"First they ignore you....". The conventional electricity industry's rearguard action against PV: the German example.

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ABSTRACT

The increasingly rapid growth of solar photovoltaics (PV) in the last several years seems to have caught by surprise the established electricity industry of large scale centralised fossil fuel and nuclear based generation. Jolted from its previous complacency, the industry has mounted what may be described as a rearguard action of attacks on PV. Taking Germany as a key example given its leading position in PV deployment, this paper examines criticisms of PV by "Big Electricity" and rebuttals by PV advocates; argues that PV is in the ".... then they fight you" phase of Gandhi's dictum; and considers the likely outcome.

A saying widely attributed to Mohandas K Gandhi, in relation to struggle against the established order, is: "First they ignore you, then they laught at you, then they fight you – then you win". A similar four stage description could be used of the growth of solar photovoltaic energy (PV) in the face of the dismissal, derision and then opposition of the established 'conventional' electricity supply industry. This paper seeks to show how the comparison is valid; and to assess whether PV will successfully get through the third of Gandhi's four stages, and emerge victorious. It will focus in particular on attacks in the last few years on PV in Germany.

Early stages

(1) First they ignored PV ....

.... and indeed renewable energy sources in general. Several have been in use for centuries, notably water and wind power to do mechanical work e.g. in mills and sailing vessels, and biomass for heat. But their contribution to energy and especially electricity supply in the industrialised economies was until quite recently tiny.

Interest in renewables rose after the "oil shocks" in the 1970s, but still remained at a relatively low level, with more emphasis placed on nuclear power, the North Sea and energy efficiency as alternatives to OPEC oil. The prospect of renewables making a

substantial contribution to electricity supply did not seem even to be on the radar of the established energy industry, which held to a large scale centralised supply paradigm.

(2) Then they laughed ....

From the 1980s, renewable energy installations increased, deployment of wind energy in Denmark being a prominent example. The disaster at the Chernobyl nuclear plant in 1986 gave added impetus. Renewables were, however, still small in scale – in the case of PV, tiny.

The established electricity supply industry, henceforth 'Big Electricity' for short, began to notice the development of renewable energy. But it sought to dismiss renewables as minuscule in scope, too expensive, and decades away from any substantial contribution to power supplies. The corollary was that the world would continue to rely on fossil and nuclear energy, whose output would go on increasing as demand rose, in 'business as usual' scenarios. The dominant paradigm remained that of large scale centralised electricity generation. Renewables were regarded as somehow not a real "grown up" energy source, rather the realm of eccentrics living off-grid in caravans or mountain huts.

Characterisation of renewables, especially PV, as "too expensive" rather disingenuously ignored large subsidies given to fossil and nuclear energy, and the cost of externalities such as health costs attributable to those sources.

The laughter muted to an extent as concern about global warming, on top of the pollution and health risks of fossil fuel use, strengthened interest in renewables as the way to reduce carbon emissions. The line taken by Big Electricity evolved to portraying renewables as perhaps having a role to play, but not in the near future, with the supply system meanwhile relying on technofix solutions such as improved power station efficiency and the next generation of nuclear plants, which (as always) would be much better. Assumptions frequently stated by major energy companies and their sympathisers, for example Großmann (2008) and WEC (2004), are that energy demand

will continue to rise; renewables will not be available on a large scale soon enough; decentralised energy supply will be part of the future system, but it is unclear *when* that future will arrive; fossil and nuclear power plants will continue to be needed. As pointed out in Tageszeitung (2009), "the so-called forecasts of the established electricity industry are not useful, because they are first and foremost driven by vested interests .... The forecasts of supporters of renewable energy have, moreover, always turned out to be accurate." (author's translation from the German).

The International Energy Agency's forecasts have long implied an assumption that the established supply paradigm will continue for decades. In its scenarios to 2050 published in 2003, renewables get a mention, but only as one item in a long list with energy efficiency, more use of gas, "cleaner coal" and CCS, nuclear (wrongly described as "zero carbon emitting"...), hydrogen (but only from coal, gas, nuclear or "biological agents"), and fusion. As recently as 2006, its World Energy Outlook stated that: "Fossil energy will remain dominant to 2030", predicting an increase in global primary energy demand of 50% by then. The 2008 edition assessed that "Oil is the world's vital source of energy and will remain so for many years to come, even under the most optimistic of assumptions about the pace of development and deployment of alternative technology.", adding however that "Modern renewable technologies grow most rapidly, overtaking gas to become the second-largest source of electricity, behind coal, soon after 2010.". The latter date is at odds with the view in the IEA's 2010 roadmap for nuclear power, which envisages it being the single largest source of electricity in 2050, at 25% of global supply from 1200 GW capacity. Its 2010 'BLUE Map' scenario for 2050 includes 24% nuclear, 17% CCS equipped coal capacity, and 48% renewables.

The IEA plays down the potential of PV, for example in its 2007 fact sheet on renewables: "Even with these supports, PV is not expected to be generally competitive until after 2020 – although it will continue to compete well in a growing range of market niches in which the cost of deployment supports is moderate.". Its World Energy Outlook in 2010 forecasts only a 2% share for PV in global electricity generation at 2035. In the IEA's

roadmap for PV published in 2010, the PV share of global electricity supply reaches only 11% by 2050. That publication is also conservative in predicting that "PV will achieve grid parity – i.e. competitiveness with electricity grid retail prices – by 2020 in many regions.". PV is now expected to reach grid parity in Germany in 2012/13. On the other hand, there is an interesting comment in the IEA's 2008 Energy Technology Perspectives report, which does not refer to 'economic cost', frequently used by vested conventional energy interests to argue against a shift to renewables. Instead it states: "This expenditure reflects a *redirection* of economic activity and employment, and not necessarily a reduction of GDP." (emphasis added).

With regard to growth in new renewable energy generation (additional to existing biomass and hydroelectric capacity) the focus has been primarily on wind. Much investment in that sector has been by major electricity companies, which may perceive it as less of a threat to their interests because it is susceptible to large scale deployment, control – and sale of the output. RWE recently announced (reported in Photovoltaik, 2010) that it is getting out the PV business, because it does not offer efficient use of its capital; its aim is to "industrialise" renewable energy, which is consistent with the large scale centralised model.

It is necessary to bear in mind that the purpose of a company is to make profit and maximise shareholder value (see e.g. Bakan, 2004). Accordingly it is natural that large electricity utilities should seek to maintain the supply paradigm on which their profits depend. As the late Hermann Scheer put it: "Since we are aiming at a fast transition towards renewable energy, decentralized power production is the only option: its installation can happen considerably more quickly. It is not by coincidence that the number of power companies that prefer a super-grid solution to the feed-in tariff concept, which at its heart is a decentralized one, grows stronger every minute. They recognize it as a convenient way to circumvent the decentralization of the global power structure and to thus perpetuate their monopolies." (quoted in Girardet & Mendonça, 2009). Dr Scheer, whose doctorate was in economics, also explained why the companies

do not switch from 'conventional' to renewable energy. Their investments in power plants and other infrastructure occur at various times, and have amortisation times measured in decades, so there will never be a point at which all investments have fully generated their expected returns. To switch to renewables would always mean some 'stranded investment', and loss of shareholder value. The companies will therefore seek to continue the status quo indefinitely, and at least to delay the shift to renewable energy for as long as they can (Scheer, 2007). Growth in renewable energy capacity to the extent that it provided a substantial proportion of Germany's electricity supply – meaning 35%, the German government's current target for 2020 (BMWi & BMU, 2010) – would obviously supplant a similar part of Big Electricity's business, even allowing for some demand growth which partly offset that loss of sales.

(3) Then they fought ….

Following Germany's introduction in 2000 of a feed-in tariff, improvement of its terms in 2004, and adoption of similar incentives in other countries, the build-up of PV was rapid. Figure 1 below shows annual growth in Germany. PV thereby came onto the radar as a serious source of electricity generation, in the GWp/TWh league. In 2009 it accounted for 1.1% of Germany's total supply, which rose to 1.9% in 2010 (BMU, 2011). Given its rapid and sustained growth rate as shown in Table 1 below , simple arithmetic permits projections that it will reach a substantial percentage of electricity supply in the fairly near term, viz. by 2020. Even a conservative assumption of annual growth of 30% would result in a PV share of 19% in 2020, comparable to the present share of nuclear energy.

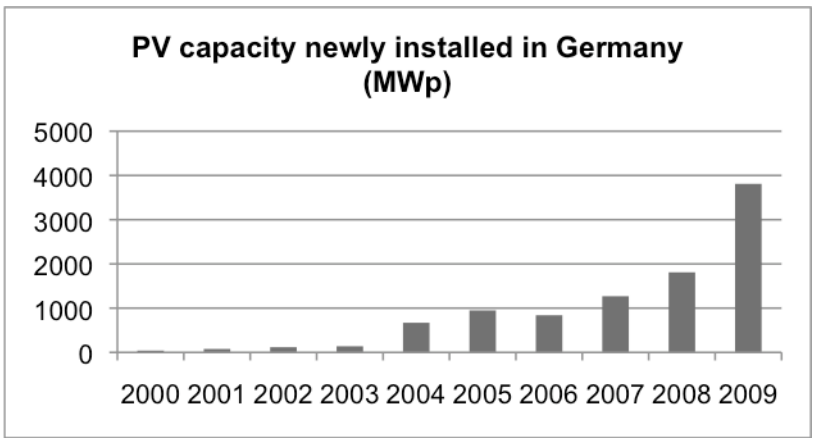

Figure 1 : annual growth of installed PV capacity in Germany in MWp, 2000–2009 (data source EPIA & Greenpeace, 2011)

Year	Capacity added (MWp)	annual growth	Total installed capacity (MWp)	Electricity generated (GWh)
2000	44		76	64
2001	110	145%	186	76
2002	110	59%	296	162
2003	143	48%	439	313
2004	635	145%	1074	556
2005	906	84%	1980	1282
2006	832	42%	2812	2220
2007	1165	41%	3977	3075
2008	2017	51%	5994	4420
2009	3806	63%	9800	6200

Table 1 : Development of PV capacity and electricity output in Germany 2000-2009 (source: "Renewable Energy Sources in Figures" 2010 English edition, German federal environment ministry, June 2010)

The acceleration in PV capacity seems to have acted as a wake-up call to Big Electricity in Germany regarding the threat of renewable energy, and especially PV, as a credible alternative to the established supply paradigm and hence to its domination of supply (and of the resulting profits). As Einstein observed, one cannot solve a problem with the mindset which created it. Large electricity companies which profit from controlling supply are not likely to be very keen on individual citizens having their own rooftop power stations. It is as Sawin (2007) predicted: "The conventional energy industry will be surprised by how quickly solar PV becomes mainstream – cheap enough to provide carbon free electricity on rooftops.".

Their reaction can be observed in the sustained attacks on PV in Germany by Big Electricity and its allies. Up to autumn 2009, it seemed that the possibility had gone for them to bring about a serious setback to the growth of PV in Germany. Renewables appeared to have become too important to the German economy – in terms of employment, exports and regional development – for any government to risk seriously damaging the industry. Solar PV employed 64,700 as of 2009, as many as the coal and nuclear industries combined, and renewable energy in total 339,500. Renewables are predicted by 2020 to provide 450,000 jobs even in a conservative scenario (BMU, 2010a), in a similar league to Germany's much vaunted motor industry, with 723,000 employed in 2009 (BMWi, 2010). The victory of the right of centre coalition in the federal election of September 2009, however, reopened the prospect of countering the PV threat.

Big Electricity lines of attack

PV opponents in Germany put forward the following arguments, as reported for example in Der Spiegel of 5 December 2009 (Spiegel 2009) in an interview with Christoph Schmidt, President of the Rhine-Westphalian Institute for Economic Research (German acronym RWI, about which more below) and member of the "Five Wise Men" panel of economic advisers to the German government; and in Renewable Energy World (online) on 15 December 2009 (Blau 2009).

(a) The PV feed-in tariff (FiT) burdens electricity users with huge costs, which bear no rational relationship to the value of PV. Module prices fell in 2009 by approx. 30%; therefore so should the FiT level. Manufacturers are making excessive profits.

(b) The projected cost in FiT payments for all PV arrays installed from 2000-2008, over 20 years as the EEG stipulates, is €35 billion. That figure would rise to €53bn by 2010. Yet PV generates only a tiny fraction of Germany's electricity.

(c) The increase in electricity tariffs announced for 2010 results from the cost of FiT payments, including the new "EEG Apportionment" system for dealing with the cost of grid transmission of renewably generated electricity.

(d) The FiT mechanism is economically very inefficient. The cost of it to electricity users reduces their purchasing power, with negative effects on consumption and employment.

(e) The EU Emissions Trading System sets a permitted level of overall emissions. Therefore any emissions reduction which results from PV capacity build-up is simply replaced by emissions elsewhere, and brings no environmental benefit.

(f) Better ways to reduce CO_2 emissions in electricity generation are carbon capture and storage (CCS) and concentrating solar power from north Africa.

(g) Increasing PV capacity makes grid operation difficult.

The following section briefly reviews these lines of attack, and counter arguments by PV supporters. For a more detailed examination see Plater (2011) forthcoming.

PV is "too expensive"

Big Electricity in Germany, perhaps realising that the claim that PV *technology* costs too much is rapidly becoming untenable given the record of cost reduction shown by PV's experience curve, has in the last few years taken to attacking instead the cost of feed-in tariff *support* for PV. They do not acknowledge that it is the growth in PV capacity, encouraged by the FiT, which drives down PV cost: "When demand for oil and coal increases, their price goes up. When demand for solar cells increases, the price often comes down." (Gore, 2008). It would serve their interests to slow down that cost reduction by cutting support, impacting on the growth in PV capacity.

A series of papers and articles have appeared about the "burden" on electricity users of FiT costs. Big Electricity has sought to blame those costs for increases in the electricity

price. Each claim has been followed swiftly by patient rebuttals, from the Environment ministry and others, including the points that electricity price rises are substantially greater than FiT costs could justify and that electricity companies are not passing on to consumers reductions in the cost of electricity on the Leipzig market (Enkhardt, 2010; Bundesnetzagentur, 2010). Those reductions are due in part to the "Merit Order Effect" of renewable generation, which largely offsets FiT support costs but which, if electricity companies can avoid passing it on, translates into extra profit (Sensfuß & Ragwitz, 2007). Since electricity generation and transmission are both part of the same businesses, they are hardly likely to accept lower revenues in one of those arms.

A source of attacks on PV in Germany often cited in the media, by politicans and by the electricity industry, is the Rhine-Westphalian Institute for Economic Research (RWI). It periodically issues reports on similar lines, each time swiftly rebutted by, among others, the Environment ministry and the solar industry.

RWI is in Essen – as is the head office of RWE, one of the "Big Four" electricity companies in Germany. The links between the organisations go deeper than the similarity of location and acronyms. The current President of the 'Friends and Supporters of RWI' is Dr Rolf Pohlig, the Financial Director of RWE; he took over the RWI role in June 2008 from Dr Dietmar Kuhnt, Chairman of RWE. The RWI website (www.rwi-essen.de/freunde-und-foerderer) states that the Friends and Supporters support the Institute financially, and thus make possible activities which go beyond its base provision – which from the same website appears to be for basic research and "evidence based political advice". As SFV (2010) comments, that is one way of putting it. Those links give rise to the question whether RWI is simply a mouthpiece for Big Electricity, putting a 'research institute' veneer onto its attacks against PV.

RWI reports – for instance Frondel et al (2007), Frondel et al (2009), Wirtschaftswoche (2010) – appear to experience some difficulty in distinguishing between annual or short term costs, and cumulative costs over 20 years or more. They tend also to such "apples

and oranges" comparisons of cumulative costs with only short term benefits; and to project current PV feed-in tariff costs decades forward, without allowing for the planned (and in the last two years accelerated) degression in FiT rates, and the effects of PV's reaching 'grid parity'.

The federal Environment ministry has rebutted the RWI criticism of the EEG renewable energy support law as "well known and refuted a long time ago" (BMU, 2009a). Neidlein (2009) also set out cogent evidence countering RWI's rhetorical number games. The Environment ministry calculates that Germany in effect makes a substantial 'profit', of approximately €6bn in 2009 (BMU, 2010b), by supporting renewables. That is the net balance of FiT support costs, grid upgrade and transmission costs, versus avoided fossil fuel import costs, CO2 emission savings and other environmental benefits. It does not include electricity cost reductions through the Merit Order Effect, nor employment and tax revenue benefits. Frank Merten of the Wuppertal Institute has pointed out that the success of PV, thanks in no small measure to the FiT, has made it possible to reduce the level of support sooner than expected (quoted in Westermann, 2008).

Criticism that PV generates an insignificant amount of electricity in relation to support costs is becoming less credible as the PV share of electricity supply rises, as described above. It is moreover arithmetically inescapable that the scale of support costs about which RWI protests can only arise if PV capacity grows rapidly - in which case that capacity will not be insignificant.

The federal Environment Ministry issued in December 2009 an analysis of the effect of renewable energy support payments on the household electricity price (BMU 2009b). It states unambiguously that renewables are not, as Big Electricity claims, the driver of rising electricity prices. The ministry reportedly (Focus, 2010) calculated that the 2010 supplementary in-year PV FiT cut would mean a mere 0.3 €¢ per kWh lower element for FiT support in the electricity price, assuming that suppliers passed that on. The head of the energy regulator, the Federal Grid Agency, put at 0.2 €¢ per kWh the rise in the

electricity price element in 2010 which could justifiably be attributed to the increase in overall FiT support costs (reported in Eckert, 2009). An expert analysis commissioned by the Greens (Harms, 2010) concluded that the electricity price increase of 7.3% announced by RWE with effect from August 2010 was not justified. Falls in the spot market price should translate into a reduction of 0.1€¢ per kWh; instead, RWE was increasing the price by 1.5 €¢ per kWh. Electricity customers in Germany were paying altogether € 1 billion more than they ought.

Another facet of the "expensive PV" criticism is that it involves a high marginal cost of CO2 emissions abatement, as set out for instance in Sims et al (2003). That argument is, however, based on a short term and linear view: that we should first pick the "low hanging fruit" in carbon abatement terms, and leave options like PV for later. But unless PV production and capacity are built up from now, it will not become cheaper. Supporting PV build-up progressively reduces its cost level, achieving intertemporal optimisation (Creutzig, 2010), or to put it another way, joining the lower hanging fruit. Initial cost is a questionable argument for not developing a technology. On that basis, we would not now have such accessibly priced calculators, personal computers, digital cameras and mobile telephones.

As for the criticism that support for PV causes economic damage, reducing purchasing power, that would imply that feed-in tariff payments somehow destroy the money involved. On the contrary, it goes to owners of PV systems, who are at liberty to spend it. So the money remains in the economy (and does leave it in payments to foreign suppliers of oil, gas or uranium).

No survey or opinion poll was seen which indicates that electricity users in Germany are unhappy about PV support costs, nor that acceptance of renewable energy has declined. If such evidence was available, one would expect PV critics to cite it. Conversely, a survey in autumn 2010 by market research firm TNS Emnid found that 75% of Germans were ready to pay more to support solar energy, up to 2 €cents per kWh (BSW, 2010a).

Emissions reduction

Critics argue that since the EU Emissions Trading Scheme allows companies to emit up to a given limit, reducing emissions in electricity generation by building up renewables capacity will simply displace those emissions to elsewhere, e.g. more coal-fired generation, within the limit. That seems a complacent position to take; the aim is to reduce emissions, not merely stabilise them. Build-up of renewable energy works in tandem with emissions cuts to combat global warming. Professor Claudia Kemfert of the German Institute for Economic Research (German acronym DIW) has pointed out that each successive negotiation about the level of CO_2 emissions certificates must take account of the reductions in emissions resulting from the growth of renewable energy capacity, in order to maintain the effectiveness of emissions trading (Kemfert 2009, DIW 2010). That would appear more logical than the RWI position, which implies a static level of emissions permits.

Other options are better?

Advocates of carbon capture and storage (CCS) appear simply to assume that it will work, and not consider the downside risk of creating dependence on it to reduce carbon emissions, then finding that it does not deliver. The head of the IEA Clean Coal Centre recognises that it may not be economically viable until 2025 (Topper, 2008), and expects government help, i.e. subsidy. Electricity companies seem reluctant to meet the €1bn per power plant price tag (see e.g. Harrison, 2008). CCS would appear to be a costly and unnecessary gamble, motivated less by climate concern than by desire to continue the large scale centralised electricity generation system. "Today, this idea [CCS] is being used as a justification for building new coal-fired power stations, with the promise that in maybe 15 years the carbon could be captured. These promises won't be fulfilled. In any

case, carbon capture would cost much more than renewables, so why bother?" (Scheer, 2008).

The 'Desertec' proposal to build concentrating solar power (CSP), not PV, stations in the north African desert would preserve the paradigm of large scale and centralised power generation, enabling the established industry to control supply and sell the electricity: essentially just another large scale energy investment project. It should not come as a surprise if Big Electricity would prefer to sell CSP derived electricity, rather than be obliged to buy PV electricity from citizen owned rooftop power stations. With initial estimated cost of €400bn for projected output of just 15% of Europe's demand, it would not seem to compare well with renewables, whose output had reached 17% of electricity demand in Germany by 2010 with target for 2020 of 35%. The new German government's national action plan on renewable energy submitted to the EU (FRG, 2010) acknowledges that "In contrast to PV, concentrating solar power will in 2020 still make no contribution worth mentioning to electricity supply in Germany." (author's translation). For a thorough and detailed critique of the Desertec proposal, see Paulitz (2010).

Grid management

The German energy agency DENA claims that the present grid faces "congestion" because of PV generation, and could only cope with total installed capacity of 30 GWp by 2020. It has called for grid renewal including 3600 km of new lines (DENA, 2010), although in the context of taking power from wind farms in the north to consumers in the south – which would seem to imply that PV capacity even in the sunnier south will not be sufficient. Concerns have, however, conversely been expressed that in a few years from now PV peak summer output could equal typical seasonal electricity demand of about 40 GW ; see for example Rentzing (2011). Why this might be cause for concern rather than to be welcomed, including in terms of reduced carbon emissions, is not clear.

The German solar industry association BSW (2010b) rebutted the DENA argument, pointing to a survey by consultants Roland Berger of grid operators in areas with high PV capacity, who anticipate no fundamental problems in grid management even with rapid PV growth. BSW added that PV electricity is used locally, thus in practice somewhat reduces the load on long distance transmission lines. Only in a few rural areas with substantial wind and PV capacity but limited local demand would some grid strengthening be required. The Renewable Energy Association, BEE (2010) pointed out that DENA's own study of the grid published in late 2010 showed that renewables could contribute to the stability of the grid. The International Energy Agency assessed that: "As most of the [PV] energy will be consumer onsite, the problems for utilities to balance grid energy flows are likely to be manageable until very high levels of penetration are seen." (IEA, 2003). Studies in Germany support that prediction, e.g. Laukamp (2008), Cramer (2008).

The issue of grid integration of PV generated electricity would accordingly not seem in practice to be a serious obstacle to the further growth of PV capacity in Germany.

Conclusions

At present we are in the "then they fight you" stage, in Germany at least. What will be the outcome: "and then you win" for PV, or for the vested interests of the established electricity supply system and decades long lock-in to fossil and nuclear plants?

The next few years will be the critical period in Germany, up to and following the next federal elections due in September 2013. It may be that Big Electricity are now privately forced to accept that renewable energy is the future, and are now seeking to *delay* rather than prevent that future, in order to collect more years of profit by keeping already amortised nuclear and coal power stations in operation. Even if that is the case, however, there is the risk that Big Electricity will also be allowed to build new plant, on the basis of

claims of a "supply gap" (unjustified, but space prevents exploring that aspect). That would mean extending "carbon lock-in" (see e.g. Trancik, 2006) for decades, assuming that such new plant would be coal- or gas-fired, with phase-out of nuclear power now confirmed by the Merkel government – actually only a reversion to the existing Nuclear Law of 2002.

Globally, it is difficult to see the progress of PV being halted. The industry's growth, investment and scale make it a mainstream part of the energy sector. There is actual and potential growth in the USA, France, Italy, the UK, Ontario, Japan, China, India and many besides. Hardly a day passes without announcement of new PV projects, and their scale is increasing. More countries have adopted feed-in tariffs to promote PV, including China where the potential market is immense.

The achievement in the short term of Grid Parity can be expected to boost demand further, aided by developments in grid management and electricity storage. Climate policy should be an important driver, if enough governments grasp that only renewables plus energy efficiency can deliver the CO_2 emission reductions needed in the time available.

Big Electricity may achieve limited local successes, but that will amount to winning a few battles while losing the war. The solar age has dawned; PV will win.

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