Ricardo De Dicco

Promote Nuclear Power All Over So. America

Energy expert Ricardo De Dicco, who works for the research center at the Universidad del Salvador in Argentina, is also an advisor to the Energy Commission of the Argentine Congress, and has written extensively on the need to develop nuclear power.

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I'll begin with a first chapter on world energy consumption (see **Table 1**). In 2004—and this is the pattern over the past 20 years—88% of energy needs depended on hydrocarbon sources: 37% oil, 27% coal, and 24% natural gas. This tendency will continue for the next 25 years; that is, through the year 2030, where the percentages of oil, gas, and coal will be similar to what we have today. Renewable energy sources, and in particular such alternatives as nuclear and hydroelectric power, will continue to have insignificant participation, given the oil companies' intent is precisely to block the development of nuclear plants, so that the interests of the thermal plants, which they supply with natural gas or with coal, as well as with fuel oil and diesel oil, are not affected.

Now, when we analyze this matrix of energy consumption, we can see that the developed countries (in the OECD, or Organization of Economic Cooperation and Development), account for 54% of the world's energy consumption; Latin America and the Caribbean, only 6%. We have monsters such as the United States, which account for 23% of the world's energy consumption. China consumes 14%, and the Middle East—which is a region that contains the largest reserves of oil and natural gas—consumes a mere 5% of the total consumed globally.

When we take a closer look at this matrix, we see that the thermal plants supplied by highly-polluting coal, meet nearly 60% of the electricity demand in the United States. Natural gas accounts for about 20%. In the case of hydroelectric power, we can see that only Latin America and Africa have a highly interesting level of participation, which is close to 22%, while in other regions of the world, it is substantially below 10%.

As for nuclear energy generation, we can see the interesting participation of the European Union and also Japan. In the case of France, nuclear supplies 80%. It has not yet reached 100% there, because the French need to use a certain number of their nuclear plants to export electricity to countries such as Germany, that have chosen to remain in the past. In the case of Italy, not only are they not building more nuclear plants, but they have dismantled the existing ones. And so, since they have a tremendous deficit in electricity supply, and energy in general, they have had to resort to the massive import of these resources. In the case of electricity, they are basically importing nuclear energy from France.

And so, for example, when you look at the cutbacks in Italy in 2003, as a result of partial flaws at the electricity-generating plants, due to problems in fuel-oil, diesel-oil, and natural gas supplies, we see that France had to come to the rescue of an Italy that is backward in this sense, in terms of diversifying the risks associated with energy supply, by not using technologies which are alternatives to non-renewable and highly-polluting natural resources.

When we analyze the grid of the installed capacity of the different electricity-generating plants in the South American Community of Nations (see **Table 2**), note that this is data from 2003. In Argentina, 55% is generated by thermal plants, the majority of them supplied by natural gas, and a few with fuel oil, diesel oil, and just one with coal. Then, 40% with hydroelectricity, and 4% nuclear energy. And then, we have 0.1% coming from the nearly 27 MW of installed wind generators, but they do not contribute to the Argentine interconnected electricity grid; that is, they operate apart from the system.

The Problem with Hydroelectricity

In Bolivia, we see a significant dependence on hydroelectricity. But the thermal dependence is even greater, and there is no development of nuclear energy. In sum, in reviewing nuclear energy participation in Latin America, only Argentina, Brazil, and Mexico have developed these technologies.

TABLE 1

World Consumption by Primary Energy Sources, 2004

(Millons of Tons of Oil Equivalent and Percentages)

Regions and countries	Amount and % of World Total	Oil	Natural Gas	Coal	Nuclear	Hydroelectric
Latin America and the Caribbean	628 (6%)	306 (49%)	150 (24%)	28 (4%)	7 (1%)	138 (22%)
Africa	312 (3%)	124 (40%)	62 (20%)	103 (33%)	3 (1%)	20 (6%)
OECD	5,503 (54%)	2,252 (41%)	1,267 (23%)	1,163 (21%)	530 (10%)	293 (5%)
U.S.	2,382 (23%)	988 (42%)	582 (24%)	564 (24%)	188 (8%)	60 (2%)
European Union	1,719 (17%)	695 (41%)	420 (24%)	307 (18%)	223 (13%)	74 (4%)
Russian Federation	667 (7%)	129 (19%)	362 (54%)	106 (16%)	32 (5%)	40 (6%)
China	1,386 (14%)	309 (22%)	35 (3%)	957 (69%)	11 (1%)	74 (5%)
Japan	515 (5%)	242 (47%)	65 (13%)	121 (23%)	65 (13%)	23 (4%)
India	376 (4%)	119 (32%)	29 (8%)	205 (54%)	4 (1%)	19 (5%)
Middle East	482 (5%)	251 (52%)	218 (45%)	9 (2%)	0 (0%)	4 (1%)
World Total	**10,224 (100%)**	**3,767 (37%)**	**2,420 (24%)**	**2,778 (27%)**	**624 (6%)**	**634 (6%)**

Sources: IDICSO—USAL (2006) and Ricardo De Dicco.

TABLE 2

Electricity Consumption in the South American Community of Nations, by Generating Source, 2003

(Percentage)

Country	Hydro-electric	Thermo-electric	Nuclear	Other	Total
Argentina	40	51	9	0.1	100
Bolivia	54	46	0	0	100
Brazil	85	7	4	4	100
Colombia	75	25	0	0	100
Chile	40	59	0	1	100
Ecuador	62	38	0	0	100
Paraguay	100	0	0	0	100
Peru	81	19	0	0	100
Uruguay	99	1	0	0	100
Venezuela	67	33	0	0	100

Sources: IDISCO—USAL (2005) and Ricardo De Dicco.

And in the South American continent, Argentina and Brazil have each been able to build two nuclear plants that are currently in operation; soon there will be a third nuclear energy plant both in Brazil and in Argentina (perhaps more advanced in the case of Argentina, which is on the verge of completing it). In Brazil's case, Angra III will be the third plant, but they have just started working on this.

We can also see the importance of hydroelectricity for Latin America, above all in Brazil, where basically, it supplies 80% of electricity demand, or in countries such as Paraguay, where electricity comes basically from the binational Itaipú project (Paraguay and Brazil) and Yaciretá (Paraguay with Argentina). Uruguay's reliance on hydroelectricity is quite significant, particularly with regard to the binational plant they have with Argentina, Salto Grande. They have a few thermal plants, supplied by crude oil derivatives and natural gas. In the case of Venezuela, the hydroelectric percentage is also very important, and it has an abundance of hydroelectric resources. And there is a similar tendency among the other countries of our subcontinent.

Problems arise, however, when we have years of little rainfall, making it difficult to increase installed electricity capacity to meet the internal market's annual increase in demand. Now the hydroelectric option is somewhat complicated, because aside from the environmental impact this kind of plant produces, there is the question of involuntary resettlements, which not only delay these projects for many years, but also destroy productive cycles, primarily in the agricultural sector, which are very difficult to rebuild.

And it's not easy to carry out these involuntary resettlements, with a few exceptions such as China, with the Three Gorges Dam, where the population is forced to move, involving nearly one million Chinese citizens. I believe that it is some 850,000 actually. Perhaps it's a little easier to carry out this kind of project, where the planning time can be drastically reduced, as opposed to the Argentina case. If they want to build the Garabí or Corpus Christi projects—Garabí would be binational with Brazil, and Corpus Christi with Paraguay—we would be talking about between 10 and 12 years to get them up and running as part of the Argentine interconnected electricity grid. This does not mean that these projects shouldn't be built, but that we must think about some alternatives to be able to simplify the problems we'll be facing in the short term.

TABLE 3
Comparison of Cost Structure of Electrical Plants in Argentina
(Dollars)

Type of plant	Amount	Variable Cost per Megawatt/hour	Fixed Cost per Megawatt/hour	Capital Cost per Megawatt/hour	Total Cost per Megawatt/hour
Nuclear CNA—II	750 MW	6	8	10	24
Nuclear CANDU	600 MW	5	8	24	37
Thermal CC	800 MW*	19	3	9	31
Thermal CC	800 MW†	25	3	9	37
Thermal CC	800 MW‡	32	3	9	44
Corpus Christi Hydroelectric	4,600 MW	0	2	45	47
Wind	50 MW	0	3	62	65
Solar	50 MW	0	5	204	209

* Gas at $3 per million BTUs.
† Gas at $4 per million BTUs.
‡ Gas at $5 per million BTUs.

Sources: Francisco Carlos Rey (2004) and Ricardo De Dicco.

Nuclear-Produced Electricity

Okay, now we have the the variable of nuclear-produced, energy-based electricity. Getting a nuclear plant under operation could take as long as four or five years, because there is also the first year of feasibility studies to determine where it will be located. Let's say that in five years, it can be brought on line. They are much cheaper than hydroelectric plants. Now let's look at a table in which we have a comparative analysis of the cost structure of electrical plants (see **Table 3**). With a classification of that cost structure, consisting of variable, fixed, and capital expenditures, we can arrive at a total value of the new nuclear plants which could be on the order of $37 per megawatt/hour (MWh). In the case of Atucha II, the cost is $24 MWh, which can be explained by the fact that it is almost 80% complete. A nuclear plant with a CANDU reactor of 600 MW of net power is $37.

With a combined cycle thermal plant, supplied by natural gas which would have to be brought here from Bolivia over the next four to five years, we're talking about net import of natural gas, we suppose, on the order of—well, when I calculated this, nobody was talking about $5.50 per million BTUs (British Thermal Units); this is the estimate that I put together last year, with help from engineer Francisco Rey. At about $5 per million BTUs [the earlier price was $3.20 per million BTU's—ed.], we are talking about a per megawatt/hour cost of nearly $44! So, in this sense, we have a difference that actually favors the development of nuclear energy.

A plant like Corpus Christi would cost on the order of $47/MWh. But we have very different completion deadlines for this kind of project, nearly triple, or a little more than double that of a nuclear plant. And we can see that wind power and solar power far surpass the budgets of what would be needed to satisfy the Argentine market's electricity consumption needs.

Also entering into the picture here, is the factor of generating capacity. A nuclear plant could operate at 90% of its generating capacity for a full year.

Thermal plants generally oscillate between 80% and 90% also. Hydroelectric plants, however, have a generating capacity that is on the order of 55-60%, because they depend on how many weeks or months there are of rainfall, or if droughts extend longer than anticipated.

The world average for wind generators shows a generating capacity on the order of 25%. In Argentina, thanks to a combination of cyclones and anti-cyclones that we have in nearly all of Patagonia's coast, we can reach a factor of 45%, which is still only half of what nuclear energy represents.

As for solar energy, it really doesn't even make sense to mention it. We're talking about an order of about 10-15%, meaning it would be very expensive, and yielding practically nothing in return.

One of the other problems in terms of non-renewable natural resources, such as hydrocarbons, is that the greatest discoveries were carried out between 1950 and 1980. Since the early 1980s, major discoveries have fallen substantially. In this last 50 years, the international price of a barrel of oil has increased enormously. Also, the main oil companies have had to make major investments in risk capital for exploration, and have basically found nothing significant. Last year, a joint operation by the (Russian) gas company Gazprom and British Petroleum, discovered a gas field in northeastern Siberia of approximately 300 billion cubic meters. We are talking about nearly two-thirds of Argentina's natural gas reserves; that is, nothing.

Right now, we see a significant increase in the level of proven reserves in Venezuela, but this isn't due to any new discovery, but rather to the fact that internationally, reserves of extra-heavy oil can be added to proven oil reserves which international agencies keep track of statistically. In this case in particular, we're talking about the Orinoco River basin. In Venezuela, their conventional oil reserves are 7.7% of the world total. If we add the existing reserves from the Orinoco Basin, we are looking at 28.3% of the world total. What is a truly frightening thought for the Venezuelan people in the period that we're living through, is what it will mean for them a few years down the road, to be the main reservoir of world oil supplies

TABLE 4
Hydrocarbon Lifespan in Argentina, 2005
(Millions of Cubic Meters)

Oil			Natural gas		
Extraction	Reserves	Lifespan	Extraction	Reserves	Lifespan
38.6	330.4	8.6 years	51.5	483	9.4 years

Sources: Argentine Energy Ministry and Ricardo De Dicco.


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"Wind and solar energy far surpass the budgets of what would be needed to be able to satisfy . . . electricity consumption," De Dicco pointed out. Denmark's windmills (shown here) consume more energy to build than they generate.

If we look at the life span of our oil reserves (see **Table 4**) and of refining capacity—which at this moment, has reached an 85% saturation level—we can see that if some of the main refineries cease to operate, either because of a planned stoppage or because of unforeseen circumstances, we will be forced to import the majority of the liquid fuel derivatives consumed in the country. And there are no encouraging signs that oil refining capacity is going to be increased, meaning that the Argentine energy problem is structural across the board. It is not just a question of being left with less oil or gas reserves. We also have a problem of installed capacity in electricity transmission.

Nuclear Energy To Produce Hydrogen

Something similar is also happening in oil refining capacity, and neither the development of alternative sources nor of renewable fuels is being financed, as Dr. Lyndon LaRouche commented earlier with regard to hydrogen.

How can nuclear energy be involved in the production of hydrogen? One of the studies we did a few years back in IDICSO (the Institute of Social Sciences Research) showed that a 700 MW nuclear energy plant could supply approximately 35 hydrolysis plants of 20 MW each, just to be able to produce hydrogen.

Unfortunately, our legislators are poorly advised, uninterested, or we don't know on whose behalf they're working. Throughout the 1990s, the only item that increased was the installed capacity of thermal plants, especially the combined cycle plants. This, in a country that is losing those strategic resources. And the importance of strategic resources like hydrocarbons is that they must serve, like energy itself, as a platform for industrialization—in this case, it would be the reindustrialization of Argentina—and for scientific and technological advances, which today need to be carried out in the context of South American regional integration.

Our hope for Argentina is that it will be able to recover that quality of being a sovereign nation that it enjoyed in the 70 years between 1922 and 1992, in terms of planning, management, and control of its own energy sector, which was promoted by YPF (Yacimientos Petrolíferos Fiscales), and later with the creation of other companies that were global models of management, such as State Gas (Gas del Estado), Water and Electricity (Agua y Energí Eléctrica), and the National Atomic Energy Commission. The Atomic Energy Commission, in particular, has an enviable 56-year professional history, and stands on a par with other, more developed nations. Despite having a zero budget during that infamous decade of the 90s—it developed a modular plant, CAREM, a fourth generation plant that can be used for multiple purposes, whether for generating electricity, or for feeding electrolysis plants, or for channeling electricity to help in the extraction of heavy or extra-heavy crude oil, such as exists in Canada or in Venezuela. It can also be used for the production of radioisotopes, whether for medicinal or industrial purposes, and, moreover, it can be mass produced.

Generally speaking, medium and large power plants are built in a personalized way, depending on the needs of a particular country. The CAREM modules, which range from 25-350 MW, can be mass produced, and is a technology that can be used by countries that haven't yet developed a capability in nuclear energy. It is much easier to incorporate this technology through import of CAREM reactors, where Argentina could make a scientific-technological transfer with a much greater cost-benefit ratio than could be provided by CANDU, Westinghouse, Framatone, or other kinds of reactors.

And this is how INVAP, the state-run company for Argentina's technological development—not only in nuclear matters but also in satellites, defense, aerogenerators, etc.—has developed experimental reactors. It has exported several of these: two to Peru, to Algeria, to Egypt, and in more recent years, to Australia. We have won these international bids, and it is INVAP that has developed the CAREM reactors.

I believe it is urgent that the current government finance the development of a prototype, and later, mass production of nuclear plants, which would be both low- and medium-capacity reactors, so that we can keep pace with the increase in demand for electricity, and can transfer this knowledge to the other nations of our South American subcontinent.