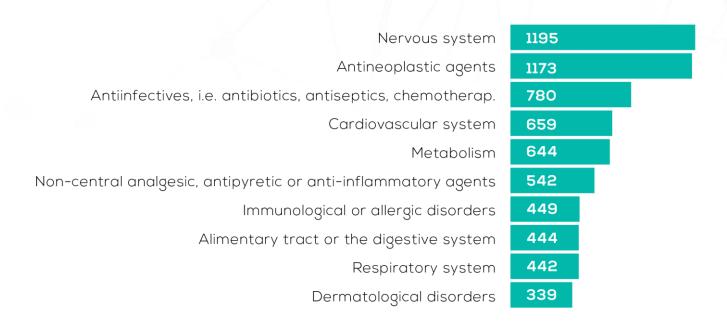
<sup>\*</sup>based on patents and utility models

The patenting activity in a particular field mainly depends on two factors: the demand for technologies or products of a certain type and the real possibility to protect the rights to inventions and solutions on which the said technologies are based. The prominent example thereof is pharmaceutical business in Ukraine - it is one of the most profitable and competitive industries at the moment. High competition on the market causes, inter alia, a large number of violations of IP rights for pharmaceuticals. This, in turn, has formed a court practice in the said area, which indicates that patents for pharmaceuticals can be enforced, and thus, there are commercial reasons for patenting in Ukraine. As a result, the research findings predictably show that foreign companies in Ukraine are most active in patenting of inventions in the sphere of pharmaceuticals.

Natalia Pakhomovska, DLA Piper Ukraine



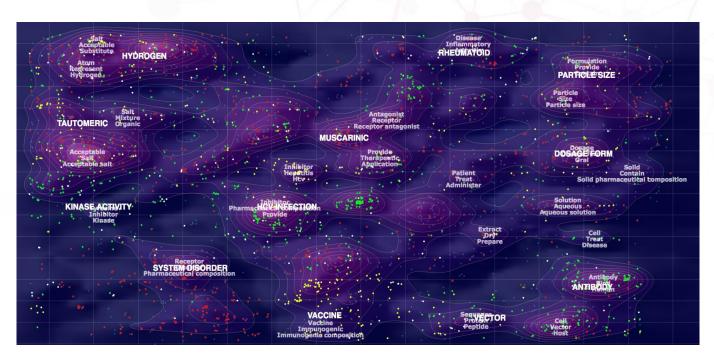
# NON-RESIDENTS' PHARMACEUTICALS PATENTING DIRECTIONS IN UKRAINE



The graph above, was built based on the IPC classification of patents belonging to non-resident companies in Ukraine . It represents the most developed topics, based on the number of related patents.



# THEMESCAPE OF NON-RESIDENTS' PATENTS IN UKRAINE



\*based on 4397 patents

ANTINEOPLASTIC AGENTS

ANTIINFECTIVES, I.E. ANTIBIOTICS, ANTISEPTICS, CHEMOTHERAPEUTICS

NERVOUS	<b>SYSTEM</b>

Salt	Disease	Acceptable	Inhibitor	Disorder	Acceptable Salt	Receptor
1,12	1,092	795	735	673	559	519
Cancer	Formulation	Select	Antibody	General Formula	Cell	Substitute
	. o.maia.ion	00.000	7	Concran Connaia	GG	Jastitute
383	339	310	304	304	303	286

Patent Themescape presents the topics of non-residents' patents in Ukraine. We highlighted selected applications such as 'Nervous system', 'Antineoplastic Agents' and 'Antiinfectives'. Topics of special interest within the above mentioned applications are HCV infection, System disorder, Vaccine, Kinase activity, Antibody, Dosage form, Particle size, Rheumatoid, Hydrogen, Tautomeric, Muscarinic.



# PATENT THEMESCAPE OF PATENTS APPLIED BY UKRAINIANS ABROAD



\*based on 319 patents and applications

- Cardiovascular system
- Antiinfectives, i.e. antibiotics, antiseptics, chemotherapeutics
- General protective or antinoxious agents

As shown in the patent Themescape above, Ukrainians are mostly active abroad in pharmaceuticals in the following topics: Antimicrobial composition, Acceptable salt, Diabetes treatment, Viral infection, Bacterium (Aeruginosa), Tuberculosis, Viral disease.





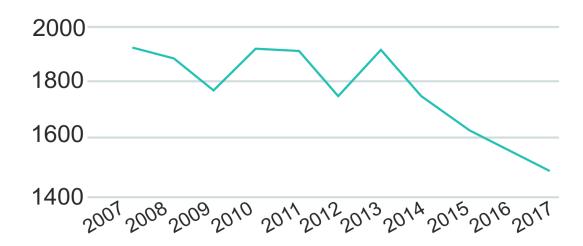
# MECHANICAL ENGINEERING: PATENT STATISTICS IN UKRAINE

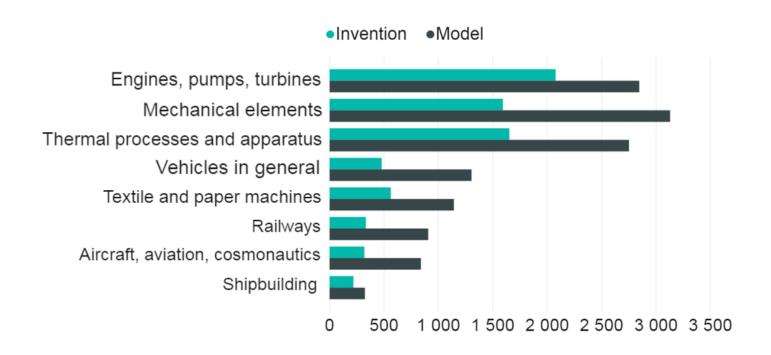
NON-RESIDENTS (from total)

ABROAD (from total)

11.4%

5.9%



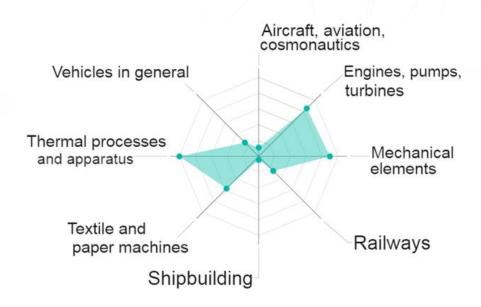




# DIRECTIONS OF PATENTING BY MECHANICAL ENGINEERING SUB-SECTORS

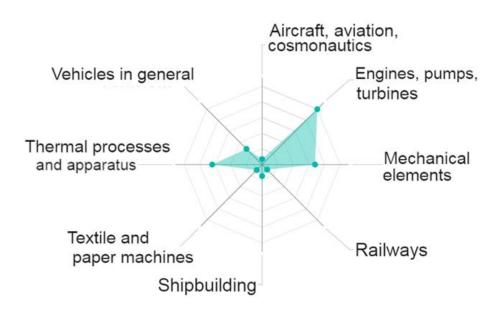
### FOREIGNERS PATENTING IN UKRAINE

\*BASED ON 2129 PATENTS



### UKRAINIANS PATENTING ABROAD

\*BASED ON 1196 PATENTS





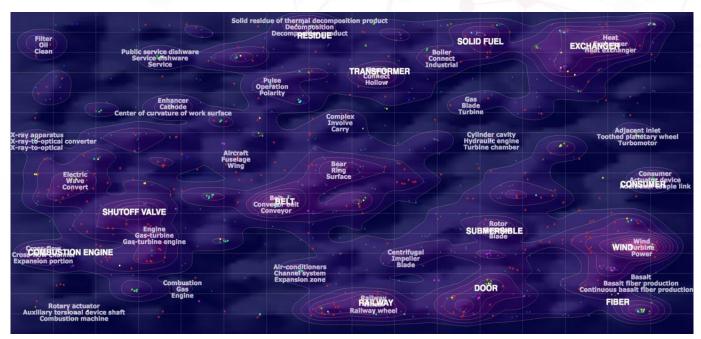
# TOP PATENT OWNERS IN MECHANICAL ENGINEERING IN UKRAINE

### TOP UKRAINIAN COMPANIES DONBAS STATE MACHINE BUILDING NOVOKRAMATORSK MACH BUILDING ILLICH MARIUPOL METALLURG WORKS OJSC STATE ENTPR "M YANHEL DESIGN OFFICE "PIVDENNE" MARIUPOL I METALLURGICAL WORKS TOP FOREIGN COMPANIES IN UKRAINE SNECMA SIEMENS WURTH PAUL SA HISPANO SUIZA SA SAINT GOBAIN ISOVER



# PATENT THEMESCAPE OF UKRAINIAN PATENTING ABROAD BY JURISDICTIONS

WO UNITED STATES



\*based on 1051 patents and applications

CHINA

Combustion Engine	Internal Combustion Engine	Link	Belt	Solution	Conveyor Belt	Absorber	Alkali	Residue
71	38	29	27	27	23	18	18	17
Shock Absorber	Work Cavity	Column	Hybrid Internal Combustion Engine	Basalt	Fibre	Continuous Basalt Fiber Production	Wind Turbine	Melt Furnace
17	16	16	16	15	15	15	15	15

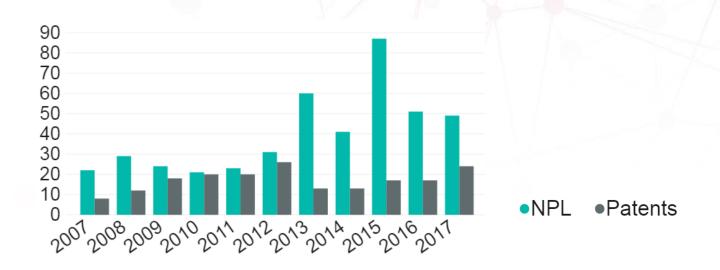
**GERMANY** 

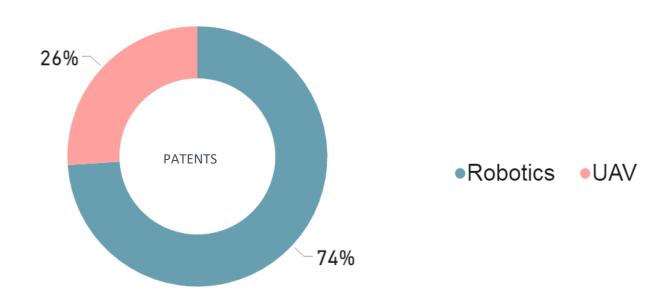
POLAND

Patent Themescape presents the most actively patented topics by Ukrainians abroad, that are Combustion engine, Conveyor Belt, Railway, Submersible Rotor Blade, Solid Fuel, Shutoff Valve, Wind turbine power, Door, Transformer, Fiber etc. Among Ukrainians top filing destinations are EP (European Patent Office), WO (World Intellectual Property Organization), USA, Germany, Poland and China.



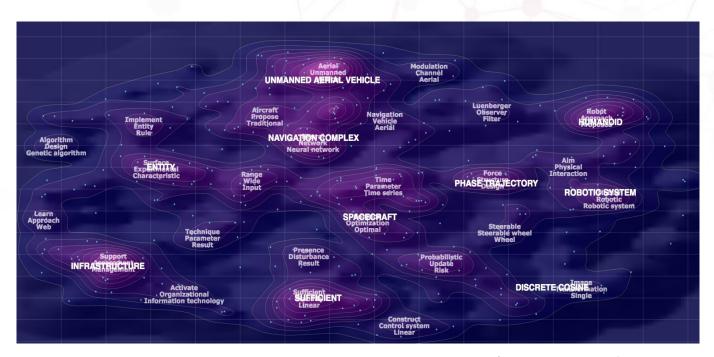
# ROBOTICS PATENTS AND SCIENTIFIC PUBLICATIONS DYNAMICS IN UKRAINE







# THEMESCAPE OF UKRAINIAN SCIENTIFIC PUBLICATIONS IN ROBOTICS



\*based on 439 scientific publications

Vehicle	Unmanned	Aerial	UAV	Robot	Unmanned Aerial Vehicle	Navigation	Equation
95	84	81	71	63	52	39	37
Mobile	Robotic	Measure	Class	Stabilization	Sufficient	Obstacle	Infrastructure
30	29	28	28	27	22	12	11

As shown in this Themescape above, international scientific publications by Ukrainian authors in Robotics are focused on Unmanned Aerial Vehicles, Navigation complex, Discrete cosine image transformation, Robotic system, Spacecraft, Humanoid robots, Surface experimental characteristics, Infrastructure (support, assessment, management).



# EXAMPLES OF UKRAINIAN STARTUPS IN MECHANICAL ENGINEERING



Source: <a href="https://solargaps.com/">https://solargaps.com/</a>

### **xBeam**

New metal 3d printing technology producing high quality parts from titanium and other metals with a high productivity at low production costs.

### Pipes.one

New Technology for onsite production of lengthy large diameter polyethylene pipes with cellular walls.



Source: <a href="http://pipes.one/">http://pipes.one/</a>



### AUTHORS OF THE REPORT

### **Innolytics Group**

Consulting company that provides technology and market research services for implementation of new technologies in business projects, investments in innovative companies, technologies, research and development of new products, in-depth competition research, technology scouting and transfer. We use big data analysis from various patent, technical and commercial data bases, as well as other sources, to evaluate technology projects, new products and solutions in the context of global technological competition and developing trends in specific technology areas. If a patentability search for a new product or solution shows a lack of its novelty, in many cases we are able to advise on how to improve and differentiate such a product to achieve patentability, or at least to avoid infringement of existing patents. For more: <a href="www.innolyticsgroup.com">www.innolyticsgroup.com</a> or contact us by email: research@innolyticsgroup.com

### **Singularity University Kyiv Chapter**

Singularity University (SU) is the benefit corporation behind a global community of innovators who share a mission to solve the world's greatest challenges. The SU Community comprises individuals, business, institutions, investors, and NGOs in more than 110 countries. The SU platform is a unique combination of services that consists of educational programs in exponentially advancing technologies, as well as innovation programs to support collaboration and initiatives leveraging those technologies to positively impact billions of lives globally. For more: www.su.org

**Singularity University Kyiv Chapter** — is a local chapter and community organization of Singularity University.



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### **UNIT.City**

UNIT.City is Ukraine's first innovation park. It is the location where matchless infrastructure and all-inclusive ecosystem enable high technology, innovative and creative businesses to happen and flourish. The goal is to become the center of innovations and a one-point entry into Ukraine for investors, partners and new technology from all over the world. The mission of UNIT.City is to create a unique innovation platform where advanced companies, start-ups and mavens get an opportunity to cross paths and work together ramping up their growth and honing quality.

Park offers its residents a package of additional services for business development: meetings with investors, counseling, mentoring and accelerating programs, prototyping laboratories, great infrastructure for work and leisure. For more: www.UNIT.City

The main investor is Vasyl Khmelnytsky, Founder of UFuture Investment Group.

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