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INNOVATION

by

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ABSTRACT

Italy's limited natural energy reserves, high dependency on imports and enormous user costs provide an opportunity to innovate. Yet the 2008-2011 Italian government failed to uphold its legislation permitting construction of innovative nuclear reactors. As this government's popularity dwindled, subsidising low-risk renewable projects appeared more popular, especially for solar installations. European and Italian subsidies for Italian renewable energy encouraged the more widespread application of existing technologies, rather than innovation. During 2012, Italy's technocratic government has debated a new energy law, which will continue incentives for low-capacity, renewable and low-risk energy projects, although with reduced subsidies. The new law will not support serious technological innovation to boost energy production, reduce import dependency or defray high costs. Instead, this paper recommends expanding hydro-electric power, exploiting shale gas, constructing more large-scale solar installations, equipping coal-fired power plants with carbon capture and storage, and building at least four nuclear European Pressurised Reactors.

1. INTRODUCTION: OVERVIEW OF ITALIAN ENERGY TODAY

Italy has witnessed considerable growth in renewable energy generation over the past few years, partially driven by European pressure. The European Union (EU) adopted a package of climate change measures in June 2009 that strengthened carbon trading, set binding targets for renewable energy, and created a legal framework for carbon capture and storage (CCS). The 2009 European Commission Directive (2009/28/EC) made it mandatory for Member States to achieve a 20 per cent share of energy from renewable sources by 2020.

This 20 per cent target takes account of the different starting point of each member state and allows the sourcing of energy from other countries. By purchasing a certificate guaranteeing the renewable origin of the energy, countries can source energy from other EU Member States. Therefore, it is not necessary for each country

to draw all 20 per cent of its energy from its own, indigenous renewable sources. Owing to Italy's extensive imports and increasing energy production from renewable sources, some claim that it has already achieved this target: "Italy currently gets 80 per cent of its energy from fossil fuels and the remaining 20 per cent percent from hydroelectric and renewable energy, according to data from power grid operator Terna SpA", recorded a 2011 report from Bloomberg [1].

Several reports indicate that about a quarter of Italy's electricity is produced from renewable sources in Italy. In 2009, overall electricity production in Italy from renewable sources stood at 69,329 gigawatts per hour (GWh), which represented 23.7 per cent of total national electricity generation, according to the *2010 Annual Report* from ISTAT, the Italian national statistics office [2]. In 2012 a report by IREX Monitor, of the Althesys Institute, recorded that no less than 26 per cent of Italian electricity was generated from renewable sources in 2011 [3]. This figure is striking, given other data indicating that the proportion of Italian energy produced from renewable sources had earlier declined. As a percentage of gross energy consumption, electricity in Italy generated from renewable sources fell from 16 to 13.7 per cent between 1997 and 2007 [4].

The rise in electricity produced from renewable sources is often attributed to the huge increase in the number of photovoltaic (PV) solar installations over the past five years. Between 2005 and 2009, Italian production of solar energy soared from four to 676 GWh [5]. Yet solar still represented a small proportion of Italian renewable electricity production in 2009; the 676 GWh generated was less than one per cent of all renewable electrical energy produced, and less than 0.25 per cent of total national electricity production. However, by 2011 solar installations were producing 12,741 GWh of Italian electricity [6]. "Italy became for the first time the top PV market with 9 GW of newly connected systems in 2011 (compared to 2.3 GW in 2010)," according to a report by the European Photovoltaic Association [7]. While the IREX Monitor report (referred to above) records the quantity of solar electricity generated at 12,741 GWh, it also gives output in GWh for other sources of renewable electricity in 2011; biomass 2,850, mini-hydro 2,815, geothermal 770 and wind 6,747.

Despite newspaper headlines about booming Italian solar power [8], hydro-electric power produces the largest proportion of Italian renewable electricity. Observing that in 2011 Italy generated about a quarter of its electricity from non-fossil fuel energy sources, Rachana Raizada wrote in *Renewable Energy World Magazine* that the majority came from hydro-electric power [9]. Indeed, the strong contribution of hydro-electric power to Italian electricity production was recorded in earlier data from ISTAT: 49,137 GWh of hydro-electric power was produced in 2009, which was 16 per cent of gross national electricity generation [10]. In this pattern, Italy is not too different from many other countries, given that in 2005, at least, more than half the world's renewable energy came from hydro-electric dams [11].

Other types of renewable sources have also contributed to Italian electricity production, although not as much as dams. As a proportion of gross national electricity generation, biomass sources produced 2.6 per cent, wind 2.2 per cent and geothermal energy 1.8 per cent in 2009 [12]. Between 2005 and 2009, the production of electricity from biomass increased by 24 per cent and that from wind tripled [13]. Then the use

of wood biomass for energy production rose by seven per cent between 2009 and 2011.

Italy has been quite innovative in its use of biomass. For example the company Uniconfort, of Padua, uses biomass to fuel 35 district heating networks for municipalities throughout Italy. For the town of Calimera in Puglia, Uniconfort also designed a combined heat and power plant that, by burning the trimmings from olive trees, produces an annual 28,800 megawatts per hour (MWh) for hot water and 8,000 MWh of electricity. Uniconfort estimates that this plant cuts air emissions of CO₂ by 4,500 tons a year [14].

Uniconfort is not alone. Termica Collefe is building another biomass-fuelled co-generation plant near Rome. It should be able to produce 300 GWh/year of electrical energy and 110 GWh/year of thermal energy when it becomes operational during 2012. Altogether, "Italy is an attractive market for wood biomass power projects, which have the strong support of the Italian government as the country strives to expand and diversify its alternative energy capacity", argues Rafael Santana, President and CEO of Gas Engines for GE Energy [15].

While national developments in Italian energy are important, we also need to register the significant regional variations in the country's conduct with renewable energy. The mountainous regions of Trentino Alto-Adige and Valle d'Aosta, for instance, are close to producing 100 per cent of their energy from renewable sources, and especially from hydro-electric power. In central Italy, high proportions of energy generation from renewable sources are also recorded in Tuscany (39.8 per cent) and Umbria (36 per cent), with Liguria registering the lowest levels of renewable energy production. In the south, Basilicata produced just under half its energy using renewable sources, with a high proportion from wind power and a more contained contribution from biomass [16].

Raizada [17] wrote that in Lombardy, Piedmont and Veneto, bio-energy and mini-hydro (1 MW or less) account for 64 per cent and 25 per cent of electrical generation from renewable sources. In central Italy, geothermal sources account for 77 per cent of renewable electricity generation and are entirely located in Tuscany. In the southern regions, which include the islands of Sicily and Sardinia, bio-energy accounts for 28 per cent and wind power 65 per cent of electrical generation from renewable sources.

Regional differences aside, to what extent has innovation propelled Italy's increase in renewable energy use over the past few years? Here, a historical perspective is useful.

2. ITALY AND INNOVATION

Like Germany and Japan, Italy industrialised late. This tardiness put the country under considerable pressure to innovate, and prompted some successes – notably by companies such as Fiat and Olivetti. On top of that, the destruction suffered by Italy during the Second World War led to the renewal of many industrial plants at higher levels of technology than existed before 1939. Italy became very innovative in particular industrial sectors, including telecommunications, defence, aerospace, machine tools, domestic appliances, and some scientific sectors. Large companies – not just Fiat and Olivetti, but also Finmeccanica and Pirelli – became national champions of innovation, before experiencing the labour disputes of the late 1960s and

early 1970s, and renewed competitive pressures since.

From the 1970s, small and medium enterprises (SMEs) concentrated in industrial districts in northern and central Italy led an economic boom. By 1991, it was estimated that there were 238 such districts, employing a total of 1,700,000 people [18]. These enterprises benefited from their proximity to the heartlands of Europe; they were also able to profit from limiting the collective bargaining power of employees by decentralising production and keeping employee numbers in each workplace low [19]. In some instances, these SMEs developed into larger companies, especially in the case of the clothing industry (for example, companies such as Benetton, near Treviso, and silk production firms around Como) [20]. By the 1980s, Italy was internationally discussed as a model of innovation in the widely-read book *The Second Industrial Divide*. The book's authors identified a cultural "tradition of familialism" as fundamental to the innovation capacities of Italian SMEs, reflected also in their reliance on family labour and networks [21].

Yet by the early 2000s slowing growth rates, inflationary pressures attributed to the single European currency and tough competition from Asian manufacturers led to debates about how Italian SMEs had suffered during the handover of ownership from the entrepreneurs of the 1970s to their sons and daughters [22]. Moreover, in Italian firms as elsewhere, the focus for innovation shifted from technological advance toward marketing and design. Innovation at Pirelli, for instance, concentrated less on tyres and cables, and more on the iconic architecture of its skyscraper headquarters in Milan, on motorcar racing promotions and on the graphic art of its annual calendars.

Despite all these pressures, however, in the first decade of the 21st century Italy did record a level of innovation slightly above the EU average. Yet the country's rate of adoption of new technology – particularly in products rather than processes – was slightly below the EU average [23]. On the other hand, when compared with other Italian industrial sectors including extractive industries, the production and distribution of electricity, gas and water in Italy have witnessed a high rate of adopting innovations. In part, this reflects Italy's relatively modest factor endowments in coal and oil, a weakness that has historically made Italy – like Germany and Japan, which lack indigenous oil and gas – quite aggressive in energy policy, innovation included.

In the 1950s and 1960s, the company Ente Nazionale Idrocarburi (ENI) exemplified Italy's dynamic approach to energy matters. Enrico Mattei led ENI's transformation from the fascist-era petroleum company AGIP into an energy group supporting Italy's post-war economic boom. ENI's discovery of methane gas and hydrocarbons in the Po Valley, and its imports of cheap liquid fuels, reduced Italy's dependence on imported coal. Between 1948 and 1962, ENI doubled its share of the amount of petrol sold in Italy. Yet Mattei achieved this by striking deals with Iran, the Soviet Union, Nasser's Egypt, the Algerian FLN and supporting the independence of Morocco. This stance led him into conflict with Italian, French and American foreign policies, as well as the leading international oil companies – the "Seven Sisters". Although Mattei died in a suspicious private plane crash in 1962, he succeeded in diversifying ENI into chemicals, synthetic fibres and fertilisers. The prices of basic chemicals fell significantly in the late 1950s and the conversion of energy from coal to oil and gas led to major savings for Italian industry before the 1970s. Then, after

suffering losses during the oil price hikes of the 1970s, the rationalisation of ENI during the 1980s brought a return to profit. It was partly privatised during the 1990s.

The National Electrical Energy Agency (ENEL) also introduced important, although less aggressive, innovations. Created in 1962, ENEL began a programme of extensive investments, which achieved the creation of a national electricity grid from locally divided systems, as well as the development of thermo-power.

Nevertheless, even though ENEL managed to unify user tariffs across Italy, it did not succeed in reducing costs for consumers – in part, perhaps, because its planned nuclear programmes were blocked (we turn to this shortly). More recently, innovation at both ENI and ENEL has weakened alongside low investment in research and development (R&D). In 2009-2010, ENI invested just 0.2 per cent of sales in R&D, with the figure for ENEL even lower at 0.1 per cent. As a symptom of the latter's sclerosis, ENEL was publicly acknowledged as Europe's most indebted utility in May 2012.

Despite the weakening of Italian energy innovation over the past 20 years, there have been some recent energy-related innovations. For example, ENEL opened the world's first hydrogen power plant at Fusina, near Venice, in July 2010; it was reported as producing energy without CO₂ emissions [24]. This plant cost €50 million and has the potential to generate 12-16 MW of electricity. Yet such a capacity is tiny if compared to, say, the 1,000-1,500 MW of a typical nuclear power station – which also emits no CO₂ in its generation of electricity. Though the hydrogen plant was publicised as a unique innovation in renewable energy, more efficient alternatives should have been explored for this location [25].

Such developments show that Italy is not immune to the international tendency to prioritise what one environmental writer calls “showcase eco-projects” [26] – what we might term low-risk, largely cosmetic innovations designed to meet short-term political needs. Most solar installations in Italy, and its hydrogen power plant, are inefficient producers of energy, and emission-free energy can also be generated using more powerful options than these. Italy's development of solar and hydrogen has been driven not so much by innovation, as by the slowing of the country's general impetus to innovate, the increasing paralysis of its government, and the country's general subordination to EU policies which favour carbon reductions more than they do technological advance. Italy now urgently needs long-term energy planning, so as to replace inefficient, prestige projects and the short-term, reactive decision-making upon which they are based.

3. THE FRUSTRATION OF NUCLEAR REINFORCES UNIQUELY LARGE ENERGY IMPORTS

Given its history of industrial innovation and its limited energy reserves, Italy spent much of the 1970s and 1980s planning the construction of new nuclear power stations. But opposition to nuclear power from Italy's environmental movement, together with a growing alienation, on the part of the political classes, from risky, large, hard-to-finance high-tech projects, have together shifted priorities away from nuclear power, and toward renewable energy.

Italy's limited oil and gas supplies have created a long-term dependency on

imports. In January 2011, Italy's crude oil reserves were estimated at 423,700,000 barrels (bbl), which placed the country at number 52 in the world ranking of oil reserves. Italy's gas reserves are 0.04 per cent of the world's total; imports accounted for 89 per cent of its total volume of consumed gas in 2010. That year, Italy was the fourth largest gas importer in the world after the US, Japan and Germany. Since the 1973 international oil shock, rising oil prices have put pressure on Italian governments to find new sources of energy. Now, though predicting the course of oil prices is always difficult, there is the possibility that Italy could be hit by the rising oil prices that are likely to follow the July 2012 EU embargo on crude oil imports from Iran. Italy imports 13 per cent of its crude from Iran, making some of its oil refineries vulnerable to closure. This would only add to the long-term problem of Italian energy dependency.

The shifts in energy policy from the early 1970s have conditioned the direction of energy innovation. In 1975, a new national energy plan focused on developing 19 nuclear power plants to add to the one functioning plant at Caorso. Then, in the 1980s, a formidable environmental movement emerged to challenge nuclear power [27]. After the nuclear accident at Chernobyl in Ukraine in 1986, anti-nuclear campaigns in Italy culminated in three referenda on nuclear power in 1987, all of which resulted in a popular rejection of it. As a result, Italy's nuclear programme was phased out.

Following the abandonment of nuclear, Italy's dependency on imports of energy increased. The country also made innovations in commercial practice and law, so that it could import electricity produced at nuclear plants abroad. ENEL established joint ventures with nuclear producers in France, Slovakia and Spain. In an interview with Bloomberg TV in May 2011, ENEL chief executive Fulvio Conti confirmed that his company would continue investing in nuclear in those three countries, so as to import electricity back to Italy. However imports from nuclear installations have more recently stalled, because of the EU-mandated stress tests that have followed the Fukushima nuclear accident in Japan in March 2011. As a result, for example, the Slovak utility Slovenske Elektrarne, which is part of ENEL, has announced delays from 2012 to the end of 2013 and into 2014 for the start of operations for two units at its Mochovce nuclear plant.

Meanwhile, since the demise of nuclear power in Italy, the country's imports of electricity and gas from other countries have soared. Italy has become the world's largest net importer of electricity; it also runs imports of energy at about 86 per cent of national energy consumption, which is far higher than the EU average of 52 per cent.

The consequences are predictable. Italian consumers and companies pay some of the highest electricity bills in the EU. In 2010, companies in Italy paid twice as much for power as those in France, 40 per cent more than those in the UK and 27 per cent more than those in Germany [28]. Dependency on foreign imports has also meant that gaps in supply from other countries have increased the risk of blackouts in Italy. Italy's first national blackouts for 21 years occurred in 2003, mainly because of shortfalls in nuclear electricity supply from France.

Eventually these problems prompted a revision in political thinking. In 2008, legislation was passed to permit the building of new nuclear facilities – a key election

pledge that Silvio Berlusconi made when he was elected prime minister in that year. By April 2010, accords were signed between ENEL and the French energy company EdF to build at least four European Pressurised Reactors (EPRs) from 2013. However, after the events at Fukushima, Japan, prompted fearful responses in Italy, Berlusconi sought to buoy up his declining popularity by first announcing that his government's own 2008 nuclear legislation faced a one-year moratorium, and then failing to campaign for this legislation in a national referendum in June 2011. On 19 April 2011, Paolo Romani, Italy's then minister for economic development declared: "The decision to abolish legal measures for the construction of nuclear power stations is perfectly in line with the strategies announced by countries like Germany, the United States, Japan and Russia".

More than 90 per cent of participants in Italy's June 2011 referendum voted against reviving nuclear power. Following on from that, Italy's dependency on imports continued to be problematic. In February 2012, during a cold spell of weather, Russian gas exports fell by 15 per cent as Russia prioritised its own gas needs and, to provide for domestic consumers, Italy restricted supplies to businesses. Italy relies on Russia for 32 per cent of its gas imports, with a similar amount coming from Algeria, and approximately 10 per cent from the Netherlands.

As with other members of the EU, energy decisions in Italy have increased the country's interest in gas from Russia: "European countries... have concentrated on trimming demand, developing renewable energy sources, and striking individual deals with Russia. Germany's shut down of its nuclear plants and Italy's decision not to restart its nuclear program post-Fukushima will further increase Europe's reliance on Russian gas", commented Robin Mills, head of consulting at Manaar Energy [29]. More than 50 per cent of Italy's electricity is generated from gas. Imports of oil and gas by Italy's energy giant ENI are projected to rise, following big finds of oil off Mozambique and Norway, the revival of Libyan production, and new start-up projects planned in Russia, Venezuela, Angola and Kazakhstan [30].

The upshot of all this is simple enough. Italy's unbending exposure to imports, and the stalling of its nuclear programme, have led successive governments to support, with the backing of Brussels, the development of renewable energy.

4. HOW REGIONAL GOVERNMENT, THE ITALIAN STATE AND BRUSSELS HAVE "ASSISTED" RENEWABLES

Geographical differences between Italy's regions obviously influence the production of energy by renewable means: mountains make for hydro-electricity, while coastlines can support offshore wind. At the same time, regional economic incentives have also strongly affected the uptake of renewable energy, and in particular that of solar power.

Given that southern Italy receives more sun than northern Italy, one would not expect Lombardy to have 20 per cent of the nation's solar projects. Yet that is the position, according to Ariel Nachman, who works for Milanese lawyers Simmons & Simmons, and who has witnessed high solar subsidies in the Lombardy region. "Several years ago the Italian government began a process that would see 20 per cent of its energy for electricity come from renewable resources and as a result the different regions set up aggressive incentives for the production of photovoltaic electricity

plants”, said Nachman [31]. By the end of 2011, the Lombardy region ranked second behind the southern region of Puglia in terms of installed solar power.

Incentives from the national and regional state, as well as those made available by European bodies, have largely driven energy generation from renewable sources. EU subsidies to support the Europe 2020 targets, including that of member states generating 20 per cent of their energy from renewable sources, focus on innovation through what is termed the RandDandI state aid programme. In the spring of 2011, the European Commission’s Scoreboard showed that RandDandI state aid stood at 0.09 per cent of GDP in 2009 against 0.05 per cent in 2005. “In 2009, €13.2 billion of state aid was granted in the EU for environmental objectives, either as direct aid or through tax reductions and exemptions”, reported States News Service [32]. The highest proportions of state aid through RandDandI went to Germany, France and Italy, with Italy receiving 11 per cent of the total allocated. As a thin layer on top of that, the EU has also subsidised “sustainable” innovation, through its Competitiveness and Innovation Framework Programme, through which €35m were allocated in 2010 and an additional €35m offered for tender in 2011.

Since the late 1980s, many European countries have subsidised solar energy through Feed-in Tariffs (FiTs). Between 1992 and 1999, under a scheme known as CIP6, Italy introduced FiTs with a 15-year life span. Though a relative latecomer to FiTs, Italy found that, by 2010, its own had given a certain boost to solar technologies: “Italy has traditionally been behind other EU countries in terms of solar installation. But the new feed-in tariffs are very interesting because they haven’t just focused on ground-mounted traditional solar, they’ve looked to develop new technology innovation as well, such as solar concentrators ... It’s helping bring through new companies and technologies”, remarked Adam Workman, of CT Investment Partners LLP [33].

Since the late 1990s, through tradable green certificates (TGCs), renewable electricity (RES-E) in the EU has also enjoyed subsidies. In Italy, these certificates applied to all renewable sources, with the exception of those solar installations already supported through FiTs. TGCs enable energy to be sold at the market price plus the value of the incentive, which currently has a 15-year life span. It is claimed that TGCs have helped Italy meet its renewable energy target of 20 per cent, although as Adolfo Maza, Maria Hierro and Jose Villaverde point out, such support schemes are a key factor limiting a further uptake of renewable electricity [34].

Once subsidies have been accessed to meet targets, where is the incentive for further innovation? Also, the cost of the TGC scheme in Italy spiralled from €615 million in 2008 to an estimated €2.1 billion in 2011 [35]. Italian TGCs are gradually being phased out for wind power in 2012, with FiTs playing a more prominent role.

In Italy TGCs and FiTs stimulated a boom in renewable energy installations between 2007 and mid-2011, especially for solar photovoltaic (PV). This market, worth billions of Euros, boosted Italian renewable energy companies and attracted major international solar firms, including America’s First Solar and SunPower Corporation, as well as China’s Suntech Power Holdings, Trina Solar and Yingli Green Energy Holdings. In solar PV, the UK’s *Financial Times* recorded early in 2012, subsidies prompted a “rush of installations” at the end of 2010, so that at the end of

2011 a total of 9 GW of new solar capacity was connected in Italy, up from just 2 GW in 2010 [36].

By 2011 the Berlusconi government faced mounting pressure to make budgetary cuts. In June of that year Italy's fourth energy law reduced and redefined 20-year FiTs for PV installations [37]. These cuts led Gestore dei Servizi Energetici (GSE), a publicly-owned company that promotes renewable energy, to announce in January 2012 that there would be no budget for registering large PV solar plants in the second half of 2012, as funds had been used up by excessive demand in 2011. Nevertheless, small PV solar installations – defined as less than 1000 KWp on rooftops or on the ground, or less than 200 KWp using net metering or placed on public buildings – would still be eligible for subsidies.

Still further cuts and changes to FiTs are occurring due to the fifth Italian energy law, which takes effect from 27 August 2012. This new law has been legislated before Italy's ceiling of €6 billion on FiTs expires, an expiry that Becky Beetz, writing in *PV Magazine*, predicted for August or September 2012 [38]. These FiT reductions follow recession in Italy during the second half of 2011 and the first financial quarter of 2012, and the replacement of the government led by Berlusconi with a new technocratic government, led by Mario Monti, which finds itself under considerable budgetary pressure. The advent of this technocratic government, appointed in December 2011 to conduct economic reform, led to expectations of cuts in energy subsidies. Indeed, Beetz notes that, at a meeting on 6 June 2012 between representatives of Italy's national and regional governing bodies about the new energy law, "the regions did not push to decrease the level of tariff cuts or ask for an increase in the annual FiT budget".

Although the fifth energy law cuts FiT subsidies, a Reuters report [39] suggests that Italy's new government remains committed to expanding the share of renewable electricity demand from 26 to 35 per cent by 2020. The report records expectations of a cut of €3 billion per year in renewable energy incentives run under the existing support scheme. Incentives for solar production will be decreased by about 35 per cent on average, while incentives for the non-solar sector will be reduced by 10-15 per cent, as Leonardo Senni, head of energy at Italy's ministry for industry explained to Reuters. Under the new energy legislation, geothermal and hydro-electric power plants with capacities above 20 MW, as well as other non-solar power plants with capacities of more than 5 MW, will need to go through an auction to receive incentives. The overall cap for solar incentives will be set at €500 million a year, with cumulative spending on annual incentives limited to €6.7 billion. Incentives for non-solar renewable power energy will be capped at €5.5 billion, according to Reuters.

The fifth energy law FiT subsidies for solar installations are complicated and details are published in Italy's Official Gazette [40]. In summary, small-scale PV installations must be registered to benefit from subsidies, although exceptions are made in various cases including those that remove asbestos on roofs, public sector systems and ones using "innovative technologies". FiT funding for registered PV systems is divided into three tranches. €140 million will be available until 26 February 2013, when €120 million can be accessed for another six months. The final tranche consists of €80 million instalments until a total of €700 million is reached.

Significantly, large-scale PV plants that have not registered in the 2012 GSE rankings and are not installed on public property cannot qualify for 2013 FiT incentives provided by the fourth energy law (of 2011) and are subject to the new restrictions of the fifth energy law even if they started operating before 27 August 2012. Therefore the fifth energy law will restrict incentives to large-scale PV installations in favour of small PV units, which limits efficiencies of scale and we regard as a regressive step for reasons explained in section six below.

Despite this step and overall subsidy cuts, Senni is remarkably upbeat about the fifth energy law: “We made some changes in the system of incentives, and the system of volume planning, prioritising technologies that have a particularly positive impact in reducing carbon dioxide emissions and [that] favour the Italian economic system and innovation”. The impact of subsidies over the past five years suggests that this assessment of the new energy law in terms of its impact on the Italian economy and innovation is overly optimistic.

5. THE DOWNSIDE OF SUBSIDISING RENEWABLES

Incentive schemes to subsidise Italian renewable energy have become increasingly costly; from €1.7 billion in 2008, to €3.4 billion in 2010 and an estimated €6.4 billion in 2011. It is especially shocking that Italian consumers have met the cost of the vast majority of subsidies. “Of this cost, 80% is the so-called A3 component, shouldered by the final consumer through electricity bills”, notes Raizada [41]. To put matters bluntly, many energy companies, and the people that own them, have received huge subsidies, largely financed through excessive energy bills that have burdened many Italian consumers and firms. In addition, those better-off consumers who can afford to buy solar panels and sell back unused electricity to energy companies can reduce their costs, while low-income consumers who cannot afford solar panels pay higher bills – effectively to subsidise those receiving incentives for solar panels.

Two of Italy’s leading banks, Unicredit and Intesa Sanpaolo, have helped finance a third of the total number of projects in the renewable energy sector [42]. However, given today’s renewed financial storms in Europe, these banks cannot be expected to continue on this path – especially with Unicredit at the centre of Italy’s financial travails, and Intesa Sanpaolo reporting losses of €8.2 billion in 2011. The tightening of credit from banks in Italy will undoubtedly restrict the financing of many renewable energy sectors: “According to the most recent 2010 Italian data, wind energy registered investments for around 2 billion euros, an important achievement but 18 per cent less than in the past years, due not only to the ongoing international crisis but to the growing difficulty in securing access to credit: lowered credibility and stability of the local economy push banks to look for other markets”, reported NEWS Press [43].

Before the collapse of Lehman Brothers and the international financial crisis of 2008, investment in energy, as well as in other sectors, was distorted by the cheapness of credit and high government debt (especially in Italy); “[A] common core to all three crises – financial, food and energy – can be located in investment patterns that did not properly reflect pressing societal scarcities”, say Peter Feindt and Richard Cowell [44]. Despite a great deal of rhetoric about restructuring and innovating energy

according to renewable criteria, in many OECD countries – Italy included – reliance on subsidies has become widespread. Feindt and Cowell confirm this:

“Since the 1990s (and the 1980s in some countries) attempts have been made at ecological restructuring, with OECD countries introducing a number of policies – market support mechanisms, research and investment assistance – to foster renewable energy. Addressing climate change and fostering independence from fossil fuels have been major drivers, coupled with much rhetoric of realizing new “green” growth. Much of this transition has, to date, reinforced existing economical and infrastructural systems...In a number of countries, investments in renewable energies have become heavily reliant on finance from international and transnational capital investment funds.”

Italy is not among the relatively few countries that have followed Nicholas Stern’s recommendation that “green measures should account for 20 per cent of global recovery plans”. According to Feindt and Cowell, only China (38 per cent), France (21 per cent) and South Korea (66 per cent), have adopted that course. In most countries, “Green New Deal” responses to recession have merely increased state regulation and subsidies, rather than leading to what Feindt and Cowell term ecological modernisation (EM); “Almost wherever one looks, however, the Green New Deal as materialized in the stimulus packages shows little indication of more reflexive forms of EM; instead, trust in a combination of regulatory standards, state support and price mechanisms prevails,” they write. Moreover, state subsidies have propped up many inefficient companies, instead of allowing the creative destruction that, by wiping out unprofitable organisations, can improve efficiency. Feindt and Cowell conclude: “Such measures not only contradict in principle the Schumpeterian assumptions underlying the notion of ecological structural change and miss the opportunity to stimulate social learning; their overall effect might well be to retard more fundamental ecological restructuring in the pursuit of short-term (environmental) problem-solving”.

Through its reliance on subsidies, Italy has ignored the fact that they are a poor substitute for transformative energy policy and innovation with new technologies. Writing in *Foreign Affairs*, David Victor and Kassia Yanosek explain [45]:

“Many innovative ideas bubble up in laboratories and even attract early stage venture capital funding. But these ideas often die because when it comes to testing and deployment, governments throughout the world overwhelmingly support the least risky concepts, which often are the least innovative. Examples include biofuels derived from food crops and onshore wind farms – technologies that absorb the bulk of clean-energy subsidies, steering investors toward existing technologies rather than innovative ones. This pattern has unwittingly created an industry that is unable to scale up and compete with existing energy sources without government help.”

Italy also exemplifies how short-term subsidies for renewable energy have meant deploying established technologies more widely, rather than encouraging genuine technological innovation. As Victor and Yanosek add:

“The root cause of today’s troubles is a boom-and-bust cycle of policies that have encouraged investors to flock to clean-energy projects that are quick and

easy to build rather than invest in more innovative technologies that could stand a better chance of competing with conventional energy sources over the long haul. Indeed, nearly seven-eighths of all clean-energy investment worldwide now goes to deploying existing technologies, most of which are not competitive without the help of government subsidies.”

Since it faces particularly challenging economic times, Italy will have to reassess the subsidies and investment it makes in renewable energy against the merits of conventional energy generation. Electricity generated from coal is widely recognised as economically cheap, yet environmentally damaging in terms of greenhouse gas emissions. In the short term, though, coal can provide cheap electricity efficiently. For a developed country, Italy produces a relatively low proportion of its electricity from coal – 14 per cent, using 13 coal-fired power plants. Several more coal plants are being constructed and there is scope to expand this kind of electricity generation, although to do so would certainly mean relying heavily on coal imports. In 2010, moreover, ENEL started experimenting with carbon capture and storage at a pilot plant, and has earmarked €2.5 billion of investment to convert an oil plant at Porto Tolle, in the Veneto region, to coal with carbon capture. Even though environmental campaigners and Italy’s State Council blocked this conversion project, ENEL is still lobbying for it to gain government approval [46].

In the long term, restarting nuclear power generation would be preferable to coal. But how economical is nuclear power? The answer to this question varies in different locations, depending on sites, engineering expertise and available resources. Also, we need to take into account the impact of carbon trading markets, especially as, in April 2012, environment minister Corrado Clini declared his intention to introduce a carbon tax in Italy. Because nuclear power does not generate CO₂, carbon trading markets and a carbon tax make it advantageous compared with hydrocarbon plants, which would need to buy carbon tax certificates. When these factors are considered, nuclear power could provide an efficient contribution to the energy supply of a developed country like Italy. H. Holger Rogner, section head of Planning and Economic Studies Section at the International Atomic Energy Agency (IAEA), summarises the benefits of nuclear power as follows [47]:

“In some locations, coal with and without carbon abatement as well as CCGT are least cost generators, whereas nuclear power maintains its overall cost-competitiveness in other locations. Whether nuclear power is economical cannot be answered universally. As noted above, the availability and appropriateness of supply options depend on national circumstances.” They also depend on market structure, the regulatory environment and the investment climate in a given country. Moreover, the economics of nuclear generation relative to fossil-fuel – particularly coal – improves with carbon pricing.”

For Italy, nuclear power would be economically advantageous. In his interview with Bloomberg TV in May 2011, ENEL chief executive Conti stated: “The experience on nuclear is that on the long run, the extra cost for the initial investments are (*sic*) more than offset by the lower viable cost of the fuels”. When a range of issues is considered, nuclear power is a crucial part of the energy mix for a developed country like Italy. It is worth quoting Rogner’s conclusions at length:

“Today, the advantages of nuclear power with respect to sustainable development include low life-cycle GHG emissions, energy security during periods of price volatility, stable and predictable generation costs, previous internalisation of most externalities, small and managed waste volumes, productive use of a resource with no competing uses, firm base load electricity supplies, and synergies with intermittent energy sources. Finally, nuclear power is consistent with “weak sustainability,” since man-made assets such as reprocessing, advanced reactor and fuel cycles as well as other associated knowledge make up for resource consumption.”

In terms of cost-effectiveness and capacity, nuclear power should be central to Italian energy generation. Instead, due to the political reasons explained above, it has been solar technologies that have enjoyed official sanction.

6. SOLAR NEGATIVES AND POSITIVES

The Italian PV solar sector has witnessed huge increases in the cost of incentives, from €110 million in 2008 to an estimated €3.5 billion in 2011. That has led Raizada to point out that, according to a 2011 KPMG report, “PV is singled out as being under optimised given the high level of expenditure per TWh” [48]. An assessment consistent with this view could be that the enormous incentives for solar have been wasteful in terms of the resulting quantity of power generated. According to GSE, the Treasury agency that supports renewable energy, Italy reached 10 GW of solar PV capacity in September 2011. That figure was calculated adding up applications for incentives. By 3 January 2012, it had increased to 12.5 GW, with a cumulative annual cost of no less than €5.4 billion and a total of 319,000 installations made [49].

Subsidies support small-scale solar installations that produce tiny amounts of power for a relatively high cost. This is graphically illustrated in the top two regions for solar power capacity we have already encountered, Lombardy and Puglia, as reported in the Italian daily newspaper *La Repubblica* [50]. By the end of 2011, in the region of Lombardy 48,692 solar installations had been completed with a total capacity of 1,321 MW with an average capacity of just 27.1 KW per installation. The situation in the region of Puglia was slightly better, due to more extensive location of solar panels on the ground, rather than on individual roofs. At the end of 2011, Puglia had 22,926 solar installations, with a capacity of 2,186 MW – more than a sixth of Italy’s national solar capacity of 12,773 MW – and an average capacity of 95.4 KW per installation. Certainly, solar panels on domestic dwellings and around small companies are highly inefficient compared with fossil fuel plant generation; “Solar panels still cannot compete with fossil fuels when it comes to generating electricity relatively cheaply”, observe Sang-Chul Park and Dieter Eissel [51].

Given the force of the recession in Italy, the comparatively lower cost of energy from fossil fuels, and the vast subsidies provided for mostly small solar installations, the latest cuts to renewable subsidies were predictable. As Victor and Yanosek note of Italy and other countries during 2011 [52]:

“Italy, one of Europe’s biggest clean-energy markets, has just capped subsidies for solar energy... These cutbacks mainly reflect an increasing aversion to subsidies, but they also reflect the fact that as these technologies decline in cost, they no

longer require subsidies as large as before. Erratic government support is one major reason why total global investment in renewable energy plunged by one-third between the last quarter of 2010 and the first quarter of this year.”

As these authors hint, innovation and economies of scale have made solar electricity cheaper. The cost of solar photovoltaic (PV) panels fell by about 70 per cent between 2008 and 2011, helping make larger solar PV sites more economical. Most notably, a site opened in November 2010 near Rovigo, north-east Italy, and was hailed as the largest single-operating PV plant in Europe, with a capacity of 70 MW [53]. Two smaller plants with a joint capacity of 10 MW in Villaperuccio, Sardinia, have been operational since July 2011. Sardinia has also made an innovation, in the shape of a huge solar greenhouse over 27 hectares near Cagliari. On top of assisting crop growth in the usual manner, this construction generates electricity from its roof-mounted photovoltaic modules. Rated at 20 MW, it started providing electricity to the Italian national grid in August 2011.

In February 2011, contracts were agreed between ABB and REC Systems to construct a 24 MW solar power plant in Italy’s Lazio region, where construction of an 8 MW PV plant has also been contracted to Spain’s Solaria Energia. In addition, a joint venture between Japan’s Sharp Corporation and ENEL Green Power has created a new company, ESSE, to build solar plants using Sharp’s single crystalline solar cell modules. ESSE has already completed construction of a 5 MW solar generation plant in Calabria, and has announced plans to build similar plants, based throughout the Mediterranean region, the Middle East and Africa, that will produce more than 500 MW by 2016.

For solar energy, large-scale plants feeding the grid are a step in the right direction for Italy. The country also stands to benefit from a €400 billion EU project designed to set up huge solar panels in the Sahara desert, and transport electricity to southern Europe through underwater cables. Indeed, Giambattista De Ghetto, Senior Vice President for technology innovation and research at ENI, has identified solar energy installations in North Africa as a priority:

“Focusing on solar technologies, possible applications of photovoltaic and concentrating solar power are under evaluation in order to develop new cost-effective solutions to support our business, especially in the more favourable geographic areas where we operate, such as North African countries. The first solar system will be installed next year in Egypt to provide energy for electrical submersible pumps of three remote wells.”[54].

The development of large-scale solar installations, both inside Italy and feeding into it from abroad, is positive. The state, however, has provided too much money to too many small solar installations and the fifth energy law of 2012 exaggerates favouring these installations over large-scale solar plants. Italian energy policy urgently needs to be reformulated. In the first place, it needs to encourage a rebalancing of priorities toward forms of energy supply more productive than, and cheaper than, those which have been “assisted” by various kinds of subsidy to date. Second, across nuclear power, fossil fuels and renewables, Italy needs a clear policy of technological advance, both incremental and radical.

7. CONCLUSION AND RECOMMENDATIONS

In timely style, ISTAT's *2010 Annual Report* recommended what it called a "redefinition" of Italy's national energy strategy. Gianpaolo Attanasio, an associate partner at the accounting firm KPMG and the person responsible for a November 2011 report titled *Investing in Renewables: Trends, Opportunities and Perspectives*, goes further than ISTAT. He suggests that Italy's collection of ad-hoc initiatives in energy does not amount to a coherent energy policy. "Attanasio believes that what the country needs is a comprehensive national energy policy, not a hastily cobbled patchwork of incentives for various renewable energy sources", reports Raizada [55]. Even ISTAT [56] concluded that such state incentives can be counter-productive: "The current system of incentives, which although it has stimulated the production of renewable energy, is affected by certain distortions (such as the mechanism of "green certificates" that alter market dynamics, and risk restraining their potential for growth and innovation". Notwithstanding this assessment, many analysts can see no alternative, in renewables, to further subsidies for existing technologies. "Structural funds should represent a major instrument for the promotion of RES-E", recommend Maza, Hierro and Villaverde [57].

Despite the current Italian government's budget-cutting, environment minister Clini has announced that new subsidies will be provided for technology innovations to produce green power [58]. So the current government will continue the subsidised incentives that ISTAT criticised, but with further cuts to funding beyond those legislated in June 2011. In addition, following comments from industry ministry undersecretary Claudio De Vincenti that "relaunching national hydrocarbons output is one of the four main pillars of the new energy plan", Kash Burchett in *Downstream Today* notes speculation that the government plans to double oil and gas production [59]. This could be achieved by lifting the 2010 ban on offshore drilling within eight kilometres of the Italian coastline and 19 kilometres of environmentally protected areas – a ban introduced after the Macondo oil spill at BP's Deepwater Horizon platform in the Gulf of Mexico. A report from Platts news service predicts an imminent decree to reduce the drilling limitation to eight kilometres from the Italian coastline and therefore within the environmentally protected areas [60]. This would take at least a couple of months to be legally approved and faces opposition from Italian politicians.

Yet Burchett convincingly argues that reduced subsidies for renewables, combined with higher oil and gas production, represent little more than gesture politics aimed at deflecting public criticism in the face of rising energy prices. At just six per cent of national oil production, that done off Italy's shores is low; doubling production would have a minimal impact on end-user prices, considering that 54 per cent of petrol prices consist of tax, which the government wants to maintain for budgetary reasons.

Given that 89 per cent of Italy's total volume of consumed gas is imported, doubling domestic gas production would also have a relatively modest impact. Moreover, as most imported gas is indexed to crude oil prices, it is possible that gas prices could rise even if domestic gas production doubles. This could occur because of the previously mentioned problem of the EU ban on Iranian crude oil imports. On 30 March 2012, Italy's independent regulatory body for gas and power announced that

electricity prices for an average household would jump 9.8 per cent, including four per cent attributed to the cost of incentives for renewables [61]. While the new energy law will do little for energy innovation, it contains plans to cut consumption using smart meters, tougher building regulations and continued (lower) subsidies for renewables.

There has been positive progress with renewable energy in Italy, especially using hydro-electric power. ENEL reported that poor water conditions during the first quarter of 2012 have been partially offset by increased hydro-electric capacity installed – and this has the potential for further expansion. For instance, drilling has begun on the new Mulbach Rio Pusteria hydro-power scheme in the South Tyrol Mountains near Bolzano.

There are also some positive examples of large-scale solar projects. Nevertheless, the direction of enormous subsidies to a vast number of small-scale solar installations has not significantly increased energy capacity. The rather modest recent rise in the proportion of Italian electricity produced from renewable sources overall – from 23.7 per cent in 2009 to 26 per cent in 2011 – suggests that the leap in the quantity of solar installations has done little to support renewable electricity generation, especially considering the growing inputs from hydro-electric power, wind and biomass. The 2012 fifth energy law will exaggerate subsidies to small PV solar installations, while restricting subsidies for large-scale solar plants.

Given public unease about nuclear power, it was simply less unpopular to throw money at solar power than to build new EPRs in Italy. But in terms of economics and meeting Italy's energy needs, this may turn out to be a mistake. It might be best if Italy builds at least four better and cheaper versions of the EPRs presently under construction in France and Finland.

Altogether, nuclear and hydro-electric power should be at the centre of Italian energy policy, and large-scale solar could usefully be expanded. If nuclear power will take some years, both politically and technically, to become operational, a stronger role should certainly also be considered for cheap and cleaner fossil fuel energy production. Victor and Yanosek [62] argue that “[c]ompetition could be increased by allowing into the mix other clean sources of energy, such as safe nuclear power and newfangled low-pollution coal plants”.

Beyond nuclear fission, Italy is co-operating with Russia to develop IGNITOR, a nuclear fusion Tokamak reactor at Troitsk, on the border with Kazakhstan [63]. While fusion holds out the prospect of enormous electricity capacity, it has remained elusive as a power source. Yet Italy and Russia have made some commitments to this exciting technology. A memorandum of understanding was signed in April 2010, setting out a preliminary structure of co-operation between Italian and Russian teams. In late December 2010, the Italian government allocated €35 million per year for three years to the project with the Russian government committed to match those funds. However, this funding is minimal when compared with Italian subsidies for solar power, and there is no prospect of results for a number of years.

In the short term, Italy's adoption of innovations around shale gas has strong potential for boosting domestic energy production, as has been shown in the US. Italy has scope to exploit shale gas domestically and in other countries, but is only in the early stages of exploration. “Shale gas could open new ways of energy supplies in a

particularly delicate moment on the global level. Italy is in favour of looking into it”, declared Stefano Saglia, former state secretary at the ministry of economic development [64]. ENI announced that it is to begin shale gas prospecting in the western Ukraine during 2012; it is also planning to start shale gas projects in Algeria.

Innovation in energy is not just a matter of supply, but also of the supporting infrastructure of grids and storage. In this respect, it is positive that ENEL and NEC Corporation announced a strategic partnership in April 2011 to develop cost-effective smart grids and energy storage based on lithium ion batteries. This follows ENEL’s innovation with smart electronic meters, which won the 2010 European Utility Award (32 million have been installed over a 15-year period). In its 2012 development plan, Terna, a power grid operator, has also assigned €2.9 billion to grid projects that have been authorised or are in progress. These include constructing new power lines, upgrading urban grids in six Italian cities, and building new power stations in southern Italy for collecting renewable electricity. Power line and upgrading projects awaiting authorisation amount to €2.1 billion.

An energy policy supporting innovation could significantly reduce Italian energy imports and costs. Yet the current government is planning new subsidies for renewable energy that still promise to stifle innovation, even if overall funding will be reduced. Improving energy innovation and a new energy policy should be central to debate about replacing Italy’s unelected government with an elected one.

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