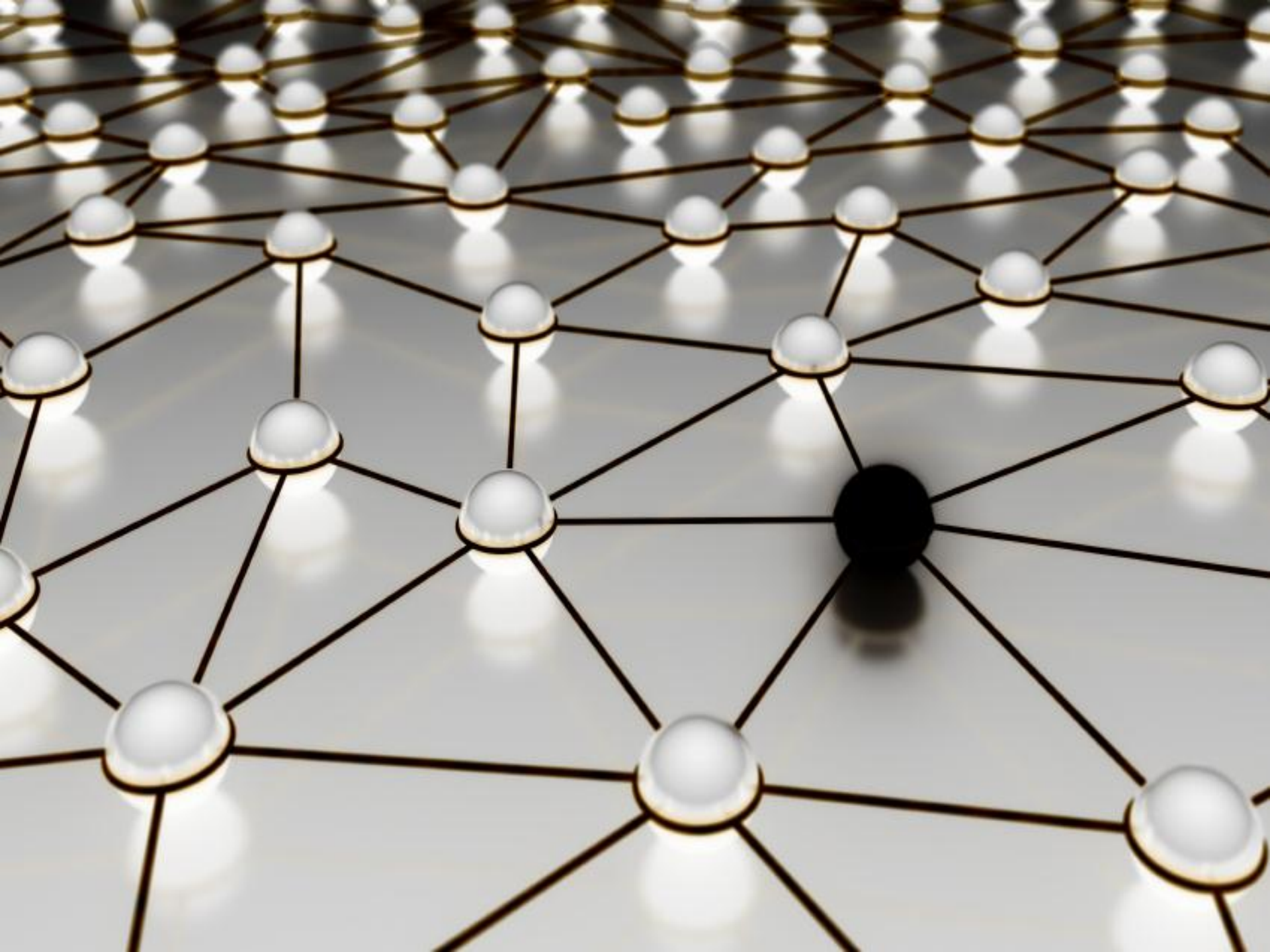


SMART GRID – FUTURE FOR BELARUS
ПЕРСПЕКТИВЫ РАЗВИТИЯ В РЕСПУБЛИКЕ БЕЛАРУСЬ

Сергей Филатов
Институт тепло- и массообмена НАН Беларуси

Минск 2012

EU TECHNOLOGY PLATFORM FOR SMART GRID

"Efficient transmission and distribution of electricity is a fundamental requirement for providing European citizens, societies and economies with essential energy resources"

Janez Potoc̆nik
Commissioner for Science and Research

We need to **renew Europe's electricity networks**, meet growing electricity demand, enable a trans-European electricity market and **integrate more sustainable generation resources,** including renewable sources.

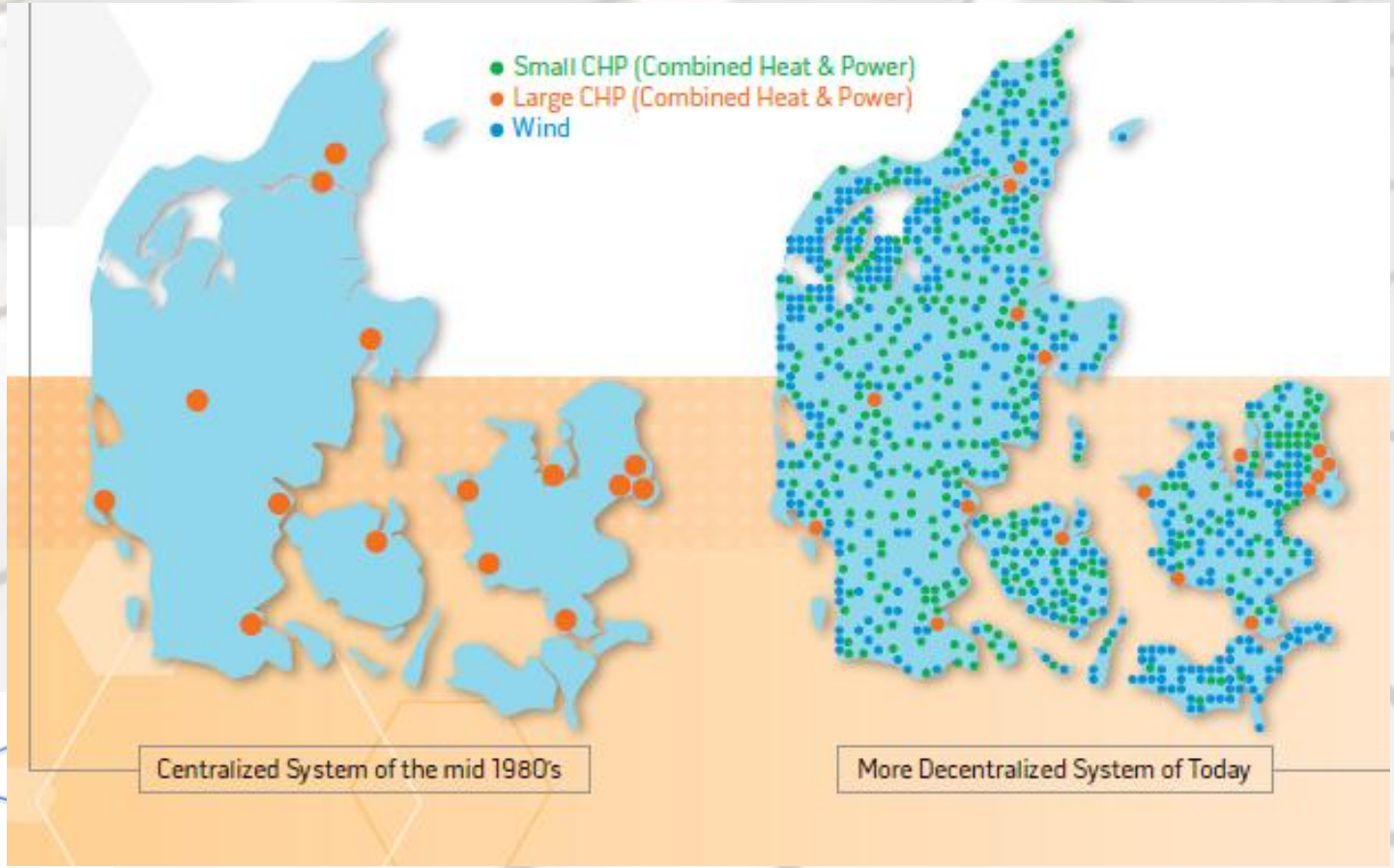
SMART GRIDS MUST BE:

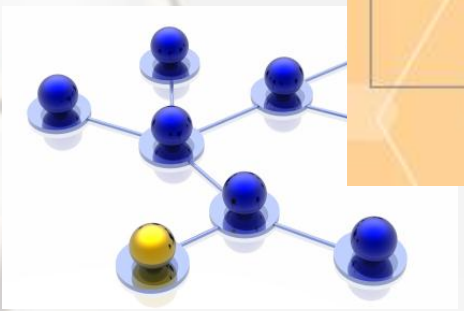
- **Flexible:** fulfilling customers' needs whilst responding to the changes and challenges ahead;
- **Accessible:** granting connection access to all network users, particularly for renewable power sources and high efficiency local generation with zero or low carbon emissions;
- **Reliable**: assuring and improving security and quality of supply, consistent with the demands of the digital age with resilience to hazards and uncertainties;
- **Economic:** providing best value through innovation, efficient energy management and 'level playing field' competition and regulation.

SMART GRID: MORE INSTALLATIONS -MORE REGULATIONS

- The term “smart grid” means concept of widely distributed power generation facilities.
- In the past, a relatively small number of power plants were controlled by a relatively small number of utilities.
- In the nearest future, more generation facilities such as wind farms and **solar power plants** will be controlled by a larger number of corporations and individuals.

SMART GRID: WHY WE NEED IT – EXAMPLE OF DECENTRALIZATION IN DENMARK





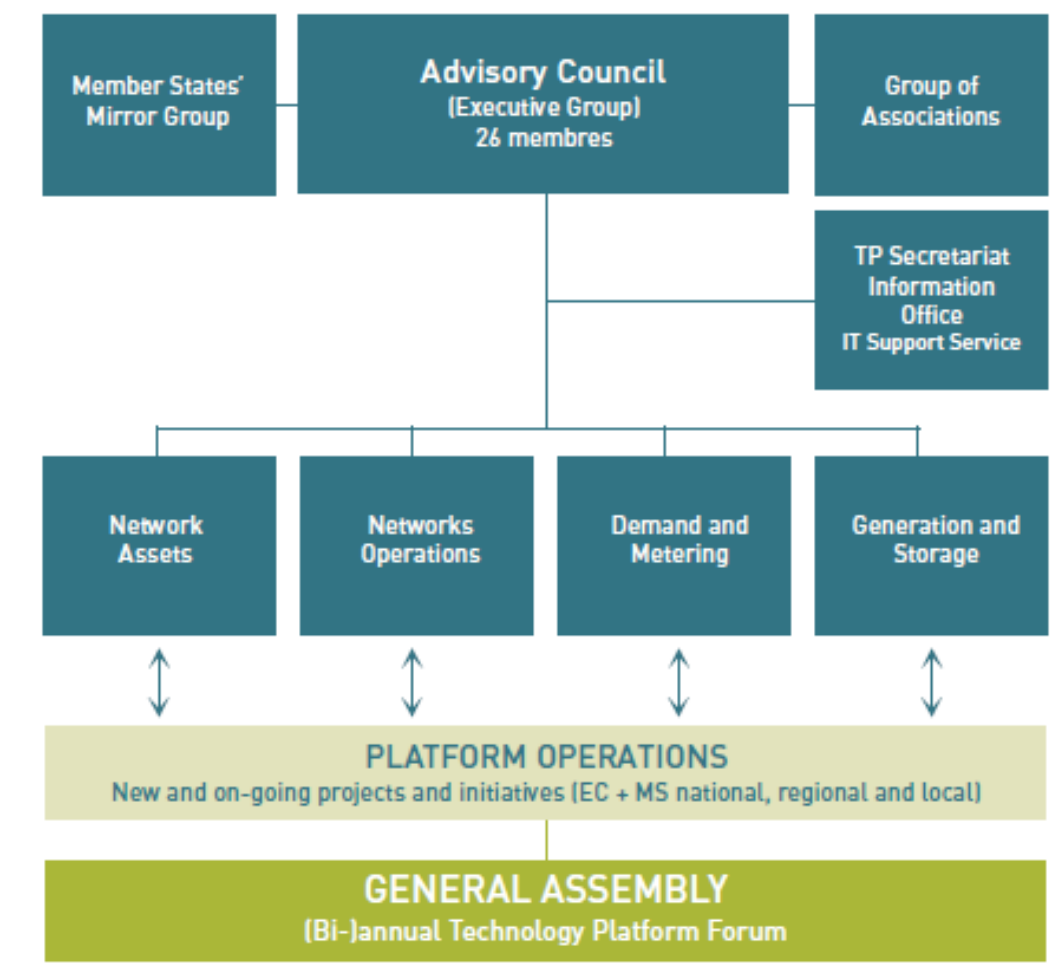
SMART GRID: STRATEGY FOR RESEARCH, DEVELOPMENT AND DEMONSTRATION

- Generation
- Networks
- Energy Storage
- Load Efficiency
- Control
- Communications
- Liberalization markets
- environmental

EU FUTURE TECHNOLOGY PLATFORM

Mirror Group: enables the involvement of Member States, candidate countries and associate states

Contact point for CIS?



SMART GRIDS: SRA 2035

SRA 2035 has to discover solutions that go beyond the EU 2020 goals: 80% cutting of emissions has been envisioned by 2050 and Europe's energy production will have to be almost carbon-free. SmartGrids research up to the year 2035 must consider the **increased impact of renewable energy** based electricity generation, 34% of the total energy consumption by the year 2020,

SMART GRIDS: WHY SRA 2035 ?

Since the initiation of the SmartGrids in 2006, the world has changed.

The large majority of Smart Grids stakeholders, including governments, are now fully aware that

a) their overall **target of 34% renewable energy** recourses by 2020 means the grid **must be re-engineered**

b) intelligent grid based systems can potentially offer a cost optimal way to re-engineer it.

SMART GRIDS 2035 TECHNOLOGICAL PRIORITIES

- Small- to medium-scale **distributed storage systems** for distributions systems exposed to a massive penetration of renewable electricity generation
- **Real-time energy use metering** and system state **monitoring systems** to increase the real-time knowledge of on-going processes (voltage, flows, short circuit, etc.) and to be able to derive critical system control measures
- **Grid modelling technologies**
- **Communication technologies**
- **Protection systems** for distributions systems exposed to a massive penetration of **renewable based electricity generation**
- **Non-technological issues** with direct impact on technologies

SMART GRID: MODELING TECHNOLOGIES

- To design and demonstrate the new **HVDC** and adapted **HVAC** transmission systems, the adapted AC medium and low voltage distribution and the new DC consumer home grids and systems.
- To **monitor** in real-time the ageing of present electricity materials and cost-efficiently signal predictive maintenance, repair and replacement times.
- To **predict** in ahead of delivery up to real-time the generation output of a massive amount of volatile, intermittent generators and the demand of many flexible electricity consumers.

SMART GRID: COMMUNICATION TECHNOLOGIES

- Need be enable the secure exchange of information among the many new involved stakeholders for an **efficient, secure, low-cost and sustainable** electricity system operation at the transmission system down to the consumer of electricity products and services.
- Need be enable operate small-scale islanded systems (short-term or in general without connection to the synchronized European power system) to securely handle distributed, renewable based generators and flexible electricity consumers and to securely connect to and disconnect from the synchronized European power system.

SMART GRID: FUNDAMENTAL TECHNOLOGIES

- ✓ **Integrated communications**, connecting components to open architecture for real-time information and control, allowing every part of the grid to both 'talk' and 'listen'
- ✓ **Sensing and measurement technologies**, to support faster and more accurate response such as remote monitoring, time-of-use pricing and demand-side management
- ✓ **Advanced components**, to apply the latest research in superconductivity, storage, power electronics and diagnostics
- ✓ **Advanced control methods**, to monitor essential components, enabling rapid diagnosis and precise solutions appropriate to any event
- ✓ **Improved interfaces** and decision support, to amplify human decision-making, transforming grid operators and managers quit literally into visionaries when it come to seeing into their systems

SMARTGRIDS: 'ENABLING' TECHNOLOGIES

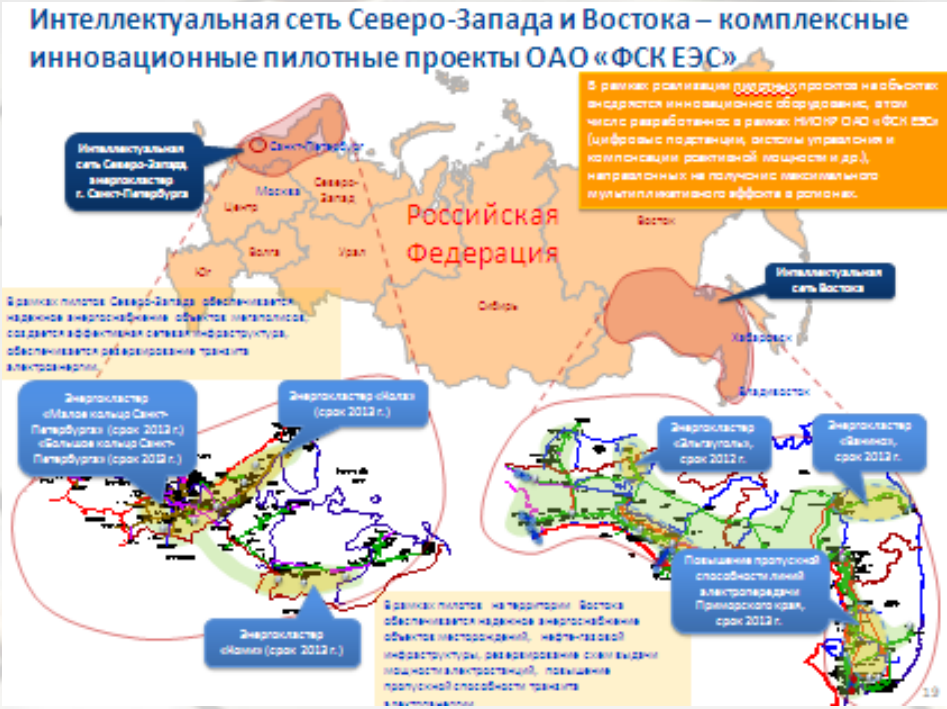
- **Active distribution networks**, revealing characteristics of today's transmission grids;
- **New network technologies** that facilitate increased power transfers and losses reduction (e.g. GIL, superconductivity, high operating Temperatures, FACTS technologies, etc.);
- **Wide deployment of communications** to enable grid automation, on-line services, active operation, demand response and DSM;
- Power electronic technologies for quality of supply;
- **Stationary energy storage devices.**

SMART GRID: EU PRIORITIES

- **Zero-net energy commercial buildings:** Smart Grid technologies capable of balancing energy generation and energy conservation.
- **Superconducting power cables:** Capable of reducing line losses and carrying 3-5 times more power
- **Energy storage:** While electricity cannot be economically stored, energy can be.
- **Advanced sensors:** Monitoring and reporting line conditions in real time, advanced sensors enable more power to flow over existing lines.
- **Plug-in Hybrid Electric Vehicles**

SMART GRID: PRIORITY FOR RUSSIA – PRIORITY FOR BORDER COUNTRIES

Smart Grid or Electrical Network with adaptive and regulation Elements – is base conception of Russian Federal Network Company (ФСК ЕЭС)



- Smart Grids
- Superconductive lines
- Energy storage
- High voltage equipment
- Smart meters technique

Обоснование выбора

- стратегическая важность (глобальный уровень)
- прогнозируется высокий рост, рынок открыт для входа
- прогнозируется появление революционных технологий, которые изменят современную энергетику
- высокий экспортный потенциал

Технологии

- «умные сети»
- сверхпроводимость
- хранение энергии
- высоковольтное оборудование для передачи энергии
- технологии учета

SMART GRID: PRIORITY FOR RUSSIA

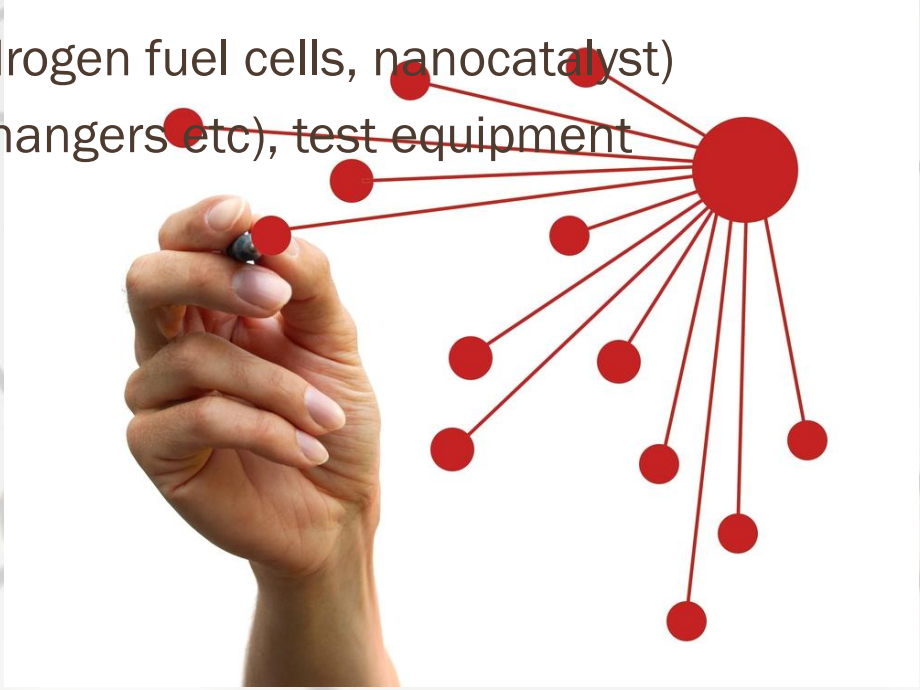
Сколково

SMART GRID: FUNDAMENTAL TECHNOLOGIES

- ✓ **Integrated communications**, connecting components to open architecture for real-time information and control, allowing every part of the grid to both 'talk' and 'listen'
- ✓ **Sensing and measurement technologies**, to support faster and more accurate response such as remote monitoring, time-of-use pricing and demand-side management
- ✓ **Advanced components**, to apply the latest research in superconductivity, storage, power electronics and diagnostics
- ✓ **Advanced control methods**, to monitor essential components, enabling rapid diagnosis and precise solutions appropriate to any event
- ✓ **Improved interfaces** and decision support, to amplify human decision-making, transforming grid operators and managers quite literally into visionaries when it come to seeing into their systems

SMART GRID: WHAT WE ARE OFFER : – JOINT PROJECTS

- **Technology and equipment for grid health monitoring** (Smart Phase Meters and Grid Events registration units, any equipment by request)
- Software for Electrical Networks Company
- **Technology for energy storage** (Solid state hydrogen storage – materials, research, equipment)
- **Hydrogen Technology** (research, hydrogen fuel cells, nanocatalyst)
- **New materials** (heat pipes heat exchangers etc), test equipment



OUR RESEARCH NETWORK

- A.V. Luikov Heat and Mass Transfer Institute (Minsk)
- Belarusian State University (Minsk)
- Institute of new materials (Chernogolovka, Russia)
- Belarusian Technology University (Minsk)
- Institute of System Analysis (Minsk)
- Institute of Energy (Minsk)
- University of Oil and Gas (Moscow)

- Department of Energy (Belarus)
- Belarusian Network Company (Minsk)

THANK YOU FOR ATTENTION!

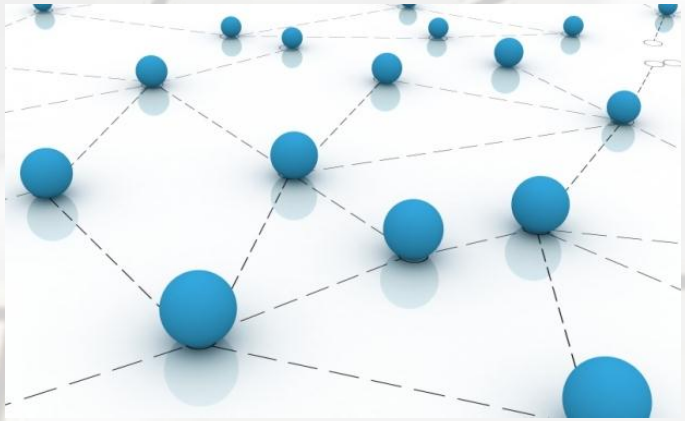
- Questions ?

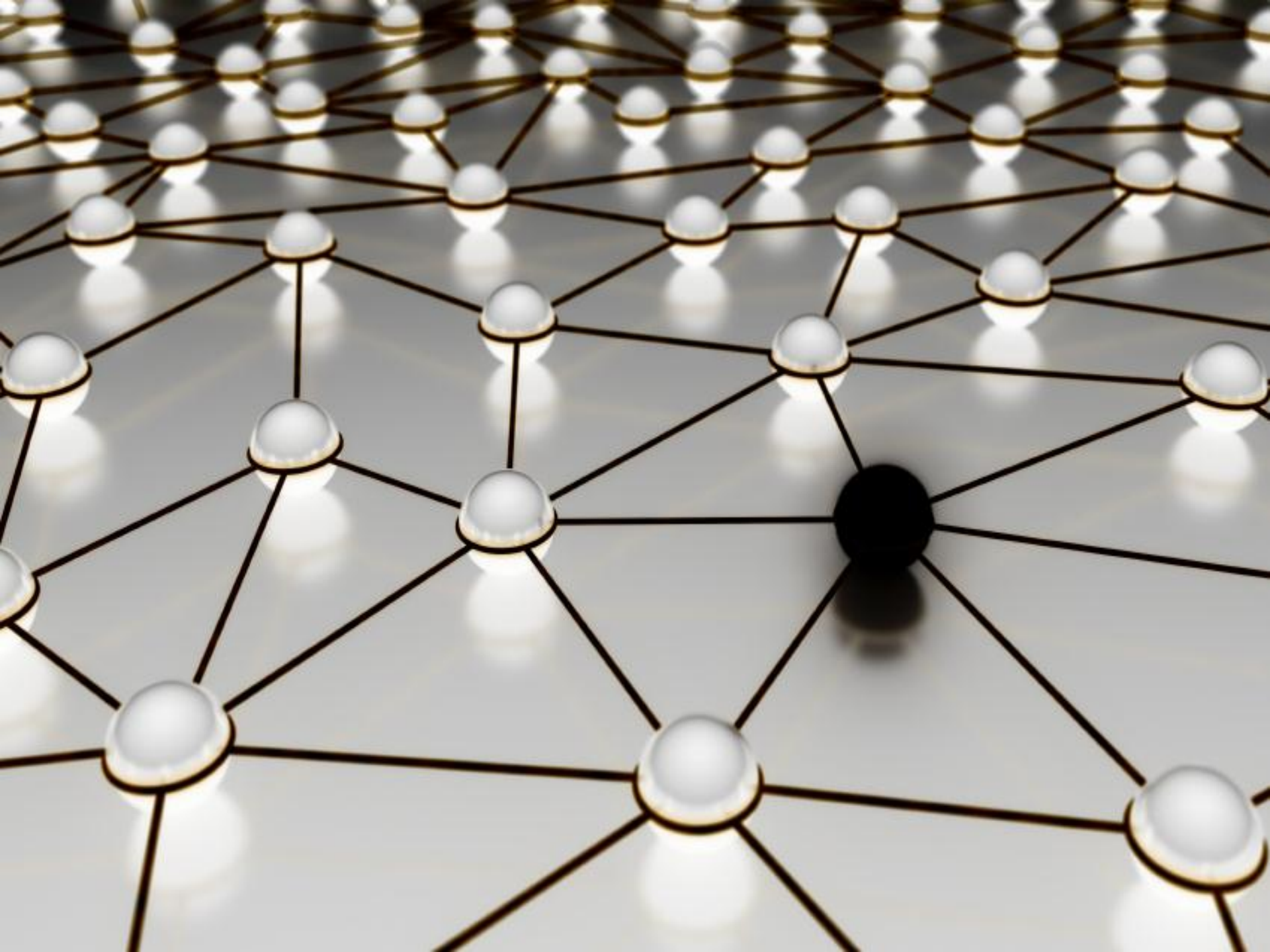
References:

- 1. *Smart Grids — European Technology Platform for Electricity Networks of the Future, 2005.*
- 2. *The National Energy Technology Laboratory: A vision for the Modern Grid, March 2007.*
- 3. *World Energy Outlook 2009. — International Energy Agency (IEA), Paris, 2009.*
- 4. *Smart Power Grids — Talking about a Revolution // IEEE Emerging Technology Portal, 2009.*
- 5. *Grids 2030. A National Vision for Electricity's Second 100 years. — Office of Electric Transmission and Distribution of USA Department of Energy, 2003.*
- 6. *Electric power research institute // www.epri.com.*
- 7. *Кобец Б. Б., Волкова И. О. Smart Grid в электроэнергетике // Энергетическая политика. 2009. № 6.*
- 8. *Дорофеев В. В., Макаров А. А. Активно-адаптивная сеть — новое качество ЕЭС России // Энергоэксперт. 2009. № 4.*
- 9. *Воропай Н. И. Задачи повышения эффективного оперативного и противоаварийного управления электроэнергетическими системами // Энергоэксперт.*
- 2009. № 4.
- 10. *Шакарян Ю. Г., Новиков Н. Л. Технологическая платформа Smart Grid (основные средства) // Энергоэксперт. 2009. № 4.*

Smart Grids activities shall focus on **research, development and full scale demonstration of new grid technologies**, including storage, systems and market designs to plan, monitor, control and safely operate interoperable networks in an open, decarbonised, climate resilient and competitive market, under normal and emergency conditions.”

?





SMART GRID: СТАНДАРТНЫЕ ПРОТОКОЛЫ ОБМЕНА ИНФОРМАЦИЕЙ

- Европейский институт телекоммуникационных стандартов (ETSI) утвердил Открытый протокол «интеллектуальных» сетей Open Smart Grid Protocol (OSGP):
- Групповая спецификация GS OSG 001: OSGP - протокол прикладного уровня может быть использован с различными средствами коммуникаций
- Технические характеристики TS 103 908: Связь через линии электропередачи (PLT) – спецификация высокопроизводительны[узкополосных каналов связи через линии электропередачи для контроля сетей в интеллектуальных сетях Smart Grid.
- www.etsi.org

ETSI
World Class Standards