IMPACT OF CSP and PV SOLAR FEED-IN-TARIFFS IN SPAIN, by Willem Post; 27 December, 2010
http://www.coalitionforenergysolutions.org/

INTRODUCTION

The purpose of this study is to show the impact of concentrated solar power, CSP, and PV Solar feed-in-tariffs, FITs, in Spain which has the largest installed base of CSP and the second largest installed base, after Germany, of grid-connected PV solar systems in the world about which much data is available.

http://1bog.org/top-10-countries-using-solar-power/

FITs for CSP and PV solar date back to 2002 and 2007, respectively. Prior to these dates, there were almost no CSP and PV solar systems in Spain, despite the fact that:

- insolation and flat land area in southern Spain are ideal for CSP plants which have capacity factors, CF, of about 0.26 without storage and about 0.40 with storage,

- the annual PV solar CF for true-south-facing, fixed-tilt, correctly-angled systems is about 0.175, which makes Spain a much better candidate for unsubsidized PV solar power than most European nations. For comparison: the CF of Vermont is 0.143, southern Canada (Toronto) 0.125, southern Germany (Bavaria) 0.115

http://www.nrel.gov/docs/fy06osti/39291.pdf

The FITs are lucrative for the households and businesses with grid-connected CSP and PV solar systems. They get to sell all of their solar power to the utilities at generous, fixed FIT rates for 25 years from date of installation.

Spain's utilities are allowed to include the additional costs of the FIT regime into their rate base. In effect, the few more wealthy households and businesses with solar systems are being subsidized by the many less wealthy households and businesses. At present, the renewables FITs add a few euros per month to household electric bills, more to business electric bills.

In 2007 and 2008, households and businesses have made multi-billion dollar investments in PV solar systems and borrowed money (much of it from foreign sources) with expectations of generous FIT cash flows for 25 years. These cash flows have become uncertain, because of Spain's precarious financial predicament; its 2010 budget deficit is 11.4 % of GDP (5 times higher than in 2008) and unemployment rate is 20% (2 times higher than the European Union average).

http://www.connectorsupplier.com/tech_updates_JB_renewable_8-3-10.htm

In 2009, the average wholesale rates at which Spanish utilities bought and sold were about 4-6 eurocents/kWh for base load power and 5-7 eurocents/kWh for peaking power.

Households with PV solar systems buy power for their own consumption from utilities at about 13 eurocents/kWh. Note: US dollar is about 0.725 euro.

http://www.energy.eu/

STUDY SUMMARY

The main results of the generous FITs have been multi-billion dollar investments in CSP and PV solar systems and multi-billion dollar FIT subsidies paid to the owners of such systems that produce just a very small quantity of variable, intermittent and expensive power and avoid the emission of a miniscule quantity of CO_2 per installed MW.

Capital Investments

During the 2002-2009 period that FITs were in effect, Spain installed a mix of 3,595 MW of CSP and PV solar systems by the end of 2009 at a cost of about 3,595,000 kW x $6,000/kWh = $21.6 billion.

Recently installed CSP systems with 6-8 hours of storage averaged about $8,200/kW. Future CSP-plant $/kW prices may decrease, but not to the $4,000/kW predicted by CSP proponents, because the technology of CSP plants is largely mature.

The 2009 PV systems averaged about $5,000/kW and the 2010 PV systems about 4,300-5,200 $/kW, depending on the type of installation. Future PV solar systems $/kW prices may decrease by a smaller percentages than predicted by PV solar proponents, because PV panel prices have leveled, but other costs are rising.

http://www.solarplaza.com/article/booming-german-pv-market-could-cost-ratepayers-70
http://www.gtai.com/fileadmin/user_upload/Downloads/Industries/Renewable_Energies/Photovoltaics/1_Englisch/IndustryOverview_Photovoltaics_August2010_GTAI.pdf

Solar Power Production

Spain's installed power plant capacity is about 93,000 MW. Its summer peak demand is about 41,000 MW and winter peak demand about 45,000 MW. Its power production was 251,300 GWh in 2009, of which CSP and PV solar power was about 6,936 GWh, or about 2.8% of Spain's production.

Some solar system owners were "augmenting" their solar output with nighttime operation of diesel engines and getting paid FIT rates for about 4.5 GWh of additional power. The Spanish government is investigating.

http://www.theecologist.org/News/news_round_up/465409/spanish_nighttime_solar_energy_fraud_unlikely_in_uk.html
http://www.aeeolica.es/userfiles/file/notas-de-prensa/100105-NP-Wind-Energy-has-consolidated-as-the-third-technology-of-the-power-system.pdf
http://www.ieawind.org/Countries/spain.html

If we assume solar power is produced from 7 AM to 7 PM, then the average level during these twelve hours was 6,936 GWh/yr x 1,000 MW/GW x 1 yr/(12 hr x 365 days) = 1,584 MW, insignificant compared to Spain's summer peak demands.

On a mid-summer day, clear sky all over Spain, all solar systems working perfectly, the maximum solar power that could be produced at about noon-time would be 232.4 MW (CSP at end 2009) + 3,363 MW (PV solar at end of 2009) x 0.85 = 3,090 MW; the 0.85 is to acoount for PV systems that are not correctly-angled, not true-south-facing, dusty, etc.

FIT Payments

For the systems installed during the 2002-2009 FIT period, the FIT amount that has been paid by utilities for the solar power fed into the grid from the start of 2002 and that will be paid to the end of 2034 has been estimated at $170 billion. When it became public, it became a major political issue in Spain.

http://www.bloomberg.com/news/2010-10-18/spanish-solar-projects-on-brink-of-bankruptcy-as-subsidy-policies-founder.html
http://www.eurasiareview.com/201006143219/spain-a-political-risk-analysis.html

In 2009, Spanish utilities paid 2.688 billion euros for the 6,936 GWh of solar power produced by an effective installed capacity of 3,357 MW (start 2009) + 1/2 x 238 MW (added in 2009) = 3,476 MW. The 2009 average FIT was about 2.688 billion euros/6,936 GWh = 0.388 eurocents/kWh in 2009; this average FIT is higher than the current FITs, because FITs were higher prior to recent reductions.

The Spanish government has placed a cap of 500 MW/yr on PV solar systems and a cap of 500 MW/yr on CSP systems to limit its future FIT obligations and is planning to reduce PV solar FITs by up to 45% on existing and new installations.

Capacity Factors

In 2009, Spain's average solar CF was about 6,936 GWh/(3,476 MW x 8,760 hr/yr) = 0.228; this CF will increase as more CSP plants with storage are installed. For comparison: In 2009, Germany's average CF was 0.95; Germany will have no CSP to raise its average because of insufficient insolation. Germany could raise its average, if it installed more sun-tracking systems that would have CFs of about 0.16

http://theenergycollective.com/willem-post/46142/impact-solar-pv-feed-tariffs-germany

In 2009, Spain's PV solar average CF was 6,422 GWh/[{3,296 MW (start of 2009) + 67/2 MW (added in 2009)} x 8,760 hr/yr] = 0.22; Spain has many utility-size, field-mounted, sun-tracking PV solar systems that have CFs up to about 0.25

In 2009, Spain's CSP average CF was 514 GWh/[{61 MW (start of 2009) + 171.4/2 MW (added in 2009)} x 8,760 hr/yr] = 0.40 , which is similar to that of the Andasol 1 plant.

STUDY ANALYSIS

CSP and PV Solar FITs

Royal decree 661/2007 covers CSP and other renewable technologies, except PV solar. Royal decree 1578/2008 covers PV solar systems.

Royal decree 661/2007
- CSP: 26.94 eurocents/kWh for 25 years, increasing annually with inflation minus 1%, plant size limit 50 MW; after 25 years 21.5 eurocents/kWh; the FIT is limited to 500 MW of new installations per year. Note: Economically optimum CSP plant sizes range from about 100-250 MW. For comparison: In France the CSP FIT is 30 eurocents/kWh since 2006, and in Italy 22-26 eurocents/kWh since 2008.

Royal decree 1578/2008.
- Building-mounted PV solar: 34 eurocents/kWh for systems =< 20 kW, 32 eurocents/kWh for systems >20 kW - 2,000 kW, for 25 years, limited to 267 MW of new installations per year.
- Ground-mounted PV solar: 32 eurocents/kWh for systems up to 10 MW; limited to 233 MW per year.

The PV solar FIT was about 41.3 eurocents/kWh for installations prior to 2009. It was reduced to about 33 eurocents/kWh for 2009 and later installations.

CSP plants are allowed to generate 10-15 % of their power with natural gas or fuel oil as a back-up. The fuels maintain the temperature of the heat storage fluid during times when solar thermal electricity production is interrupted. Question: If additional solar power output occurs due to use of the back-up fuel, will this output qualify for FIT rates?

http://www.energy.eu/
http://www.docstoc.com/docs/7777658/csp-2009-outlook
http://www.e-parl.net/eparlimages/general/pdf/080603%20Solar%20thermal%20toolkit.pdf

Installed CSP and PV Solar Capacity

Spain has a mix of CSP and PV solar power capacity, as shown in the table, in MW. The values are approximate, as information is scattered among various sources, the values stated in various sources do not agree, and often CSP and PV capacities are lumped together.

	2006	2007	2008	2009
Existing CSP	0			
Existing PV	88			
CSP added		11	50	171.4
PV added	30	526	2652	67
Cumulative, CSP	0	11	61	232.4
Cumulative, PV	118	644	3296	3363
Cumulative Total	118	655	3357	3595.4

Almost all CSP plants are located in Southern Spain and in the US Southwest. Spain has 16 plants, totaling 690 MW, under construction and a further 2,342 MW have been approved. Spain has standardized on 50 MW plants. Three companies are planning 26 plants, each rated at 50 MW, with storage at a capital cost of about 6,000 euro/kW, or $8,220/kW. See website.

Studies indicate that optimal CSP plants have capacities of 150-250 MW. These plants would have lower capitals cost per kW. They can be located only where large flat areas are available for the solar fields. Based on the capital cost experience with 50 MW CSP plants in Spain, it appears the capital costs of 150-250 MW plants will not decrease to about $4,000/kW in the near future, as some CSP proponents claim. See websites.

By August 2010, Spain had completed eleven CSP plants: PS10 (11 MW), PS 20 (20 MW), Andasol 1 (50 MW), Puertollano (50 MW), Puerto Errado (1.4 MW), La Risca (50 MW), Andasol 2 (50 MW), Solnova 1 (50 MW), Extresol 1 (50 MW), Solnova 3 (50 MW) and Florida (50 MW) totaling 432.4 MW.

The US has 422 MW of CSP plants in the US Southwest. About 48,000 MW of US CSP plants are planned.

http://social.csptoday.com/industry-insight/csp-legislation-green-light-2339-mw-spain
http://social.csptoday.com/industry-insight/global-shift-underway-concentrated-solar-power-market
http://seia.org/galleries/default-file/2009%20Solar%20Industry%20Year%20in%20Review.pdf
http://www.pv-tech.org/news/_a/isuppli_forecasts_impact_of_germanys_fit_cuts_in_2010/
http://www.altenergymag.com/emagazine.php?issue_number=09.02.01&article=spanishsolar
http://cleantechnica.com/2010/07/17/spain-opens-largest-solar-power-plant-in-world-passes-us-as-largest-solar-power-generator/
http://www.scribd.com/doc/35204700/Renewable-Energy-2010-Global-Status-Report
http://www.renewablesmadeinspain.com/noticia/pagid/155/titulo/Spain,%20leading%20producer%20of%20solar%20thermal%20power/len/en/

Description of an Operating 50 MW CSP Plant With Storage in Southern Spain

Andasol 1, steam turbine capacity 50 MW, output 180 GWh/yr, thermal storage system includes two tanks filled with molten salt at 750 F with a capacity of 1,010 MWh (82.5 tons of salt per MWh) to run the 50 MW turbine at rated output for 7.5 hrs (electricity out/heat in = 375 MWh/1,010 MWh = 0.37), altitude 3,650 ft, insolation 2,200 kWh/sq m/yr, occupies about 500 acres (10 acres/MW), the first parabolic-trough power plant in Europe, online in March 2009. The plant CF is 180 GWh/yr/(50 MW x 8,760 hr/yr) = 0.41

Capital cost about 300 million euros, or $411 million ($8,220/kW). The owners' estimate of production cost is 27.1 eurocents/kWh which is about equal to Spain's feed-in-tariff for CSP. Based on the operating experience with 50 MW CSP plants in Spain, it appears the production costs of 150-250 MW plants will not decrease to grid parity in the near future, as some CSP proponents claim. See websites.
Based on extensive See website.

The steam turbine output is augmented using stored heat during dawn and dusk periods, when the sky is overcast, and to offset parasitic loads. The result is that hours of operation at part load are decreased and the average operating efficiency of the turbine is increased.

The plant helps meet summer peak demand primarily caused by air conditioning units. The electricity supplied from the plant is used for demand during the day, particularly early afternoon, when demand, solar radiation and power plant output are near their peaks.

http://en.wikipedia.org/wiki/Andasol_solar_power_station

CSP and PV Solar FIT Cost, Production and Capacity Factors

Spain's installed power plant capacity is about 93,000 MW and its peak power demand is about 45,000 MW. Its power production was 251,300 GWh in 2009, of which CSP and PV solar power was about 6,936 GWh, or about 2.8% of Spain's production.

As no data could be found regarding the output of Spain's CSP plants, the output for 2009 was determined from the above Andasol 1 plant: 180 GWh/yr/50 MW = 3.6 GWh/yr/MW. The 3.6 was adjusted downward to 3.0 to account for some plants being older and some plants not having as much storage as the Andasol 1 plant.

The CSP output for 2009 = {61 MW (start of 2009) + 171.4/2 MW (added in 2009)} x 3.0 GWh/yr/MW = 514 GWh.
The PV solar power for 2009 = (6,936-514) GWh = 6,422 GWh

In 2009, Spanish utilities paid 2.688 billion euros for the 6,936 GWh of solar power produced by an effective installed capacity of 3,357 MW (start 2009) + 1/2 x 238 MW (added in 2009) = 3,476 MW. The 2009 average FIT was about 2.688 billion euros/6,936 GWh = 0.388 eurocents/kWh in 2009; this average FIT is higher than the current FITs, because FITs were higher prior to recent reductions.

http://theenergycollective.com/willem-post/46142/impact-solar-pv-feed-tariffs-germany

In 2009, Spain's PV solar average CF was 6,422 GWh/[{3,296 MW (start of 2009) + 67/2 MW (added in 2009)} x 8,760 hr/yr] = 0.22; Spain has many utility-size, field-mounted, sun-tracking PV solar systems that have CFs up to about 0.25

In 2009, Spain's CSP average CF was 514 GWh/[{61 MW (start of 2009) + 171.4/2 MW (added in 2009)} x 8,760 hr/yr] = 0.40, which is similar to that of the Andasol 1 plant.

http://theenergycollective.com/willem-post/46142/impact-solar-pv-feed-tariffs-germany
http://books.google.com/books?id=lCJwi7bEbOAC&pg=PA41&lpg=PA41&dq=Yearly+PV+power+production+GWh++in+Spain&source=bl&ots=FAZkFXtXUK&sig=0Dfq2qZrV_1fxmh0YKXdH_03zpI&hl=en&ei=xXLQTOWrE4eglAev8bSuBg&sa=X&oi=book_result&ct=result&resnum=10&ved=0CDYQ6AEwCQ#v=onepage&q&f=false

Variation of Solar Power and Grid Stability

PV Solar

Without energy storage, PV solar power does not provide all of the characteristics necessary for stable grid operation. For example, PV provides the most electricity from 10 AM-2 PM on sunny days, little on cloudy days, little at dawn and dusk and none at night. PV output can increase and fall rapidly during cloudy weather (New England, Germany), making it difficult to maintain balance on a grid with a larger penetration of PV power. Additional generating capacity, usually gas-fired, simple-cycle gas turbines and combined-cycle gas turbines, must be in spinning mode or at part load, which is inefficient and produces more CO_2/kWh.

As small amounts of PV power can be fed into the grid with few changes, the development of grid-monitoring technologies, i.e., the so-called Smart Grid, and cost-effective large-scale electricity storage systems (not yet invented for PV solar systems) will be needed to deploy larger capacities of PV systems.

CSP

Modern CSP plants respond more slowly to changing weather, especially when combined with thermal energy storage. Output from such plants is less variable, easier to forecast and integrate into the electric grid. About 5-7 hours of thermal energy storage enables CSP plants to contribute more power during dawn and dusk periods.

Combinations of CSP, PV, Wind and Hydro Power

The highest and most economical penetration of solar power will be possible with a combination of PV power and CSP with storage as practiced in Southern Spain and Southern California, just as the highest and most economical penetration of wind power will be possible with a combination of wind farms and pumped-storage hydro plants, as practiced by Denmark using Swedish and Norwegian hydro plants and by Portugal and Spain using their own hydro plants.

Pumped-storage hydro power plants are the most economical and operationally preferred option to smooth wind power because:

- they are the most flexible of the technologies in performing continuous startups and shutdowns without a significant detrimental effect on the equipment's service life.
- their load variation speed is high. For example, it is possible to vary the power by about 100%/min.
- their minimum load is low, often less than 10% of rated capacity.
- their fuel cost is zero.
- they do not produce CO_2.

http://www.nrel.gov/docs/fy10osti/45653.pdf
http://www.bsc.nodak.edu/gpee/presentations09/ChrisShelton.pdf
http://www.iberdrolaingenieria.com/ibding/contenido/documentacion/12.pdf

Daily Power Demand

Spain's summer peak demand is about 41,000 MW and winter peak demand is about 45,000 MW.

The RED Electrica de Espana website displays a typical daily power demand curve for Spain. On 1 November, 2010, a peak demand of about 30,000 MW occurred from 8 PM-11PM. A lower peak of about 25,000 MW occurred from 11 AM-2 PM which coincides with the highest levels of solar production.

The demand curve will vary somewhat during the year. To simplify the analysis, we will assume the curve is valid for all days of the year, which will not affect the conclusions of the study.

http://www.ree.es/ingles/operacion/curvas_demanda.asp

CSP and PV Solar Power Impact on Peaking Unit Operation

Peaking units usually are gas-fired, simple-cycle, gas-turbine generators. Their efficiency at full load is about 35%, or about 9,750 Btu/kWh, and at 50% load about 30%, or about 11,375 Btu/kWh. Peaking units usually operate at about 50% load otherwise they cannot modulate as needed by demand.

For this study, utility long-term gas contract prices are assumed at $4/million Btus.

As we know the total FIT subsidy paid in 2009, we can allocate a part of it to the 10 AM to 2 PM period and the rest to all other hours of of solar power production.

If we assume the average power output during the 10 AM and 2 PM period of each day of 2009 for CSP at about {61 MW (start of 2009) + 171.4/2 MW (added in 2009)} x 0.80 = 117 MW, and for PV at about {3,296 MW (start of 2009) + 67/2 MW (added in 2009)} x 0.80 = 2,664 MW, and all of it is fed into the grid, then Spanish utilities save about (117 + 2,664) MW x 1,000 kW/MW x 4 hrs/day x 11,375 Btu/kWh x $4/million Btu = $0.5 million/day in fuel expenses. The 0.80 factor is to account for weather events. The savings are somewhat less due to spinning reserves kept in operation in case solar power lessens due to weather events (clouds, snow, rain, etc.).

There are very little additional savings, because the peaking units are in service during other peak periods of the day when PV solar power is much less. The operating personnel are present whether the peaking units are operating or not.

In 2009, Spanish utilities credited, as required by the FIT scheme, the monthly bills of the owners of CSP systems on average about 117 MW x 1,000 kW/MW x 4 hrs/day x $0.372/kWh = $0.174 million/day for this 10 AM to 2 PM power, or 365 days/yr x $0.174 million/day = $63.6 million for all of 2009.

In 2009, Spanish utilities credited, as required by the FIT scheme, the monthly bills of the owners of PV solar systems on average about 2,664 MW x 1,000 kW/MW x 4 hrs/day x $0.455/kWh = $4.85 million/day for this 10 AM to 2 PM power, or 365 days/yr x $4.85 million/day = $1.77 billion for all of 2009.

The FIT amount credited for all other hours of solar power production was about $3.707 billion - ($0.0636 + $1.77) billion = $1.83 billion.

Spanish utilities could have bought the solar part of the 10 PM to 2 PM peaking power for $0.069/$0.54 x $5.02 million = $0.68 million/day from the grid, instead of buying it from solar system owners for $5.02 million/day.

A drawback of the PV solar power during the 10 AM to 2 PM period is that it is variable from day to day due to weather events, which means the peaking power purchases by utilities will vary from day to day more so than if the peaking power had been bought only from the grid.

This average level of PV solar power will increase as more PV solar systems are installed. It will have an increasing effect on the costs of owning and operating spinning reserve power plants and on the costs of standby power plants and transmission and distribution systems.

PV Solar Job Creation

There are several German studies and at least one Vermont study that conclude jobs created in the PV solar sector reduce about an equal number of jobs in other sectors, because resources, due to subsidies, are shifted to the PV solar sector away from other sectors; i.e., there is no free lunch.

According the Vermont Department of Public Service, VT-DPS, report "The Economic Impacts of Vermont Feed in Tariffs", about $228.5 million will be required to implement 50 MW of FIT subsidized renewables and that 35% of that amount would be supplied by Vermont sources, the rest, mostly equipment, by non-Vermont sources. For example: PV panels from China and inverters from Germany are about 70% of a PV system's materials cost.

The VT-DPS report states: "There would be a spike of about 550 short-term jobs during the 1-3 year construction stage which would flatten to a permanent net gain of 13 long-term full-time jobs during the operation and maintenance stage. In essence jobs are created in one sector (renewables) of the Vermont economy at the expense other sectors".

It appears using scarce ratepayer/taxpayer funds for a government-subsidized, capital-intensive renewables program that produces just a little of expensive power and reduces CO2 at a high cost per dollar invested is NOT the jobs creation panacea so much talked about by proponents of renewables. If the legislature were to bless Vermont with more such ineffective programs Vermont would be in even deeper financial trouble than it is now. See below website.

http://publicservice.vermont.gov/planning/DPS%20White%20Paper%20Feed%20in%20Tariff.pdf
http://www.coalitionforenergysolutions.org/renewables_are_expensive_an.pdf
http://www.germany.info/Vertretung/usa/en/09__Press__InFocus__Interviews/03__Infocus/03__ClimateBridge/Studies__Pubs/BMU__Gross__employment__from__RE__in__Germany__2009__DD,property=Daten.pdf

CONCLUSIONS

The study indicates the political decision of "going solar" in Spain in 2000 is beyond reason with regard to economics, air pollution and global warming, with the exception of CSP. It is an extremely expensive way to subsidize an industrial sector, create jobs and reduce CO2.

Because of the large gap between the FIT rates and utility electric rates, it is an easy decision for Spanish households and businesses to "go solar", much to the delight of PV solar vendors, financiers and developers who call this (for them) a success. Germany is having a similar disastrous experience with its solar FITs.

http://www.bloomberg.com/news/2010-10-18/spanish-solar-projects-on-brink-of-bankruptcy-as-subsidy-policies-founder.html

If we are to slow down climate change at a reasonable cost, we must use technologies that provide the greatest reduction in CO2 per dollar invested, such as energy efficiency (CF about 1.0) and nuclear (CF about 0.90). As a renewable, PV solar is among the highest in capital cost per installed kW and the lowest in power production and CO2 reduction per dollar invested.

Those advocating PV solar for creating new industries and jobs, etc., completely miss the point; those are, at best, side issues. We NEED to do energy efficiency, nuclear and renewables to avoid/minimize global warming. Therefore, we need to have a structure of priorities.

For example: It is much better to first deal with the urgent issue of global warming and later work on viable solutions for decommissioning, waste processing and storage. France, 80% of its power from nuclear, reprocesses its spent fuel and reuses it in its reactors, whereas the US mostly stores it on the nuclear plant sites. an unsmart approach.

Capital-intensive investments in inefficient PV solar systems that, without subsidies, have simple paybacks of 20-40 years divert resources from less capital-intensive measures, such as energy efficiency that, without subsidies, has simple paybacks of 1-5 years, AND reduces CO2 more effectively, AND requires no changes to the grid, AND is quiet, AND is INVISIBLE.

Doing energy efficiency first and renewables later is an easy choice to make. There may be money in Germany, but not in the US and other nations, to do both at the same time.

http://repec.rwi-essen.de/files/REP_09_156.pdf
http://uvdiv.blogspot.com/2010/02/german-solar-industry-protesting.html
http://www.renewableenergyworld.com/era/news/article/2010/05/germanys-solar-pv-industry-a-victim-of-its-own-success
http://www.solarplaza.com/article/booming-german-pv-market-could-cost-ratepayers-70

Supplementary Websites

http://en.wikipedia.org/wiki/Solar_power
http://en.wikipedia.org/wiki/Solar_power_in_Germany
http://www.coalitionforenergysolutions.org/power_capacity_and_producti.pdf