

BIOENERGY: A NEW CHALLENGE FOR RESEARCH AND INVESTMENT

PROF.ATANAS ATANASSOV
USDA Global Conference on Agricultural Biofuels
Minneapolis, Minnesota, USA

AGROBIOINSTITUTE
DIRECTOR



HUMANITY'S TOP TEN PROBLEMS THE NEXT 50 YEARS

- 1. ENERGY**
- 2. WATER**
- 3. FOOD**
- 4. ENVIRONMENT**
- 5. POVERTY**
- 6. TERRORISM & WAR**
- 7. DISEASE**
- 8. EDUCATION**
- 9. DEMOCRACY**
- 10. POPULATION**

POLICY DRIVING FORCES FOR BIOENERGY DEVELOPMENT

- The production of renewable energy from agriculture involves several sectors, such as energy sector, environmental, agricultural and economic sector
- There are 3 Directives that are potential driving forces for bioenergy development:
 - *The Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal energy market*
 - *The Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustions plants*
 - *The Directive 2003/30/EC on the promotion and use of biofuels or other renewable fuels for transport*

EU WHITE PAPER ON RENEWABLE ENERGY SOURCES (RES) (1997)

- **Goal: to double the share of renewable energy in gross energy consumption from 6% to 12% by 2010**



DIRECTIVE 2003/30/EC on the promotion and use of biofuels or other renewable fuels for transport

- Goal: The Directive aims to promote the use of biofuels to replace petrol and diesel for transport purposes within Member States.
- Member States are required to set national indicative targets for 2005 and 2010 for the minimum proportion of biofuels and other renewable fuels in road fuels, against reference values of 2% by energy content for 2005 and 5.75% by energy content by 2010.

COMMON AGRICULTURAL POLICY (CAP)

- The increase of biomass from agriculture is largely affected by the developments related to CAP
- CAP is an EU wide agricultural policy, adopted by all its Member States
- CAP was reformed in terms of support schemes to EU farmers
- The CAP reform decoupled subsidies from the production volume and the type of crop cultivated

COMMON AGRICULTURAL POLICY (CAP) & NEW MEMBER STATES

- With the accession of 12 new Member States to the EU in 2007, the utilized agricultural area increased by 30%
- New Member States have a huge agricultural potential that has not been exploited to the full extend
- Not all CAP mechanisms entered into force for new Member States: on one hand farmers received immediate access to the EU single market but on the other hand the direct payments are phased in gradually over 10 years, having started from 25% of the EU rate in 2004 and reaching the same rate with the EU-15 countries in 2013
- There is also an option to 'top-up' the EU payments with complementary national payments under certain conditions in order to bridge the difference.

COMMON AGRICULTURAL POLICY (CAP) & ENERGY CROPS

- **Under CAP reform there are two methods for receiving support for energy crop cultivation by farmers:**
 1. **The first one: Energy crop aid, which is additional to the Single Payment Scheme. The energy crop aid is 45 EUR per ha for all crops produced for energy purposes on agricultural land**
 2. **The second one: The pre-reform system of receiving support for cultivating non-food crops on set-aside land within the Single Payment System continues to operate**
- **Currently conditions and rates for energy crop cultivation differs for new Member States due to the adopted temporary payment schemes (e.g. Single Area Payment Scheme and crop specific direct payments under CAP)**

BIODIESEL

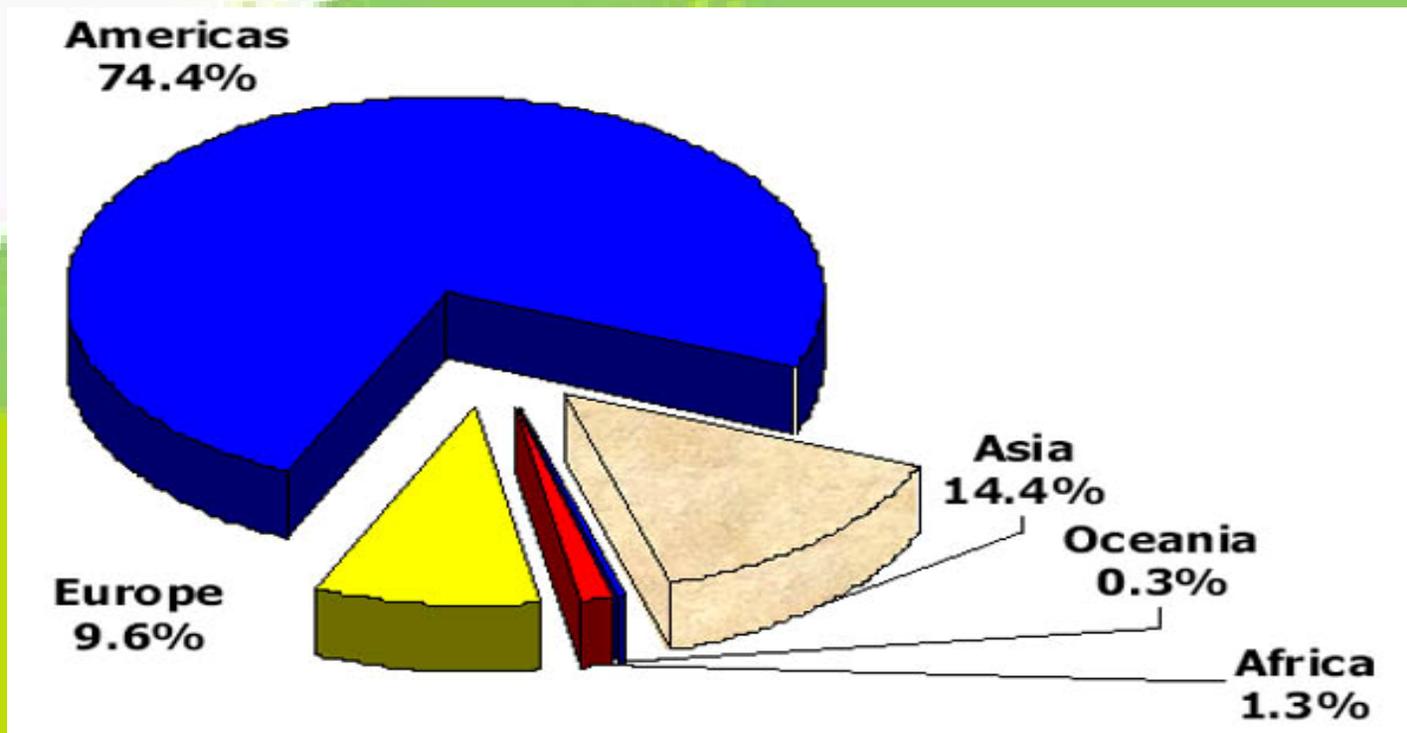
- Global production expected to exceed 2.2 billion gallons in 2006
- The EU is the largest producer with an estimated capacity of over 1.8 bbgly (billions gallons per year)
- The US is expected to produce about 400 million gallons per year (mmgy) in 2006 - app. 0.7% of US diesel use



BIODIESEL IN THE EU

- EU 2005 3,184,000 tonnes
- EU 2006 6,069,000 Tonnes
- Three Largest producers are...
 - Germany 2005 1,669,000 tonnes
 - Germany 2006 2,681,000 tonnes
 - France 2005 492,000 tonnes
 - France 2006 775,000 tonnes
 - Italy 2005 396,000 tonnes
 - Italy 2006 857,000 tonnes

BIOETHANOL



RESOURCE AVAILABILITY

- Bulgaria has excellent natural conditions for development of the agricultural and forestry sector. Arable land stands at about 4.9 million ha or 44% of the total territory of the country. The favourable climate for the production of different crops and the existence of agricultural lands, as well as traditions, contribute towards well-developed agriculture and animal husbandry.
- In 2005 unused agricultural land (fallow land and uncultivated land) amounted to 12% of the entire agricultural land. This provides an opportunity for development of this potential for the production of biofuels, providing that the necessary stimulation mechanisms are laid down in legislation.

RESOURCE AVAILABILITY

- **Principal crops for the production of biofuel and their potential** - The energy crops used as raw material for the production of **bioethanol** are maize, wheat and sugar beet.
 - **Wheat** is the agricultural product with the largest volume of production – 3,961,000 t from 1,039,678 ha of land in 2004. In addition to covering the needs of the domestic market, the favourable climatic and macroeconomic conditions permitted exports to the amount of 667,036 t in 2004. The average wheat harvest in Bulgaria stands at 3.09 t/ha (according to data of the Ministry of Agriculture and Forestry) which corresponds to 0.88 t/ha alcohol.
 - **Maize** is produced on irrigated lands as it is a crop favouring humidity and warm weather. The average maize harvest in Bulgaria stands at 4.47 t/ha which corresponds to 0.41 t/ha alcohol.
 - **Sugar beet** – Production of sugar beet in Bulgaria is inconsiderable – 26,367 t in 2004 in spite of favourable climatic conditions. This situation does not allow a forecast to be made for its use as raw material for bioethanol in the near future, except if special measures for stimulation of production are not applied. The average harvest of sugar beet in Bulgaria stands at 22.55 t/ha (according to data of the Ministry of Agriculture and Forestry) which corresponds to 1.97 t/ha alcohol.
 - **Sweet sorghum** – the tradition to be renewed

RESOURCE AVAILABILITY

- **Principal crops for the production of biofuel and their potential**
 - The energy crops used as raw material for **biodiesel** are sunflower and rapeseed:
 - **Sunflower** is the agricultural crop – the third in importance after wheat and maize. The average harvest of sunflower in Bulgaria stands at 1.48 t/ha which corresponds to 0.59 t/ha oil.
 - The climatic and agro-meteorological conditions for the production of **rapeseed** in Bulgaria are favourable. Low winter temperatures, quick warming in the period of ripening (May-June).
- The above data indicate the conclusion that since rapeseed farming in Bulgaria harbours risks (frost during winter) it is recommendable to use sunflower for the production of biodiesel.
- Although the lack of tradition, the rapeseed acreage has been increased from 22,388 ha (2004) to 44,000 ha (2007). It is expected to exceed 100,000 ha in 2008.

DEVELOPMENT OF GENOMICS TOOLS TO IMPROVE SORGHUM BIOMASS /FEEDSTOCK QUALITY FOR BIOENERGY

AGROBIOCENTER OF GENOMICS

- **PROJECT RATIONALE:**
- To use advanced genomics tools approaches to produce sorghum genotypes with the genetic potential for use in bioenergy production
- Sorghum (*Sorghum bicolor L. Moench*) has the potential to be one of the species dedicated to biomass production in Bulgaria because of its:
 - high productivity
 - drought tolerance
 - established production systems
 - its genetic diversity
 - 1 ton of grain sorghum produce as much ethanol as 1 ton of maize grain but it uses about half as much water as maize to produce one (1) ton of biomass

DEVELOPMENT OF GENOMICS TOOLS TO IMPROVE SORGHUM

BIOMASS /FEEDSTOCK QUALITY FOR BIOENERGY

- **EXPECTED DELIVERABLES**

- Identification of major QTLs related to biomass quality for biofuels
- Knowledge transfer to sorghum breeding institutes and companies for application of MAS to select and register new high yielding sorghum varieties with improved biomass quality for biofuel
- Increased capacity to participate in EU and international collaborative projects

GENOMICS APPROACHES TO IMPROVE SUNFLOWER OIL YIELD AND COMPOSITION FOR BIODIESEL PRODUCTION

- Sunflower is one of the most traditional adapted crops to dry conditions typical to the Bulgarian environments.
- The oleic acid content in sunflower oil are considered to be suitable for biodiesel production with regard to fuel oxidative stability.
- Particularly pressing appears the request to increase the technical efficiency of the cropping pattern and to genetically improve the set of cultivars' availability, in order to reach the double purpose, to reduce cultivation costs and to increase the crop productive potentiality and stability.
- The conditions in Bulgaria are very suitable for sunflower cultivation in rainfed conditions in the context of global warming. In comparison with rapeseed and maize it is quite tolerant to reduced water availability and high temperature regime due to a hot, sub-arid climate.

GENOMICS OF FIBER, WOODY BIOMASS FOR BIOFUEL PRODUCTION

- **PROJECT RATIONALE**

- In Bulgaria, trees of the genus *Populus* (poplars and poplar hybrids) and *Salix* are particularly well suited for such applications.
 - grow and produce mature wood rapidly
 - inhabit a diverse geographic range
 - show inter-species hybrid vigour
 - can be propagated clonally and coppiced
 - can grow well on marginal lands
- The sequencing of the *Populus* and *Salix* genome and the development of genomics tools in this system provide unprecedented opportunities to gather insights and develop tools to maximize benefits from this genus
- Genomics data from other such plants and from microbes that produce cell wall degrading enzymes will have similar benefits.

FUTURE – NEXT GENERATION BIOENERGY CROPS

- GERMPLASM:
 - Existing crops – wheat, maize, sunflower
 - Under utilized crops – sweet sorghum, rapeseed
 - Discover of completely new (alternative) crops – safflower, Miscanthus
-
- APPROACHES:
 - Marker assisted breeding
 - Transgenic enhanced
 - Genomic enhanced

FUTURE RESEARCH WORK

- TECHNICAL BIOMASS ASSESSMENT:
- Bulgaria has to address its ability to produce sustainable its own biofuels base from an energy, environmental, and economic perspective. A major component of sustainable biofuels production on a scale large enough to meet the EU directive is to assess the country's agricultural resource base as it pertains to
 - current land use and economic costs and returns
 - potential bioenergy crop production and associated energy outputs, and
 - environmental enhancement and/or degradation associated with large-scale bioenergy crop production versus current crop production scenarios.
- ABI is under preparation of a project that aims to provide answers concerning use of the land base in Bulgaria for bioenergy/biofuels production.

FUTURE RESEARCH WORK

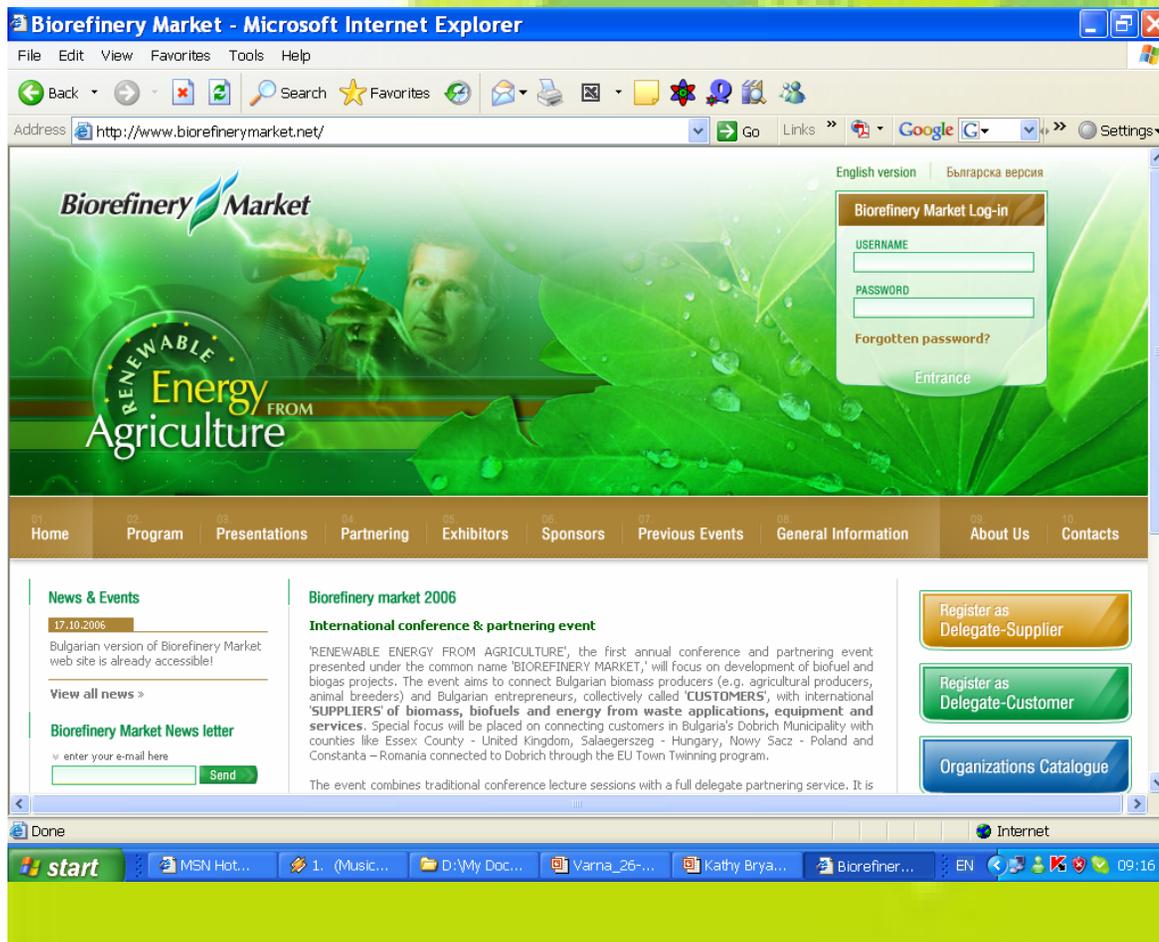
- **TECHNICAL BIOMASS ASSESSMENT:**
- **Determine from the yield estimations the total gross energy (GJ, liters of ethanol or biodiesel, etc.) that could potentially be derived from biomass/bioenergy production in this geographic sector.**
- **Compare select environmental parameters such as soil erosion, nutrient transfer, and carbon exchange associated with production of each bioenergy crop versus production of current agricultural cropping systems of wheat and maize.**
- **Compare the economics of production of wheat and maize with each bioenergy crop.**
- **Determine from data derived in these objectives, the optimum agricultural/land base scenarios for bioenergy crop production.**

COLLABORATION WITH USDA

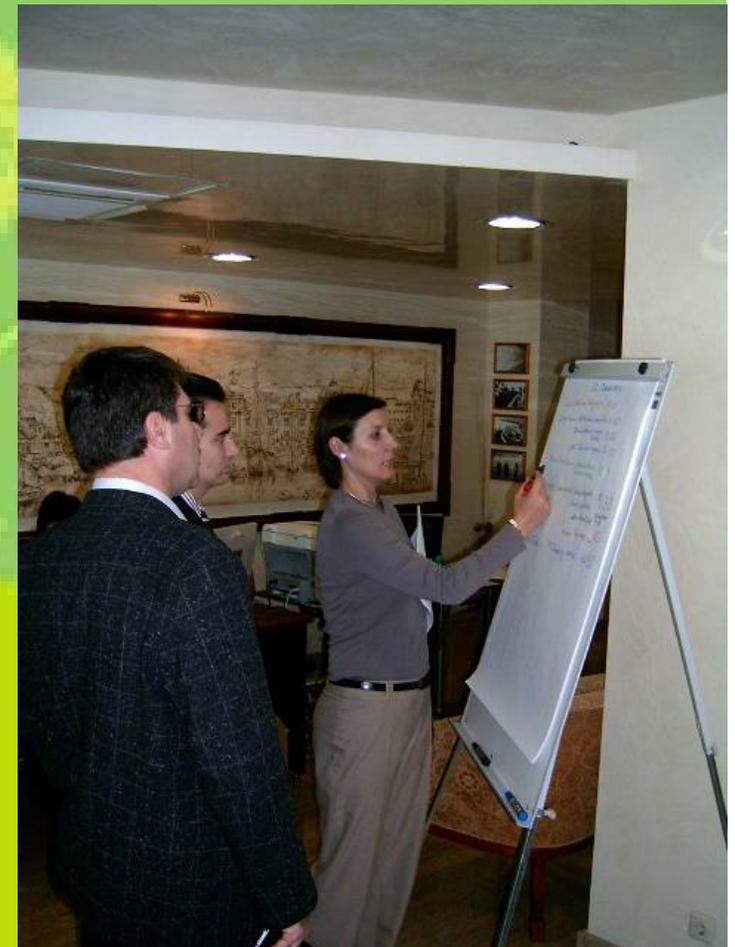
- Technical assessment of Bulgarian biomass resources – collaboration with prof. Richard Nelson, Director of extension services, Kansas State University.
Funding is needed.

COLLABORATION WITH USDA

- Conference & partnering event: Renewable energy from Agriculture, December 2006

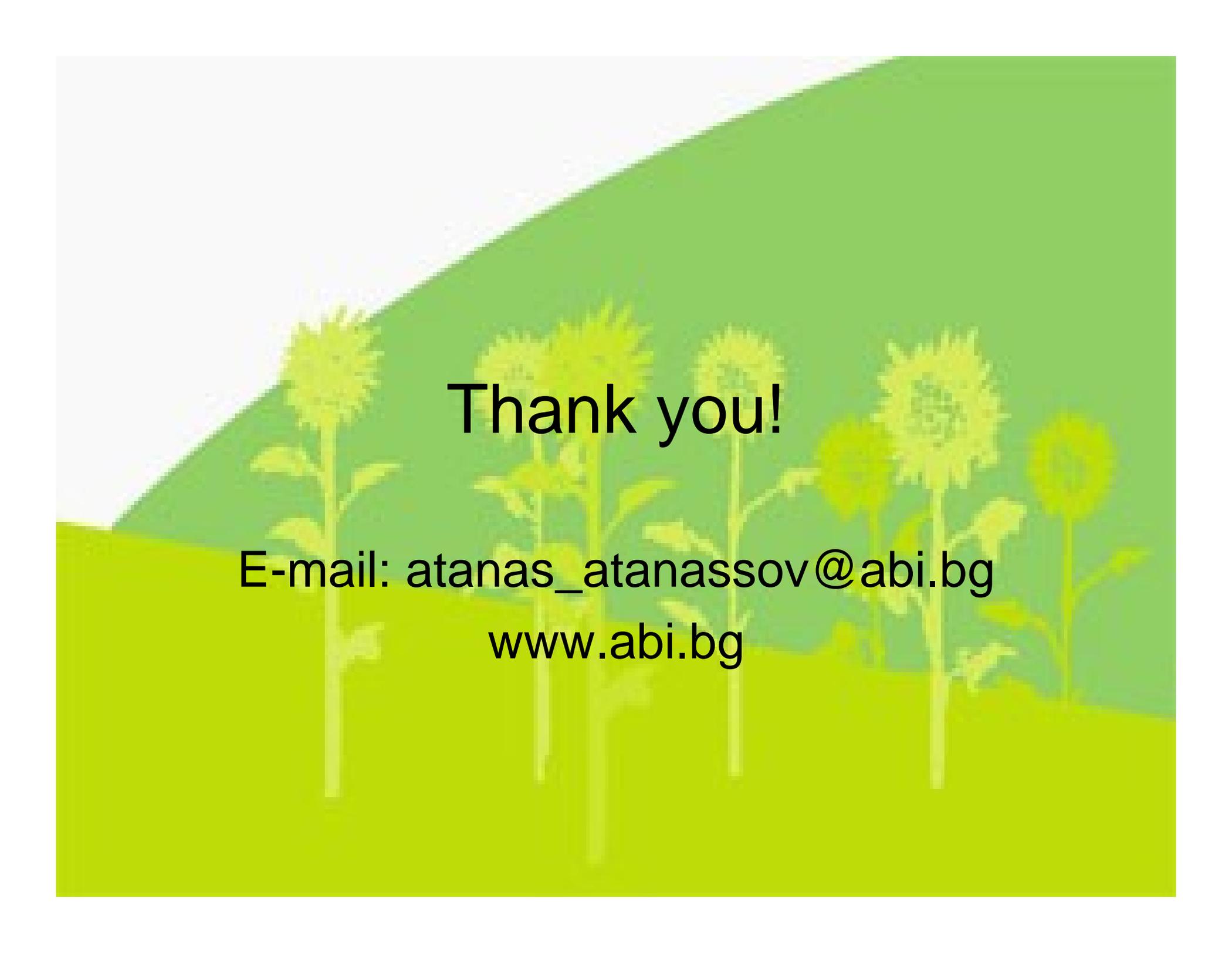


The screenshot shows the Microsoft Internet Explorer browser window displaying the Biorefinery Market website. The address bar shows the URL <http://www.biorefinerymarket.net/>. The website features a green-themed header with the text "Biorefinery Market" and "RENEWABLE Energy FROM Agriculture". A navigation menu includes links for Home, Program, Presentations, Partnering, Exhibitors, Sponsors, Previous Events, General Information, About Us, and Contacts. A "Biorefinery Market Log-in" form is visible, with fields for USERNAME and PASSWORD, and a "Forgotten password?" link. Below the navigation menu, there is a "News & Events" section with a date of 17.10.2006 and a "Biorefinery market 2006" section titled "International conference & partnering event". The event description mentions "RENEWABLE ENERGY FROM AGRICULTURE" and lists various participants and locations. On the right side, there are three buttons: "Register as Delegate-Supplier", "Register as Delegate-Customer", and "Organizations Catalogue". The Windows taskbar at the bottom shows the Start button, several open applications, and the system clock displaying 09:16.



CONCLUSION

- Bulgarian agriculture can play a key role in energy supply without influencing on food supply
- The expanding bioenergy industry could:
 - Increase the income of agricultural producers
 - Diminish the dependence on fuel import
 - Improve the benefits for the environment
- Depending on the way this potential will be used, will be defined the social effect on agriculture and its impact on environment.



Thank you!

E-mail: atanas_atanassov@abi.bg

www.abi.bg