

## Renewable energy

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By

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## 1. Introduction

As part of policies to combat climate change, there is a global commitment to increase the proportion of electricity generated from renewable energy sources, including hydro-electric, wind, solar and geothermal. This reduces the use of fossil fuels such as coal, oil, and gas, which produce CO<sub>2</sub> emissions and so contribute to climate change. National and global policies for renewable energies reflect the result of public debates and democratic decisions.

This growth in renewable energy is leading to changes in the structure of the electricity industry. This paper examines a number of aspects of these changes:

- The relative role of the public and private sectors. Businesses and the international institutions see the change as an opportunity to profit from a new sector created by these decisions, but evidence shows that the public sector remains central to developing renewables
- Restructuring in high income countries: the cases of Germany and the UK show how changes affect the power of multinationals, local companies and the public sector, and their implications for employment
- In developing countries, there are big opportunities to use sources of renewable energy to extend systems that can provide universal connections. But experience in Africa and Latin America shows that when the private sector captures business, the development of renewables suffers badly
- Renewables and 'off-grid' energy in developing countries: some donors and others argue that in rural areas of developing countries, small local electricity systems of solar and wind energy can provide cheap alternatives to extending the electricity grid itself

## 2. Public and private sector roles in renewable energy

Historically, the private sector has played little role in investing in renewable energy generation. Governments have been responsible for nearly all such investments.

By contrast, privatisation and other attempts to persuade private companies to make investments have produced very little results – and actually made things worse in Central America.

An active role for government and public sector utilities is thus a far more proven method for developing renewable energy than any expensive system of public subsidies for markets or private investors.

### 2.1. History: public sector investment in renewables

Historically, investment in low-carbon generation has been driven by government programmes and integrated state-owned companies, not by markets. In countries which already source over 70% of their power generation from low-carbon sources, whether hydro or nuclear: "investment has typically only occurred with substantial government intervention, even where markets have subsequently been liberalised".<sup>1</sup>

China is the leading current example of the development of renewable energy through public sector bodies using public finance. By 2012, renewables accounted for 20% of all electricity generated, a rise from 16% in 2005, despite great economic growth in the same period. Solar power produced 6.5 million kilowatts (KW), hydroelectric 249 million KW, and wind power 63 million KW. The process has been driven by a government commitment to finance the development of renewables by the state-owned generation companies. This has been on a huge scale: public spending on renewable energy is expected to total nearly \$300 billion between 2010 and 2015. In the process, China has also created a solar panel manufacturing sector which is now the world leader and obtaining much business in the USA and Europe.<sup>2</sup>

Chile, by contrast, which is praised by supporters of its strictly market electricity system, has failed badly in respect of renewables, which only provide 3.7% of the country's energy. The only recent major development is a US\$2.6 m?billion 360MW solar park in the Atacama desert, to be built by Iberdrola for the mining industry.<sup>3</sup>

### 2.2. Little 'leverage' of private investment from IFI loans

The World Bank and other IFIs have made extensive use of international public funds in their attempt to attract and support private sector investment in renewables. But the amount of private sector funding 'leveraged' by IFI loans for climate related projects is very small. Loans and guarantees from the World Bank and other donor funds account for nearly two-thirds of the costs of projects, and national governments for a further quarter: the private sector only contributes 8.4% - less than \$1 for every \$10 dollars invested by national and international public sectors.<sup>4</sup>

**Table 1. Climate-related loans by World Bank Group (USD \$millions, 214 projects, 2005-2011)**

	Total project cost	WB Group	GEF/CTF	Other donors	Government	Private sector	WBG/donors as %	Govt as %	Private as %
IBRD/IDA	12686	9569	0	113	2896	107	76.3%	22.8%	0.8%
MIGA	1762	1762	0	0	0	0	100.0%	0.0%	0.0%
GEF	9672	2979	737	945	3475	1536	48.2%	35.9%	15.9%
CTF	12406	2704	1869	3319	2859	1428	63.6%	23.0%	11.5%
<b>TOTAL</b>	<b>36526</b>	<b>17014</b>	<b>2606</b>	<b>4377</b>	<b>9230</b>	<b>3071</b>	<b>65.7%</b>	<b>25.3%</b>	<b>8.4%</b>
<i>IFC</i>	<i>7839</i>	<i>2608</i>	<i>0</i>	<i>0</i>		<i>secret</i>	33.3%	0.0%	secret

Source: WRI 2012<sup>5</sup>

### 2.3. Indonesia: missing geothermal energy

The specific case of Indonesia shows the same pattern. Indonesia has extensive potential for renewables, not only through wind and solar, but the biggest geo-thermal resources in the world, with a potential of 28GW. The government offers various tax reliefs, guarantees, subsidies, free data on potential geothermal resources, and grants for exploration which are only repayable if a site is developed.

Yet a recent review concluded that: "It is difficult to assess the extent to which investment incentives succeed in attracting investment": the private sector was deterred because it is reluctant to observe laws protecting forest areas. The private sector has only responded when the public sector is prepared to sign long-term power purchase agreements (PPAs), with government-guaranteed prices – using the Independent Power Producer (IPP) model which has seen so many problems with corruption and over-charging in the last 30 years.<sup>6</sup>

### 2.4. Deceptive auctions and failed investment: India, Brazil,

Some countries, including Brazil, India and South Africa, are also holding auctions, promising guaranteed public finance through long-term PPAs to companies which offer the lowest price on future renewable energy generation. But these auctions carry the same risks as other large-scale contracts or PPPs, including 'dive' bids and corruption:

- One risk is of unrealistically low bids, to capture market share, in the expectation of later renegotiation. In India, 18 out of 28 companies which won bids for solar generation failed to deliver and were fined 20% of the contract value; 5 received further fines of 40% after further delays. Similar fines were applied in Rajasthan against a company whose construction plans were found to be fictitious. The tendering process in Andhra Pradesh was also vulnerable to various forms of corruption and extortion.<sup>7</sup>
- Brazil has held a series of auctions, at which the average price for wind power has fallen sharply. In December 2012, it accepted private bids to build over 250 MW of wind projects – but the winning bids promised to sell at \$42 per MWh, implying such low profits that investment analysts have questioned how much of this capacity will in fact be built.<sup>8</sup>

### 2.5. Central America: more private, less renewable, more diesel

In Central America, private companies (including mixed public-private companies) now generate over 60% of electricity, compared with less than 1% in 1990. Over the same period, however, the proportion of electricity generated by renewable sources has declined from 70% in 1990, to 49% in 2011.

This is almost entirely due to the growth in the share of diesel oil generation. Since 1995 the capacity of renewables, including hydro, has doubled, but diesel capacity has increased six-fold. In the sub-region as a whole, diesel is now the second largest source after hydro, with 30% of the total. Indeed in Nicaragua, Honduras and El Salvador, diesel is the biggest single source of electricity generation – larger even than hydro.

The growth of privatisation has thus brought with it a move away from renewable sources, and the growth of the most expensive, polluting and non-renewable form of electricity generation.

### 3. Europe: liberalised market fails to deliver renewables

The experience in Europe presents a similar picture. Europe introduced a compulsory internal market in electricity in the 1990s, and has more recently adopted targets for renewable energy. But it is now clear that the climate change policies are incompatible with the market rules, because the cheapest options, fossil-fuel plants, must be discouraged in order for renewables to flourish. An attempt to provide a market solution by creating a carbon trading scheme, the ETS, failed. European governments are now creating mechanisms to develop renewable energy which involve public spending and the public sector.

These policies include some very different approaches with different implications. In Germany, a policy of explicit priority for renewable energy has simultaneously encouraged re-municipalisation, and created a large number of small firms and cooperatives, and undermined the dominance of the multinationals. In the UK, the government plans to create a new state agency to decide what power is required, and act as the single buyer of all electricity – but through long-term contracts with private companies.

#### 3.1. Germany: 'energiewende' (energy transformation)

In Germany renewable energy is now growing very fast as a proportion of electricity generation – much faster than anyone expected. By mid- 2013 the share of renewable energy was nearly 25%, with 25,000 wind turbines and 1.3 million solar photovoltaic facilities - and on 18 April 2013, for the first time on a working day, more than 50 percent of the entire country's electricity was generated by wind and solar power. The policy objective is for renewable energy to provide 35% of all electricity by 2020, and 50% by 2030, and 80% by 2050. Nuclear power stations will be closed completely by 2022. Gas-fired power stations and combined heating plants will become flexible backup sources. This process is known as the 'Energy transformation' [energiewende].<sup>9</sup>

The transformation is based on a law which provides guaranteed prices for renewable energy and priority over electricity generated from other sources. This was the result of effective long-term campaigns for environmental policies to combat climate change, and campaigns against nuclear energy, which culminated in the decision, after the Fukushima disaster in Japan, that nuclear power will be completely phased out. There is widespread public support for these policies.<sup>10</sup>

The growth in renewables is changing the structure of the electricity sector. The large private companies which have dominated German energy in recent decades – E.on, RWE and Vattenfall - only produce 6.5% of the renewable energy. The private companies are reluctant to develop renewable energy if it displaces more profitable forms of generation, especially as its profitability is subject to political decisions on tariffs. The companies have campaigned hard, but so far unsuccessfully, to stop or at least slow down the 'energiewende'.<sup>11</sup>

Part of the growth comes from the public sector. There has been a big revival of municipal electricity companies [stadtwerke], not only taking over distribution networks but also expanding into generation of electricity – especially renewables. Municipalities plan to boost their share of electricity production from a tenth to at least a fifth by 2020..

There is a much greater role for democratic political decision-making in planning, as well as in generation. Over 100 municipalities want to be "100% renewable", including large cities such as Munich, and the regions [länder] have set targets for renewable energy which add up to double the national target for 2020. The public sector is also responsible for developing the new 'smart' transmission grid necessary to manage the intermittent nature of renewable energy.<sup>12</sup>

- The city of Munich has decided that all its energy will come from renewables by 2025, and that all of it will be generated by the public sector. This was powerfully articulated in 2011 by Dieter Reiter, a Munich city councillor, addressing an international conference of economists: "Energy supply was one of the key sectors affected by privatization of formerly public enterprises. Today, energy supply is characterized by oligopolies of private energy suppliers. ...The transition to renewable energies is made rather reluctantly and only as a consequence of massive state subsidies and regulatory requirements...The example of Munich shows how the transition process can be sped up if a city owns a utility company. By 2025, our utility company aims to produce so much green energy, that the entire demand of the city can be met. That requires enormous investments – around 9 billion euros by 2025 – and can only be successful if the long-term goal is sustainable economic success rather than short-term profit maximization."<sup>13</sup>

The second part has come from the installation of solar and wind energy generators by private households, small and medium-sized businesses, farmers, and energy cooperatives – accounting for about half of all renewable energy production. Some even operate their own village distribution networks, but the connection to the grid remains as a

key source of guaranteed sales for surplus. The proportion of renewable generation operated by these groups may decline in future as they may be unable to provide energy on the scale needed for industrial users.<sup>14</sup>

This changes the structure of employment.

- Because of the technology, there will be fewer jobs involved in operating and maintaining generators, compared with nuclear or coal or gas power plants. Employment in coal and gas plants may be maintained while the nuclear plants are being closed.
- There are about 400,000 new jobs in the renewables sector. The great majority of these are in construction; energy efficiency measures in homes and business premises; and some in manufacturing equipment, rather than in operation of generating equipment.
- Because of the restructuring, there will be fewer people employed in generation with large multinational private companies – most obviously because of the closure of the nuclear power plants, but also because of the smaller role of the multinationals in renewables. So far, coal and gas generation has been maintained, while nuclear plants are being closed.
- There will be some new jobs in renewables generation, partly in the municipal stadtwerke, and partly in the small-scale private and cooperative producers. There will also be some more jobs in transmission, because of the expansion and development needed by renewable energy, including greater use of storage.
- Employment in distribution and supply could be broadly unaffected, as the new renewables are all connected to the grid. Because of the big switch from private to public sector in distribution (see section on ownership) a much greater proportion of jobs will be in the public sector.

The German union Ver.di supports the 'energiewende'. It calls for the creation of a national public sector transmission company to ensure the necessary investments, including greater storage, to manage the greater complexity of a system based on renewables. It also demands stronger requirements for workers to have basic skills and qualifications, to improve quality and deter the use of outsourcing, and for the extension of collective bargaining to cover workers in the small local renewable energy companies.<sup>15</sup>

### **3.2. UK: government agency guarantees long-term purchases from private power stations.**

The UK has in the past led trends to privatisation and liberalisation of electricity, as in other sectors. But the requirement for more renewable energy has led the current government to introduce a law which will effectively override the market and create a government agency to make investment decisions, and finance them.

The reason is a realisation that the market will not deliver the required levels of renewable energy. The UK committee on climate change advised that: "we should not accept the significant risks and costs associated with the current market arrangements... changes to the current arrangements are both required and inevitable." The UK regulator, OFGEM agreed: 'There is an increasing consensus that leaving the present system of market arrangements and other incentives unchanged is not an option.'<sup>16</sup>

But the UK plans involve long-term commitment of public money to private renewable power projects. A new energy law, the Energy Bill, is currently being debated in parliament. The main provisions of this bill are that new low-carbon generation plants would be given long-term power purchase agreements that guarantee the volume and price of sales at non-market prices – in effect, a series of PPPs. All or virtually all wholesale power purchases would be made by a central state agency, known as the 'counterparty body', effectively a single buyer, which would in turn sell the power on to retail suppliers at identical costs. This model seems to simply override the EU Electricity Directive 2003/EC/54, which prohibits single buyer systems.

## **4. Developing countries**

The historical evidence, and evidence from Europe, thus suggests that developing countries should be looking to develop renewable energy through the public sector, rather than expect such investment from private companies. This is strengthened by experience with major renewable energy opportunities, and with the alternative advocated by some for 'off-grid' electricity in remote areas, which usually results in a growth of diesel generation rather than renewables.

### **4.1. The huge potential for renewable energy in Africa**

The private sector is not a reliable partner for investing in major renewable energy projects. Multinational companies have abandoned the two largest renewable energy projects in Africa, Desertec and Grand Inga. Development of these projects now depends on governments and public sector utilities.

#### 4.1.1. Desertec: private sector walks away

Desertec was an ambitious plan to harness solar energy in the North African deserts to generate electricity. The Desertec Industrial Initiative (Dii) was set up by a group of major multinationals, mostly German, including Siemens, to establish a network of Concentrating Solar Power (CSP) plants in the deserts of Algeria, Morocco and Tunisia, creating 100GW of generating capacity by 2050 at a cost of €400-600 billion. The plan was to export most of the energy to Europe, to meet 15% of Europe's energy needs by 2050, using high voltage direct current cables under the Mediterranean Sea. Civil society organisations and unions in north Africa argued that the huge potential for solar energy should rather be developed to meet the energy needs of African countries, and should be subject to democratic control by African countries.

Now the private companies have dropped the initiative. In November 2012 Siemens pulled out, and in May 2013 Dii announced that the whole project was being abandoned. The company admitted that the project's initial export-focus represented "one-dimensional thinking", and failed to provide for the growing energy demands in Africa itself. North African governments and public sector utilities are now making their own plans to exploit this great potential source of renewable energy.<sup>17</sup>

#### 4.1.2. Inga III and Grand Inga: private sector walks away

The Democratic Republic of Congo has some of the largest hydro-generating potential in the world on the Congo river. Two dams are already in operation, with capacity of 1.8GW. Two other projects would provide even greater capacity: the planned Inga III dam could generate 3.5GW capacity, and the Grand Inga dam could generate 39 GW. Grand Inga alone would represent an increase of 40% in the electricity generation capacity of the whole of Africa.

The development of Inga III and Grand Inga was initially planned as an intergovernmental project – 'Westcor' - made up of the utility companies of five African countries – Eskom, South Africa; Empresa Nacional de Electricidade in Angola; SNEL in the DRC; NamPower in Namibia; and Botswana Power Corporation. The project would develop Inga III and distribute the energy generated to the grids of Angola, Namibia, Botswana and South Africa. The World Bank, European Investment Bank and African Development Bank would provide the financing.

But this was scrapped at the beginning of 2010 in favour of a private sector scheme. Why? The DRC government announced that it had decided to drop Westcor, and instead agreed that BHP Billiton, a major mining multinational, should develop Inga III, with its output used for the company's aluminium smelter in the Bas Congo province.<sup>18</sup>

Two years later, in February 2012, BHP Billiton announced it was abandoning the project. It pulled out of building the aluminium smelter, because of high construction costs, and was therefore no longer interested in the dam either: "The company has chosen to not continue the [smelter] project following a review of its economics."<sup>19</sup>

Governments and public utilities have therefore had to relaunch plans to develop Inga III and Grand Inga. Under a treaty between South Africa and the DRC, the South African government is providing USD\$20 billion towards financing the development, and the World Bank and African Development Bank are again expected to contribute. Half of the output will be bought by the South African public sector utility, Eskom, the rest is expected to be sold to the public utilities of other governments.<sup>20</sup>

#### 4.2. Off-grid electricity and diesel

The idea of 'off-grid' electricity is promoted by many IFIs, business groups and NGOs as an affordable alternative to extending electricity grids into rural areas. Local systems are encouraged by donors as viable ways of starting to provide electricity without waiting for connection to and extension of distribution and transmission grids.

These initiatives include, for example: the Global Lighting and Energy Access Partnership (Global LEAP), which is intended to catalyse markets for off-grid energy products and services; D.Light Design, which is committed to providing solar lamps to 30 million people in more than 40 countries by 2015; the Energising Development programme, which aims to provide modern energy access to eleven million people by 2014; and Lighting India, which plans to bring clean lighting services to two million people by the end of 2015.<sup>21</sup>

Such schemes however have limited benefits, because they fail to enable the use of electrical appliances which are crucial for social benefits and industrial development, and are hard to sustain because of lack of local capacity. They also encourage 'temporary' solutions, most often diesel generators, which are a profitable market for international companies but the worst possible option in terms of cost and impact on climate change.



#### 4.2.1. India

India has found little benefit from attempts to promote off-grid systems. The Ministry of New and Renewable Energy (MNRE) has run the Remote Village Electrification Programme (RVEP), based on 90 per cent capital subsidy, which claims to have electrified 9,000 villages. However, the RVEP “is rife with corruption and non-performance”, and very few off-grid projects have taken off.

If off-grid projects are commercially viable, then they are likely to be prohibitively expensive for poor villagers. A project in Rajasthan, using smart meters, was criticised for unaffordable charges. Universal connection to the grid is thus important to protect villagers from this kind of exploitation, according to a local expert: “It is important for main grid to reach small areas because many developers charge unfair tariff from the poor and do not want the grid to reach their areas of operation.”<sup>22</sup>

#### 4.2.2. Dominican Republic – off-grid as failure

The cost of off-grid provision can be seen in the Dominican Republic, whose electricity supply system experienced a major crisis in the early 2000s, as a result of privatisation. Many consumers turned to alternative self-generation units such as small diesel generators, inverters, kerosene lamps or large power generators (for large industrial consumers). Self-generation accounted for about 2,214MW, equivalent to 38% of total installed capacity. Consumers in the residential, commercial and industrial sectors had to carry the costs of equipment purchase, maintenance and fuel supply –in the industrial sector, about 60% of its electricity consumption became self-generated.<sup>23</sup>

#### 4.2.3. Africa: off-grid limitations and diesel generators

Many African countries rely on temporary power solutions, which are expensive. In a number of countries facing power shortages, the government has entered into short-term lease agreements with private companies who set up short-term plants using diesel generators. It is estimated that temporary emergency generators currently account for about 750 MW of capacity in Sub-Saharan Africa. Not only are temporary power solutions expensive, but because they use diesel, they are also a high carbon option. They do not provide a long-term solution by developing local capacity. They are also extremely noisy for local residents. The procurement processes for temporary power have also resulted in corruption and bribery problems: the Tanzanian Prime Minister and Energy Minister were forced to resign in February 2008<sup>24</sup>.

Attempts to develop rural electricity schemes in Tanzania and Mozambique failed because of lack of capacity, according to a study which also found that they usually involved temporary diesel generators:

“lack of access to human capital, to difficulties in planning and donor dependency, to low rural markets and little interest from private sector, and to more straightforward technical matters such as difficulties with installing electric equipment in traditional buildings.....Off-grid systems in Tanzania and Mozambique are most often powered by diesel generators and dependent on fuel transport for their operation. Thus, off-grid has a higher running cost per KWh than grid-connected system ... all respondents agree that they are inadequately managed and too expensive”.<sup>25</sup>

There is capacity in the public sector utilities, but it is not used. The public sector utility in Mozambique, EdM, has a reputation for efficiency, and is the only body in the country developing renewable energy, but is frustrated for lack of funding. It has: “a strategy to electrify rural centers with administration, schools, hospitals, industry, and business. The focus on poverty alleviation is strong.....but implementation ultimately depends on external funding.” The external funding from donors instead goes to a different body, FUNAE (National Fund for Rural Electrification), which is responsible for rural off-grid electrification. Its off-grid installations are “mainly diesel generators and solar PV systems in district headquarters, schools, and clinics”. And it is “strongly supported by donors”.

In Uganda, the government became frustrated towards the end of 2011 with the continued high charges by Aggreko, the supplier of emergency power plants at Mutundwe and Kiri. The government is planning to shut down all the emergency thermal plants.<sup>26</sup>

#### 4.2.4. Aggreko

Private companies benefit hugely from this demand for temporary power. The biggest beneficiary of these approaches is the UK-based multinational, Aggreko. Its business plan, set out in its 2012 annual report, is based explicitly on a continuing failure to extend the connections and generating capacity of utilities in developing country. In the years to 2020 :

“In our core market, which we define as non-OECD countries excluding China, we estimate that the shortfall will increase 9-fold, from 22GW to 195GW. The ultimate size of the shortfall will depend on both the rate of increase in demand and the net additional generation and transmission capacity brought into production during the period. We are confident that such a level of power shortage will drive powerful growth over the medium and long term in demand for temporary power as countries struggle to keep the lights on.”<sup>27</sup>

Aggreko is not just a passive beneficiary of this failure. It actively encourages governments to accept this failure, and rely instead on its diesel plants:

“our own activities serve to create market demand – Bangladesh and Indonesia did not figure highly in our estimates of market size a few years ago, but they are now important customers as a result of our sales efforts.”<sup>28</sup>

## **5. Conclusion: renewables through the public sector**

The public sector remains central to the development of renewable energy, for sound political, economic and social reasons.

The development of the energy sector in any country must be determined by transparent, accountable and participatory democratic processes. The public sector itself should be subject to constant challenge and improvement, through the same public and democratic processes.

Public democratic processes ensure that decisions are taken in the interests of the people as a whole. The development of renewable energy should not be based on a framework which privileges private company interests, enforced by the same kind of undemocratic conditionalities used by development banks in the 1990s to impose privatisation in the sector.

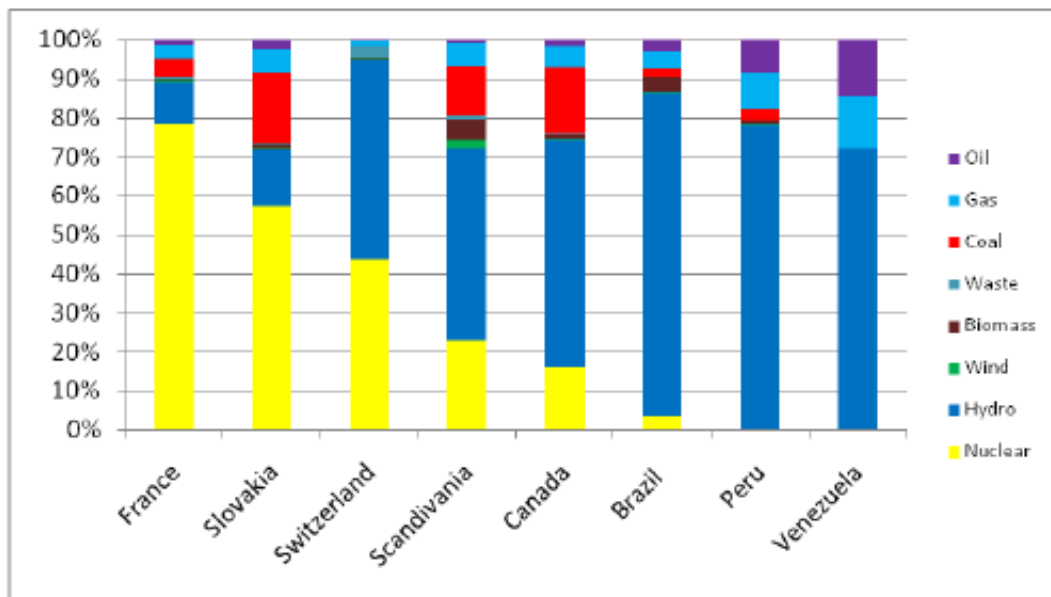
In developing countries, the twin objectives of extension of networks and expansion of renewable energy generation depend overwhelmingly on public finance, as they have done in high income countries in the north. The myth of ‘leveraging’ private investment is an empty promise for the development of renewable energy.

The public sector provides not only a means of financing investment in renewables, but also a collective resource of knowledge embodied in workers who are securely employed, paid a decent wage, and working in conditions that prioritise safety for both workers and public. It also has the flexibility to develop renewables on a large scale, and to support sustainable local electricity services.



Annexe: Charts and tables

Chart A. Generation mix in low-carbon electricity systems



Source: UK Committee on Climate Change, 2009. *Meeting Carbon Budgets –the need for a step change. Progress report to Parliament*. P.136-137 <http://www.theccc.org.uk/reports/progress-reports>

Table 2. Public-private generation in Central America 1990-2010

	Generación neta GWh		
	Pública	Privada	% privada
1990	14175.2	83.9	0.6%
1995	17160.8	2430	12.4%
2000	13370.6	13584.8	50.4%
2005	13739.6	20764.4	60.2%
2006	14790.3	21589.9	59.3%
2007	15116.8	23112.2	60.5%
2008	16130.4	23014.7	58.8%
2009	14835.0	24709.7	62.5%
2010	16334.0	24334.1	59.8%
2011	16789.4	25325.8	60.1%

Source: Centroamérica: estadísticas de producción del subsector Eléctrico, 2011. CEPAL/ECLAC [http://www.eclac.org/mexico/publicaciones/xml/6/46906/2012-014-Estad.subs.elect.-2011-L.1061-alta\\_res..pdf](http://www.eclac.org/mexico/publicaciones/xml/6/46906/2012-014-Estad.subs.elect.-2011-L.1061-alta_res..pdf)

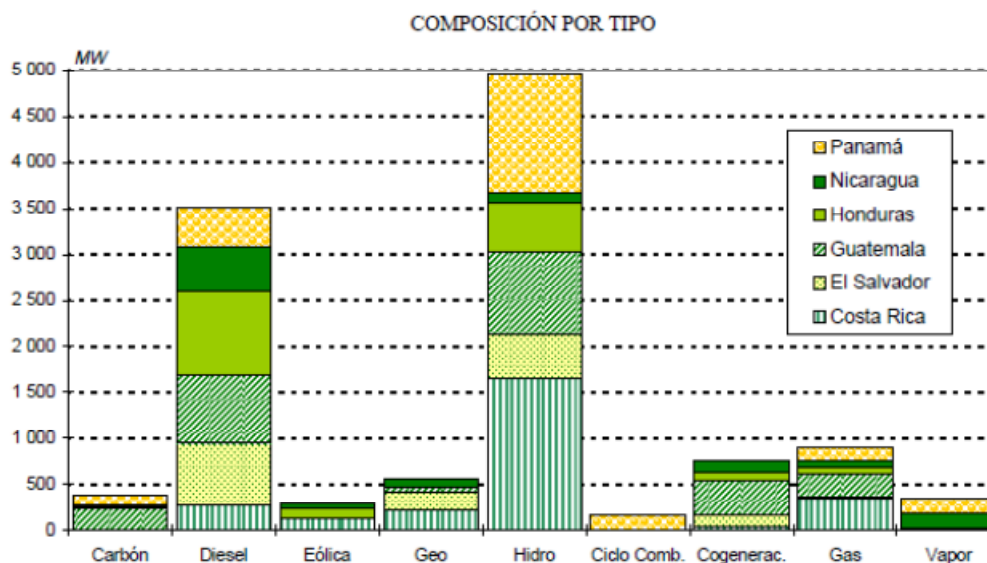
**Table 3. Central America installed capacity (MW) by type of generation, 1990-2011**

Año	Total	Hidro	Geo	Eólica	Tot renov	Renov % of total	Carbón /vapor	Gas/CC	Diesel	Diesel % of total	Tot thermal	Thermal % of total	Cogen
1990	4129	2709	165	0	2874	70%	520	518	219	5%	1256	30%	0
1995	5218	2797	235	0	3032	58%	474	1063	577	11%	2114	41%	73
2000	7258	3315	405	43	3762	52%	650	896	1745	24%	3291	45%	205
2001	7393	3312	409	62	3783	51%	750	826	1743	24%	3319	45%	291
2002	7893	3525	416	62	4003	51%	880	688	2011	25%	3580	45%	311
2003	8289	3728	434	69	4231	51%	787	771	2150	26%	3708	45%	351
2004	8865	3800	427	69	4296	48%	791	854	2504	28%	4150	47%	420
2005	9134	3881	437	69	4387	48%	791	829	2597	28%	4217	46%	530
2006	9369	4081	433	69	4583	49%	702	737	2744	29%	4184	45%	603
2007	9673	4244	502	70	4816	50%	710	771	2742	28%	4224	44%	634
2008	10246	4284	502	70	4855	47%	735	771	3196	31%	4702	46%	688
2009	10711	4287	507	160	4954	46%	749	911	3362	31%	5022	47%	735
2010	11205	4491	507	183	5180	46%	783	913	3605	32%	5301	47%	724
2011	11865	4959	559	298	5816	49%	726	1060	3504	30%	5290	45%	759

Source: Centroamérica: estadísticas de producción del subsector Eléctrico, 2011. CEPAL/ECLAC

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**Chart B. Type of electricity generation in generation in Central America 2010**



**Sources**

This briefing is based on a number of PSIRU reports on the energy sector, all of which are available on the PSIRU website at [www.psiru.org](http://www.psiru.org), including in particular:

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## Notes

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