E&P Ventures in the Eastern-Central Europe Transformation States after 1989 – a Review of Expectations and Results

*By H. DOBROVA, E. KOLLY and U. SCHMITZ**

Abstract

Following the breakup of the communist era, Eastern-Central Europe's transformation states had initiated E&P licensing processes, inviting non-state, western oil companies to apply for license rights. Offers ranged from reconnaissance to EOR license rights. Oil companies and government authorities expected the new era to yield success, for a variety of reasons. The opportunities offered attracted in particular and increasingly independent and niche-player companies. E&P activities were particularly successful, in terms of having discovered economically viable oil and gas reserves and having achieved incremental production, in Poland, Lithuania, Hungary, the Czech Republic and Romania. Newcomers were involved in the latter four countries. Field reserve sizes, both for oil and gas, are moderate to small; such fields are also expected to contribute mainly to future reserve replacement of the region. The involvement of small-size companies, which have found the means to also make smaller fields economically viable, will support this.

Introduction

Upon the breakup of the communist regimes, the majority of the Eastern-Central Europe (ECE) states initiated fundamental socio-economic changes. That majority group was soon perceived as the group of transformation states. Those states, essentially, had manifested their intention to abolish controlled economic practices and had initiated new, appropriate processes. Their energy industries, and in particular the oil and gas sector, had begun to establish the new processes at an early stage of the new era. Consequently, at that early stage, the international oil community's attention was attracted by the region's potential oil and gas opportunities [1].

Fig. 1 The ECE states, with E&P licensing status, as of early 2002

The ECE region comprises 21 states (Fig. 1). All of them, apart from four, produce oil and/or gas. The four non-producers are Estonia (although having an appreciable production from oil shales), Bosnia, Moldova, and Macedonia. Many of the countries look back on a long lasting period of oil production [2], such as Romania [3] and Poland [4]. From the reserves and production tables (Table 1, Figs. 2, 3) it is obvious that the traditional producers of the region still contribute the main bulk of the volumes.

The comparison with other defined regions places this region in terms of total production and reserve volumes at the very bottom of the global ranking, both for oil and gas, and both for reserves and production [5]. For oil, the shares represent 0.5% of the global production and 0.2% of total reserves. The

*Dr. Helena Dobrova, IHS ENERGY, Geneva, Switzerland (, Etienne Kolly, IHS ENERGY, Geneva, Switzerland, Dr. Ulrich Schmitz, LO&G Consultants, Essen, Germany. Review compiled from oral presentation H. Dobrova at the 20 February 2003 Bucharest Geoscience Forum and from poster presentation H. Dobrova & U. Schmitz at the 28 April 2003 Celle DGMK Annual Spring Conference.

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shares are 1.0% each for gas production and reserves.

In the early days of the deep-rooted changes there was a feeling that a new age was about to dawn, and both oil companies and transformation states authorities were confident that there was a scope for improvement in ECE's E&P sector. The improvement was expected to hold true for all factors governing economic success in E&P [6], i.e potentials, costs, terms and market issues.

The main aim of this paper is to analyse the expectations of both the state authorities and foreign companies and to review the results achieved so far. To investigate the reasons for the mismatch between expectations and results and the underlying successes and failures obviously requires (1) to take into account the regional petroleum geological setting, (2) to analyse the offers made by government authorities, (3) to assess the resulting companies' activities, and (4) to correlate with the underlying company strategies.

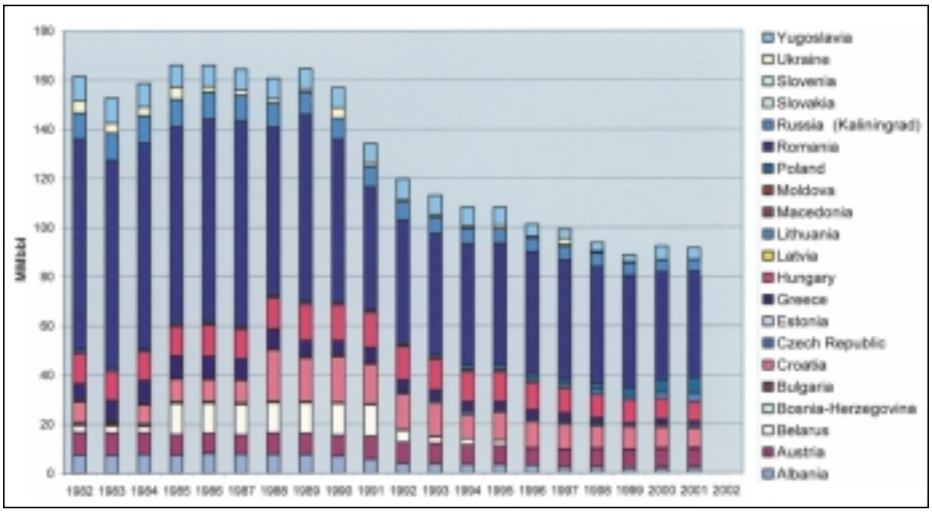

Fig. 2 Liquids production of the ECE States, from 1982 to 2001

1 Petroleum Geology of the Region

Upon the opening of Eastern-Central Europe, a wealth of data was made available to the public in most of the countries concerned. The first compilation, pointing the way ahead in this respect, was the oil geology review of the major producing countries published in 1994, edited by B. Popescu, and sponsored by Petroconsultants (now IHS Energy) [2]. Later publications of significance and of fundamental interest were thematically oriented, their themes ranging from thrust belt geology [7] to improved drilling techniques [8].

1.1 Regional setting

Eastern-Central Europe is not a geographic/geological coherent entity but consists of several major features (see Fig. 6). The region is subdivided into two different mega-tectonic complexes: the northeastern East European Platform, and the southwestern complex which is mainly dominated by the Carpathian and Dinaride/Albanide/Hellenide fold-thrust belt (FTB) units. They are separated by the deep-seated northwest-southeast trending Tornquist-Teysseire Lineament.

The two mega-elements are characterized by further subdivision. The southwestern element is evidently less uniform, i.e. next to the fold-thrust belts – and their foredeeps – massifs together with highs, and basins of different type and age are developed. The most prominent subunits of the northeastern element are the Baltic Basin ("Syneclise") in the north [9], and the Pripyat-Dniepr-Donets Graben in the southeast [10]. The latter, trending northwest–southeast, is flanked to the northeast by the Voronezh High, and to the southwest by the Podolian Massif.

As far as the fold-thrust belts' subdivision is concerned, they have in common the separation into inner and outer FTB units. Of these, the outer belts show similarities as to thrusting, section stacking and overriding foreland sediments. Along the strike, the fold-thrust belts show local differentiation, with Albania representing an appropriate example [11]. The foreland basins which are associated with the foldbelts vary in width, depth and time of basin fill.

Complementary features within the southwestern complex, next to the FTB units, are: (1) The Northwest German – Polish Basin in the northeast, that takes up the area between the East European Platform and the Carpathian Foredeep and the Bohemian Massif areas [4]. (2) The Pannonian Basin system in the central part, which is encompassed by the Carpathian and Dinaride foldbelts and which extends across several countries, particularly covering the Hungarian territory [12]. (3) The Transylvanian Basin in central Romania which replaces the Pannonian Basin towards the southeast [3]. (4) The smaller-size features of the southern sector, which are the Crimean extension of the Caucasus foldbelt, the Romanian/Bulgarian Moesian Platform, the Bulgarian Balkan mountain range, and the Rhopode Massif.

Obviously, the Eastern-Central Europe regional setting results from a fairly complex geologic history. Particularly, since its two mega-tectonic elements developed differently. The geologic history of the East European Platform sub-basins has been reviewed, in terms of plate tectonics, by Leighton & Kolata [13], Kanev et al. [14] and Kabyshev et al. [10]. The southwestern, FTB dominated complex, which essentially is a part of the Peri-Tethys, has comprehensively been dealt with by the Peri-Tethys Memoir, edited by Ziegler & Horvath [15] and by the Mediterranean Basins compendium of 1999, edited by Durand et al. [16].

1.2 Key hydrocarbon systems and plays

The complexity of the regional setting is reflected, in terms of petroleum geology, in the large number of significant hydrocarbon systems and plays. The characteristics of the key systems may be summarized as follows:

– The Baltic Syneclise, dominating the northwestern part of the East European Platform, yields oil production from Early Paleozoic reservoirs [9]. The hydrocarbon system of this oil province, the Early Paleozoic hydrocarbon system, owes its efficiency to Late Ordovician and Early Silurian intra-shelf source shales [14]. The basin obviously is provided with a limited number of viable, i.e. economically sized traps. Produced and remaining proven recoverable reserves are in the order of magnitude of 500 million boe [17]. Undiscovered re-

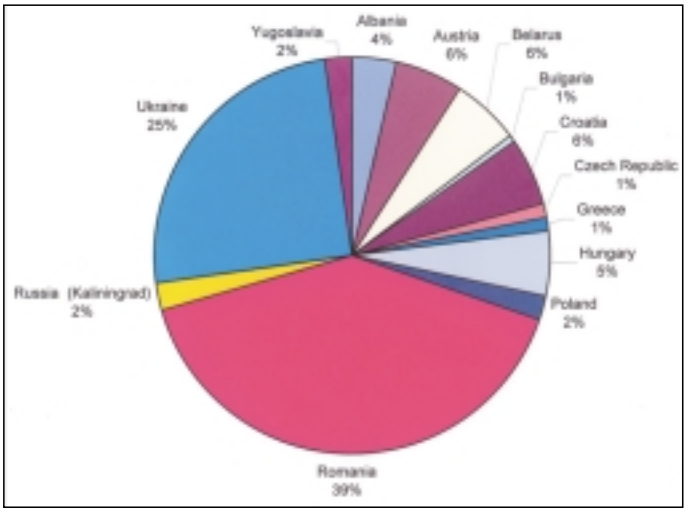

Fig. 3 Liquids Recoverable Reserves of the East-Central Europe States, as of End 2002

Table 1 **Oil and gas cumulative productions, remaining reserves and recoverable reserves (EUR) of the ECE states**

	P+P Recoverable Reserves		Cumulative Productions		P+P Remaining Reserves	
	Oil (MMB)	Gas (BCF)	Oil (MMB)	Gas (BCF)	Oil (MMB)	Gas (BCF)
Albania	569	1.168	317	369	252	798
Austria	903	4.198	788	2.732	115	1.466
Belarus	889	257	435	154	453	102
Bosnia-Herzegovina	0	0	0	0	0	0
Bulgaria	121	375	61	162	59	212
Croatia	888	3.818	690	924	198	2.894
Czech Republic	176	664	37	200	140	464
Greece	152	144	111	97	41	47
Hungary	845	10.115	652	6.997	193	3.122
Latvia	4	0	0	0	4	0
Lithuania	61	10	19	0	42	10
Moldova	3	15	0	9	2	6
Poland	349	15.641	167	6.929	182	8.712
Romania	7.153	48.343	4.439	26.896	2.719	21.708
Russia (Kaliningrad)	346	57	210	22	135	35
Slovakia	58	1.484	28	1.189	30	295
Slovenia	8	62	6	37	1	25
Ukraine	3.998	88.121	1.507	50.651	2.491	37.470
Yugoslavia	378	1.464	261	604	116	860
TOTAL	**16.898**	**175.936**	**9.729**	**175.936**	**7.174**	**78.228**

sources and EOR measures will likely deliver additional volumes.

– The Pripyat-Donez Graben, subdividing the East European Platform in its central parts, yields oil and gas production mainly from Late Paleozoic reservoirs [10]. The responsible hydrocarbon system is the Devonian-Carboniferous hydrocarbon system, with Late Devonian synrift source shales and Early Carboniferous postrift source shales and coal seams having charged reservoirs primarily of Late Devonian, Carboniferous and basal Permian age. As shown by Kabyshev et al. [10], the mechanisms determining the system and its plays (inversion, migration across faults) lead to limitations in hydrocarbon trapping, both laterally and in terms of prospective section. Less than half of the estimated ultimate recovery (EUR) have been produced until now, which, by the mid-1990's, were about 1200 million b of oil and 1022 billion m^3 of gas, contained in the Ukrainian part [10].
– The North German – Polish Basin, adjoining the East European Platform to the west, is mainly gas-producing; gas charged reservoirs are Late Carboniferous, Permian and Triassic. The charge is from Late Carboniferous paralic coal seams which constitute the source rocks of this Late Carboniferous hydrocarbon system. In Poland, the various plays have been matured through heavy exploration activities (including campaigns for CBM). Current targets are deeper reservoirs, burdened, however, with diagenetically induced deterioration. As of end-1990, the remaining reserves were roughly estimated at 89,6 billion m^3 of gas [4].
– The North German–Polish Basin has, in its Polish segment, also oil production from Paleozoic reservoirs. This, however, is less significant than its gas production. The oil producing levels are mainly Permian, i.e. Zechstein carbonates. The oil charge is from Zechstein basinal shales [4]. Those shales provide the effective source rocks of the Zechstein hydrocarbon system. In terms of areal distribution and potential, the system is of limited nature – yet not fully explored. Additional reefal buildups, flanking the basinal kitchen area, are suggested as being the targets. In 1989, the remaining proven reserves were set at some 13 million b of oil (for the entire Polish Lowlands [4]).
– The southwestern, TFB dominated region is, in its central and southwestern parts, oil and gas productive from reservoirs ranging in age from Early Mesozoic to Neogene. The areas concerned are the Albanides and their overburden, and the Pannonian Basin. They are – partly – charged from Middle/Late Triassic and/or Early Jurassic source rocks [18,19], which are mainly carbonates. Those source rocks determine the Triassic–Early Jurassic hydrocarbon systems. The Albanian carbonates owe their source rock character to the structurally induced platform segmentation of the periadriatic area, having given birth to the Albanian basinal sequence [20]. No potential estimate for the system is available, particularly because the respective traps are suggested as being charged from more than one source rock. The Albanian EUR of 569 million b of oil, with 252 million b of oil remaining reserves (see Table 1), may suggest the order of magnitude to be expected.
– Of the southwestern, FTB dominated region, the Vienna Basin [21], the Czech Carpathian system [7], and the Albanides [18] and Hellenides [22] rely, at least partly, on Late Jurassic–Cretaceous hydrocarbon systems for their oil and gas prospectivity. Whilst in the northern areas the Cretaceous and post-Cretaceous reservoirs are suggested to be sourced from Late Jurassic shales (marls), the Albanides hydrocarbons are suggested to partly derive from Early Cretaceous carbonate source rocks [18] and those of the Hellenides from Late Cretaceous shale and carbonate source rocks [19]. Evidently, a couple of reasons account for the patchy distribution pattern, and hence limited potential, of the systems. In the case of the Eastern Alps and the Northern Carpathians, as illustrated by Ziegler & Roure [23], the Alpine deformation caused a profound disruption of the sedimentary cover, thus controlling the preservation of the Mesozoic section with its Late Jurassic source rocks. As for the systems' hydrocarbon potential, no estimate is available. Basically the same applies as for the above. However, the Vienna Basin, with some 800 million b oil of EUR may suggest the order of magnitude in terms of oil potential at basin level.
– The Early Tertiary hydrocarbon system significantly contributes to the oil and gas reserves and production of the southwestern, FTB dominated region. Production is mainly from Paleogene, yet also Neogene reservoirs. The system is being exploited in mainly frontal FTB areas and their adjoining forelands, comprising the Eastern Alps [29], the Carpathians from the Czech Republic to Romania [27] and the northeastern rim of the Black Sea, including Crimea, being affected by the Caucasus Orogeny [30]. Paleogene, mainly Oligocene deep water shales, are the outstanding source rocks. The hydrocarbon volumes of this system, as estimated by Popescu [27] for the Romanian segment of the Carpathian trend, demonstrate its potential can be an EUR of some 4060 million b of oil. For obvious reasons, the hydrocarbon system is suggested to hold undiscovered reserves. Picha [7], in this context, refers to several spectacular morphostructures along the Northern Carpathian rim, suggested to be charged from shallow marine lateral equivalents of the otherwise deepwater source shales. Popescu [27], in contrast, points to the low success ratio in this play for Romania and the resulting high finding costs.
– The Cenozoic basins of the southwestern, FTB dominated region, host, in their majority, Mid and Late Tertiary gas-bearing reservoirs. The gas is largely of biogenic nature. This holds true for the forelands of the Eastern Alps [24], of the Carpathians from Poland [25] through Ukraine [26] to Romania [27], and for those of the Albanides [11] and Dinarides [26]. The latter merges, in the Adriatic offshore, with the most distal parts of the Po Delta. Additionally, the Vienna Basin [24], Romania's Transylvanian Basin [27] and the Pannoni-

an Basin systems deliver a part of the production of biogenic gas; the latter involving the southeast Slovenian and northwest Croatian [29], eastern Slovak [23] and northwest Romanian [27] territories. The source rocks are Oligocene and Miocene shales, ranging in environment from shallow to deep marine. Peat coal has also been suggested, e.g. in the Albanian Durres Basin [11], to have contributed to biogenic gas generation. In the context of this review, the system is, simplified, referred to as the Late Tertiary hydrocarbon (gas) system. The potential of the system has not yet been fully evaluated [31], particularly owing to the fact that most of the reservoirs have trapped both biogenic and thermogenic gas. It is thought to hold additional substantial undiscovered reserves.

Obviously, numerous other hydrocarbon systems contribute to the prospectivity of Eastern-Central Europe. They are of local nature. Popescu [27] describes 18 systems being effective in the Romanian territory alone. One local system, however, is outstanding: that of the Pannonian Basin in Hungary, where Miocene source rocks delivered substantial oil and gas volumes, having gained anomalously high maturities, reflecting an anomalously high heat flow [32].

2 Expectations

2.1 Authorities' expectations

Fundamentally, the authorities' expectations were focussed on two issues: the increase in reserves and production and the increase in state income, as a result of new investments. Consequently, respective opportunities were offered and particular measures were taken to attract the industry's interest:

– By introducing terms and regulations compatible with European standards, and by offering license / participation rights on that basis, authorities expected a substantial commitment from the industry,
– By inviting investments, a sizeable increase in E&P activities was expected to result (1) in increased state income through fee and bonus payments, royalties and tax raising, and (2) in success in E&P, with an effect on the countries' hydrocarbon potential, i.e. reserves were expected to grow, production was expected not to decline any further [4] but to improve, and undiscovered resources were expected to materialize as reserves,
– By establishing and accepting market rules, which particularly would mean deregulation in pricing of oil and gas and unrestricted disposal of production, it was expected to result in competitive conditions, being as attractive as for other hydrocarbon provinces,
– By encouraging competition, as opposed to the former state-governed and controlled activities, an increase in efficiency and a decrease in costs per unit were expected.

The privatization of the state oil and/or energy companies, although mainly politically driven, may also be seen in the context of the authorities' expectations since they, directly or indirectly, also served the above purposes.

2.2 Companies' expectations

Although the companies' expectations, particularly in the initial phase, were based to some extent on an almost irrational, benevolent bias, the companies' analyses of opportunities and eventual entry into Eastern-Central Europe ventures were governed by the evaluation of factors determining economic success. The expectations may consequently be summarized as follows:

– application of alternative approaches, mainly by transferring technology [1], was expected to enhance the region's potential, i.e. its reserves and production,
– replacement of the processes of the controlled economy by those of the free economy was expected to have an effect on costs, i.e. by essentially lowering them,
– introduction of fundamental changes in terms and conditions was expected to result in (part-) ownership of reserves and to make ventures economically viable, and
– acceptance of market forces, which control the price achievable at the well-head, was expected to yield profits.

Relative to the above factors, companies obviously set different priorities, employ different decision criteria and follow different strategies. In addition, priorities, decision criteria and strategies change with time. The resulting difficulty of unequivocally assessing expectations has been overcome in this review by categorizing companies into major, government-controlled, independent and explorer companies, inferring that companies of the same category are governed by similar to comparable priorities and/or decision criteria and/or strategies. For the purpose of establishing categories which reflect the spread of companies active in Eastern-Central Europe, we investigated the respective company involvements: the majority of the companies are small-size local companies, niche players and independent companies, as opposed to large-size companies (utility companies, majors).

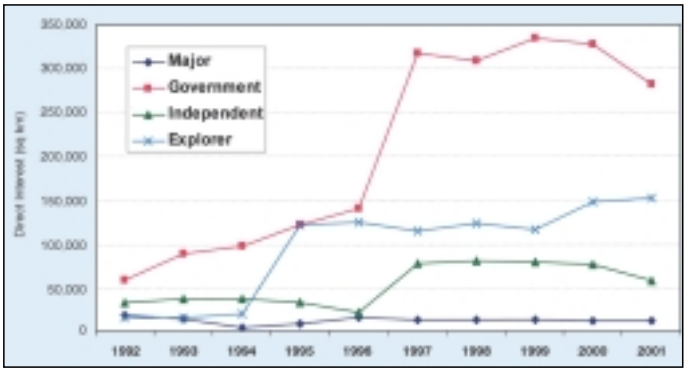

Fig. 4 Net acreage interests in East-Central Europe, by company categories, from 1992 to 2001

3 E&P Activities

Company strategies manifest themselves in the mode of entry into E&P ventures. In case of Eastern-Central Europe, post-1989 opportunities which had been taken up by the companies fundamentally cover all phases of the E&P cycle. They range from performing technical evaluation studies to participating in field rehabilitation. This is illustrated by the following listing:

1. Technical evaluation studies were typically carried out by majors (Amoco: Poland, BP: Ukraine) at or soon after the region's opening for non-state-run E&P.
2. Pre-drilling investigations, generally being undertaken by contractors, were commissioned/sponsored by few oil companies (Sherritt: Poland offshore).
3. Technical assistance/feasibility studies were particularly performed by companies offering regionally or thematically compatible expertise (Dong: Latvia).
4. Farm-ins into E and/or P licenses that were awarded on pre-1989 terms to state companies remained exceptional (BG: Poland).
5. License round offers were pursued most frequently (see Fig. 1).
6. Farm-ins into E and/or P licenses that were awarded on post-1989 terms were concluded at large scale (Fountain Oil: offering farm-ins in several countries).
7. Production ventures attracted foreign companies under very specific conditions (Svenska Petroleum: Lithuania).
8. Rehabilitation projects were initiated mainly where new technologies were expected to deliver incremental production (Premier: Albania).

The key to the understanding of the E&P activities in Eastern-Central Europe, interpreted to reflect particular expectations, is obviously the correlation of company types (categories) with those activities. As demonstrated by Fig. 4, the net acreage holding vs. company category plot reflects an obvious trend, i.e. "Majors" showed little interest, whilst "Independents" and "Explorers" acquired substantially higher shares in the ECE E&P business. Noteworthy, the financial exposure (investments incurred or contractually committed) vs. company category plot shows a similar distribution, yet is not being used owing to the fact that, for obvious reasons, the data set is not as coherent as that for acreage holding.

The fact of increasing dominance of smaller companies in the ECE arena is being interpreted to reflect particularly the expectations of smaller volumes. Such volumes make

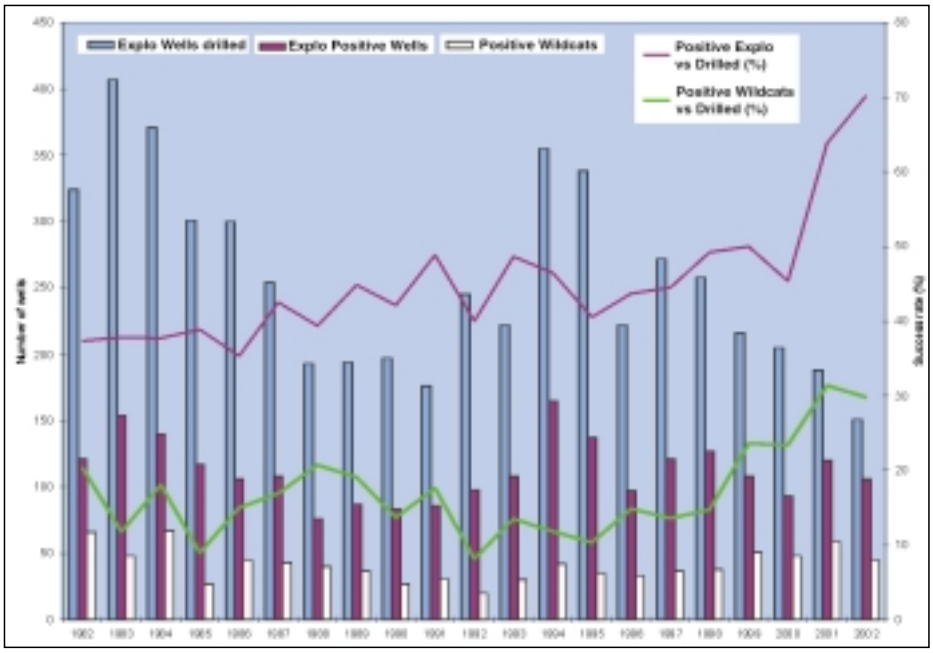

Fig. 5 **Exploration wells in East-Central Europe: number and success ratios by years, from 1982 to 2002**

ventures economically viable to those company categories. Fundamentally, the volumes expected seem to lack attraction for major companies and obviously attract the national companies (as long) as they are owners of the infrastructure, representing different economic scenarios for them.

4 E & P Results

Yardsticks in E&P to measure success (failure), for the comparison of expectations and results, are employed in post mortems. Although those particularly refer to individual wells and/or projects, they are obviously applicable also in the context of this review. The drilling success ratio would be one of those yardsticks. The ECE statistics, however, show that the ratios derived from government sources exceed by far the 15% world average. Critical review suggests that the classifications employed are not according to standards and/or are not uniform, i.e. appraisal and partly also development wells are included in the statistics. Screened statistics (see Fig. 5) still show an above average trend. The trend is interpreted to reflect mainly the drilling of low risk prospects by the national companies after 1989. As yet, the company and government expectations have not been met.

For the same reasons as above, the finding costs and reserves replacement ratios require scrutiny. Additionally it was found that finding costs reflect to a noticeable degree low drilling costs – the Polish drilling campaigns show a good example – and that reserves statistics in this context until now reflect the national companies' drilling for reserves replacement. Consequently, the figures arrived at are not particularly representative.

For the purpose of this review, additional indicators are being used. They are company entries and farm-outs, work and financial commitments, including the preparedness to drill deep wells and/or survey onshore 3D seismic, and the field sizes of new discoveries.

4.1 Failures

In the following, failures are being itemized and are referred to as they occurred at various stages of the E&P activities in Eastern-Central Europe.

1. Pre-studies, at regional scale, were not followed up by acreage acquisition and/or drilling campaigns. The Sherritt project in the Polish offshore, next to proven oil and gas reserves, is an appropriate example.
2. License offers, mainly through bidding rounds, were in many cases not or inadequately taken up by the industry. Examples are the early Romanian round(s) [33] and the Latvian 1st offshore round [34], which required reiteration. Industry reactions resulted from a variety of reasons, they mainly reflected inadequate terms – in not adequately honouring the risks involved –, insignificant financial reward, poor potentials, inadequacy of databases, or, simply, poorly designed offers, such as those of Romania where existing fields at shallow depths were carved out.
3. Pre-drilling and post-dry hole re-assessments in many cases led to an exploration halt and to concomitant farm-out attempts. The Albanian and Polish farm-outs (attempted or concluded) represent good examples as to this. At one point in time more or less the entire Albanian licensed area was on offer for farm-in. Farm-out attempts in particular seem to reflect the mismatch between expectations and results. Mainly, they resulted from revisiting risk assessments and potential estimates. Revisiting processes also addressed missed strategic targets (such as larger volumes) and jeopardized economics.
4. Early relinquishments, assuming almost exodus proportions, affected particular countries, basins, round acreage and plays. Hungary, the Albanian offshore and partly the FTB play represent the respective evidence. The rationale behind that is disappointing results, either dry holes or insignificant volumes. Failures leading to relinquishments range from tests of platform Cambrian prospects in the Polish Lowlands, where seismic "misties" obviously had suggested trap configuration [17], to deep FTB tests, e.g. of the Albanian offshore and of the Romanian Carpathian trend, where seismically defined targets were not met. Typically, major companies took the lead in early relinquishment, such as Chevron and Agip offshore Albania and Mobil in Hungary.

4.2 Success cases

The successful ventures which are reviewed in the following exemplify positive results resulting from activities carried out under the new rules. The selection is not complete. Missing examples may be those from Albania, where companies had acquired production and EOR rights but it is too early to declare them successful ventures.

As far as production is concerned, Fig. 2 shows the relevant trends. Lithuania, in this context, represents a success case. It is explained in section 4.2.5.

It will be noted from the examples that reserve sizes, where available, of the new discoveries are rather small. Possibly one exception from Poland shows higher reserves, yet the preliminary estimates need to be verified (see section 4.2.4). Fundamentally, the success cases demonstrate the growing significance of the involvement of independent and explorer companies. Majors, in expectation of small reserves, reduced their engagements, and are expected to continue to do so.

4.2.1 Romania

In Romania, two successful ventures with participation of foreign partners evolved. Gas production started already or has been announced to be forthcoming.

In the Transylvanian Basin, Wintershall and Romgaz are preparing to put their Sighisoara 3 discovery on production in late 2003. Recoverable reserves are estimated by the operator at 1.8 to 2.5 billion m^3 of gas. The well was suspended as a gas discovery in late 2002 after gas had been tested at a rate of 178,000 m^3 of gas per day from one Sarmatian reservoir interval, with three shallower Sarmatian sections having yielded gas at lower rates. Sighisoara 3 tested an east-west dome prospect located near the town of Sighisoara, in the southern part of the basin. The Transilvania Sud block, which hosts the new gas find, encompasses

fields being held by Romgaz. They are, however, carved out.

Romania's second successful venture with foreign involvement represents a different type of company involvement. In mid 2003, Amromco started production from the first rehabilitated well on the Finta-Gheboaia gas field. The field is located southwest of Ploiesti, on the Oltenia Arch of the Carpathian Foredeep. Production from the Dacian sandy reservoir averaged 109,000 m^3 of gas per day, which is more than the production from the entire field before. Rehabilitation follows a phase of gas production in the field which started in 1963, with a cumulative production of 9.97 million m^3 as of early 1989, from Meotian reservoirs. After their depletion, Romgaz started to produce from Dacian reservoirs by nine wells, at an initial low flow rate to keep the wells clean of sand. Recoverable reserves of the 1400 m deep Dacian reservoirs were estimated by Romgaz at 0.8 million m^3, in 1989. Recoverable packers, to separate high cut intervals, jet perforation guns, for high penetration re-perforation, and sand control equipment were announced to be employed for increased recovery.

4.2.2 Hungary

Upon contract awards of E&P license rights covering several sub-basins, one block eventually delivered positive results. Gas was tested and the discovery was put on-stream in mid 2003.

In the Somogy–Drava Sub-basin, located in the central part of the Pannonian Basin near Lake Balaton, El Paso successfully tested the Torokkoppany structure by the end of 2001, after having drilled two dry holes on the same license, i.e. on the Igal block. The well, Torokkoppany 1, was drilled to a total depth of 771 m in the Miocene, probably in the Karpatian. It tested 166,000 m^3 of gas per day below 525 m from Sarmatian limestones and some gas also in the 652–662 m interval. Later re-perforation of the lower section yielded 237,000 m^3/d. No reserve estimates have been released by the operator. An order of magnitude of 840 million m^3 appears to be a reasonable assumption.

4.2.3 Czech Republic

The Czech E&P activities in partnership with foreign companies focussed on the oil and gas producing basins in the southeast, i.e. the Molasse-type and Vienna basins which straddle the border with Austria. The two drilling successes were achieved on an already tested structure and next to a large field, respectively.

On the south-eastern slopes of the Bohemian Massif, which is on trend with the Austrian Molasse, the subthrust Nesvacilka Graben had initially been drilled by the Krumvir 1 wildcat which was plugged & abandoned in 1989 at a total depth of 3559 m with a stuck pipe. In 1998, the MND/Ramco group drilled Krumvir 2 and made an oil and gas discovery. Light, low sulphur oil was tested at rates of 750 bpd on a restricted 14/64″ choke from a 30 m gross section of Paleogene sandstones. The group pursued the trend, upon re-entering the first well. Designated Krumvir 1R, the well was deepened by MND / Ramco, in 1999, to 3608 m. The re-entry proved gas-bearing Paleogene sandstones, according to the operator. Yet, no reserve estimates are available. The structure is suggested as having been drilled by the 2nd well near the top of the accumulation, reservoir extent and OWC have to be proven by further drilling.

Drilling in the northern extension of the Vienna Basin led to another oil discovery with foreign company participation. In early 2002, the CNS/Geocan/Unigeo/Carpathian group tested the Postorna prospect, related to the marginal Schrattenberg fault zone of the basin. The area, i.e. the Breclav block, is little explored, but it is adjacent and west of the Hrusky oil and gas field which is the largest producer in the Czech Republic. The first well, Postorna 1, was completed as an oil discovery in the Badenian Lab Horizon. The average flow was 25 bpd, with a temporary rate of up to 200 bpd. To evaluate the economy of the find, in April 2002, the well was put on a long-term production test. In mid 2002, outpost Postorna 4 was drilled and it was plugged & abandoned as a dry hole at a total depth of 1570 m. In December 2002, deviated outpost Postorna 5 was suspended as a non-commercial oil well.

4.2.4 Poland

Successful exploration and production activities in the country were related to the drilling of prospects in the Baltic Sea and in the Polish Lowlands, which essentially cover the North German–Polish Basin.

In the Baltic Sea offshore area, i.e. in the

Fig. 6 ECE oil geological setting and selected successful ventures, post-1989

Baltic Syneclise, oil and gas discoveries in Cambrian reservoirs had already been made before 1989, by Petrobaltic, initially a joint venture of the USSR, Polish and German (GDR) state companies. This included the largest B3 field. After 1990, Petrobaltic as a restructured Polish successor company continued E&P activities on the Polish offshore territory, resulting in the first production start up in 1992, producing oil from two wells of the B3 field. By the end of the last century, reserves estimates referring to the Polish sector of the Baltic Sea were at 118.5 million boe. This includes some 8.9 billion m^3 of gas [17].

More recently, in late 2001, Petrobaltic drilled the B5–1 wildcat, which was plugged & abandoned as an oil discovery. The well was drilled to a total depth of 2288 m into the Precambrian. Oil was tested at undisclosed rates from Middle Cambrian sandstones below 1952 m. The well results and 3D seismic interpretation obviously suggested to sidetrack the borehole with the aim to reach the reservoir in a structurally more favourable position. In early 2002, Petrobaltic suspended B4–N1 as a gas well. The well, initially planned as an appraisal to the B4 gas/condensate field, discovered a new gas accumulation, designated B4 North and located northeast of B4, with recoverable reserves estimated by Petrobaltic at 980 million m^3 of gas. The well was drilled to a total depth of 1286 m, having encountered the Middle Cambrian sandstone reservoir. In mid 2002, appraisal B4-2A was suspended as a gas well. On the B6 gas/condensate field, appraisal B6-3 was suspended as a gas well in late 2002.

In late 2002, the Polish national oil company PGNG spudded Lubiatow 1 with targets in the Zechstein Main Dolomite and in the Rotliegend sandstones. The well is located 3 km southwest of the Miedzychod gas/condensate field in the Fore-Sudetic Monocline, which is a sub-unit of the North German – Polish Basin. Lubiatow 1 was drilled to a total depth of 3591 m into the Permian. The 1st DST yielded oil with gas (and H2S) between 3242–3260 m in the Zechstein Main Dolomite. The 2nd DST yielded a weak gas flow only from a Rotliegend sandstone section. In early 2003, the well was suspended as a significant oil and gas discovery. Further tests in the Main Dolomite, from 3280 to 3286 m, flowed 951 BOPD with gas through a 16/64″ choke. Upon perforating two intervals (3250 –3275 m and 3280–3286 m), acidizing, and production testing, flow rates of up to 1283 bpd (16/64″ choke) and 498 bpd (10/64″ choke) were achieved. The discovery well was followed by Lubiatow 2, in mid 2003, located 1 km to the southeast. The flow rate reportedly tripled, coming from the same reservoir. Based on an oil column of 53 m (in the Lubiatow 1 well), on good reservoir properties, and on volumes combining the Lubiatow, Grotow and Miedzychod structures, PGNG estimates OIP reserves at 730 to 1100 million b of oil. Recovery is assumed at 20 to 50%. The estimate – suggesting a substantially higher volume than typically found in that hydrocarbon system (see section 2.2) – obviously needs to be verified. Further appraisal drilling will follow, yet it is suggested already that Poland's onshore production will increase significantly.

4.2.5 Lithuania

In Lithuania, E&P activities after 1989 focussed increasingly on achieving production growth from existing onshore fields. Three main producers contribute to the production, which was about 9100 bpd in the year 2002.

The main producers are the Minijos Nafta joint venture (including a Danish group of companies), the Genciai joint venture (with Svenska Petroleum as partner) and the national oil company Geonafta. Their production comes exclusively from Middle Cambrian sandstones. Lithuania started producing its first oil in 1990 from two wells in the Genciai field, two well in the Kretinga field, and one well each in the Vilkyciai and Nausodis fields. Daily output in 1990 was some 260 bpd. The growth reflects the application of altered drilling and completion techniques. As documented by Haselton et al. [8], underbalanced drilling (UDB) contributed to drastically improved flow rates. Essentially the poorly porous-permeable, irregularly fractured sandstone reservoirs had suffered from invasion damage upon previous overbalanced drilling. The wells drilled by Minijos Nafta in 2000 in a pilot project as close offsets to the existing G-7 well on the Pietu Siupariai field, which was drilled overbalanced in the 1970's with production rates that declined from the initial 400 bpd to 130 bpd, yielded outstandingly higher flow rates. Initially, 4000 bpd rates were achieved which levelled off at 2800 bpd, employing ESP lifting.

Lithuanian operators have not released revised reserves estimates. Both the above mentioned production increase and the calculated PI of 1.51 bpd/psi as compared to the earlier one of 0.014 of the AS-1 well, however, indicate the significance of the measures taken.

5 Conclusions

The most conspicuous changes in E & P, which have taken place after 1989 in the Eastern-Central Europe transformation states, relate to the offers and awards of license rights to non-state companies. Fundamentally, all transformation states had initiated respective measures, encompassing the range from reconnaissance to EOR license rights.

An analysis of license acquisitions shows that projects and opportunities offered after 1989 attracted increasingly independent and niche-player ("explorer") companies. This reflects particularly the volumes expected to be found, i.e. volumes which would make ventures economically viable mainly to those company categories. Our list of successful efforts obviously confirms this.

Successful E&P activities achieved by newcomers comprise those of Lithuanian, Czech, Hungarian and Romanian ventures.

Further changes relate to exploration activities, resulting in improved drilling success ratios and production performance, which resulted only recently in production increases. Both changes, however, need to be placed in their context, i.e. are not necessarily related with the new licensing:

– Improved drilling success ratios were achieved mainly by state companies, due to drilling structures for appraisal and/or of insignificant risk while largely reducing drilling activities.
– Current production increases result mainly from traditional producers' activities, not yet from those of newcomers.

From the results achieved so far it is reasonable to conclude that the future will bring additional discoveries which will be put on-stream, and which will to some degree compensate for the production decline of the existing fields. This will be mainly owing to the fact that also moderate and small-size fields are being appraised and developed by smaller-size companies as these have found means to make smaller fields economically viable.

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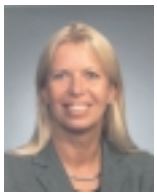
Etienne Kolly *graduated from Geneva University with a BS. in Earth Sciences and a MSc. from the Geology and Paleontology Dept. He joined IHSEnergy in 2001, firstly as well analyst. Since end 2001 he is field researcher in the Eastern / Western Europe Group.*



Helena Dobrova *is Regional Manager Central & Eastern Europe for IHS Energy and she is based in Geneva. Previously, she was working for Petroconsultants SA, Geneva, in the Foreign Scouting Service division and was responsible for Central & Eastern Europe and Latin America. She holds a Doctorate in Natural Scienses from Charles University in Prague.*

Ulrich Schmitz *received his Ph.D. degree in geology from Münster University. From 1971 to 1974 he worked with Deutsche Texaco, from 1974 onwards with Deminex. In Deminex he held managerial positions both in Operations (Trinidad, Abu Dhabi, Norway) and in New Ventures (Western Hemisphere). In 2000, he joined LO&G Consultants.*