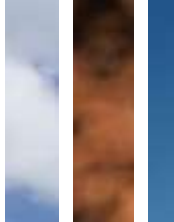


**Phytoremediation driven energy crops
production on heavy metal degraded areas as
local energy carrier**



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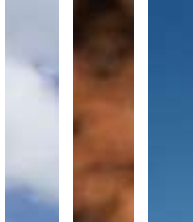


IN BRIEF

ISPE, company active since 1949, is a leader in engineering, technical, financial and institutional consulting in energy and environment sectors.

From 1998 ISPE became a private company.





MARKET ROLE



Investor



Project Developer and Resources Integrator



EPC Contractor



Consulting and Engineering Company

BUSINESS AREAS

-  **Energy:**
 -  Power & Heat Generation from Conventional Sources
 -  Power & Heat Generation from RES
 -  Power Transmission & Distribution
 -  Energy Efficiency
-  **Environmental Protection**
-  **Municipal Services**
-  **Industry**
-  **Civil Works**

CORE SERVICES



Technical, Financial and Institutional Consulting



Energy & Environment – Policies & Strategies



Studies, Research & Development



Basic and Detail Engineering



Project Management

CLIENTS



Public

- Governmental Authorities
- Regulatory Authorities-ANRE (Regulatory Authority for Energy), ANPM (Romanian Environmental Protection Agency), ANRM (Romanian Agency for Mineral Resources)
- Local Authorities
- Research-Development-Innovation Agencies
- National Utilities (Nuclearelectrica, Hidroelectrica, Transelectrica, Oltenia Energy Holding, Hunedoara Energy Holding, Romgaz, Transgaz, etc.)
- Universities
- NGOs



Private

- Utilities (ENEL, EON, CEE, GDF, Petrom etc.)
- International Organizations and Financing Bodies
- Industrial Project Developers (energy, oil and gas, metallurgy, transport, chemistry, cement industry etc.)
- Investors
- Consulting companies
- EPC contractors

REFERENCES



POWER SYSTEMS

- ✓ Developing strategies, energy models and forecasting studies for the NES
- ✓ Energy policy support to governmental authorities and regulators
- ✓ Assessment studies for energy supply, primary resources and costs safety

POWER AND HEAT GENERATION

- ✓ Design of over **18 000 MW** installed power capacity in TPP on fossil fuels
- ✓ **Over 6 000 MW** installed from RES
- ✓ **1400 MW** - Nuclear electrical projects
- ✓ **35 000 MW** - studies and consulting for RES out of which 85% wind sources, 10% photovoltaic sources and 5% biomass, micro-hydro and geothermal sources
- ✓ Retrofitting and upgrading programs developed for over **50% of the NES** production capacity
- ✓ **258 DHS** for 2.5 million conventional flats
- ✓ Over **1300 MW** in studies for the connection to the grid of storage-pumped hydro-power plants



TRANSMISSION AND DISTRIBUTION

- ✓ Over **150** substations and around **25,000 km** Overhead Transmission Lines of medium and high voltages, with upgrading and retrofitting programs for about **75% of the existing transmission and distribution systems**

ENVIRONMENTAL PROTECTION

- ✓ Unique local **EU-ETS consultant** (energy, industry, waste, agriculture sectors)
- ✓ **Environmental impact assessment for over 200 power plants**, existing industrial facilities and new investments
- ✓ **Financial and technical consulting for CCS technology** implementation and development in Romania

RESEARCH - DEVELOPMENT- KNOWLEDGE SHARING

- ✓ more than **100 research-development - innovation projects** financed through European funds, international and national funds accessed
- ✓ more than 50 international workshops and conferences organised for best practices and knowledge sharing



NATIONAL STUDIES, RESEARCH & DEVELOPMENT PROJECTS

✓ **2014 – 2016 PARTNERSHIP Programme** “Innovative materials and processes to selectively remove heavy metals from wastewater (**HAP-CHIT-MAG**)”

Client: UEFISCDI Romania

✓ **2014 NATIONAL PLAN** “Research services for performing the study on "Building and defining upon the relevant values of the Industrial sectors' parameters and use of the National Greenhouse Emissions Inventory (**INEGES**) values to allow implementation methods for calculating GHG emissions, associated with higher levels of approaches for the following categories: lime, glass and nitric production under IPCC 2006 Methodology”

Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2014 NATIONAL PLAN** “The environmental report prepared within the procedure for plans and programs environmental assessment applied to the transition national plan for combustion plants under the Directive 2010/75/EU, according to governmental Decision no. 1076/2004, with its further amendments”

Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2014 NATIONAL PLAN** “Research services for development in Romania of the study on the application of the Decision no.406/2009/EC provisions (Effort Sharing Decision)”

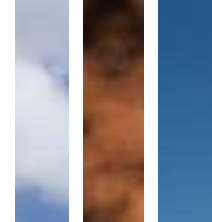
Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2013 – 2015 INNOVATION Programme** “Innovative technologies in coal power plants for energy conservation (**NOVENER**)”

Partners: CET Govora (coordinator)

Client: UEFISCDI Romania



✓ **2013 – 2015 INNOVATION Programme “Electricity Supply, Monitoring, Control And Communication Systems for Temporally Insulated Habitats (SIGHAB)”**

Client: UEFISCDI Romania

✓ **2013 NATIONAL PLAN “The National Communication of Romania as part of the United Nations Framework Convention on Climate Change (UNFCCC) AND biannual report no.1”**

Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2013 NATIONAL PLAN “Determination of biodegradable industrial waste amounts and sludge amounts derived from waste water treatment stored in compliant landfills (for the period 1989-2012) and non-compliant landfills (for the period 1950-2012). Determination of incinerated waste types/amounts and incineration specific parameters for the period 1989-2012. Estimation of N2O emissions derived from waste incineration”**

Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2013 NATIONAL PLAN “Preparing elements which are part of the foreseen progress, report under article 3.2. of 280/204/EC Decision”**

Consultant and Coordinator: ISPE – Institute for Studies and Power Engineering

Client: Romanian Ministry of Environment and Climate Change

✓ **2012 – 2015 PARTNERSHIPS IN PRIORITY FIELDS “Technical-economic and environmental optimization of CCS technologies integration in power plants based on solid fossil fuel and renewable energy sources (biomass) (CARBOTECH)”**

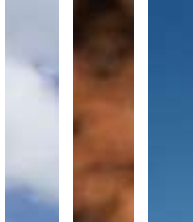
Client: UEFISCDI Romania

✓ **2011 SECTORAL RD PLAN FOR industry “ Solutions for transitional free allocation for the power generation sector upgrading, according to Directive 2009/29/EC - art. 10c, amending Directive 2003/87/EC”**

Client: Romanian Ministry of Economy, Trade and Business Environment



Institute for Studies and Power Engineering



INTERNATIONAL RESEARCH PROJECTS



✓ 2014-2017 IEE 2013 “PROMOTION OF SMART AND INTEGRATED NZEB RENOVATION MEASURES IN THE EUROPEAN RENOVATION MARKET” (NeZeR)”

Project coordinator: VTT Technical Research Centre of Finland - VTT/Finland
Client: EASME - Executive Agency for Small and Medium - sized Enterprises



✓ 2014-2017 RFCS2013 “ENHANCED COAL EXPLOITATION THROUGH UCG IMPLEMENTATION IN EUROPEAN LIGNITE MINES (COAL2GAS)”

Project coordinator: ISPE, Romania
Client: European Commission Research Programme



✓ 2014-2017 RFCS2013 “COMPETITIVE PRE-DRYING TECHNOLOGIES AND FIRING CONCEPTS FOR FLEXIBLE AND EFFICIENT LIGNITE UTILIZATION (DRYLIG)”

Project coordinator: SINTEF ENERGI AS, Norway
Client: European Commission Research Programme



✓ 2014-2018 FP7 “PHYTOREMEDIATION DRIVEN ENERGY CROPS PRODUCTION ON HEAVY METAL DEGRADED AREAS AS LOCAL ENERGY CARRIER (Phyto2Energy)”

Project coordinator: Institute for Ecology of Industrial Areas (IETU), Poland
Client: REA – Research Executive Agency



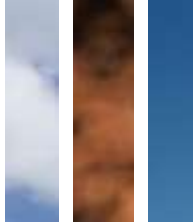
✓ 2013-2015 LLP “Leonardo da Vinci” Tol “Educational and Training System for a Clean Coal Technology (CleanCOALtech)”

Project coordinator: University „Politehnica” Bucharest / Romania
Client: European Commission Research Programme





Institute for Studies and Power Engineering



✓ 2013-2016 FP7 “THE IMPACT OF THE QUALITY OF CO2 ON TRANSPORT AND STORAGE BEHAVIOUR (IMPACTS)”

Project coordinator: SINTEF ENERGI AS, Norway

Client: European Commission Research Programme



✓ 2011-2014 IEE 2010 “PROMOTION TO REGIONAL BIOENERGY INITIATIVES (PromoBio)”

Project coordinator: Finnish Forest Research Institute-METLA/Finland

Client: EACI - Executive Agency for Competitiveness and Innovation



✓ 2011-2013 BS-ERA.NET “CO2 TRANSPORTATION RISK ASSESSMENT FOR CARBON CAPTURE AND STORAGE (CO2TRACCS)”

Project coordinator: National Technical University of Athens – NTUA / Greece

Client: Ministry of National Education – UEFISCDI



✓ 2011-2013 FP7 “KNOWLEDGE TRANSFER AND RESEARCH NEEDS FOR PREPARING MITIGATION/ADAPTATION POLICY PORTFOLIOS (PROMITHEAS-4)”

Project coordinator: Energy Policy and Development Centre of the National and Kapodistrian University of Athens /Greece

Client: European Commission Research Programme



✓ 2010-2013 IEE 2009 “PROMOTING BEST PRACTICES OF INNOVATIVE SMART METERING SERVICES TO EUROPEAN REGIONS (SmartRegions)”

Project coordinator: Jyväskylä Innovation Ltd /Finland

✓ 2010-2011 Global CCS Institute “ROMANIAN CCS DEMONSTRATIVE PROJECT”



Project Manager: ISPE, Romania

Client: Global CCS Institute Ltd./Australia

✓ 2009-2010 PHARE “TECHNICAL ASSISTANCE FOR PREPARING A DHS PROJECT PORTFOLIO”

Project consultancy and coordination: ISPE, Romania

Client: Ministry of Economy and Finance/Romania



- Acronym: **Phyto2Energy**

- Funding scheme:

Industry Academia Partnerships and Pathways under Maria Skłodowska Curie Actions of the 7FP

- Start up date: **1 February 2014**

- Duration : **48 months**

Consortium of 6 partners

R&D

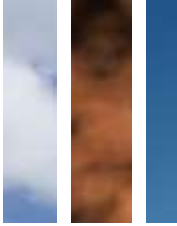


HelmholtzZentrum münchen
Deutsches Forschungszentrum für Gesundheit und Umwelt



Industry





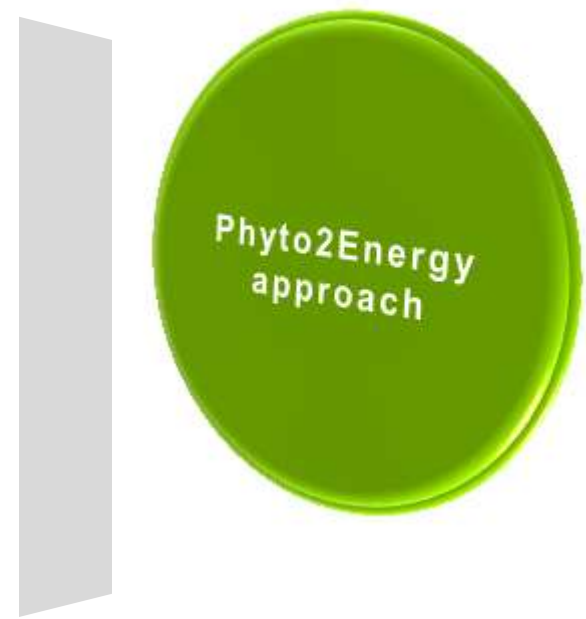
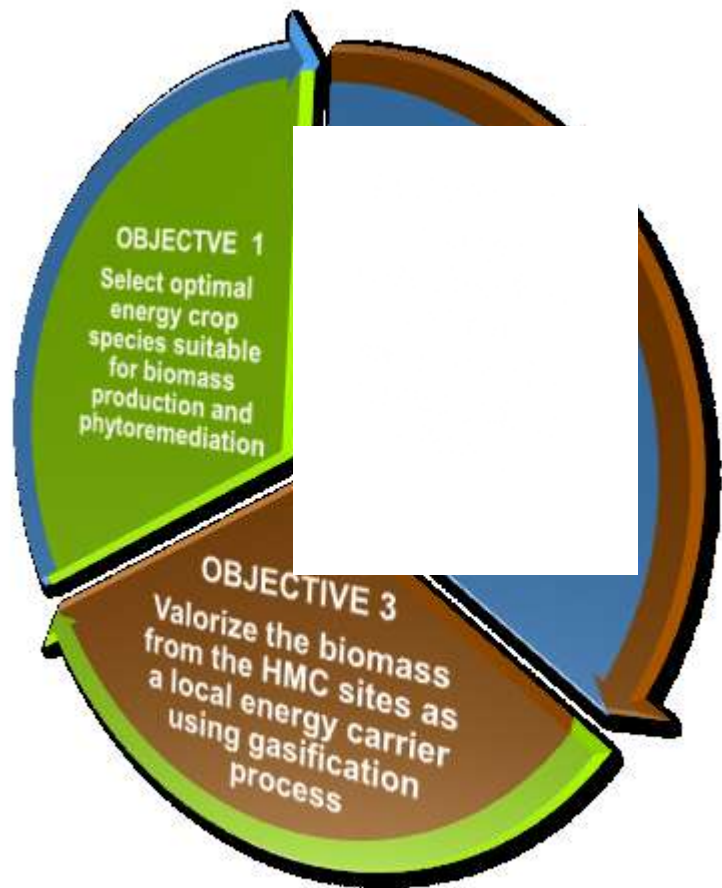
SCIENTIFIC AND TECHNOLOGICAL GOAL

- ✓ to develop and validate a novel approach to biomass production on heavy metal contaminated (HMC) sites, ensuring:
 - its environmentally safe use for energy purposes
 - a simultaneous improvement of soil quality and functions of the sites by phytoremediation

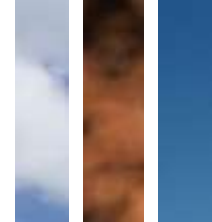
TRANSFER OF KNOWLEDGE GOAL

- ✓ strengthen the cooperation between industry and academia to make advancement in knowledge and arrive to pro missing near-to-market innovations addressing the S&T goal

S&T Objectives - Phyto2Energy



ISPE contribution to the project



Extensive practical experience in bioenergy and RES field:

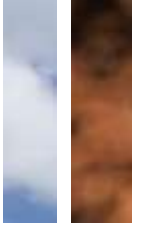
- ✓ development of energy generation using biomass, agricultural and non-agricultural residues, studies and analyses for promoting E-RES
- ✓ development of the biomass-coal co-combustion systems

Setting up the control parameters for valorization of biofuel feedstock for gasification and performance of analyses and tests of the HMC biomass according to this set of parameters.

- ✓ ISPE contributes with an extensive expertise in performing:
 - the cost-benefit analysis
 - environmental impact studies of the biomass gasification process from phytoremediation driven energy crops production as local energy carrier

WP 3 overview

Biomass valorization and use as local energy carrier



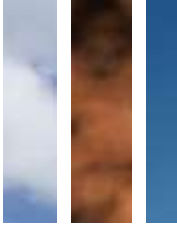
To develop and validate an innovative approach combining phytoremediation and production of biomass on heavy metal contaminated (HMC) areas which could be used as local energy carrier.

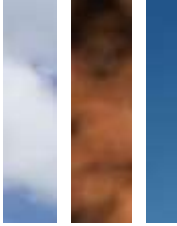


To demonstrate an environmentally safe way of converting the HMC biomass into energy in a small scale local installation **with special focus on gasification** as a promising technology which may become a competitive alternative for handling HMC biomass.

Objectives

- ✓ determine parameters to valorize biomass from HMC sites as feedstock from the viewpoint of:
 - the characteristics and technical operation of gasification installations
 - potential environmental concerns
 - environmental benefits delivered by the treatment
- ✓ analyze and assess the impact of the biomass parameters on the quality and composition of the end gas and other gasification products (e.g. char and ash)
- ✓ get a better understanding of the behaviour of heavy metals during this process to determine if and which mineral components contained in the biomass due to e.g. agrotechnical measures may affect the gasification process.





We are involved in:

WP3 - Biomass valorization and use as local energy carrier

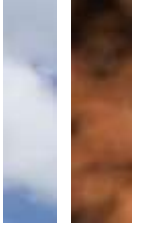
The main task where we are involved is:

- **Task 3.7** Final lab tests and analyses of biomass as biofuel feedstock according to the defined control parameters
- **Task 3.8** Final characteristics of the biomass potential as fuel for gasification, report development

Delivery date - **month 48**

WP4 Dissemination & outreach

- **Task 4.2** Planned seminars and/or training activities at host organization to be delivered by the fellow
- **Task 4.3** External project promotion activities in which the fellow was involved during secondment



Ioana Cristina DIMA - Fellow ID - ESR3



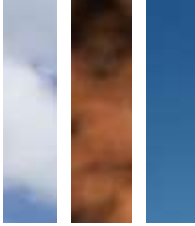
Tel: 0040212061196

E-mail: cristina.dima@ispe.ro

✓ **MSc. Diplomat Engineer – Engineering Department - Studies/Projects Financing**

✓ **Representative projects:**

- Feasibility study of the power plants
- CHP plant based on conventional /bio fuels
- New energy capacities (electricity & heat) for industrial consumers - Feasibility study
- Coal power plant - Feasibility study
- Biomass (straw) CHPs in a town in Southern Romania – Study and analysis
- CHPs on the chemical platform - Feasibility Study



Iuliana CARDAȘOL - Fellow ID – ER6



Tel: 0040212061064

E-mail: iuliana.cardasol@ispe.ro

Position in the home organisation – ISPE / Thermo-mechanical Systems Department

Process /Design engineer, Technology Project Manager.

My background

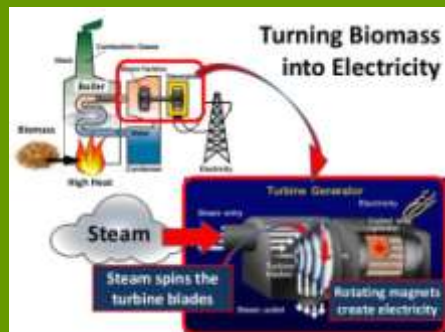
- ✓ Activities related to the design work and management of the projects in the Power Plants;
- ✓ Feasibility study, Tender documentation, Basic and Detail design of the power plants;
- ✓ Responsible for students practice in the ISPE.

Representative projects

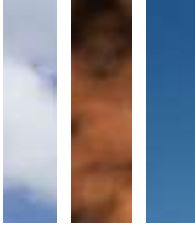
- ✓ Design for installing liquid fuel firing pilot installation – Foster Wheeler Boiler no.4 - Lukoil Energy & Gas
- ✓ Installation for biogas catching, transport and control firing installation at waste dump Teplita (Sighetu Marmatei) and Satu Nou – (Baia Mare)
- ✓ Project for municipal waste capitalizing (waste-to-energy) by conveying and adequate plant and its integration within Timisoara Sud CHPP– project in stand-by
- ✓ Cogeneration plants AMONIL Slobozia, AMURCO Bacău, DONAU CHEM SRL Turnu Măgurele, GA-PRO-CO-CHEMICALS Săvinești, NITROPOROS SRL Făgăraș

Biomass in Romania

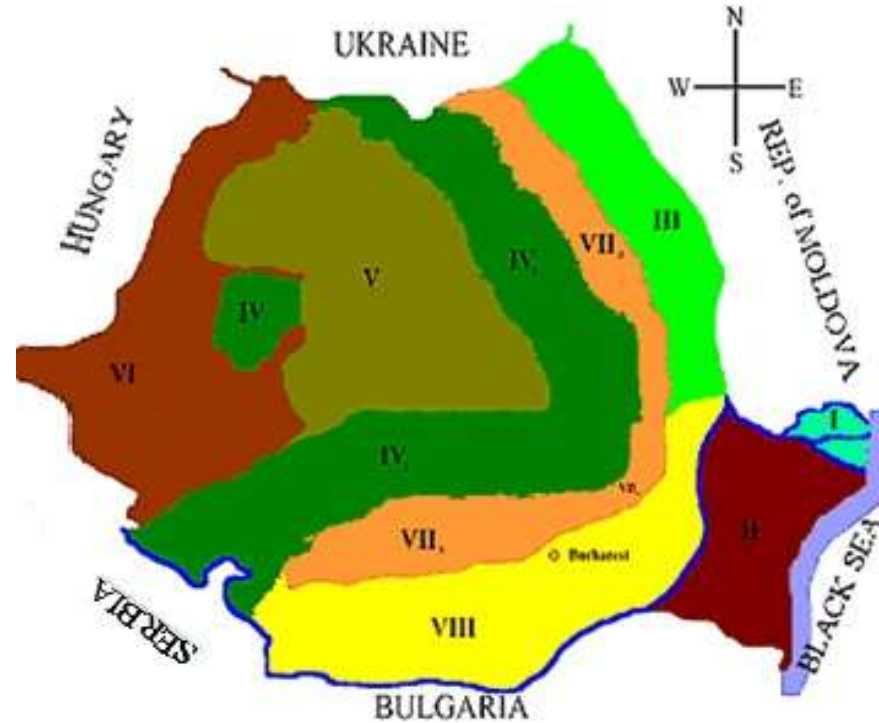
Phytoremediation driven energy crops production on heavy metal degraded areas as local energy carrier



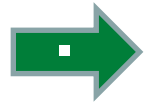
RES potential in Romania



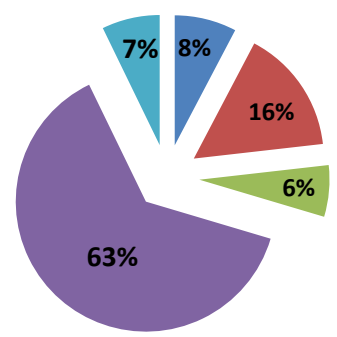
- I. **Danube Delta** - Solar energy, biomass
- II. **Dobrogea region** - Solar energy, wind power
- III. **Moldova** - micro-hydroenergy, wind power, biomass
- IV. **Carpathian mountains** - micro-hydroenergy, wind power, biomass
- V. **Transylvanian Plateau** - micro-hydroenergy, biomass
- VI. **Western Plain** - geothermal power, wind power
- VII. **Subcarpathians** - high potential for biomass and micro-hydroenergy
- VIII. **South Plain** - biomass, micro-hydroenergy and solar energy



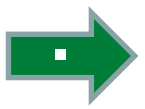
Biomass potential in Romania



Biomass energy potential - 7.6 mil toe/year



- Biogas
- Lumber and firewood waste
- Wood waste
- Agricultural waste
- Urban household waste

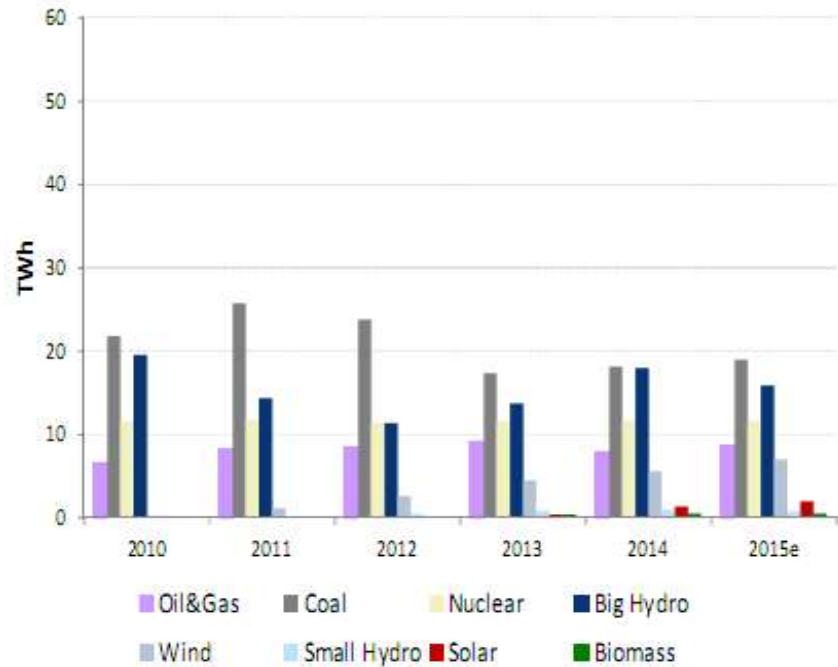


According to the Romanian Regulatory Authority for Energy (ANRE) report at the end of 2015:

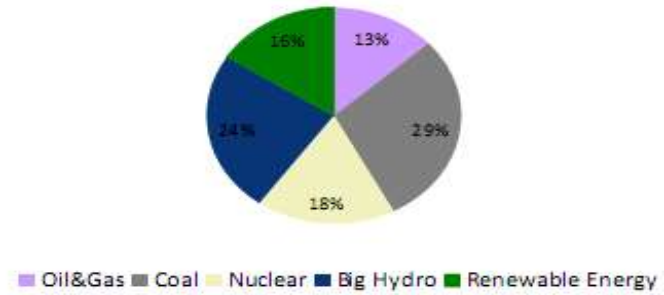
- ✓ **106 MW** - installed capacity in power plants using biomass or its derivatives (such as biogas;
- ✓ **25** - authorized producers

Romanian Electricity Production

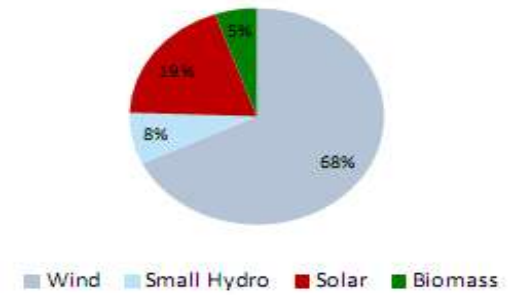
Electricity Production by Energy Source



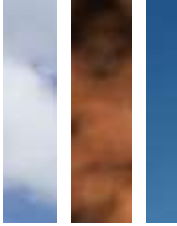
Electricity Production by Energy Source 2015



Electricity Production from RES 2015



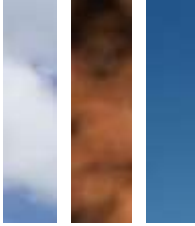
Current situation and targets for the future



- ➔ For urban area - **80%** of the existing CHPP supplying the district heating systems were installed in the period 1960 – 1980 and their useful life had expired and their performance is low.
- ➔ CHPP fulfilling the conditions for dismantling by 2030 represents **72%** of the power currently installed in such power plants.
- ➔ The rural area is heated with classical stoves in the households (which have low efficiency, below 25%).
- ✓ **The primary objective of Romania** is to ensure compliance with the mandatory renewable energy target, of **24%** in **2020** assumed through **Directive 2009/28/EC** on the promotion of the use of energy from renewable sources .



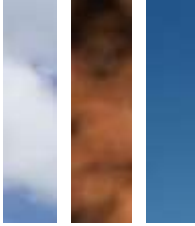
Biomass, the energy resource with the highest potential in Romania



- ✓ The RES contribution, such as the biomass, assumed through **Directive 28/2009/EC**, shall focus both on the electricity production in the CHPP and also by using the biomass in separate heating systems in the rural areas:
 - In order to maintain the heat supply capacity of the consumers connected to CHPP is estimated that shall be installed a new capacity of 1200 MW in CHPP based on new cogeneration technologies (combined cycle, heat recovery from gas turbines), with 15% of this new installed capacity (200MW) based on biomass;
 - In rural areas must be replaced the existing classical stoves in the households with new system using modern technologies with higher efficiency based on biomass.
- ✓ The current installed biomass capacity of 106 MW is expected to growing to **210 MW** in the next 2 years.
- ✓ Romania will need additional electricity generation capacity by 2035 in order to meet the increased demand, to de-carbonize its electricity sector and to replace the aging power generation facilities.

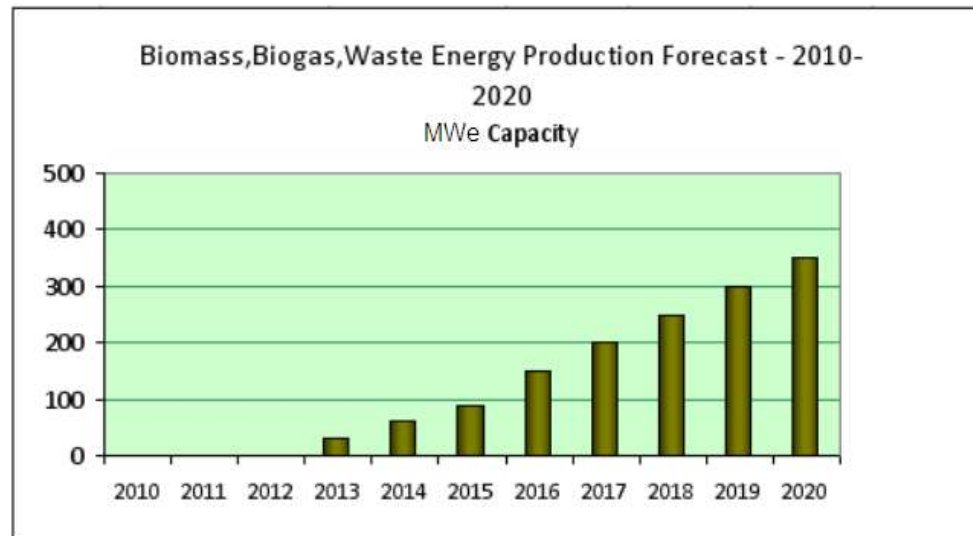


Forecast Growth of the Biomass Development in Romania 2010-2020



Biomass Applications can be grouped into the following main market segments:

- ✓ Substitution of a part of the fossil fuels in existing district heating schemes;
- ✓ Increase the uses of biomass as industrial fuel;
- ✓ Using biomass for new district heating schemes for small towns and villages near the resources, where the population has no access to central co-generation or gas supply;
- ✓ Using of the straw and biogas for heat supply of farms and small villages (in the medium term).



Romanian Regulation for Renewable Energy



- ✓ Creates a national legal frame work in order to fulfill the **Directive 2009/28/EC mandatory targets**;
- ✓ Establishes the promotion system for electricity produced from renewable sources;
- ✓ Introduce the support scheme of Green Certificates based on EU provision for Romania.

Structure of the GC system for biomass can be summarized the following way:

- **2 GC** for each 1 MWh produced and delivered by the producers of electricity from new power plants based on all types of biomass;

in addition

- **1 GC** for each 1MWh produced and delivered from high efficiency CHPP or from new power plants based on energy crops.

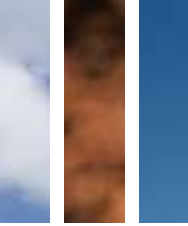
Support period - 15 years for electricity produced in new electrical units.

At the end of each year, distribution companies have to deliver a certain amount of GC corresponding with the annual quota.

The certificates have been traded at the electricity market administrator **OPCOM (Romanian Gas and Electricity Market Operator)**.

The tariffs are regularly adapted to the actual production costs by the Romanian Regulator.

The annual minimum and maximum values for Green Certificates trading is **27 and 55 euro/certificate**.



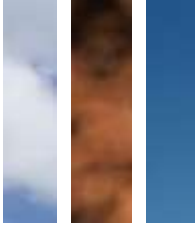
Applications in Romania

Egeer Group – Biomass Power Plant in Radauti, Romania

- Investment 39 million EUR
- Electrical Power Output 15 MWe
- Rated Thermal Input (total) 83 MWt
- Fuel Scrap Wood, Technological residues
- Year of Commissioning 2013



Applications in Romania



Objectives

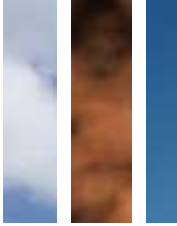
- ✓ The power plant was built in order to transform the wood processing facility into an integrated site and to reduce the consumption of the fossil fuel;
- ✓ Generate electricity and process steam, by using biomass, for their internal consumption;
- ✓ A special feature of this facility is the generation of hot gas used for drying the wood from the chipboard plant.

Biomass benefits

- ✓ The existence on their industrial platform of a large amount of biomass resulted from the technological processes;
- ✓ Is renewable and leads to independence from external raw materials and energy providers;
- ✓ Waste management by harnessing of the internal biomass;
- ✓ Creates local value providing jobs.



Applications in Romania

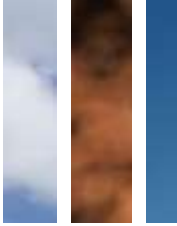


Adrem Invest - Bioenergy Suceava

- Investment 86 mill. EUR
- Electrical Power 30 MWe
- Annual heat 270 000 Gcal
- Fuel Biomass from forestry and related industries
- Year of Commissioning 2013



Applications in Romania



Objectives

- ✓ The new power plant is a critical and strategically industrial unit in Suceava taking into consideration that the local central heating system was partially functional and with low efficiency;
- ✓ Supplies the heat and hot water for 22.000 households, representing more than 60.000 of citizens of Suceava;
- ✓ The power plant is based on a high efficiency cogeneration system, which operates on natural gas and biomass as fuels.

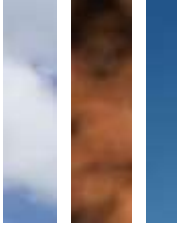
Achieved goals

- ✓ Ensuring thermal supply continuity in DHS;
- ✓ Increasing energy efficiency of the power source in Suceava.

ISPE implication

- ✓ Feasibility Study;
- ✓ Permitting Documentation;
- ✓ Basic and detail Engineering.





Institute for Studies and Power Engineering



Thank you for your attention



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