AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

„European energy security, including its economic dimension”

Prof. Ireneusz Soliński

Bruxelles, 2011.11.25

Presentation plan

1. Presentation of AGH

2. Projects AGH from 7th Framework Program

SEVENTH FRAMEWORK PROGRAMME

3. Concept of the project from 7th FP

4. Energy Security

5. Renewable Energy Sources

6. Presentation of myself

Facts & History - AGH-UST

- **In 1919 Józef Piłsudski**, the Head of the State, inaugurated the ***Academy of Mining.***
- **In 2011 - 92 anniversary of the AGH – UST.**
- **90 years** of scientific experience
- **15 faculties** and Interfaculty School of Biomedical Engineering
- **50 fields of study**, more than 200 specializations
- Over **36 000 students,** 750 doctoral students
- Over 150 000 graduates have passed through the halls our university
- **2 033 researchers** including **227 full professors** (more than 500 independent research workers)

BACK

Faculties

ENERGY & GEO SCIENCES

- Mining and Geoengineering
- Geology, Geophysics and Environmental Protection
- Drilling, Oil and Gas
- Fuels and Energy
- Mining Surveying and Environmental Engineering

BASIC, COMPUTER

- Electrical Engineering, Automatics, Computer Science and Electronics
- Physics and Applied Computer Science
- Applied Mathematics

MANAGEMENT & HUMANISTIC SCIENCES

- Management
- Humanistic Sciences

METAL & MATERIAL SCIENCES

- Metals Engineering and Industrial Computer Science
- Materials Science and Ceramics
- Non-Ferrous Metals
- Foundry Engineering
- Mechanical Engineering and Robotics
- School of Biomedical Engineering

BACK

International collaboration

- Cooperation with 190 academic centers from 50 countries (e.g. the USA, Japan)
- Cooperation with numerous companies (e.g. IBM, Valeo, Comarch, Motorola, EDF, L.G., Philips, RWE Power AG, Lafarge, Cemex, Delphi, Siemens, KGHM)
- Participates in many research and educational programs e.g.: FPs of EU, SOCRATES-ERASMUS, CULTURE, INTERREG III, LEONARDO, TEMPUS, EUREKA, COST, e-TEN

BACK

PARTICIPATION OF AGH IN PROJECTS FINANCED FROM 7th FRAMEWORK PROGRAM

IN YEARS 2007 – 2011

Short characteristics of chosen energetic projects

I. Number of projects, in which AGH-UST participates

- from 2007 - till 2011 – **40**

Including:

II. Number of projects of energy topic

- from 2007 - till 2011 – **9**

III. Number of projects financed from 6 FP:

- 70

BACK

Short characteristics of chosen energetic projects

No.	Subject
1.	Innovative Dual mEmbrAne fueL Cell: IDEAL Cell
2.	Energy Observation for monitoring and assessment of the environmental impact of energy use: EnerGEO
3.	Characterization of European CO_2 storage: SiteCHAR
4.	Holistic Management of Brownfield Regeneration
5.	Advanded High-Temperature Reactors for Cogeneration of Heat and Electricity R&D: ARCHER
6.	Advanced Technologies for the Production of Cement and Clean Aggregates from Construction and Demolition Waste: C_2Ca
7.	Nanostructured energy-harvesting thermoelectrics based on Mg_2Si: THERMOMAG
8.	Accelerated Discovery of Alloy Formulations using Combinatorial Principles
9.	Integrated non-CO_2 greenhouse gas Observing Systems Research Infrastructures for Carbon Cycle Observations Environment (including Climate Change)

More information about those projects you can see in an attachement to this presentation.

PROPOSED SUBJECTS BY AGH-UST FOR NEW RESEARCH IN A RANGE 7th FRAMEWORK PROGRAM

IN 2012-2013

Proposed topics by AGH-UST of new projects financed from 7th Framework Program

No.	Autor	Subject
1.	Prof. Ireneusz Soliński	ANALYSIS AND EVALUATION OF INFLUENCE OF CLIMATE PACKAGE (3X20) ON CONDITION OF CHOSEN ECONOMIES OF EUROPEAN COUNTRIES.
		The forecast of wind conditions in purpose of balancing the energy deliveries from wind power plants by co-operation with gas turbines.
		The analysis of wind conditions supporting the application of small wind turbines.
2.	Dr Artur Wyrwa	Centralized trigeneration.
		Environmental assessment of shale gas extraction.
		Integrated assessment of RES potential with the use of GIS based tools and Earth Observation system.
3.	Prof. Barbara Tora	Development of technology in production of alternative fuels from wastes.
4.	Dr Jarosław Nęcki	Development of CCS technology by supporting the modern measuring methods and research infrastructure concerning the coal dioxide emission from point and scattered sources (crucial for designing the energetic plans for EU countries and construction of models of energy influence on environment, particularly on atmosphere composition).
5.	Prof. Jerzy Cetnar	Development of allothermal processes of hydrogen and liquid fuel production from methane and coal.
		Technology development of CO_2 recycling into hydrocarbon fuels using nuclear heat source.
		High temperature heat pump system for application in energy storage and cogeneration systems.
6.	Grzegorz Malina	Energy from Biomass and Waste.

BACK

Project I

ANALYSIS AND EVALUATION OF INFLUENCE OF CLIMATE PACKAGE (3X20) ON CONDITION OF CHOSEN ECONOMIES OF EUROPEAN COUNTRIES

Autor: Prof. Ireneusz Soliński

ENERGY AND CLIMATIC PACKAGE EU „3X20"

Assumptions:

1. Lowering of emission of **greenhouse gases by 20%** comparing to year 1990.

2. Lowering of **energy consumption by 20%** comparing with forecasts for EU in 2020.

3. Increase of participation of **renewable sources of energy till 20%** of total energy consumption in EU, including increase of **renewable energy in transport till 10%.**

BACK

METHODOLOGY

Reasons for taking up the subjects

- **Realization of climatic package will cause** various economic effects in economies of individual countries.
- **Economic effects will depend on:**
  - state of economy,
  - structure of consumed energy sources in perspective till 2030.
- **Assumption** of proposed emission limits by EU for each country **without evaluation** of economic effects in their economies will generate:
  - high risk of price inflation growth,
  - lowering of GDP,
  - lowering standard of living of citizens.
- **It is particularly important** for countries of coal structure of fuel and energetic balance.

BACK

METHODOLOGY

Assumptions

Partners of project will be selected countries by EC of coal structure of fuel and energetic balance, the most imperilled on negative effects of application of package 3x20.

1st part of realization of project is elaboration of research methodology and analyzes of influence of climatic package 3x20 on the basic parameters of economic growth in chosen countries of EU: inflation, GDP, unemployment etc.

2nd is conduction of researches, analyzes and calculations of elaborated methodology and determination of the values of economic parameters mentioned above for each investigated country.

3rd is elaboration of energetic politics – for each of researched countries – which will determine possibly acceptable values (optimal for assumed criterion) being the climatic package.

4th Such project can be submit for the contest in 2012 in contact with KE in 7th Framework Program. The co-ordinator may be Poland, AGH-UST in Krakow.

BACK

METHODOLOGY

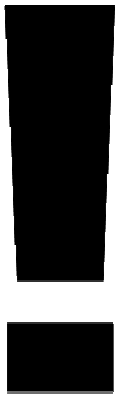
CRITERION

The presented example justifies the conduction of research and analyzes of economic situation in chosen countries of EU **in purpose of determination of optimal parameters of emission limits for such countries**, applying criterion of maximization of sum of economic and ecological effects in formula:

$$SUM\ (E_{ekol} + E_{ekon}) = MAX$$

$$E_{ekol} = KZ_w - KZ_o$$

$$E_{ekon} = K_w - K_o$$



KZw – **EXTERNAL** cost of coal energy

KZo - **EXTERNAL** cost of energy from (Renewable of Energy Sources)

BACK

METHODOLOGY

Ecological and Economical Effect

- for each method of limiting emission the ecological effects Eekol and economical effects Eekon **should be determined** (this concerns conversion of coal energy by renewable energy);
- **ecological effect may be positive** – then we talk about benefits or negative – the we talk about costs;
- **economical effect may be positive** – then we talk about profit or negative – then we talk about loss. Two methods of limiting emission and evaluating the effects for economy should be considered in calculations.

BACK

Example I.

Negative economical and social consequences

Consequences	Value		
direct costs for energetic sector will grow	**2015** – about 2 billion PLN (**1,3 % of GDP**)	**2020** – about 8 billion PLN (**4 % of GDP**)	**2030** – about 15 billion PLN (**4,8 % GDP**)
the prices of energy offered by producers will grow	**by 60 %** in comparison with basic scenario (without climatic politics)		
increase of energy expenses in their total structure	about **14 %**		
slower growth of benefits of households	about **11 %**		
lower production of energy consuming sectors	**by 8-24 %** comparing with basic scenario		
indirect costs for whole economy will cause lowering of GDP	**2020** – lower by 154 billion PLN (**8%** comparing to basic scenario)	**2030** – lower by 503 billion PLN (**15%** comparing to basic scenario)	
indirect costs for whole economy will cause lowering yearly average dynamics of economy growth indicator	in 2010-2030 – **by 0,5%**		

BACK

Example I.

Negative influence of package 3x20 on condition of polish economy

- **costs of additional investements in energetic sector** during **2006 -2030 - about 294 billion PLN** in comparison with 169 billion PLN in basic scenario (so-called „without climatic politics”);
- if the energetic efficiency improvement programmes are applied during investigated period then the **investment costs** will be respectively: **248 billion PLN and 131 billion PLN;**
- for economy future the prices of authorization to CO_2 emission will cause negative consequences which will also cause **the growth of energy prices**.

BACK

Example II.
Who will bear the costs of CO2 reduction?

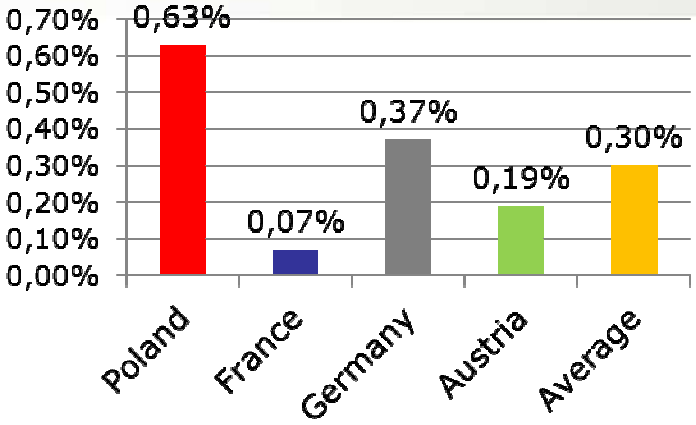


Fig. 1. Share of costs of reduction of CO2 emission in national income in 2030 (%)

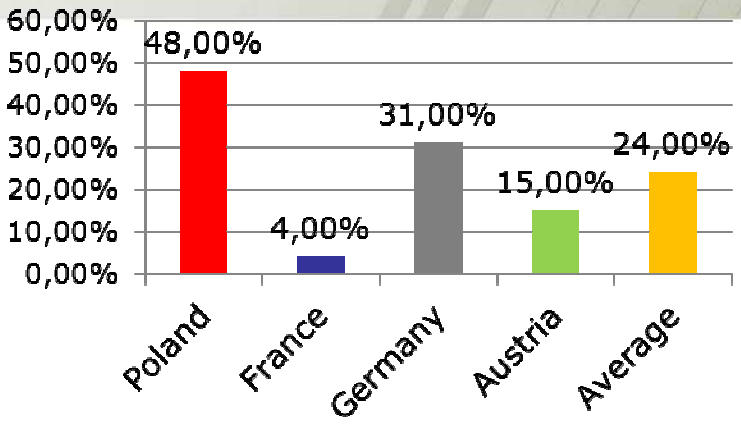


Fig. 2. Share of costs of reduction of CO2 emission in energy costs in 2030 (%)

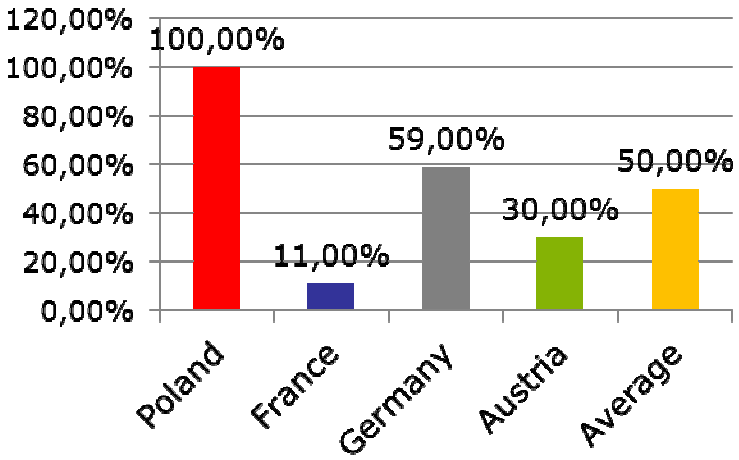


Fig. 3. Proportional shares in costs of reduction of CO2 emission in 2030 (%)

BACK

Example II.
Who will bear the costs of CO2 reduction?

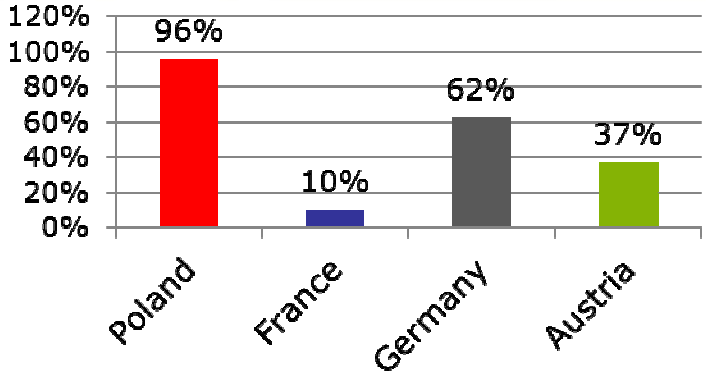


Fig. 4. Percentage share of energy production by application of coal as the fuel (%)

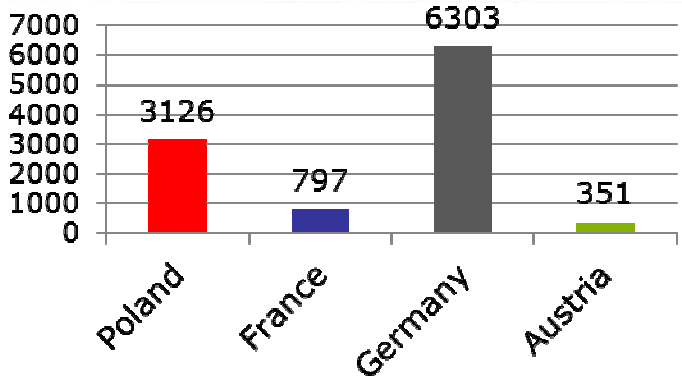


Fig. 5. Total year costs which will be beard by individual countries because of limitation of CO2 emission by 20% in 2020 (mln EURO)

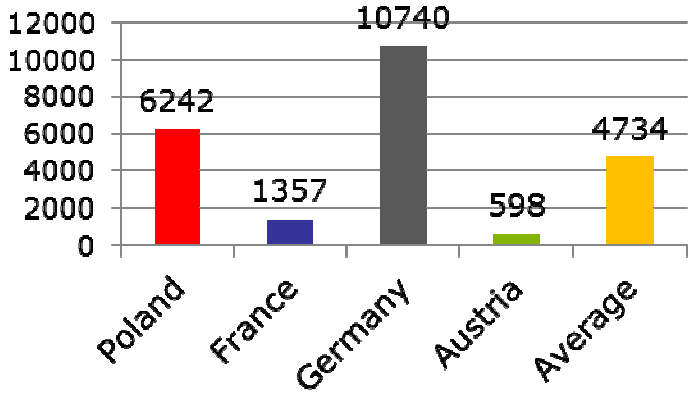


Fig. 6. Total year costs which will be beard by individual countries because of limitation of CO2 emission by 20% in 2030 (mln EURO)

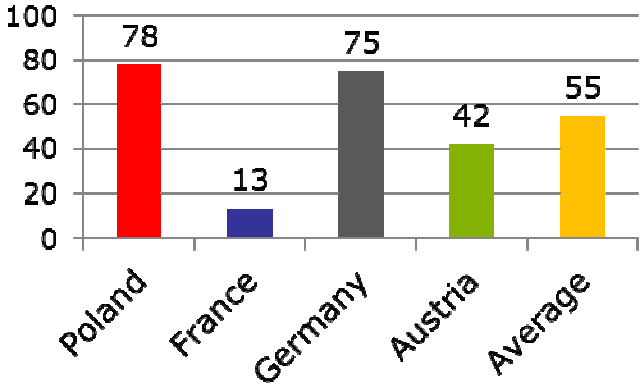


Fig. 7. Year cost of reduction of CO2 emission for one habitant in 2020 (EURO) (%)

BACK

Example II.
Who will bear the costs of CO2 reduction?

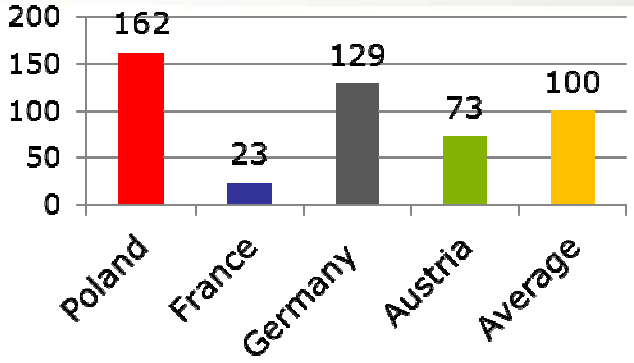


Fig. 8. Year cost of reduction of CO2 emission for one habitant in 2030 (EURO)

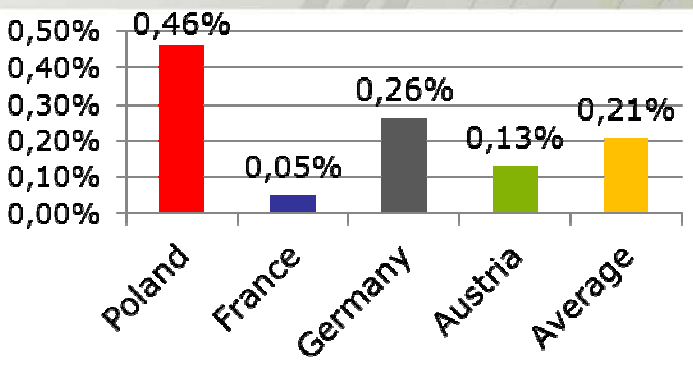


Fig. 9. Share of costs of reduction of CO2 emission in national income in 2020 (%)

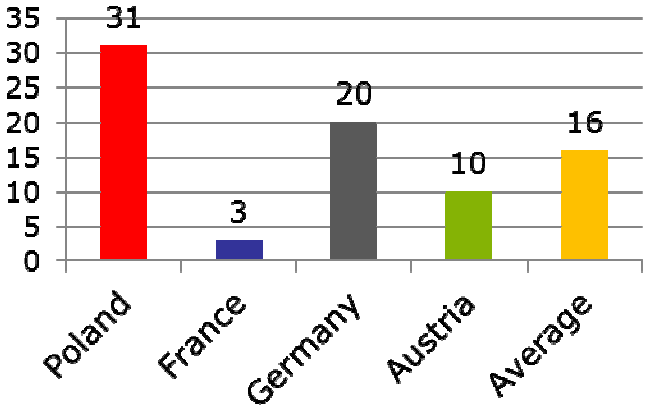


Fig. 10. Share of cost of reduction of CO2 emission in cost of energy in 2020.

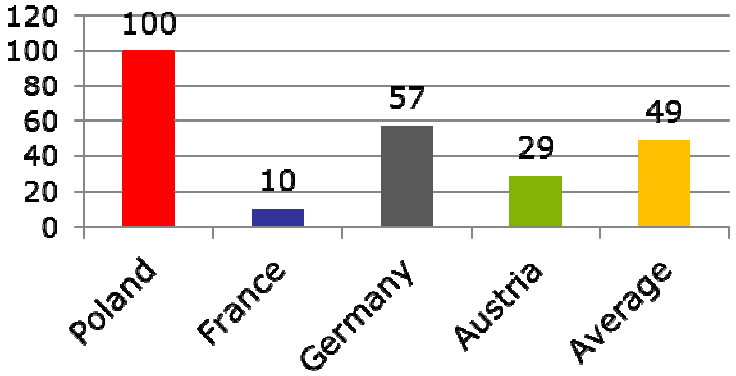


Fig. 11. Proportions of share in costs of reduction of CO2 emission in cost of energy in 2020 .

BACK

ENERGY SECURITY

BACK

ENERGY SECURITY DEFINITION

By **SECURITY of fuels and energy deliveries** it is understood the ensurance of **stable deliveries of fuels and energy on level guaranteeing fulfillment of national needs** by prices accepted by economy and society assuming the **optimal managment of national deposits of energetic raw materials** and by diversification of sources and directions of deliveries of oil, liquid fuels and gas fuels.

BACK

ENERGY SECURITY

FACTORS DECIDING ABOUT ENERGY SECURITY:	ENERGY SECURITY SHOULD BE ACCOMPLISHED BY:
• level of energy production,	• lowering of energetic dependency,
• level of energetic raw materials extraction,	• lowering of inner demand for energy and raw materials,
• level of power installed of power plant,	• diversification of energy and raw materials sources,
• transfer and distribution power of energetic and material infrastructure,	• countermeasure the homogenic energetic infrastructure,
• diversification of energy and material deliveries (sources and directions),	• development of connections between countries and regions.
• level of energetic raw materials deposits,	
• stocking system,	
• materials transport system,	
• system of regulation of energetic sector,	
• stability of economic and political system,	
• unstability of international situation.	

BACK

ENERGY SECURITY

Forecast of fuels and energy demand taking into consideration the requirements of package 3x20

Modernization of energetics, withdrawal of old coal powerplants from exploitation:

- Power obtained from **coal**: 2020 - 28844MW; 2030 - 27394MW
- Power obtained from **gas of Earth**: 2020 - 1473MW; 2030 - 3330MW
- Power obtained from **renewable sources**:

- **Wind**: 2020 - 6089MW; 2030 - 7867MW
- **Solid biomass**: 2020 - 623MW; w 2030 - 1218MW
- **Biogas**: 2020 - 802MW; 2030 - 1379MW

- Power obtained from **nuclear** plant: 2022 - 400MW

BACK

ENERGY SECURITY

Basic directions of energy politics:

- Adjustment of energetic efficiency.
- Increase of safety of fuels and energy deliveries.
- Diversification of energy production structure by introduction of nuclear energy.
- Development of applying renewable sources of energy, including biofuels.
- Development of competitive markets of fuels and energy.
- Limitation of influence of energy on environment.

BACK

ENERGY SECURITY

EU

Energy security in the European Union

World share of EU deposits:
- Oil – 0,5 %
- Gas of Earth – 1,6 %
- Hard Coal – 3,6 %

Static factor of deposit adequacy in EU (27):
- oil deposits will be finished during 10 years,
- gas deposits during 15 years,
- hard coal deposits during 50 years.

Forecasts (30 – 40 years) depending EU on:
- import of energy - 70%,
- import of oil - 90%,
- import of gas of Earth - 80 %.

BACK

ENERGY SECURITY

EU and PL

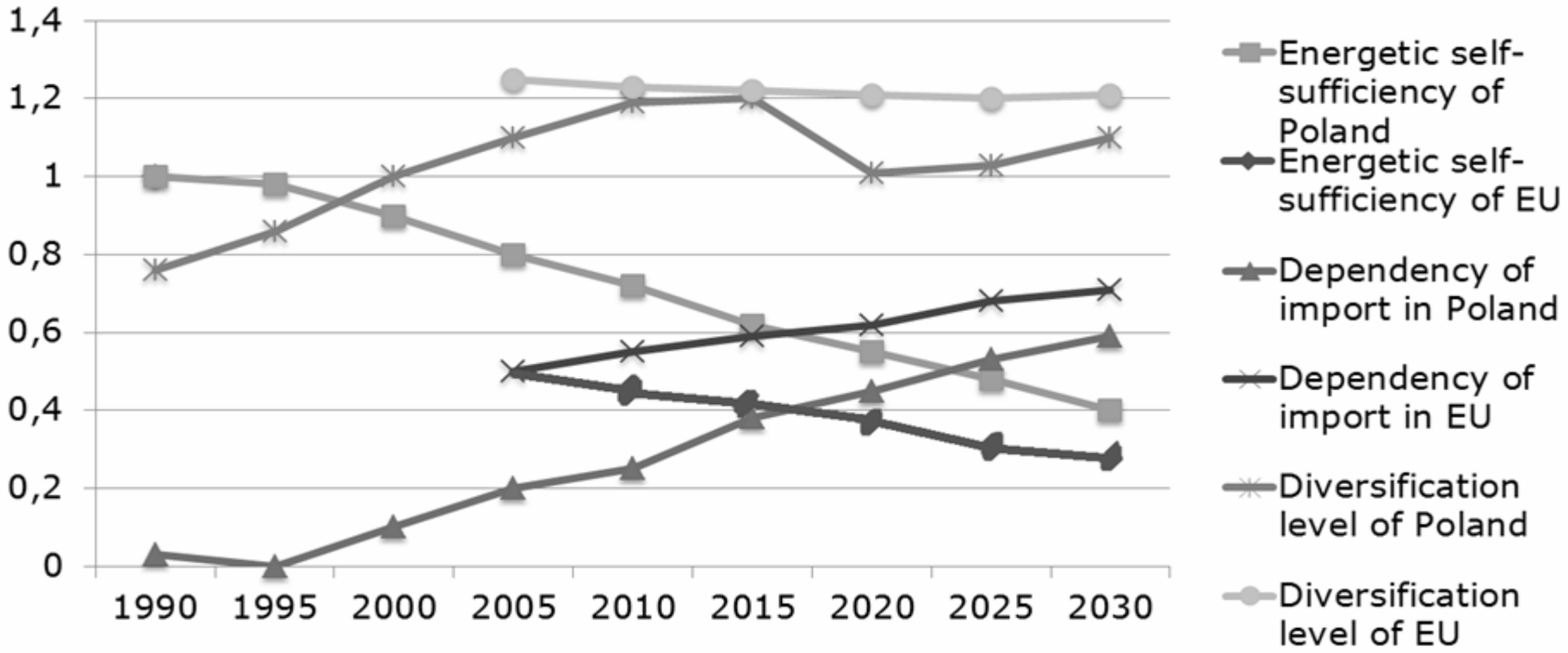


Fig. 1. The changes of energy sources diversity, self-sufficiency and import dependency indicators for Poland in 1990−2030 and the forecast for EU in 2005−2030.

BACK

ENERGY SECURITY

PL

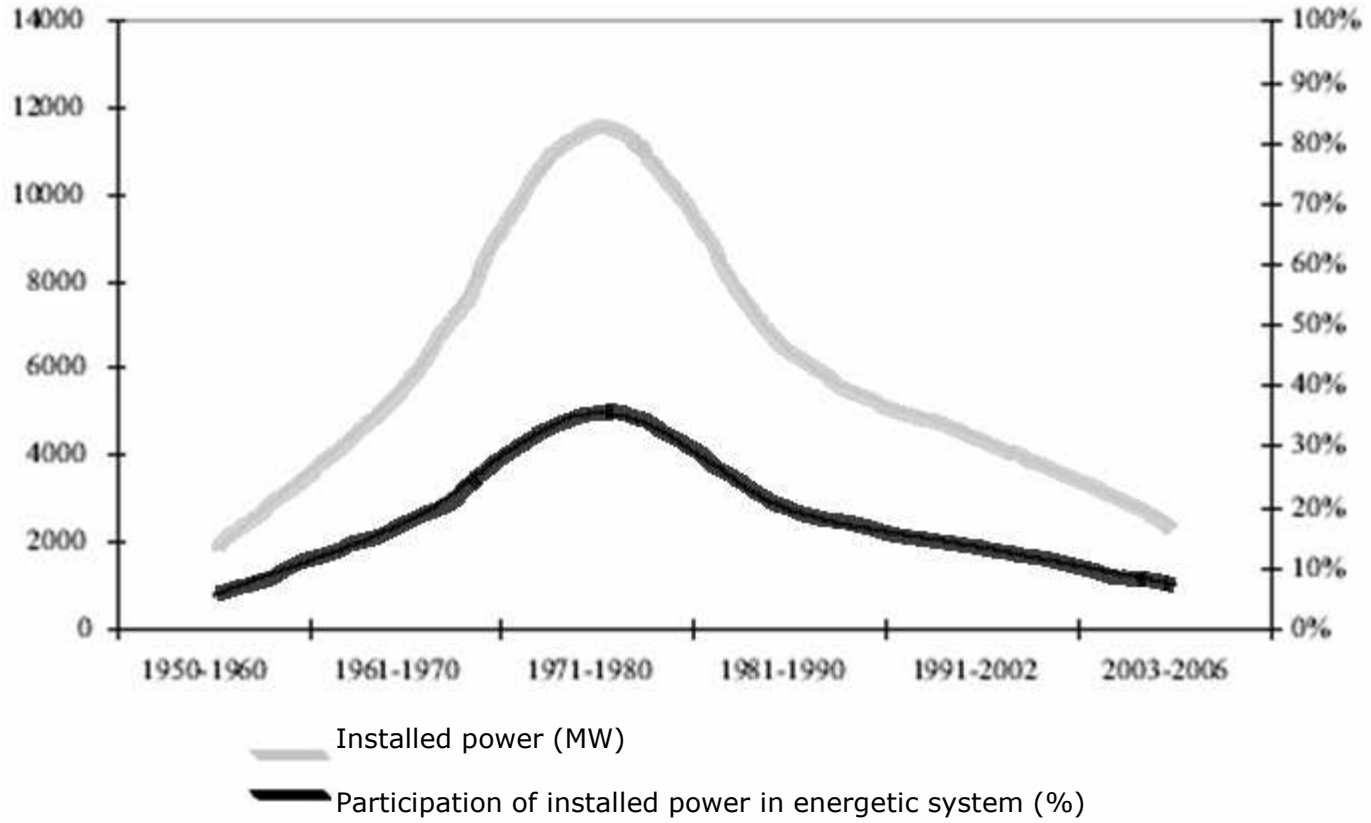


Fig. 2. Domestic Energy System − the capacity installed in 1950−2006.

BACK

RENEWABLE ENERGY IN POLAND

Renewable energy in Poland

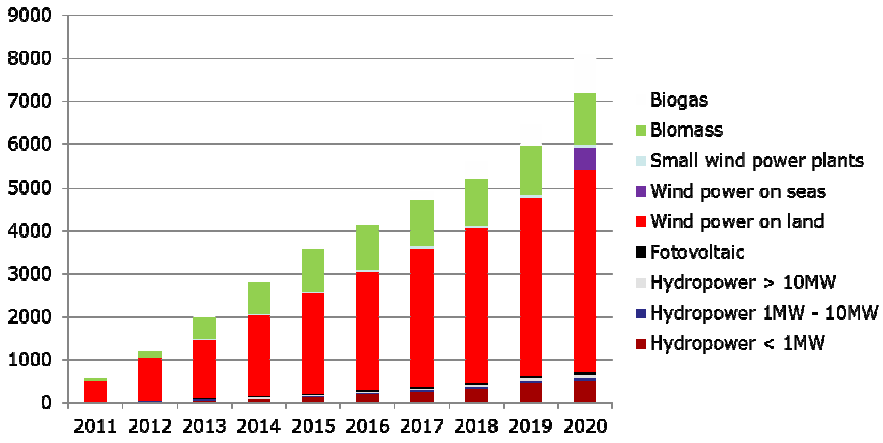


Fig. 3. Forecasted increase of electrical power installed in RES during 2011-2020 (MW).

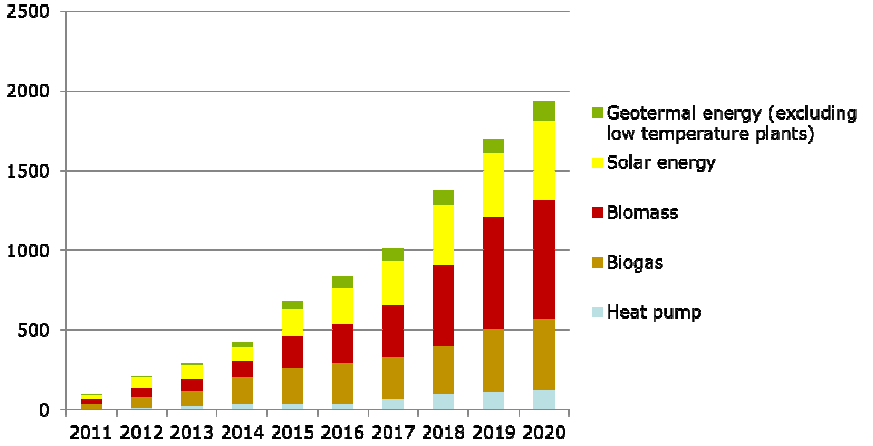


Fig. 4. Forecasted increase of heat production from new powers installed in RSE during 2011-2020 (ktoe).

BACK

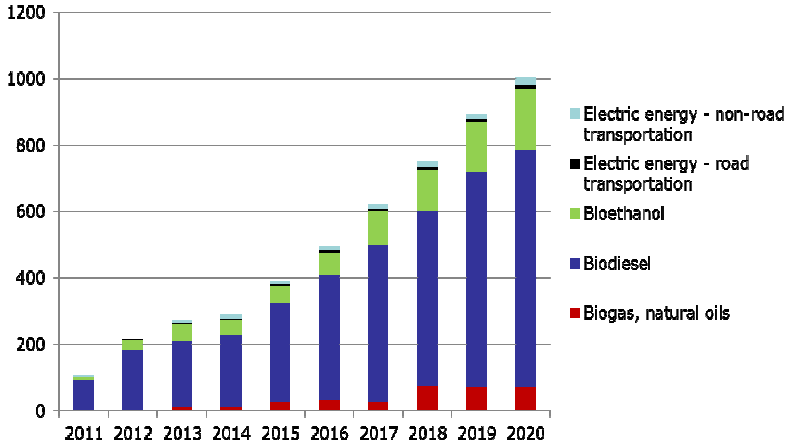


Fig. 5. Forecasted increase of production of biofuels and alternative fuels – produced from renewable energy sources in 2011-2020 (ktoe).

DEVELOPMENT OF NUCLEAR ENERGETICS

- Poland **does not have any** nuclear power plants.
- It is planned to build the nuclear power plant of power of 400 MW, the forecasted activation will occur in 2022.

BACK

Silhouette author

EDUCATION	**1974** - Master of Science
	1978 - Doctorate
	1990 - Habilitation
	1996 - Position of Associate Professor
	2004 - Title of Professor of Technical Sciences
	2009 - Position of Full Professor
SCIENTIFIC ACHIEVE-MENTS	5 books
	20 monographs - collective works
	120 publications
	200 works for the Industry
EXPERIENCE SINCE 1978	IPPT - PAN in Warsaw, GSMIE - PAN in Cracow, AGH - UST in Cracow
SPONTA-NEOUS HOBBY	Playing the violin, walking with dog
„FORCED" HOBBY	Housework such as: cleaning floors, stairs and windows, hanging laundry and shopping

PROFESSIONAL INTERESTS	Economics of Mining and Energy
	Enviromental Engineering
	Renewable Energy Sources
SPECIAL INTERESTS	Wind energy
	Wind resource monitoring
	Optimal selection for wind farm localization
	Wind farm planning
OTHER SCIENTIFIC ACHIEVEMENTS	Promotion of 5 doctoral students
	Construction of Solar-Wind Laboratory
	Construction of labolatoral hybrid (solar-wind) power system
	Documentation of wind energy resources in Dukla pass
	Finalizing first windmills investment (10 MW farm) in that region
	Leadership and managing of Małopolsko-Podkarpacki Cluster of Clean Energy

BACK

AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Thank you for your attention.

I highly recommend to check an annex to this presentation.

Prof. Ireneusz Soliński

TO THE ANNEX

Bruxelles, 2011.11.25

ANNEX

PARTICIPATION OF AGH IN PROJECTS FINANCED FROM 7th FRAMEWORK PROGRAM

IN YEARS 2007 – 2011

I. Innovative Dual mEmbrAne fueL Cell: IDEAL Cell

Coordinator:	**Association pour la Recherche et le des Processus Industriels DĂŠveloppement MĂŠthodes â SupĂŠrieure et Ecole Nationale des Mines de Paris (ARMINES), FRANCE**
Contract Type:	Small or medium-scale focused research projects
Project manager, AGH:	WIMiC, Prof. Kazimierz Przybylski
Implementation period:	01.01.2008 - 31.12.2011
Partners in the project:	9 partners from 5 countries
Deals with the issues:	Innovative concepts for fuel cells (new innovative and competitive concept for a high temperature Fuel Cell operating in the range 600 -700° C)
Subject realized at AGH:	
Budget project:	4,368,742 EURO

Summary

EAL-Cell proposes a new innovative and competitive concept for a high temperature Fuel Cell operating in the range 600-700°C.

The IDEAL-Cell concept effects a considerable enhancement of the overall system efficiency (fine-tuning of the electrode catalytic properties, possibility of pressure application on both electrode sides, simpler and more compact stack-design with less sophisticated interconnects, more efficient gas pre-heating, simplified heat exchange system for co-generation, availability of high quality pure water for vapour-forming)

BACK

II. Energy Observation for monitoring and assessment of the environmental impact of energy use: EnerGEO

Coordinator:	**Netherlands Organization for Applied Scientific Research, DELFT, NETHERLANDS**
Contract Type:	Large-scale Integrating Project
Project manager, AGH:	WEiP, Dr Arthur Wyrwa
Implementation period:	01.11.2009 - 31.10.2013
Partners in the project:	12 partners from 6 countries
Deals with the issues:	Developing Earth Observation for the monitoring and prediction of environmental impacts from energy resource extraction, transportation and/or exploitation (strategy for a global assessment of the current and future impact of the exploitation of energy resources on the environment and ecosystems)
Subject realized at AGH:	
Budget project:	7,866,511 EURO

Summary

The main objective of the **EnerGEO** project is to develop a strategy for a global assessment of the current and future impact of the exploitation of energy resources on the environment and ecosystems and to demonstrate this strategy for a variety of energy resources worldwide.

BACK

III. Lead-cooled European Advanced Demonstration Reactor: LEADER

Coordinator:	**NUCLEAR ANSALDO SPA, GENOVA, ITALIA**
Contract Type:	Small or medium-scale focused research project
Project manager, AGH:	WEiP, Prof. George Hundredweight
Implementation period:	02.04.2010 -01.04.2013
Partners in the project:	16 partners from 11 countries
Deals with the issues:	Conceptual design of lead and gas cooled fast reactor systems (development is a conceptual level of the Lead Fast Industrial Reactor plant size - LFR technology)
Subject realized at AGH:	
Budget project:	5,688,185 EURO

Summary

The LEADER proposal deals with the and of a scaled demonstrator of the LFR technology. The proposal is based on previous achievements obtained during the 6th FP of the EU in the ELSY project but takes into account the indications emerged from the European Strategic Research Agenda as well as the main goals of the European Industrial Initiative on Fission.

BACK

IV. Characterization of European CO_2 storage: SiteCHAR

Coordinator:	**IFP Energies Nouvelles, RUEIL MALMAISON, FRANCE**
Contract Type:	Collaborative Project (generic)
Project manager, AGH:	WWNiG, Prof. Stanislaw Nagy
Implementation period:	01.01.2011 - 31.12.2013
Partners in the project:	17 partners from 9 countries
Deals with the issues:	CCS - storage site characterization carried out in the AGH Post
Subject realized at AGH:	
Budget project:	5,072,670 EURO

Summary

SiteChar will facilitate the implementation of CO_2 storage in Europe by improving and extending standard site characterisation workflows, and by establishing the feasibility of CO_2 storage on representative potential CO_2 complexes suitable for development in the near term. Reasonable estimates of the theoretical capacities of storage sites have been undertaken in previous studies.

BACK

V. Holistic Management of Brownfield Regeneration

Coordinator:	**Stichting DELTARES, DELFT, NETHERLANDS**
Contract Type:	Small or medium-scale focused research project
Project manager, AGH:	WGGiOS, Prof. Gregory Malina
Implementation period:	01.12.2010 - 30.11.2014
Partners in the project:	14 partners from 7 countries
Deals with the issues:	Environmental technologies for brownfield regeneration
Subject realized at AGH:	
Budget project:	4,472,774 EURO

BACK

Summary

The project recognizes four different main tasks as part of a HOlistic Management of Brownfield REgeneration (**HOMBRE**) to be accomplished in associated case studies (mining, urban, industrial) with stakeholder participation:

•**Zero brown-fields strategy**: a better understanding of the life cycle of urban, industrial and mining sites and the origination of brown-fields in these settings is necessary to device a successful overall brown-field redevelopment program.

•**Assessment of brown-field regeneration scenarios**: development of an improved sustainable spatial planning and decision making processes to enhance the up-take of brown-field regeneration projects based on a holistic approach.

•**Integrated Regeneration Technologies**: combination of technologies that address different site aspects or issues (f.e. linking soil, water, energy and materials) to create faster and cheaper solutions during brownfield regeneration.

•**Intermediate Renewal**: solutions for greening, landscaping and amenity improvement of brown-fields to ensure social, economical and environmental cohesion with the surrounding land use.

VI. Advanded High-Temperature Reactors for Cogeneration of Heat and Electricity R&D: ARCHER

Coordinator:	**Nuclear Research And Consultancy Group, Petten, NETHERLANDS**
Contract Type:	Large-scale Integrating Project
Project manager, AGH:	WEiP, Prof. George Hundredweight
Implementation period:	02.01.2011 - 01.31.2015
Partners in the project:	33 partners from 9 countries
Deals with the issues:	Concerns the issue of R&D activities in support of the Implementation of the Strategic Research Agenda of SNE-TP
Subject realized at AGH:	
Budget project:	9,772,783 EURO

Summary

In line with the Sustainable Nuclear Energy Technology Platform (**SNETP**) Strategic Research Agenda (**SRA**) and Deployment Strategy (**DS**), the **ARCHER** project will extend the state-of-the-art European (V)HTR technology basis with generic technical effort in support of nuclear cogeneration demonstration. The partner consortium consists of representatives of conventional and nuclear industry, utilities, Technical Support Organisations, R&D institutes and universities. They jointly propose generic efforts composed of:

- System integration assessment
- Critical safety aspects of the primary and coupled system Essential HTR fuel and fuel back end R&D
- Coupling component development
- High temperature material R&D
- Nuclear cogeneration knowledge management.

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VII. Advanced Technologies for the Production of Cement and Clean Aggregates from Construction and Demolition Waste: C_2Ca

Coordinator:	**Delft University Of Technology, NETHERLANDS**
Contract Type:	Small or medium-scale focused research project
Project manager, AGH:	WIMiC, Prof. John Deja
Implementation period:	01.01.2011 - 31.12.2014
Partners in the project:	14 partners from 8 countries
Deals with the issues:	Innovative technologies and eco design. Recommendations for reuse and recycling of Construction and Demolition (C&D) waste with a special focus on technologies for onsite solutions
Subject realized at AGH:	
Budget project:	4,918,490 EURO

Summary

The recycling of end-of-life concrete into new concrete is one of the most interesting options for reducing worldwide natural resources use and emissions associated with the building materials sector. The production of the cement used in concrete is responsible for at least 5% of worldwide CO_2 emissions. On-site reuse of clean silica aggregate from old concrete saves natural resources and reduces transport and dust, while the re-use of the calcium-rich cement paste has the potential to cut carbon dioxide emissions in the production of new cement by a factor of two. In order to achieve this goal, a new system approach is studied in which automatic quality control assesses and maintains high standards of concrete demolition waste from the earliest stage of recycling, and novel breaker/sorting technology concentrates silica and calcium effectively into separate fractions at low cost.

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VIII. Nanostructured energy-harvesting thermoelectrics based on Mg_2Si: THERMOMAG

Coordinator:	**European Space Agency, PARIS, FRANCE**
Contract Type:	Small or medium-scale focused research project
Project manager, AGH:	WIMiC, Prof. Elizabeth Godlewska
Implementation period:	01.05.2011 - 31.10.2014
Partners in the project:	15 partners from 9 countries
Deals with the issues:	Thermoelectric energy converters based on nanotechnology. Thermoelectric materials harvesting and proof-of-concept modules, based on Mg_2Si bulk nanostructured solid solutions)
Subject realized at AGH:	
Budget project:	5,996,252 EURO

Summary

The core concept of the **ThermoMag** project revolves around developing and delivering new energy-harvesting thermoelectric materials and proof-of-concept modules, based on nanostructured bulk Mg_2Si solid solutions. This class of TE material would have the following attractive characteristics:

- ZT value > 1.5 for both n-type and p-type doped material,
- operational in the temperature range 300 - 550°C,
- very low density of 2g/cm3, especially suitable for transportation applications,
- high melting point of > 1000°C, and good thermal stability up to 600°C,
- good oxidation and corrosion resistance and mechanical strength,
- isotropic thermoelectric properties,
- non-toxicity of elements,
- widely-available pure materials with very large EU supply chains and low raw material cost < 15 Euros/kg, combined with low manufacturing costs.

A number of methods will be looked at to achieve 3D bulk nanocrystalline Mg_2Si including low-cost combustion synthesis, mechanical alloying and high-temperature solid-state synthesis in inert crucibles.

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IX. Accelerated Discovery of Alloy Formulations using Combinatorial Principles

Coordinator:	**European Space Agency , PARIS, FRANCE**
Contract Type:	7th Framework Program; COOPERATION (NMP)
Project manager, AGH:	WIMiC, Prof. Elizabeth Godlewska
Implementation period:	01.01.2011 – 31.12.2016
Partners in the project:	25 partners
Deals with the issues:	The core concept of Accelerated Metallurgy is to deliver an integrated pilot-scale facility for the combinatorial synthesis and testing of unexplored alloy formulations. The robotic alloy synthesis will be much faster than conventional methods
Subject realized at AGH:	
Budget project:	overall costs 400000,00 euro, contribution from EU 295265,00 euro

Summary

The core concept of **Accelerated Metallurgy** is to deliver an integrated pilot-scale facility for the combinatorial synthesis and testing of unexplored alloy formulations. The robotic alloy synthesis will be much faster than conventional methods. The discrete samples will be submitted to a range of automated, standardised tests that will measure chemical, physical and mechanical properties. Industrial interests include:

- lightweight fuel-saving alloys,
- high-temperature alloys (stable > 1000°C),
- high-TC superconductor alloys,
- high-ZT thermoelectric alloys for converting waste heat into electricity,
- magnetic and magnetocaloric alloys for motors and refrigeration and phase-change alloys for high-density memory storage.

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