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IS THE CIVIL NUCLEAR INDUSTRY RELEVANT TO NUCLEAR DISARMAMENT?

A CASE STUDY ON ITS GROWTH PROSPECTS

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Introduction

Over the last few years, there has been once again considerable talk all over the world about a revival of the civil nuclear industry. Up until the burst of the financial bubble in the second half of 2008, world economic growth was so strong as to drive the price of fossil fuels higher and higher. On top of that, evidence was mounting as to the harmful effects of the burning of fossil fuels on the environment, i.e., global warming. It was mainly the combination of these two factors to make an increased recourse to nuclear energy the world over look likely or even inevitable.

Unfortunately, the nuclear industry is not unrelated to nuclear proliferation, insofar as the fissile materials needed to have a controlled chain reaction in a nuclear reactor are the same as those needed for an uncontrolled chain reaction in a nuclear bomb.

With Uranium the *degree* of enrichment is very different: around 3 percent for a reactor, more than 90 percent for a bomb. But the technologies, and the attendant equipment to enrich it, are the same. This is, after all, what the international concern about the Iranian nuclear program is about. Plutonium is a fission by-product and does not exist in nature, but once separated from spent nuclear fuel, it may be used to fuel a bomb as well as a reactor.

As a consequence, *other things being equal*, the more nuclear reactors are around, the more fissile materials are around, the more difficult becomes countering the proliferation of nuclear weapons. Trying to understand whether a worldwide nuclear renaissance is really in the making

may therefore have some bearing on nuclear non-proliferation. This chapter first discusses this situation in a very succinct way.

But of course global tendencies are the resultant of a series of many individual decisions taken in different places under different sets of circumstances. Thus, as a further exploration on the nuclear revival issue, this paper will dwell on Italy as a case study. Italy is the only G-8ⁱ member with no nuclear power plant on its territory, but one of the many countries of the world whose government recently stated the intention of building such plants in the years to come. Others, just to remain in Europe, include Poland and Turkey—while Sweden has reneged on its previous pledge not to replace its existing reactors at the end of their life-cycle.

The German general elections of 27 September 2009 brought to power a coalition between Christian-Democrats (CDU-CSU) and Liberals (FDP). This is certainly going to be more sympathetic toward the civil nuclear industry than the previous one, which included the Social Democrats (SPD), and the one before, which included the Social Democrats *and* the Greens. A 2002 law passed under the latter puts a moratorium on the construction of new nuclear reactors and requires the shutdown of any nuclear facilities by 2020. Preliminary talks to form the new coalition indicate that this deadline may be postponed, even though polls show substantial public support to meet it. An outright repeal of the law appears therefore highly unlikely at the moment.ⁱⁱ

There is a tendency to consider any country that has manifested a renewed interest in nuclear power as a *de facto* new or confirmed supporter of this kind of energy. Less noted is the huge gap that always intervenes between words and deeds, intentions and facts. I will analyze the breadth of this gap in the case of Italy to see how likely an Italian nuclear renaissance really is.

A Worldwide Nuclear Renaissance?

The growth prospects of the nuclear industry are a function of several factors. These factors—chiefly the economy, the environment, and security of supply—have their own peculiar way to change continuously and always stay the same.

Here are two headlines from *The New York Times*, one recent, the other old.

“President Offers Plans for Revival of Nuclear”

“Where Should the Nuclear Waste Go?”

Which is which? The former is of October 1981 (the President was Ronald Reagan), the latter of December 2008.ⁱⁱⁱ But the fact that it might have very well been the other way around goes a long way to show that hopes and delusions in the civilian nuclear field tend to remain the same.

Let’s briefly review the three factors separately.

The economy

In mid-2008, the word most frequently associated with the adjective “nuclear” was indeed “revival,” showing that after two decades of nuclear neglect we were on the eve of a spectacular growth in the industry. World GNP was then growing at a historically unprecedented rate and with it world energy demand. A rising demand for energy was driving up, in a way that seemed irreversible and even unbounded, the price of fossil fuels. High prices of fossil fuels make all other energy sources, including nuclear, more competitive.

In July 2008, the price of a barrel of oil hit the \$147 mark. At about the same time, Arjun N. Murti, an energy analyst for Goldman Sachs, made the headlines (again in *The New York Times*) predicting a price of \$200 “soon.”^{iv}

A typical problem with the nuclear industry—that of being capital intensive—appeared to have been overcome because capital was abundant back then. Merchant banks, including Goldman Sachs, still existed.

In the space of a few months, all these conditions went upside down, and therefore the economic case for a nuclear renaissance became far less self-explanatory. First, the price of oil plummeted: in December 2008 it was near \$30 per barrel, despite the usual Christmas tinkering by Russia with its gas exports to Europe via Ukraine; and a war in the Gaza strip, Middle East, at that same time. Then it went gradually up to around \$70 per barrel, where it seemed to stabilize, at least

for the time being. These swings demonstrate an important fact: the price of this most important commodity—that, among other things, drives the price of all fossil fuels—remains too volatile to allow the kind of long-term economic calculations associated with the nuclear industry lead times.

Second, credit froze, with devastating, systemic consequences, and with little hope for substantial relief in the near term. Finally, world GNP growth turned negative in 2009, for the first time since the end of WWII. World trade also experienced negative growth. Most of the richest countries have experienced their sharpest economic contraction of the last 60 years or so.

On the other hand, the sharp economic downturn the world over has triggered, in most places, so-called stimulus packages of public spending. In other words, capital may be plentiful once again in 2009–2010. But consisting as it does mostly of taxpayers' money, it will be up to the Treasuries to decide how to use it.

Normally, this used to favor the nuclear industry—think of France, for example. But these are not normal times. If the objective is to jumpstart or jolt the economy, it is doubtful that many rich nations will embark on projects, such as the construction of nuclear power plants, that take at least a decade to come to completion. The packages approved so far, beginning with the U.S. one, confirm this line of reasoning.

These are the main known, or knowable, economic factors. *Right now* (October 2009) they do not seem to support any nuclear revival.

Then there are the perennial unknowns or unknowables. How much does it really cost to decommission a nuclear power plant? How much does it really cost long term-waste storage? Who will bear these costs? Governments, i.e., taxpayers? The utilities, i.e., consumers? In Italy, households and firms are still—since 1988—covering nuclear decommissioning costs through a specific item in their electricity bills. In excess of €9 billion have been collected so far, and this will go on well into the next decade and possibly beyond to the tune of €0.5 billion a year. Similar schemes are now applied elsewhere to cover *commissioning* costs. “Customers of Georgia Power, a subsidiary of the Southern Co., will pay on average \$1.30 a month more in 2011, rising to \$9.10 by

2017, to help pay for two reactors expected to go online in 2016 or later.”^v

Ultimately, what is the proper economic environment for the nuclear industry, a command economy or a market economy? The logical answer would appear to be: a market economy, but with some public guarantees of an explicit or implicit kind. The mortgage giants Fannie Mae and Freddie Mac used to have an “implicit” public guarantee that, when called, ended up costing U.S. taxpayers hundreds of billions of dollars.

The environment

Nuclear power plants do not emit greenhouse gases, if one excludes the emissions linked to the construction phase. To the extent that global warming is a real and present danger the nuclear industry scores many points. Actually, global warming is one of the strongest arguments behind the latest renaissance of the nuclear renaissance idea.

Nuclear energy does not affect, however, one major producer of greenhouse gases, the transportation sector, that relies almost entirely on the internal combustion engine and thus on fossil fuels. This may change if and when advances in battery technology will allow mass-produced cars and trucks to run on electricity. This is clearly another environmental plus for the nuclear industry, albeit still potential.

It often happens to stumble on this adjective, “clean,” when reading about nuclear energy. But non-emission of carbon is perhaps not enough to grant the nuclear industry a certificate of cleanness. For the sake of the argument, let us assign zero probability to a major release of radioactivity from a nuclear power plant, either intentionally (terrorism) or unintentionally (accident). Nonetheless, can one really define as “clean” the radioactive waste which is the inevitable by-product of the fission process? The amount of High Level Radioactive Waste (HLW) worldwide is currently increasing by about 12,000 metric tons every year. HLW includes radionuclides whose half-life is measured in tens of thousand, hundreds of thousand and even millions of years. Mixed in the waste but chemically separable there is plutonium, a raw material

for nuclear bombs.

Things are not going to get any better with more recent technology. The new, so-called third generation plus, European Pressurised Reactor (EPR), built by the French company Areva, was expected to produce less waste than its predecessors, for example. It turned out instead that its waste will be more radioactive by a factor of seven according to Greenpeace, and by 15 percent according to Areva itself.^{vi}

No country in the world can fairly say to have solved the problem of permanent nuclear waste disposal. Most countries do not even know *where* to locate their disposal sites—the issue obviously triggers the perfect NIMBY storm. And those who know are not sure.

Take the U.S. site at Yucca mountain, Nevada, to which referred one of the two *New York Times* headlines above. President Barak Obama won in Nevada with a pledge to “end the notion of Yucca mountain.” The Senate majority leader, Nevada’s Democratic Senator Harry Reid, is a long-term opponent of the nuclear repository. Obama’s 2010 budget made good on his electoral promise by cutting off most of the money for it. The decision to do away with the Yucca project may cost the government billions of dollars in payments to the utility industry. On top of that, the \$9 billion already spent on the site would be wasted.^{vii} Even if the site manages to survive this political barrage, its capacity—70,000 metric tons of HLW—will equal U.S. spent reactor fuel and military waste now in “temporary” storage in 2010; in other words, the capacity will be over-subscribed before it opens.

Security of supply

As a general rule, the more diversified energy sources are the more security of supply one has, especially if there are scarce domestic sources to rely on in the first place. Take Europe, for example. In 2005 the EU-27 import dependency was 57 percent for natural gas, 82 percent for oil and 39 percent for coal. It is projected to climb to, respectively, 84 percent, 93 percent, and 59 percent by 2030.

To be sure, the EU depends on imports for almost 100 percent of its uranium ore. But these are different sources (about half from Canada and Australia) than those for oil and gas (about half from Russia, Norway, and Algeria).^{viii} On top of that, the cost of uranium is a small fraction (a few percentage points) of the total cost of producing electric power, with or without externalities and unknowables, of a nuclear generated kWh. What is true for Europe also applies wherever access to energy basically depends on imports, i.e., in most of the world. Thus, the need to diversify is another plus for the nuclear industry.

Moscow has a special ability to drive home this point of diversification and security of supply to the EU, by plainly closing gas pipelines and halting shipments every other winter around Christmas.

It goes without saying that renewable sources (solar, wind, hydro etc.) share with nuclear energy the pros of low or zero carbon emissions and diversification—actually they can be considered home sources.

Italy and the Nuclear Industry

Italy's economy is the 7th in the world in terms of the sheer size of its Gross National Product (GNP). Its energy intensity (energy input per unit of GNP) is the lowest among the countries of the Organization for Economic Co-operation and Development (OECD), thanks to an industrial structure based on small enterprises and relatively light production, a favorable climate and, last but not least, high energy prices.^{ix}

There are no nuclear power plants in operation on Italian territory. Italy is the only nuclear-power-plant-free member of the G-8 and one of the few of the G-20—the others are Australia, Indonesia, Saudi Arabia, and Turkey. This was anything but a foregone conclusion for the country. Right after World War II, it had a good industrial base—far less damaged, say, than Germany's and Japan's—a relatively sophisticated engineering tradition and an excellent school of nuclear physics, whose founding father, before emigrating to the U.S. in 1938, had been Enrico Fermi.

In the mid-sixties, with three nuclear plants connected to the electricity grid, each of a different design, Italy was the third Western country, after the U.S. and the UK, in terms of nuclear power production.^x The end of the sixties and the seventies were times of uncertainty for the largely state-owned Italian nuclear industry, characterized by domestic divisions on whether to adhere to the Nuclear Non-proliferation Treaty (NPT), and thus on the country's nuclear status, and by an intense competition for scarce resources with the giant state oil and gas company, Ente Nazionale Idrocarburi (ENI).

Italy thus missed the big wave of nuclear plant constructions that occurred in most rich countries as a reaction to the oil shocks of the 1970s. In 1986, at the time of the big accident at the Soviet nuclear reactor of Chernobyl, Ukraine, Italy still had no more than three operational nuclear power plants—two of them of the sixties vintage, and one newer and more powerful (882 MW) replacing another shut down in the early 1980s. Two additional plants were under construction.

Then, in November 1987, three referenda were held. One proposed the abrogation of a norm that allowed the central government, after a given delay, to overwhelm the local opposition to the construction of a nuclear plant; another proposed the abrogation of a norm that allowed the central government to compensate local jurisdictions for the acceptance of a nuclear plant in their territory; and the third proposed the abrogation of a norm that allowed Enel, the then state-owned monopolist producer of electricity, to take part in international joint ventures for the construction of nuclear power plants outside Italy. The three propositions won with an 8-2 margin.

Undoubtedly, such outcome made clear a generic public aversion to making use of nuclear energy. Less obvious is the political conclusion drawn by the Italian government of that time, supported by all the governments in power since then but the current one—i.e., halt the ongoing construction of two nuclear plants, close the existing ones, and renounce the recourse to nuclear power altogether “out of respect to the popular will.”

As a matter of fact, the letter of none of the three referenda truly justifies this political conclusion. The outcome of the third referendum in particular, as it will be described below, was

never enforced, neither in its letter, nor in its spirit. Thus, if the decision of renouncing in practice the civilian use of nuclear energy in Italy was a political interpretation of the referenda results, perhaps it was an unwarranted interpretation all along. But that is not what the current government—headed by Silvio Berlusconi and in power since May 2008—says when it promises, as it has done repeatedly, to go back to nuclear power. It just seems to take for granted that the public mind has changed—precisely what a democracy should not take for granted, but rather ask the electorate through a fresh consultation.

The point is, all the Italian political elite—left and right and including Berlusconi—when asked about the country’s stance on nuclear power have always answered, from 1987 to 2008, with a “no, we can’t” due to the 1987 referenda. And therefore, no one now has the political freedom to declare that the decision taken then was wrong and unwarranted. On the other hand, the current government has no appetite for a new referendum, one that, if lost this time around, might translate into the unambiguous end to any Italian nuclear program. Recent opinion polls indicate that the change of course promised by Berlusconi has yet to win popular support in Italy.

But no one knows for sure, and the outcome of a consultation with the public is difficult to predict. Nuclear energy once used to be a left (against) right (for) issue in Italy, but this time around there are more contradictory signals: while the main party on the left, the Democratic Party, has kept largely silent, on the right Ugo Cappellacci, the governor of Sardinia, stunned his and Berlusconi’s Freedom Party by declaring just days after his election that whoever wants to build a nuclear plant on his region will have to do it “over his dead body.”^{xi}

In early 2009, however, the governments of Italy and France signed an agreement on the development of the nuclear industry—paralleled by another one on the same matter between the respective largest electricity utilities, Enel and Electricité de France (EDF). These moves were hailed, especially by the French and Italian media, as definite proof of Rome’s nuclear U-turn. The whole text of what most sources described as a *Protocollo d’intesa* (*Protocole d’accord* in French), i.e., a Memorandum of Understanding (MoU), “in the energy field” between France and Italy is not

publicly available. The only thing that is indeed certain is that it was signed by the French President, Nicolas Sarkozy, and Italy's Prime Minister, Silvio Berlusconi, in Rome on 24 February 2009.

On the website of Italy's Ministry for Economic Development, the agreement is presented as an MoU "on nuclear cooperation," and one learns that it foresees the creation of a Franco-Italian "executive committee" charged with fostering bilateral cooperation between nuclear operators, power plant builders, nuclear regulatory agencies, R&D entities, and universities. A new draft law establishing an Italian nuclear regulatory agency and some general criteria for the localization of nuclear power plants was introduced in the Italian Parliament in 2008 and approved, after a prolonged debate, in early July 2009. Particularly those norms intended to deny local authorities a veto power on the location of nuclear plants have encountered strong opposition from MPs of all parties.

Even though the inter-governmental agreement seems to contain no firm commitment on anything, both Berlusconi and Claudio Scajola, Italy's Minister for economic development, have declared that the government intends to begin the construction of at least two nuclear plants before the current legislature ends in 2013. A further and more ambitious goal is to get one fourth of Italy's electricity needs (the equivalent of some 12,000 MW) from nuclear sources "around" the year 2020. This would imply the construction of 6–10 nuclear power plants over the next 10–15 years. According to the financial daily, *Il Sole 24 Ore*, the idea would then be to build by 2020 four 1,600 MW French-designed Areva EPRs, plus others—either additional EPRs or 1,100 MW U.S.-designed Westinghouse AP1000, or a combination of them.^{xii}

Programs of this scale clearly need government backing well beyond the words of both the Franco-Italian MoU and what the draft law on nuclear energy may say on regulation. One can only note at this stage that Rome, burdened by one of the world heaviest public debts in proportion to the size of the economy, has been extremely reluctant to counter the current economic downturn by opening the public purse. As a percentage of GNP, the G-20 (weighted) average of budgetary

stimulus is 2.0 in 2009 and 1.6 in 2010—as opposed to 0.2 and 0.1 respectively in Italy.^{xiii} There is, in other words, little public money for anything, nuclear and non-nuclear alike. Elsewhere—in the U.S. and Britain, but also in France—the nuclear industry has been conspicuously absent from far more generous stimulus packages, a plausible reason being the very long lead times of nuclear construction that make it scarcely fit for countercyclical purposes.^{xiv}

What about private money? The largest Italian power company is Enel, the signatory of two MoUs with its French counterpart EDF on the same date as the governmental one. The first MoU, whose duration is five years, launches “a feasibility study” to create an Enel-EDF joint venture that would eventually build and run the four EPRs mentioned above.

In the second MoU, Enel states its intention to extend its current participation (12.5 percent) in the EPR under construction in Flamanville, France, to five further reactors also to be built in France, beginning with the one recently authorized in Penly. Note that both companies are owned (31 percent Enel, 87 percent EDF) and controlled by their respective governments, so one can speak of private money only in a rather limited sense.

Note also that Enel is doing exactly what it was forbidden to do by the third 1987 referenda mentioned above: it is taking part in international joint ventures for the construction of nuclear power plants outside Italy—perhaps on the assumption that in 1992 it changed its legal status, from state enterprise to public company. Prior to its EPR venture, Enel used to have a 33 percent stake in the development of the now defunct French Super-Phénix 1200 MW fast breeder reactor at Creys-Malville, France.

At the end of the day, however, everything is confined to feasibility studies and intentions—again, with no firm commitment. This applies in particular to nuclear plants to be built in Italy. The one plant in France, at Flamanville, with its attendant Enel stake, is the only think that does exist at this stage.

From the point of view of hedging its bets by diversifying the sources of its electricity, Enel’s strategy makes sense. Located next door to Italy, Enel’s main market, EDF and Areva are

top world experts in terms of, respectively, running and designing-building nuclear power plants. Rather than reinventing the wheel and going against a public opinion which may still be highly sceptical vis-à-vis the nuclear industry, it is understandable that Enel prefers to invest in France.

Italy buys about 13 percent of its electricity from sources outside its territory, mainly from France, i.e., from French nuclear power plants. Here one has, then, the rather peculiar situation of a country—Italy—with no functioning nuclear reactors on its soil, with zero domestic production of nuclear electricity, which nonetheless uses nuclear-generated electricity for well above 10 percent of its total consumption, importing it from outside its territory.

In light of this situation, the first move that makes sense is to expand the interconnection capacity between Italy and France—which is precisely what the electricity network companies spun off of EDF and Enel, Réseau de Transport d'Electricité (RTE) and Terna respectively, are doing: their target is an increase in such capacity of 60 percent over the next couple of years.

More importantly, however, we have come to touch upon a point that, although crucial, rarely appears in Italy's domestic debate on the nuclear industry: the making of Europe's single market in energy, and in electricity in particular. The latter was launched about a decade ago and has led to a high degree of reorganization of the European industry, whereby several former national monopolists have compensated the loss of market share at home with an increasing presence in other EU member states. For example, Enel controls the main electricity companies—the former monopolists—of Spain and Slovakia, and thus has ended up directly managing several nuclear reactors in both countries.

Mergers and acquisitions, plus fostering interconnection, are the main instruments for the creation of a single electricity market. There is, however, a third and important element—public attitude. Governments and politicians, particularly in Italy, are reluctant to think in terms of Europe's single market. A common argument to support the notion of an Italy's U-turn on nuclear matters goes like this: we import so much electricity from French nuclear plants that we may as well build these plants on our territory. But buying electricity from France should not be called an

import anymore—as much as it would sound strange to call import or export a transaction between different Italian regions. Behind this particular transaction as well there is a market rationale that satisfies both buyers and sellers. In particular, “France has a huge generating overcapacity, which it uses to export electricity to neighbouring countries at cheap prices.”^{xv}

Thus the argument above should be turned on its head: is there a market for additional nuclear power plants on Italian territory? Let Europe’s single market decide the level of supply, the different sources of energy, and the location of productive units. And note that while the different European national governments still think in terms of national energy markets, energy companies have already jumped to a multi-national European market level of competition and have adjusted to managing the whole gamut of different energy sources, from coal and gas, to nuclear and renewables.

Energy self-sufficiency is impossible, for Europe as a whole as well as for each and every EU member state. Diversification of energy resources is the only realistic course of action to increase security of supply. But it is Europe as a whole that must have a mix as diversified as possible—and at the same time as market led as possible—not each and every EU member state, including Italy.

If one takes Europe as a whole, then perhaps what the French have invested so far in the nuclear field is enough to ensure diversification of energy sources for all. “In 2007, France’s 59 reactors produced 418.6 terawatt hours or 77 percent of its electricity.”^{xvi} Currently, in the EU-27, the nuclear share is estimated between 28 and 33 percent of the electricity and 12 and 15 percent of primary energy.^{xvii} Taking the nuclear share of electricity alone, Japan is in the same ball park (27 percent), but the U.S. (20 percent) and Russia (16 percent) are decidedly below Europe’s level.

On 24 February 2009, the day of the Franco-Italian summit, the daily *Il Sole 24 Ore* also reported that Finmeccanica—a large Italian, state-owned, defense, electronics and engineering holding company—was about to buy the 34 percent of Areva that the German company, Siemens, had decided to divest itself of at the end of January. The news was promptly and peremptorily

denied by Finmeccanica, which through one of its controlled companies, Ansaldo Nucleare, builds components for the Westinghouse's AP-1000 reactor (Areva's EPR main competitor), four units of which are under construction in China.

Areva's stock was worth at that time about half what it was 12 months earlier—a little worse than the performance of Eurostoxx 50, the blue-chip index for the euro-zone, over the same period. Siemens' exit entails a put option, and Areva will have to pay about €2 billion to its former German partner at some point over the next three years.^{xviii}

New firm orders—as opposed to good intentions—are not yet in sight for the French company. To the contrary, expectations go more and more unfulfilled—such as those in the United States and in South Africa, whose reported order of 12 reactors has been cancelled. The EPR under construction at Olkiluoto, Finland “has been plagued by water-logged concrete, faulty welds and flawed pipes, delaying the reactor start date by at least three years and raising costs by roughly 50 percent.”^{xix}

Finmeccanica's lack of enthusiasm in buying a stake in Areva is thus rather understandable.

Bearing in mind that the nuclear share of the EU-27 electricity is already quite high by world standards, energy companies interested in investing in Italy, as well as the Italian government itself, may eventually find advantageous to bet rather on non-nuclear sources—besides renewables, natural gas pipelines from Algeria-Tunisia and from the Caspian sea via Turkey and Greece, plus Liquefied Natural Gas (LNG) terminals^{xx}—precisely for the usual reasons of diversification and security of supply.

By no means this would entail the abandonment of a nuclear expertise on the part of Italy. On the one hand, Enel keeps a stake in the ongoing French nuclear effort, thus remaining a credible candidate to run potential future nuclear plants on Italian territory. On the other, Finmeccanica, through its subsidiary Ansaldo Nucleare, partners with the U.S. firm Westinghouse in nuclear construction and engineering.

For good measure, Scajola and the U.S. Secretary of Energy, Steven Chu, signed on 30

September 2009 in Washington D.C. a “Joint Declaration concerning industrial and commercial cooperation in the nuclear energy sector” and an “Agreement for Cooperation in civilian nuclear research and development.” The move confirms the two track (France *and* the United States) Italian approach to nuclear energy, as well as the increasing contradiction between words (abundant) and deeds (scarce).^{xxi}

Ansaldo Nucleare is also at the forefront of EU-funded research efforts on the next, or fourth, generation of nuclear reactors, specifically designed to be more economical, to be “intrinsically” safe, to minimize the production of high level radioactive waste, and to be more resistant to proliferation via a closed fuel cycle that would entail the separation of plutonium and its use as fuel. This fourth generation of reactors is expected to become available around 2030. Beyond that date, it is to be hoped that the international research on nuclear fusion may begin to bear some fruits. Through the EU, Italy takes part in the International Thermonuclear Experimental Reactor (ITER) under construction at Cadarache, in southern France. Buying time to join the next nuclear energy train may therefore turn out to be a sensible option for Italian decision-makers.

To sum up, an Italian nuclear revival appears unlikely in the short term—no firm commitment on building new nuclear power plants on Italy’s territory has yet been taken. If anything, the Italian case is illustrative of the huge gap between the nuclear declaratory policy of governments and firms and the harsh financial, environmental, and public opinion constraints on actually building new nuclear power plants.

Conclusions

Beyond the Italian case, what’s the foreseeable future of the nuclear industry worldwide?

According to Mycle Schneider, author of the “World Nuclear Industry Status Report,” it is not very brilliant.^{xxii} The number of operating nuclear reactors in the world is actually decreasing: they were 439 in 2008 in 31 countries, five fewer than five years before. Total installed capacity—372 gigawatts in 2008—is slightly increasing, though, thanks to technical improvements, or

“uprating” at existing plants. This roughly corresponds to about 14 percent of the world’s commercial electricity, or less than 6 percent of the commercial primary energy.

Estimating “the number of plants that would have to come online over the next several decades simply to maintain the same number of operating plants around the world,” Schneider reaches the conclusion that “70 reactors (in addition to the 20 now under construction with a scheduled start-up date) would have to be planned, completed and started up by 2015—one every month and a half—and an additional 192 units over the subsequent decade—or one every 18 days.” He believes this is highly unlikely, if not impossible.

Not surprisingly, Schneider’s conclusions are that “contrary to the public’s perception and the industry’s efforts, nuclear power will continue its long-term decline rather than move toward a flourishing future revival.”

Several other sources reach very similar conclusions. In 2003, a group of Massachusetts Institute of Technology (MIT) faculty issued a study on the “Future of Nuclear Power” that advocated an increased recourse to nuclear energy in order to mitigate global warming. The last sentence of the 2009 update of that report, issued in May 2009, reads: “The sober warning is that if more is not done, nuclear power will diminish as a practical and timely option for deployment on a scale that would constitute a material contribution to climate change risk mitigation.”^{xxiii}

Even the International Atomic Energy Agency (IAEA) notes with concern that “The industrial capacity of nuclear suppliers has generally decreased over the past 20 years. Not only are there fewer reactor designers and less reactor choice, but there also fewer architect engineers and project management organizations with experience in implementing large nuclear projects...[These difficulties]...may constrain growth plans even in some countries with established nuclear programs.”^{xxiv}

All in all, then, this brief review supports the conclusion that non-proliferation efforts are *not* going to be made more difficult in the near future by any nuclear renaissance.

Which does not amount, however, to saying that non-proliferation is going to be any easier

than it is now. North Korea and Iran have shown that the route to the bomb now goes through the NPT and the access it grants to nuclear technology, rather than around it. These cases also show that it does not take hundreds of new nuclear power plants to shake the foundations of the non-proliferation regime. One or two reactors may suffice.

If one's main concern is proliferation, it would be better turn attention, then, to those initiatives—such as the internationalization of the nuclear fuel cycle and/or the elimination of nuclear weapons—that have the best chances to strike at the heart of the problem.

ⁱ The members of the G-8 are Canada, France, Germany, Italy, Japan, the United Kingdom, the United States, and Russia. The G-20 members are Argentina, Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, and the United States.

ⁱⁱ See “Germany’s New Government May Extend Reactor Lifetimes,” *Spiegelonline* (www.spiegel.de/international), 29 September 2009; and “Nuclear Poker Heats Up in Berlin,” *ibid.*, 5 October 2009.

ⁱⁱⁱ The first headline is quoted in M. Schneider, “2008 world nuclear industry status report: Global nuclear power,” *Bulletin of the Atomic Scientists*, 16 September 2008; the second headline is the title of an editorial reprinted in the *International Herald Tribune*, 24 December 2008.

^{iv} See L. Story, “An Oracle of Oil Predicts \$200-a-Barrel Crude,” *New York Times*, 21 May 2008.

^v J. Kanter, “Not So Fast, Nukes,” *The New York Times*, 29 May 2009.

^{vi} See J. Kanter, “Rebound of nuclear plants raising worries over waste,” *International Herald Tribune*, 31 January 2009.

^{vii} See M.L. Wald, “Nuclear waste challenge resurfaces,” *International Herald Tribune*, 6 March 2009.

^{viii} Commission of the European Communities, *An Energy Policy for Europe*, COM (2007) 1 final, 10.1.2007.

^{ix} See “OECD Key Environmental Indicators,” OECD Environmental Directorate, Paris, France, 2004. Within the EU, only Malta has an energy intensity lower than Italy. See Commission of the European Communities, *Doing More With Less—Green Paper on energy efficiency*, COM (2005) 265 final, 22.06.2005.

^x See E. Cerrai, A.M. Lombardi, and F. Parozzi, “Cirene: storia di un progetto atomico italiano,” *Le Scienze*, June 2009.

^{xi} “Cappellacci: ‘Da Noi nessuna centrale’,” *Il Corriere della Sera*, 26 February, 2009.

^{xii} See F. Rendina “Italia-Francia, patto sull’atomo,” *Il Sole 24 Ore*, 24 February 2009; and A. Geroni “Nuovo asse Italia-Francia,” *Il Sole 24 Ore*, 25 February 2009.

^{xiii} See International Monetary Fund, *The State of Public Finances: A Cross-Country Fiscal Monitor*, Staff Position Note, July 2009.

^{xiv} See E. Grasland, “Le plan de relance américain réjouit les spécialistes européens des énergies renouvelables—Le nucléaire grand oublié,” *Les Echos*, 17 February 2009.

^{xv} M. Schneider, “2008 world nuclear industry status report: Western Europe,” *Bulletin of the Atomic Scientists*, 19 September 2008.

^{xvi} Schneider, “2008 world nuclear industry status report: Western Europe.”

^{xvii} The lower-end estimate is from Schneider, “2008 world nuclear industry status report: Western Europe,” the upper-end one from Commission of the European Communities, *Nuclear Illustrative Programme*, COM (2006) 844 final, 10.1.2007.

^{xviii} See “Nuclear fission,” *The Economist*, 30 January, 2009.

^{xix} J. Kanter, “Rebound of nuclear plants.”

^{xx} These are all Trans-European Energy Network projects of EU-wide interest.

^{xxi} For example the Joint Declaration intends, among other things to “*encourage* nuclear industry to *seek contractual opportunities* for the construction of nuclear power plants” (emphasis added).

Unlike the Franco-Italian nuclear MoUs, the texts of both the Joint Declaration and the Agreement for Cooperation between the U.S. and Italy were made public. They are available on the Energy Department website, at <http://www.energy.gov/news2009/8086.htm>.

^{xxii} See M. Schneider, “2008 world nuclear industry status report: Global nuclear power,” *Bulletin of the Atomic Scientists*, 16 September 2008.

^{xxiii} The 2003 MIT Report and its 2009 Update are available at <http://web.mit.edu/nuclearpower/>.

^{xxiv} *International Status and Prospects of Nuclear Power* (Vienna: International Atomic Energy Agency, 2008), p. 3.