ANALYSIS OF THE RENEWABLE ENERGY MARKET IN ROMANIA

An Overview of the Renewable Energy Market in Romania

TRIGLAV CARPATI
SLOVENIAN ROMANIAN BUSINESS CLUB

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The Liberalized Energy market

History

The Energy Charter Treaty was ratified by the Parliament in 1997.

The Government Ordinance (GEO) 29/28 regarding the setting up to organize the functioning of the National Electricity and Heat Regulatory Authority (ANRE). ANRE was set up in order to create and implement a national-wide regulatory system to ensure an efficient, transparent and stable functioning of the electricity and heat while protecting the interests of consumers and investors.

In 2002, the Government appointed consultants to advise the Romanian National Energy Authority:

1. on options for the future structure of the Wholesale Energy market
2. to assist in the development of the chosen option

The Wholesale electricity market design was planned to meet the following objectives:

a. to provide effective mechanisms to ensure that the short-term scheduling and despatch of energy from the generator to meet demand is done at the lowest cost;

b. to provide an appropriate framework, through price signals, on which long-term investment decisions in the sector (in generation, demand and networks) can be made in an optimal manner by the sector participants acting on an independent basis. This also applies to decisions to decommission plant from service;

c. to ensure the security of supply of the system in real time by properly allocating responsibility for system operation and the provision of ancillary and balancing services; and

d. ensure that the supporting regulatory arrangements protect captive consumers whilst allowing them to benefit from competition wherever possible.

A detailed overview of the development objectives of Romania’s liberal Energy market is available on the ANRE website - http://www.anre.ro/documente_tot.php?id=151
Market Structure

Source: - ANRE & Invest East

International Energy Utility Companies on the Romanian market

In 2010, International utility companies have established a significant place on Romania’s energy market. It is worthwhile noting there is no dominant player that might create a market distortion.
Snapshot of Romania's Electricity Wholesale Market in May 2010

It is considered useful to analyse the Wholesale & Day Ahead Markets during a period of low economic activity, during which industrial activity is well below normal levels. The impact on energy demand and pricing should establish a firm baseline on which future energy pricing forecasts can be derived.

The current pricing of wholesale market for medium to long term bilateral contracts should provide investors in the energy sector a trusted guideline on which to base their forecast budget revenues. The Spot market, known in Bucharest as the Day Ahead Market (DAM) is a less useful marker.

Romania’s Wholesale Energy Market

At the time of writing this report, an analysis of the latest market data has been evaluated. All data is provided from historical data supplied by the National Electricity and Heat Regulatory Authority (ANRE).

The above table details Energy pricing on the Wholesale Market in August 2010 by segmentation and divides the market into 5 primary segments. The respective price/MWh across the market ranges from EUR €52 for Industrial Consumers to EUR 33 on the Day Ahead Market.
In calculating the prevailing wholesale market average price / MWh, account has been taken of the overall consumption of each market segment.

![Wholesale Energy Market Segmentation - August 2010](image)

**Day ahead market (Spot Market)**

Our analysis of the Day ahead market (DAM) reveals the weakness of off-peak energy demands combined with the holiday season in 2010, during a period of weakened industrial output influenced by weak demand in North American and European markets.

An analysis has been conducted using historical reports of Opcom, the regulatory authority responsible for both the DAM market and the Green Certificate markets.

In the first instance we have analysed the hourly average price throughout 2010, and have seen marked disparity between prices transacted in the off peak period from 12:00pm – 8:00am as compared to a peak demand period extending from 9:00am – 11:00pm.

Off peak prices average between EUR 34 /MWh and EUR 23 /MWh, although peak prices during this time zone exceeded EUR 50 MWh in every month except June, July and September.

Peak Prices ranged from monthly highs of EUR 60 per MWh that peaked at EUR 73 in January, February, March and April during the hours of 8pm – 9 pm.
Our conclusion is that this scenario will alter as industrial activity increases peak energy demands, with less price disparities between peak and off-peak demand.

Once Romanian industry returns to multiple shift operation, average energy prices can be expected to harden significantly.

The weakness of the Off Peak market potentially represents a twofold opportunity for investors in the Renewable energy market.

1. Project profitability may be enhanced as volatility decreases and the Off Peak market hardens.
2. Until the market becomes more balanced, there are possibilities to purchase energy at less than half the market norms, store this in a Sodium ceramic batteries or Hydrogen generating systems for reconversion into energy during Peak demand hours.

Producers of both Wind and Solar energy need to be able to apply energy balancing solutions to level out production fluctuations, and the current market provides an opportunity to subsidise such investments.
Decommissioning Program for Lignite, Coal & Oil Thermal Power Stations

There are more than a few power stations that are approaching the end of their viable economic life, and European laws further dictate near term decommissioning dates. Of the above, the most modern facility, Turceni, out of the above list was commissioned in 1978, and many of the remainder were built in the 1950s.

The most significant facilities that are listed for decommissioning total 5,500 MWe.
Since 2000, there has been a significant change in market segmentation for Romania’s energy production, and it is expected that reliance on solid fuel Thermal Power stations will be further reduced as significant levels of Renewable energy sources come on stream.
Electricity Production by Primary Resources  
May 2010

- Gas, 4.90%  
- Nuclear, 14.50%  
- Hydro, 44.60%  
- Solid fuel, 35.50%  
- Liquid, 0.50%

Source: ANRE

Renewable Energy Sources (RES):


Definition:- renewable energy sources (Law 139/2010)
Non-fossil energy sources, namely: wind, solar, geothermal, hydrothermal and ocean energy, hydro, biomass, landfill gas, known as gas storage and gas from sludge digestion sewage treatment plants and biogas.

- Wind  
- Small Hydro Plants (<10MW)  
- Solar PV  
- Biomass & other Biofuels  
- Geothermal  
- Hydrothermal  
- Wave energy
The key to commencing a successful development of renewable energies in Romania has required a combination of political commitment and decision making as well as support mechanisms that are now set in law and are comprised within Law 220/2008 & more recently further modified beneficially in Law 139/2010.

The Energy laws promoting production of renewable energy have set well defined targets for all types of renewable energy production.

The total rural population, together with the urban population living in medium-sized towns will be considered as the primary market segment for RES applications (about 61% of a total population of 22.8 million).

Historically, Romania’s domestic energy production from coal, lignite, oil, gas and hydropower, covered about 70% of the energy needs. In 2002, the share of RES to the primary energy consumption was less than 1% excluding large hydro facilities (> 10MW).

The average figure for the European Union is about 4% (including large hydro) with increasing trends in all RES sectors, especially in wind energy. RES project implementation will reduce the dependency on energy imports and consequently improve the balance of payments for the energy sector. Moreover, efforts will primarily focus on decentralized RES systems targeting the growing domestic, industrial and agricultural energy demands for thermal and energy needs.
Wind Energy

Forecast Growth of Wind Energy Development in Romania 2010-2020

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<thead>
<tr>
<th>Year</th>
<th>MWh</th>
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<tbody>
<tr>
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<td>2011</td>
<td>1206</td>
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<td>2012</td>
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<td>2366</td>
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<td>2016</td>
<td>2566</td>
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<td>2017</td>
<td>2666</td>
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<td>2018</td>
<td>2666</td>
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<tr>
<td>2019</td>
<td>2866</td>
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<tr>
<td>2020</td>
<td>2866</td>
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There are several influences that may impact the speed of development of commercial wind energy projects:

- Grid connected applications on a strictly commercial basis. In the past, the successful roll-out of these applications depended largely on the support structures being put in place. In July 2010, the Romanian Energy laws 220/2008 and 139/2010 have been signed by Parliament and the President. It is now anticipated that with the clarity of the support systems comprised within the Energy laws, that there are a strong reasons to support large scale commercial development of Wind energy solutions over the next 7 years. One wind developer alone has sold wind projects totalling 880 MWp. A number of Europe’s leading energy utility companies have made commitments to develop large scale wind energy investments in Romania, the largest of which is the Czech Energy company, CEZ, whose wind park is the world’s largest outside the USA. This is an indication of future velocities in the wind energy segment.

- Romania’s potential in wind energy is considered the highest in south eastern Europe. The Moldova and Dobrogea provinces (in the southeast of the country, near the Black Sea) were considered the most appropriate areas for wind farm developments. In particular, the southeast of Dobrogea was ranked, according to different specialized studies, second in terms of potential in Europe.
- The wind potential of Romania is estimated at 14,000 MW installed capacity, equivalent to total annual production of 23 TWh. According to a development scenario proposed by the National Institute of Energy (IRE), it would be sustainable for wind farms units to make a contribution of 13 TWh in 2020, which would involve complementary development of flexible gas turbine power units up to production of 15 TWh.

The anticipated implementation of up to 3,000 MW in wind farm capacity in the period up to 2011-15 would lead to an increase in the total investments in new capacities of over EUR 5bn (+28%).

- Romania is fortunate to have large areas of onshore locations in areas of low population that are classified as excellent on the American Wind Energy Association (AWEA) scale. The low environmental impact in these areas of low population, in a coastal belt devoid of buildings or forested areas provides optimal wind conditions for Wind energy development.

- The escalating cost of Offshore wind solutions that are being considered on the North Sea and Atlantic coasts of Europe is likely to result in a stronger focus on onshore wind locations that can provide strong year round wind speeds. A recent project in the Netherlands estimated that the construction costs of a specific offshore wind project was close to three times that of an onshore wind solution.

- Supply of isolated remote areas. If there is a political commitment to supply isolated rural towns, then small wind turbines are an economically attractive alternative in conjunction with PV systems, where wind resources are sufficient.

- There are distinct advantages to combine Wind and PV solutions to achieve important energy balancing advantages. It is likely that operators of wind farms will make a second stage investment into solar pv systems thereby increasing their energy sales on the forward markets.
Solar Energy

Forecast Growth of Wind Energy Development in Romania 2010-2020 Year

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<td>Mwe</td>
<td>12</td>
<td>42</td>
<td>74</td>
<td>94</td>
<td>102</td>
<td>110</td>
<td>118</td>
<td>126</td>
<td>134</td>
<td>142</td>
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Source: - Lumen Romania

Solar Photovoltaics (PV):

Solar PV generates electricity in well over 100 countries and continues to be the fastest growing power-generation technology in the world. Between 2004 and 2009, grid-connected PV capacity increased at an annual average rate of 60 percent. An estimated 7 GW of grid-tied capacity was added in 2009, increasing the existing total by 53 percent to some 21 GW (off-grid PV accounts for an additional 3–4 GW). This was the largest volume of solar PV ever added in one year and came despite a precipitous decline in the Spanish market relative to 2008. Solar PV accounted for about 16 percent of all new electric power capacity additions in Europe in 2009 (Source: Renewables 2010 Global Status Report).

Germany again became the primary driver of PV installations, more than making up for the Spanish gap with 3.8 GW added—about 54 percent of the global market. This was far above Spain’s prior record-breaking addition of 2.4 GW in 2008, and brought Germany’s capacity to 9.8 GW by the end of 2009, amounting to 47 percent of existing global solar PV capacity. Other strong markets included the Czech Republic, which saw a nine fold increase in total capacity relative to 2008—to 411 MW—thanks to generous feed-in tariffs for solar PV, although they are not likely to remain that high after 2010. The country installed more new PV per capita than any other country except Germany. It was followed by Belgium (292 MW), France (185 MW, with and China (160 MW).

Under the current situation, a number of stand-alone PV plants could be developed within a rural electrification program supported by the State as a least cost and effective electrification solution for the rural population. In the medium term, PV applications for rural electrification could be developed with limited public funds. Other specific applications could be developed on a commercial basis without any public funds, particularly, now that the performance of Solar PV technology has become increasingly efficient during 2009-2010 and at the same time, price performance improvements have been little short of dramatic.

Active Solar Thermal Systems: Domestic Hot Water (DHW) solar systems for single or multifamily buildings and for commercial buildings (mainly hotels), drying and swimming pool heating are the most promising applications. Solar DHW systems as Demand Side Management measure for electricity or gas utilities, has gained an increasing awareness all around the world.
Small Hydro Power (SHP)

The most promising applications and priorities are presented below:

Forecast Growth of SHP Development in Romania 2010-2020

![Graph showing Micro Hydro Energy Production Forecast - 2010-2020](image)

Mwe: 0 0 0 10 20 30 40 40 40 40 40

- It has been estimated that there are more than 2000 locations in the Transylvania mountains that are suited for the development of small hydro plants.

- From an economic perspective, it is considered that Greenfield developments offer greater economic returns than obtainable from renovating existing facilities.
Biomass

Forecast Growth of Biomass Development in Romania 2010-2020

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<tr>
<td>Mwe</td>
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<td>0</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>


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

- substitution of part of the fossil fuels in existing district heating schemes (wood chips)
- enhanced uses of biomass as industrial fuels (wood chips and logs as industrial fuel for steam or hot water boilers) instead of oil
- improved uses of biomass for new district heating schemes for small towns and villages near the resources, in the countryside, where the population has no access to central co-generation or gas supply
- uses of straw and other agricultural by-products in appropriate biomass boilers for heat supply of farms and small villages (in the medium term)

Geothermal Energy

Thanks to the implementation of medium temperature power plants (binary cycle), some new locations have engaged in geothermal power plant development (especially CHP plants, due to the more economical usage). Such areas are found in the following the west of the country.
While the average temperature gradient throughout the world is around 3°C per every 100m of depth (e.g., in the Pannonian basin in Hungary), this value varies between 5 and 7°C per 100m, which allows for cost-efficient binary plants. This is due to the fact that amortization (around 20 years) is the highest cost in the operational expenses; in other words, the initial investment is the highest cost, while the gross operating margin is very high (~90%). In terms of investment cost, drilling is very high-cost—around 30% for an HCP plant, while for a heating plant it is even higher, around 50-70% of the total investment. The drilling cost increases almost exponentially with the depth of the well. In the above-mentioned regions, at 2-3km depths, a proper (110-220°C) temperature exists.

Estimated geothermal electricity potential

Although the utilization of geothermal energy can be considered broadly cost-competitive, it has a relatively high investment cost as one disadvantage. However, its availability is high and it has stable production. These are significant advantages compared to wind or solar power production. The lack of geological availability can be solved by the Enhanced Geothermal System (EGS), which allows for low-to-medium temperature applications via binary cycles and cascading usage.

Applications for geothermal energy can be grouped into three main market segments:

- market for district heating for urban areas and possibly for villages.
- market for thermal applications within the primary, secondary and tertiary sectors
- market for power generation connected to the grid in case of high enthalpy sources.

According to the discussion on economic potentials, the top priority is the use of geothermal sources for thermal applications:

- mainly in existing district heating supply system in the cities nearby the geothermal fields and in new DH schemes for smaller towns and large villages,
- thermal applications for industrial or agricultural uses.
Summary of Renewable Development – Present Day & Forecast

Green Certificate Market

Our take on the Green Certificate market is related to the supply /demand imbalances between the demands mandatory quota requirement and the forecast supply of Energy from qualifying Renewable Energy sources.

Our maximum Renewable Energy forecasts have been made in consultation with Romania's leading developers of Renewable energy resources, and our data is considered optimistic.

Our conclusion is that the Mandatory supply quotas imposed on all energy suppliers in the Romania market will remain out of reach during the period 2010-2023.
Given the size of the gap between the mandatory renewable energy quotas imposed on energy market suppliers and the availability of sufficient volumes of Green Certificates to enable the market suppliers to meet their quota targets and avoid penalties amounting to EUR 100MWh. We anticipate a hard market in Green certificates until RES production and Quotas are near parity.

Unless RES development acquires an unforeseen acceleration and velocity, we believe that supply / demand imbalances will maintain the pricing of the Green certificate market near the top of the established price range (EUR 27-55 MWh).
 Tradable Green Certificates (TGC) by energy source

Definition of “Green Certificate”:- A document - showing title to renewable energy production of a specified quantity of electricity.

For the promotion of the production of electricity from renewable energy sources, a system of Green Certificates is in place, including a purchase obligation for distribution companies and the obligation to fulfil an annual quota of purchased green electricity. At the end of each year, distribution companies have to deliver a certain amount of "Green Certificates" corresponding with the annual quota. Since October 2005, the certificates have been traded at the newly created electricity market administrator OPCOM. According to the Energy Law, all producers of electricity have equal access to the network. 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, respectively, calculated at the exchange rate established by the Romanian National Bank for the last working day of the December of the previous year.

<table>
<thead>
<tr>
<th>Renewable Energy Source</th>
<th>TGCs per MWh Energy produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>2 till 2017</td>
</tr>
<tr>
<td>Small Hydro Plants (&lt;10MW)</td>
<td>1 from 2018</td>
</tr>
<tr>
<td>Solar PV</td>
<td>6</td>
</tr>
<tr>
<td>Biomass &amp; other Biofuels</td>
<td>3</td>
</tr>
<tr>
<td>Geothermal</td>
<td>3</td>
</tr>
<tr>
<td>Hydrothermal</td>
<td>3</td>
</tr>
<tr>
<td>Wave energy</td>
<td>3</td>
</tr>
</tbody>
</table>


Green Certificate pricing forecast

Future Green Certificate pricing will be influenced by imbalances between established mandatory supplier RES quotas and the achievement of RES generator targets.

All indications are that Renewable Energy targets of 20% by the year 2020 will fall short by approximately 60%. Note:- These estimates exclude all energy from Hydro production sources > 10 MW, whose facilities are not included in the Romanian Renewable Energy targets.
### National Target Quota for Renewable Energy Production (Excluding large Hydro >10MW)

<table>
<thead>
<tr>
<th>Year</th>
<th>Forecast RES Production</th>
<th>Mandatory RES Quota</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.3%</td>
<td>8.3%</td>
</tr>
<tr>
<td>2011</td>
<td>2.4%</td>
<td>10.0%</td>
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<tr>
<td>2012</td>
<td>3.2%</td>
<td>12.0%</td>
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<tr>
<td>2013</td>
<td>4.0%</td>
<td>14.0%</td>
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<tr>
<td>2014</td>
<td>4.6%</td>
<td>15.0%</td>
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<tr>
<td>2015</td>
<td>5.2%</td>
<td>16.0%</td>
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<td>2016</td>
<td>5.7%</td>
<td>17.0%</td>
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<td>2017</td>
<td>6.0%</td>
<td>18.0%</td>
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<tr>
<td>2018</td>
<td>6.2%</td>
<td>19.0%</td>
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<tr>
<td>2019</td>
<td>6.7%</td>
<td>19.5%</td>
</tr>
<tr>
<td>2020</td>
<td>6.8%</td>
<td>20.0%</td>
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</table>


1) **Renewable energy production remains at less than 33% of the National Target Quota**
   - We forecast that TGC pricing will remain in a band of EUR 48-55.

2) **Renewable Energy production > 50% & <65% of the National Target Quota**
   - We forecast that the TGC market will soften slightly to a band of EUR 38-50

3) **As Renewable Energy production above 65% of the National Target Quota**
   - becomes closer to the Mandatory quota targets, the TGC market will gradually soften until 85% of quota when prices may fall to the lower end of the TGC price range (EUR 27).
For the promotion of the production of electricity from renewable energy sources, a system of Green Certificates is in place, including a purchase obligation for distribution companies and the obligation to fulfil an annual quota of purchased green electricity. At the end of each year, distribution companies have to deliver a certain amount of "Green Certificates" corresponding with the annual quota. Since October 2005, the certificates have been traded at the newly created electricity market administrator OPCOM. According to the Energy Law, all producers of electricity have equal access to the network. The tariffs are regularly adapted to the actual production costs by the Romanian Regulator.

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<tr>
<td>Mandate Quot</td>
<td>8%</td>
<td>10%</td>
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<td>16%</td>
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<td>18%</td>
<td>19%</td>
<td>19.5%</td>
<td>20%</td>
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## Renewable Energy Promotion Policies

<table>
<thead>
<tr>
<th>Country</th>
<th>Feed-in tariff</th>
<th>Renewable Portfolio Standard/Quota</th>
<th>Sales tax, energy tax, or excise tax</th>
<th>Tradable RE certificates</th>
<th>Public investment, loans, or financing</th>
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<td>Austria</td>
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<td>Belgium</td>
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<td>Bulgaria</td>
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<td>X</td>
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Market Participants

The Participants

**ELECTRICITY GENERATING COMPANIES**
- SC CET BACĂU SA
- SC CET BRAŞOV SA
- SC CET GOVORA SA
- SC CET IAŞI SA
- SC CET ORADEA SA
- ELECTROCENTRALE BUCUREŞTI SA
- SC ELECTROCENTRALE GALAŢI SA
- SC DALKIA TERMO PRAHOVA SRL
- SNP PETROM SUCURSALA PETROBRAZI
- SC TERMICA SA SUCEAVA
- SC TERMOELECTRICA SA
- SPL DE TERMOFICARE PITESTI
- SC UZINA TERMICĂ GIURGIU SA
- SN NUCLEARELECTRICA SA
- SC CE ROVINARI SA
- SC CE TURCENI SA
- RAAN
- SC CE CRAIOVA SA
- SC CET ARAD SA
- SC ELECTROCENTRALE DEVA SA
- SC HIDROELECTRICA SA

**TRANSMISSION SYSTEM OPERATOR**
- CN TRANSELECTRICA SA

**DAY AHEAD MARKET OPERATOR**
- SC OPCOM SA

**DISTRIBUTION NETWORK OPERATORS**
- SC CET BACĂU SA
- SC CET BRAŞOV SA
- SC CET GOVORA SA
- SC CET IAŞI SA
- SC CET ORADEA SA
- SC ELECTROCENTRALE BUCUREŞTI SA
- SC UZINA TERMICĂ GIURGIU SA
- SC CE ROVINARI SA
- SC CE TURCENI SA
- SC ELECTROCENTRALE DEVA SA
- SC CET ARAD SA
- SC HIDROELECTRICA SA

**TRANSMISSION SYSTEM OPERATOR**
- CN TRANSELECTRICA SA

**ELECTRICITY SUPPLIERS ACTING EXCLUSIVELY ON THE WHOLESALE MARKET**
- ALPIQ ENERGY SE SC GLOBAL ELECTRIC TRADING SRL
- SC AMV STYLE SRL SC GRIVCO SA
- CEZ AS SC INVEST DINAMIC PROJECT SRL
- SC CEZ TRADE ROMANIA SRL SC JAS BUDAPEST ZRT
- EDISON TRADING SPA SC KORLEA INVEST SRL
- SC ENCAZ SRL MVM PARTNER ENERGY TRADING LTD
- SC ENEL TRADE ROMANIA SRL SC RE ENERGIE SRL
- SC ENERGY MARKET CONSULTING SRL SC ROMELECTRO SA
- E.ON ENERGY TRADING SE SC RUDNAP SRL
- SC EZPADA SRL SC RBS SEMPRA ENERGY EUROPE LTD
- EZPADA SRO STATKRAFT MARKETS GMBH
- SC GDF SUEZ ENERGY TRADING ROMANIA SRL SC STATKRAFT ROMANIA SRL
- SC TRANS ELECTRIC POWER SRL SC TEN TRANSILVANIA ENERGIE SRL
- GEN-I BUKAREST ELECTRICITY TRADING AND SALES
DISTRIBUTION NETWORK OPERATORS
SC CEZ SA
SC ENEL BANAT SA
SC ENEL DISTRIBUTIE DOBROGEA SA
SC E.ON MOLDOVA SA
SC ENEL DISTRIBUTIE MUNTENIA SA
SC FDEE ELECTRICA MUNtenia NORD SA
SC FDEE ELECTRICA TRANSILVANIA SUD SA
SC FDEE ELECTRICA TRANSILVANIA NORD SA

INCUMBENT SUPPLIERS
SC CEZ Vanzare SA
SC ENEL ENERGIE SA
SC E.ON MOLDOVA Furnizare SA
SC ENEL ENERGIE MUNtenia SA
SC FFEE ELECTRICA MUNtenia NORD SA
SC FFEE ELECTRICA TRANSILVANIA SUD SA
SC FFEE ELECTRICA TRANSILVANIA NORD SA

ELECTRICITY SUPPLIERS
SC ALPIQ ROMENERGIE SRL SC ENNET GRUP SRL
SC ALPIQ ROMINDUSTRIES SRL SC ENOL GRUP SA
SC ALRO SA SC EURO-PEC SA
SC ARCELORMITTAL GALATI SA SC FIDELIS ENERGY SRL
SC ARELCO DISTRIBUTIE SRL SC GDF SUEZ ENERGY ROMANIA SA
SC ATON TRANSILVANIA SRL SC GENERAL COM INVEST SRL
SC BENVY ALEX SRL SC GVECO SRL
SC BIOL ENERGY SRL SC HIDROCONSTRUCTIA SA
SC EFE ENERGY SRL SC ICPE ELECTROCOND TECHNOLOGIES SA
SC ELECTRICA SA SC LUXTEN LC SA
SC ELECTRICOM SA OET OBEDINENI ENERGINI TARGOVTSI
SC ELECTROMAGNETICA SA SC PETPROD SRL
SC ENERGOTRANS SRL SC RENOVATION TRADING SRL
SC ENERGY DISTRIBUTION SERVICES SRL SC TINMAR IND SA
SC EFT ROMANIA SRL SC TRANSENERGO COM SA
SC ENERGY HOLDING SRL SC TOTAL ELECTRIC OLtenia SRL
SC ENERGY NETWORK SRL SC UCM ENERGY SRL
SC ENEX SRL

Source: - ANRE
## Energy unit conversion table

### Conversion factors

- **Terawattour:** 1 TWh = 1 Mrd. kWh
- **Gigawattour:** 1 GWh = 1 Mio. kWh
- **Megawattour:** 1 MWh = 1.000 kWh

### Units for energy and power

<table>
<thead>
<tr>
<th>Unit</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joule</td>
<td>J</td>
<td>for energy</td>
</tr>
<tr>
<td>Watt</td>
<td>W</td>
<td>for power, current</td>
</tr>
</tbody>
</table>

1 Joule (J) = 1 Newtonmeter (Nm) = 1 Wattsecond (Ws)

### Cross rates

<table>
<thead>
<tr>
<th>Cross rates</th>
<th>PJ</th>
<th>TWh</th>
<th>Mio t SKE</th>
<th>Mio t ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Petajoule</td>
<td>PJ</td>
<td>1</td>
<td>0.2778</td>
<td>0.0341</td>
</tr>
<tr>
<td>1 Terawattstunde</td>
<td>TWh</td>
<td>3.6</td>
<td>1</td>
<td>0.123</td>
</tr>
<tr>
<td>1 Mio t black coal (unit)</td>
<td>Mio t SKE</td>
<td>29.308</td>
<td>8.14</td>
<td>1</td>
</tr>
<tr>
<td>1 Mio t crude oil (unit)</td>
<td>Mio t ROE</td>
<td>41.869</td>
<td>11.63</td>
<td>1,429</td>
</tr>
</tbody>
</table>
Untapped Wind markets in the EU

The graph above shows that Germany and Spain already use wind-power quite extensively.

<table>
<thead>
<tr>
<th>Country</th>
<th>Wind Energy Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania</td>
<td>0.30%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>0.40%</td>
</tr>
<tr>
<td>Hungary</td>
<td>0.35%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.39%</td>
</tr>
<tr>
<td>Poland</td>
<td>0.44%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.45%</td>
</tr>
<tr>
<td>Austria</td>
<td>3.28%</td>
</tr>
<tr>
<td>EU 25</td>
<td>3.89%</td>
</tr>
<tr>
<td>Germany</td>
<td>7.00%</td>
</tr>
<tr>
<td>Spain</td>
<td>11.76%</td>
</tr>
<tr>
<td>Denmark</td>
<td>21.22%</td>
</tr>
</tbody>
</table>
In terms of density Denmark is the most advanced European market. Wind thereby supplied 21% of electricity consumption in Denmark last year and 7% in Germany, but its share is approximately 30% in the German state of Schleswig-Holstein. In the short term, the installed wind power is expected to grow at a CAGR of 15.3% to 118 GW in 2012. Particularly additions in France and the UK, which enjoy a lot of abundant wind potential growth, will increase. In the CEE area, countries like Poland (planned capacity of 12 GW by 2020) and Romania (potential for 14 GW) have good prospects to utilize energy from wind power.

Romania has a large volume of projects under development, in August 2010, close to 1000MW have been sold. The largest onshore wind park outside the USA has been sold to the Czech energy company CEZ, and has been developed and constructed by a Swedish owned company that can offer a portfolio of projects totalling 2 100 MW.

**What does Romania offer**

- The low risk of an under developed market
- Highest wind power potential in southeastern Europe (2nd place in entire European continent)
- Large unpopulated areas in ideal onshore wind energy locations
- Experienced developers
- Zero Renewable Incentive risk
- Developed open energy market

**Renewable Energy Support systems**

Institutional investors and Banks formerly believed that Government provided Feed-in Tariff subsidies were a better bet than an open market Green Certificate regime driven by the onus of a Quota system placed on energy suppliers.

Spain started the rot by reneging on its laws supporting investment in renewable energy, followed by Germany, Italy and the Czech Republic. In an instant Investor confidence is blown away - from Feed-in tariffs.

The Green certificate "horse" has come from behind and provides, in 2010 and beyond, a more risk resistant platform for investors in Renewable Energy.

**The Winners are:-**

United Kingdom
Sweden
Latvia
Poland
Belgium
Romania
Romania’s Grid Operator to receive a EUR 65 million loan from EIB

The European Investment Bank (EIB) will grant a EUR 65 Million loan to Transelectrica SA to support its medium-term investment programme which includes the modernisation and upgrading of seven electric high voltage stations within the electric transport network, as well as the replacement of the transformers and autotransformers from the high voltage stations.

This is the first direct loan allocated to a partially state-owned Romanian company based on a single signature (EUR 32.5 Million). The rest of the amount will be guaranteed from third party banks. The investment will contribute to optimizing the supply rehabilitation and quality.

The EIB loan covers 50% of the project’s total cost and it is granted on a 15-year period, with a grace period of 2 years. Currently, this is the third credit Transelectrica receives from EIBI resources. The previously granted loans went to investments in the rehabilitation of the transport electric network as well.

A Superior Return in Depressed Times

- Equity IRR > 12.5 – 13.5%
- Initial Dividend Yield 10%
- Revenues start within 60 days of Investment
- Returns do not depend on arbitrary exit value but on cash flows
- Investment per 1 MW Special Purpose Vehicle, EUR 2.5 million
- (EUR 600 000 Equity, EUR 1.9 million Debt Finance)

Hassle-free, pre-packaged investment

- Investment SPV established
- Legal and administrative services – outsourced
- All permits and authorisations – secured
- Power Purchase Agreement and Green Certificate Sales Mechanism – secured
- Land – secured
- Fixed Cost Construction and Equipment Contract – secured
- Guaranteed technical performance warranty/guarantee - secured by Lumen
- All risk insurance - secured
- Finance, 70% of Capital Expenditures, 7 year term, 6.5% interest rate – secured with bank
- Management of all cash flows by bank (Collects revenue from Electricity company, deducts operational expenses and debt service payments and deposits remaining available cash in Investor’s account)
EU Regulatory Framework for Renewable Energy

- It is EU Policy that by 2020 renewable energy represents 20% of all electricity generated in each member state.

- No renewable energy (wind, solar, biomass, geothermal) is economically viable without subsidies, feed in tariffs or green certificate legislation. This is also the case for conventional energy.

- Investment in renewable energy is speeding up throughout the EU
- Compared to surrounding countries Romania lags significantly behind in terms of investment in all forms of renewable energy.
- Romanian Renewable Energy Legislation has recently been adopted.

Solar PV in Romania – Today & Tomorrow

- Current investment in Solar EUR 2m
- Forecast next 5 yrs (150mw) EUR 450 million
- Projects with permits – 2010 35 projects totaling 44mw

Romanian Energy Market

- Romanian energy legislation – Passed into Law on July 7 2010
- Romania has a Green certificate regime in contrast to a Feed-in tariff.
- A feed-in tariff approach has a direct impact on state budgets, which are under pressure.
- Under this legislation, Solar energy benefits from a 50% increase in Green certificates (6/mWh), and an extension of validity to at least 2025.
- Redpoint – Europe’s Leading Energy Consultants
- Redpoint have concluded study of Romanian Energy Market in June 2009, and this has been updated in Autumn 2010.
- Included in study are forecasts for Energy & Green Certificate prices 2010-20
European Energy Regulation
Romanian Energy Market

Green Certificates – Pricing
2010–2025 Pricing forecast
EUR / MWh

-31A-
Romanian Energy Market

<table>
<thead>
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<th>High</th>
<th>Base</th>
<th>Low</th>
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<td>52.8</td>
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Green Certificates - Pricing /MWh

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Solar PV - Energy + Green Certificate Pricing

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<td>2025</td>
<td>366.3</td>
<td>252.4</td>
<td>2248</td>
</tr>
</tbody>
</table>

The best location for Solar Parks in Romania?

- High radiation – southern Romania – higher radiation, higher production
- Low electricity transport costs (Transelectrica)
- Close to medium/high voltage network
- In areas where there is enough spare grid transport capacity
Project Performance Estimates – 2mw Solar Park

Location – Buchilasi, Ploiesti

<table>
<thead>
<tr>
<th>Month</th>
<th>kWh/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>115 000</td>
</tr>
<tr>
<td>Feb</td>
<td>143 000</td>
</tr>
<tr>
<td>Mar</td>
<td>208 000</td>
</tr>
<tr>
<td>Apr</td>
<td>242 000</td>
</tr>
<tr>
<td>May</td>
<td>288 000</td>
</tr>
<tr>
<td>Jun</td>
<td>280 000</td>
</tr>
<tr>
<td>Jul</td>
<td>302 000</td>
</tr>
<tr>
<td>Aug</td>
<td>301 000</td>
</tr>
<tr>
<td>Sep</td>
<td>261 000</td>
</tr>
<tr>
<td>Oct</td>
<td>219 000</td>
</tr>
<tr>
<td>Nov</td>
<td>120 000</td>
</tr>
<tr>
<td>Dec</td>
<td>93 600</td>
</tr>
<tr>
<td>Total for year</td>
<td>2 572 600</td>
</tr>
<tr>
<td>Yearly average</td>
<td>214 383</td>
</tr>
</tbody>
</table>
2MW Buchilasi - 2mw Solar Park
Nominal power of the PV system: 2000.0 kW (CdTe)
Estimated losses due to temperature: 0.8% (using local
ambient temperature)
Estimated loss due to angular reflectance effects: 2.8%
Other losses (cables, inverter etc.): 14.0%
Combined PV system losses: 17.1%

Finance Structure

\[
\text{BANK/LEASING COMPANY} \quad \longrightarrow \quad \text{INVESTOR(S)}
\]
70% Debt Finance / Lease \quad 30% Downpayment / Equity

Operational Structure

\[
\text{BANK/LEASING COMPANY} \quad \longrightarrow \quad \text{SOLAR SPV} \quad \longrightarrow \quad \text{ELECTRICITY COMPANY}
\]
Sale of Electricity
Sale of Green Certificates

\[
\text{SOLAR SPV} \quad \longrightarrow \quad \text{ENERGY INVESTMENTS}
\]
\[
\text{MAINTENANCE & SECURITY} \quad \text{TECHNICAL & COMMERCIAL}
\]

Operational Expenditures
1. Maintenance and Security

2. Technical
   • Remote monitoring of Panel / Inverter performance
   • Remote monitoring of Energy production

3. Commercial

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ROMANIA – EUROPE’S CENTRE FOR WIND ENERGY PROJECTS

Wind Energy

Romania’s potential in wind energy is considered the highest in south eastern Europe. Energy Investments & Finance can offer the following Wind Farm Projects to serious investors.

Invest East's client companies are developing Europe's largest onshore Wind Farm, a 600MW facility, at Fantanele close to Constanta - Development cost - €1.1 bn.

EI & F have placed offers for Renewable Energy Financing in Romania totalling more than EUR 3.7 billion in 2010.

Hydro Electric Projects in Romania

The technically feasible hydro potential is 36 000 GWh/year, corresponding to 11 500 MW of capacity. The economic transition to a market economy means that it is difficult to assess the economically feasible potential, but it is approximately 28 000 to 32 000 GWh/year (9100 to 10 300 MW). So far, about 42 per cent of the technically feasible hydro potential has been developed.

The planned projects were designed before 1990, but insufficient funds are available to begin construction. They include development of the Tisa river through a joint Romanian Ukrainian project (30 MW, 200 GWh/year).

There is significant uprating potential at existing hydro plants: 370 MW through rehabilitation of about 30 hydro units which have low reliability or generating limitations as a result of deficiencies. At present this capacity is considered permanently unavailable, although it is included in the 5912 MW hydro capacity given above. There is an additional potential of 206 MW through the uprating of 14 hydro units, including the Iron Gates plant.

A 1000 MW pumped-storage plant is planned, Tarnita Lapustesti, which will have four 250 MW units. Romania's first nuclear power unit (700 MW) requires a large base load, and a pumped-storage plant was planned to operation in conjunction with it before 1990. However, the start of construction was delayed, again because of lack of funds. Construction of the plant is now planned with the help of an international loan, and Government guarantees.

Micro Hydro Electric Projects in Romania

There are 256 small, mini or micro hydro plants in operation (up to 10 MW), with a total capacity of 332 MW. A further 28 are under construction (70 MW), and 46 are planned (223 MW). Since July 2010, there has been a significant increase in interest in small hydro projects. Permitted projects with a sound technical analysis remain unsold for days rather than weeks.
In East-Central Europe, hydroelectricity already represents a substantial source of power in some countries such as Albania (96% of total electricity generation), Croatia (59%) or Romania (37%). Most of the potential for future hydropower expansion lies in Romania, Bulgaria and Albania, as well as in the former Yugoslav republics. But despite a very large potential for future expansion, as yet, these countries have found it difficult to secure financing for such projects.

**Romania sells 16 hydros in privatization auction**

Government utility Hidroelectrica S.A. in Romania sold 16 small hydropower projects totaling 5.8 mw to three purchasers in a privatization auction.

Hidroelectrica said it received bids totaling 11 million euros (US$16.9 million) for the five groups of small hydro projects.

Winning bidders and their acquisitions include:

- **Wienstrom GmbH of Austria**: Ilfov River Basin group in Dambovita County, consisting of 220-kw Adunati, 140-kw Bratesti, 196-kw Bunget 1, 220-kw Bunget 2, and 182-kw Ilfoveni;
- **Romenergo of Romania**: Suha Mare River Basin group, consisting of 108-kw Gainesti, 241-kw Malini, 548-kw Poiana Marului, 273-kw Suha Mare, and 448-kw Valeni; and Suha Mica River Basin group, 713-kw Slatina and 54-kw Suvarita, all in Suceava County;
- **Consortium of SC H&M Co., SRL Negresti Oas, and SC Lescaci COM of Romania**: Fenes River Basin group in Alba County, consisting of 1-mw Fenes 1 and -mw Fenes 2, and Sovata River Basin group in Mures County, 160-kw Sacadat 1 and 330-kw Sacadat 2. Hidroelectrica said it planned to speed up the privatization process for 86 other small hydros to be sold.

**Solar PV Energy**

PHOTOVOLTAIC POWER PLANTS

Lumen (PL) is one of Europe's most experienced companies in Solar PV Energy and has constructed and operate approximately 140mw of Photovoltaic Power Plants with a combined capital investment value of EUR 500 million.

**Geothermal Energy in Romania**

Exploration for geothermal resources began in Romania in the early 1960's, arising from a hydrocarbon research program, which, as an unexpected benefit, also identified some promising geothermal areas. Within these areas, over 250 wells, drilled to depths between 800 and 3,500 m, showed the presence of low enthalpy geothermal resources. Completion and experimental exploitation of over 100 wells during the past 25 years has enabled evaluation of the exploitable heat available from these geothermal resources. Proven geothermal reserves in Romania are currently about 200,000 TJ for 20 years.
Geothermal Energy in Romania

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The main Romanian geothermal resources are found in porous and permeable sandstones and siltstones (for example, in the Western Plain and the Olt Valley), or in fractured carbonate formations (Oradea, Bors, North Bucharest).
OPPORTUNITIES FOR GREEN CONSTRUCTION

Energy Efficient products, material and technology in Romania and the Central Eastern European region

Executive Summary

Mandated European Union commitments, improving government capability, and increasing interest of leading investors, real estate developers and tenants/occupants’ in achieving greater energy efficiency and environmental responsibility have contributed to a significant increase in the market for green construction in Romania and the surrounding region. Opportunities exist to take a market leadership position for products, materials, technologies, expertise and other service providers across all aspects of the green industry. The need for improved energy efficiency, water efficiency/quality, recycling/waste management, or the marketing and development of solar or wind energy systems, energy efficient geothermal HVAC systems, low-VOC chemical products and other green construction solutions present a significant opportunity for Romania and for the region.

Introduction

Within the recent past, the following trends have converged to create significant opportunity for “green” development - including construction and eco-efficiency - in Romania and the surrounding region:

- increasing competition for existing fossil fuel reserves and falling (or eliminated) energy subsidies and the resulting rising energy prices
- unprecedented international political and business enthusiasm and demand for securing reliable sources of energy, reducing dependence on unstable suppliers of oil and combating climate change.
- scarce natural resources leading to significantly higher prices for a variety of construction inputs
- demonstrated investor interest in green building certification
mandated green procurement targets currently implemented

- falling prices for eco-efficient building solutions

- significant EU Funding for sustainable development (4.5 Billion Euros allocated between 2007 and 2013 for Environmental initiatives in Romania alone) and a general allocation of 30 Billion Euros to Romania for "Structural Funds" to improve infrastructure, competitiveness, governance, etc.

- greater willingness of financial institutions to consider total life-cycle costs in approving project financing

- relatively recent introduction of mortgage lending and other forms of construction financing that makes available more purchasing power when planning and designing homes and buildings for better energy efficiency.

- implementation in Romania and other member states of the mandatory European Energy Performance Building Directive (EPBD) requiring energy certification for new (2007) and existing (2010) buildings

These trends have converged to create a unique opportunity in developing regions, particularly Romania, where needs for rapid solutions and immediate improvements are critical to long term sustainability and competitiveness.

The need for cost-effective, energy-efficient green development in Romania is uniquely suited to innovative businesses and construction firms, who have pioneered the development of the green industry and the institutionalization of green practices within government agencies, public institutions, and throughout the design and construction industry.

There are at least six real estate developers constructing buildings using either the US Green Building Council’s LEED certification or the Building Research Establishment's BREEAM standard. Importantly, Large U.S. and European Real Estate Funds have begun funding buildings in Romania conditioned on achievement of one of the aforementioned certifications. In addition, all building owners/developers will be required to produce, at time of sale, an energy certificate that indicates the results of an energy audit.

As noted in many real estate development journals, Romania has been and is projected to be a strong performer in the central and eastern European region because of the size of the Romanian market (22 million), its strategic location, the projected new construction (500K to 800K new housing units) and renovation to replace substandard apartment blocks and because it represents a platform for the region... including Bulgaria, Moldova, Ukraine, Georgia, Serbia, etc., where similar problems exist.
Market trends for construction market opportunities in Romania

- Strong growth in GDP – 8.5% Q1 2008; 6% projected for 2008 Growing presence of international manufacturers of construction materials
- The construction market had significantly accelerated growth, ROI yields were higher than in other West-European countries, attracting investors from Israel, Spain, Greece, Turkey, Germany, Austria, UK, USA, Canada, etc,
- 33.6% construction growth for 2006, the highest growth of all UE countries (12.6% more than Poland and 10.9% more than Sweden) according to Eurostat sources
- 25% construction growth in 2007 representing 1.59 billion euro in the construction investments (47% representing commercial space and 37% office space)
- For the overall construction market, 2008-2009 was slower considering global economic events and new stricter lending conditions announced by the central bank. Nevertheless, strategic companies are continuing with planned investments with green RE developments increasing six fold from 2007.
- Alignment of Romanian codes and practices with EU requirements ( currently the European Commission is further strengthening its energy efficiency targets for all member states)
- Not enough experience (and experienced personnel) in the implementation of large construction and infrastructure projects that utilize higher performing solutions.

Complexity of the problem

In general, the primary environmental problems in Romania are of a systemic nature. Energy or manufacturing production and consumption is related to building performance, air quality, water quality, waste management, and noise pollution. The inefficiency of centralized heating and power systems, and the aging infrastructure and building stock across all industries in Romania is well documented. Furthermore, the inter-relationships of the problems are complex, and coordination of improvements or changes between related systems has not been consistent. Consequently, significant environmental improvements may require systemic solutions as well as synergy across a number of environmental concerns. Improvements to energy production or consumption may need to be combined with improvements to buildings, waste management systems, water quality systems, noise reduction measures, or air quality systems in order to create sustainable improvements in Romania.
Therefore, the "professionalization" of many industries is needed in order to develop systemic approaches to development and construction practices. An opportunity exists for training-service providers for training and educational development, as well as engineering and equipment controls services, funded by EU structural funds (where human resource improvement via training is a priority target for funds). There is also funding available for implementation of solution for renewable energy production.

Considering that Romania has to fulfill its commitments to the EU in the area of Renewable Energy Sources (RES) - assuring that by 2010 33% of the total energy consumption in Romania will be produced by renewable energy sources - there are significant opportunities in the market for RES. Public authorities estimate that by 2015, 2.7 billion euros will be spent for RES.

The public funding that will be available in the next year will be spent mainly on projects related to:

- water quality and infrastructure
- reducing air pollution
- implementing efficient waste management systems
- rehabilitation of existing district heating units
- alternatives for district heating (there are plans for replacing the Large Combustion Plants with smaller and more efficient units)
- production of energy out of RES
- biodiversity
- protection of natural areas

Opportunities for immediate improvement

As has been noted by multiple sources, although policies are in place by various funding sources to encourage collaboration and synergy, the administrative and cultural aspects of creating collaborative teams and synergistic solutions for large-scale systemic problems are complex. Therefore, an intermediate measure, particularly for the current boom in building construction, may be the implementation of smaller-scale green construction practices which may over time develop synergy and create precedents for future construction. In short, a successful demonstration project may be the best approach to encourage significant change towards greener development.
Green Construction Opportunities

The following are opportunities resulting from green construction practices as promoted by BRE International using the BREEAM standard, the US Green Building Council using LEED as its primary assessing tool, and the Romania Green Building Council (RoGBC) that is promoting the comprehensive implementation European Performance for Buildings Directive (EPBD).

Energy efficiency:

- **Lighting**: The energy-efficient lighting industry - 1. Energy efficient lamps; 2. Energy efficient and lighting-efficient fixtures; 3. Energy efficient and lighting efficient lighting systems (coordination with day lighting and task lighting). – is currently under-represented and under-serviced in Romania for all except the biggest clients utilizing a direct contract with the biggest global suppliers. Starting in 2007, the EU encouraged all member governments to promote the use of energy efficient lighting and to be proactive toward all domestic lighting. However, the subject of modern lighting is complex, and affords service providers the unique opportunity to provide services and consulting for lighting design and planning for commercial applications, consulting and training for construction and facilities personnel, in addition to simply selling units. However, the industry in Romania is mainly composed of retail outlets selling standard units and offering no services. An opportunity exists for sophisticated firms to provide advanced services for the entire region, or to establish manufacturing facilities. Barriers to entry include lack of awareness and costs of installation or maintenance. However, EU backing is creating greater awareness of the issue.

- **Energy Efficient Motors and Variable Speed Drives**: It is estimated by the International Institute for Energy Conservation (IIEC) that 50% of industrial energy consumption [in Romania] is used by electric motors driving pumps, fans, and compressors. Due to the fact that many of the existing motors are either over-sized or over 15 years old and under-maintained, an opportunity exists for manufacturers, suppliers, and service-providers to market products and services for new construction, renovations, equipment replacement, and training for equipment maintenance and controls. Effective use of equipment and variable speed drives (to replace older equipment) has resulted in significant reductions in energy usage and cost savings for both governmental and industrial applications. Due to growing EU emphasis on energy efficiency, increasing energy prices, and growing public awareness of the issues, demand for effective products and services is increasing, and funding is available to create cost-effective solutions and incentives. Further, the amount of aging equipment still in use, the increasing demand for energy efficiency, and the current construction boom, presents a unique opportunity for product and service providers in Romania. The US Dept. of Commerce indicates the largest opportunities for US firms are in consulting, engineering, management software, control equipment and other specialized hardware.
- Tubular Day lighting Devices: An opportunity exists for the marketing and manufacture of tubular day lighting unitized systems in Romania, for single story and low-rise buildings to supplement the use of conventional fluorescent light fixtures. Whereas this technology is well-developed and documented in the US for many mid and low-rise commercial and residential applications (and represented by very few manufacturers), this technology is currently under-developed in Romania and the region. The dominance of mid and low-rise development throughout the region, and the dominance of traditional unitized fluorescent systems, and the criticality of energy efficiency across Europe, makes this energy efficient technology particularly relevant and under-utilized in Romania. Entry barriers include: lack of awareness, and lack of products in the market. EU funding is available to create incentives and offset costs.

- Insulation: Opportunities exist for the introduction of materials and competition into the insulation market in Romania, including: various forms of finished or unfinished foam insulation, aerated concrete, insulative concrete materials, insulated panelized wall and roof systems, and insulated wall systems to be applied over the existing typical concrete (or concrete frame) construction. Advanced products or systems are under-represented in Romania and the region, or insulative material markets are dominated by a few firms who have established local manufacturing facilities. Barriers to entry include additional construction costs over typical poorly-insulated construction methods, lack of awareness of the importance of insulation, "traditional" communist-period construction methods, and lack of experience regarding effective design of roof and wall systems for insulation and moisture. Additional opportunities exist for service providers regarding training and expertise regarding effective construction methods for insulation. EU funding is available to offset costs for additional costs for insulation or insulative systems for energy efficiency.

- Moisture: Due to the dominance of "traditional" communist-period construction practices, and lack of sophistication regarding the control of moisture, vapor retarders, and thermal separation, opportunities exist for sophisticated construction and design firms experienced with design and construction methods for climate sensitivity and the control of moisture. Control of moisture is a significant problem in ex-communist Europe due to the dominance of concrete structures with poor insulation and poor detailing for control of moisture and thermal separations. Consequently, many "period" buildings show significant signs of deterioration resulting from moisture. Furthermore, many structures currently under construction utilize many of the "traditional" construction practices, with little attention paid to control of moisture, effective insulation, and effective thermal separations. Energy efficiencies resulting from effects.
Whereas good practices can ensure long-lasting, efficient buildings; lack of such practices can cause buildings with short life spans and quickly deteriorated performance, causing further wastes in energy and materials. Opportunities exist for materials and service providers capable of providing expertise or systems for effective control of moisture. Barriers to entry include lack of awareness or importance of moisture control in buildings, and additional costs of materials or installations. However, funding is available for firms capable of demonstrating cost savings effects or energy efficiencies resulting from effective construction practices.

- **Green Roofs**: An opportunity exists for provision of retrofit or new green roof technologies or systems for reduction of solar gain on new and existing roofs. Provision of green roof materials (high-reflectance roofing materials) or green roof systems (plant materials on roof) for shading can assist reduction in municipal runoff levels and improved air quality / natural filtration. Green roof systems are a very old and widespread technology in Europe, particularly Germany, and some sources indicate as much as 10% of roofs in Germany utilize a green roof planting system, with approximately 70% growth in the German market since 1994. However, this technology or market is under-developed in Central and Eastern Europe, and the proliferation of concrete construction in the Romania presents a potentially ideal substrate for this technology, as well as a potential for coordination with various horticultural or unique entrepreneurial opportunities. Due to the well-documented use of this technology in Germany, EU funding is possible to offset costs and provide incentives for developers.

- **Photovoltaics** – Europe is the fastest growing market in the PV industry. Currently approximately 48% of European photovoltaics are supplied from Japan. An opportunity exists to establish the manufacture and implementation of photovoltaics under license on a variety of scales in Romania, for use by individual or commercial/institutional consumers, to capture a portion of the European market. Barriers to entry in central and Eastern Europe have been training, awareness, costs, and investment; however costs and investment can be offset by EU funding sources to make this venture attractive. Note that whereas the local market for PV may not be attractive at the current time, Romania could be suitable as a base for export to other markets.

- **Solar water heaters**: An opportunity exists for off-the-grid building and water heating: to reduce or eliminate load on LCP. Average EU growth rates in this market of approximately 13%, with significant adoption in Austria, Germany, and Greece, and mandatory use in Spain since 2005. However, despite significant market growth and widespread utilization in Europe, this opportunity is significantly under-developed in Romania, especially for medium or large or multi-unit installations by sophisticated firms.
- Reduced solar gain on glass: retrofit awnings and horizontal or vertical exterior shading devices for reduced solar gain on glass surfaces and improved energy efficiency in existing and new buildings – opportunity potential throughout the European market with little introduction in central and eastern Europe by advanced manufacturers with integration capability with smart-home technologies. Although reduction or prevention of solar gain on glass has been well-documented as a primary strategy for energy efficiency, few sophisticated exterior shading systems are currently available. Barriers to entry include lack of awareness, lack of products on the market, and costs of installation.

- HVAC: An opportunity exists for retrofit solutions for interior or exterior stack ventilation systems for existing buildings to improve natural ventilation, reduce building energy consumption, and reduce reliance on wall AC units. Due to the extent of existing mid-rise, poorly-cooled buildings throughout ex-communist Europe, market potential exists for a creative entrepreneur or manufacturer able to adapt existing technologies or strategies to this problem. Entry barriers include lack of awareness, costs of modification, lack of trained personnel, and the complexities of building ownership for residential apartment buildings (or “blocs”). However, EU funding is available to offset installation or modification costs to make this venture attractive. For new construction projects or a major renovation of existing buildings, complete HVAC system that use the ground, water and/or air as a “heat sink” and/or the agent to insure a constant temperature for the living area while exchanging the air can present a welcome addition to the local market.

Water efficiency and quality:

- Water efficiency is not just about selling toilets or pipe in the Romanian marketplace. The European Commission reports in the EU Water Initiative, that "In most developing countries, rural economic growth is critical for overall economic growth", and that in rural areas “the poorest and most vulnerable rural dwellers are particularly sensitive to lack of [clean drinking] water.” The EU Water Initiative, in place since 2002, encourages all member governments to develop or improve system-wide management practices for water efficiency and water quality as a primary strategy for development and the fight against poverty and disease. Improvement to water management in Romania is critical to long-term growth and development overall. Opportunities exist for manufactures and service providers of all aspects of water management, distribution, treatment, and domestic fixtures to enter the market, promote awareness of the issues, and provide improved products and services and professionalization of the industry in Romania.
Although typical low-flush or dual-flush toilets and some applications for "green" residential products may be on the market, and although some measures for water treatment have been implemented in Romania, significant coordination of water management and "green" strategies is lacking, and an opportunity exists for manufacturers and service-providers to take a critical leadership role in promoting (and developing) successful and coordinated water management practices in Romania, and throughout the region.

- Opportunities exist not only in urban areas, for district-wide improvements and services, but also in rural areas, to provide products and services for on-site management, treatment, distribution, or collection systems, as well as water-efficient fixtures. Products and services for specific technologies include: Low-flush toilets, waterless urinals and automatic fixtures, retrofit/replacement of existing fixtures, rainwater / gray-water collection and distribution systems for new and retrofit conditions, technologies for improvements to municipal water systems, and on-site filtration and treatment technologies or strategies. Barriers to entry include costs of retrofit or installation (compared to maintenance of current systems), awareness of the issues, and awareness of solutions. However, EU funding is available to offset costs for improved water efficiency or quality.

**Waste Management / Recycling:**

- Recycling is not just about used bottles and newspapers. The European Commission’s Waste Framework Directive (codified and in force since 2006), states that “the essential objective of all provisions relating to waste management should be the protection of human health and the environment", and that poor waste management and disposal "may affect the quality of the environment and the smooth operation of the internal market.” Recycling and effective waste management is necessary for long-term economic growth in Romania.
Article 3 of the Directive mandates that all member governments take actions to prevent or reduce waste, and develop strategies of recycling, reuse, and reclamation. However, recycling and effective waste management is a significant and well-documented problem in Romania, and although there is awareness of the issues by the public and officials, a lack of coordinated waste management persists. In addition, green building certifications reward best practices in construction waste management. Consequently, an opportunity exists for manufacturers and service-providers to take a critical leadership role in promoting and developing successful and coordinated recycling and waste-management practices in Romania, and throughout the region. Barriers to entry include costs of installation or implementation of management practices, and lack of awareness of impact on environmental quality. However, funding is available to offset costs and to provide financial incentives.

Opportunities exist for the introduction of recycling processes and strategies, equipment, recycled-content materials, and professionalized recycle/salvage services across all industries, including paper products, glass products, steel products, concrete products, rubber products, wood products, and plastic products.

Additional opportunities exist for provision of engineered wood products and forestry practices for introduction of "alternative" light-gauge and energy efficient construction practices to the region.

Additional opportunities exist for the provision of improved road-building technologies and engineered geotextile materials for improved road performance, retaining wall or landfill applications, and reduced maintenance costs.

Low-VOC materials:

The European Chemical Policy (REACH), finalized in 2006, aims to protect human health and environmental quality while maintaining competitiveness and as documented by many sources, prior to 1989, Romania was a leader in the chemical industry in central and Eastern Europe; however, due to lack of investment, many sub-sectors in the industry in Romania have vanished. A report by UN/ECE dated 2000 states "Potential partners [and opportunities] may be found among the chemical firms that already exist in many sub-sectors of the industry, including basic petrochemicals, pharmaceuticals, polymers and plastics, fibers, fine chemicals, paints and varnishes and a host of other products." An opportunity exists for manufacturers and services providers in the chemical industry to develop sustainable and low-VOC technologies for European or international markets. Entry barriers include costs of development and consequent higher product costs; however, EU funding is available to offset costs and provide incentives.
Specific to construction, opportunities exist for entrepreneurs to develop various petrochemical, polymer, plastic, fiber, paint, varnish, sealant, and adhesive products for construction applications, including for compliance with current low-VOC standards.

Both leading green building certifications reward the use of low (or no) VOC paint and other applications listed above.

Conclusion

As indicated above, there are numerous opportunities to enter the Romanian and surrounding market for green products, services, and technology. On the ground experience in construction and other industries has demonstrated that the local market – after reasonable awareness building efforts are made - readily adapts to superior solutions that can demonstrate return on investment. Significantly higher energy costs and mortgage financing has encouraged longer term planning in design and equipment with particular regard to energy efficiency.
Kontakti

Triglav – Carpati Slovenian-Romanian Business Club

Majda Grgič

majda.grgic@tc-club.ro
majda.grgic@gmail.com

M: + 40 729 916 518