Connecticut Debate Association

December 10, 2011, Darien and Joel Barlow

Resolved: The U.S. should significantly increase investment in microgeneration.

Microgeneration

From Wikipedia, the free encyclopedia

Microgeneration is the small-scale generation of heat and power by individuals, small businesses and communities to meet their own needs, as alternatives or supplements to traditional centralized grid-connected power. Although this may be motivated by practical considerations, such as unreliable grid power or long distance from the grid, the term is mainly used currently for environmentally-conscious approaches that aspire to zero or low-carbon footprints.

Technologies and set-up

Microgeneration technologies include small scale wind turbines, Micro hydro, photovoltaic solar systems, Plant Microbial Fuel Cells, ground source heat pumps, and Micro Combined Heat and Power (MicroCHP) installations.[1]

The power plant

In addition to the electricity production plant (e.g. wind turbine, solar panel, ...), infrastructure for energy storage and power conversion and a hook-up to the regular electricity grid is usually needed and/or foreseen. Although a hookup to the regular electricity grid is not essential, it helps to decrease costs by allowing financial recompensation schemes. In the developing world however, the start-up cost for this equipment is generally too high, thus leaving no choice but to opt for alternative set-ups.[2]

Costs

Depending on the set-up chosen (financial recompensation scheme, power plant, extra equipment), prices may vary. According to Practical Action, microgeneration at home which uses the latest in cost saving-technology (wiring harnesses, ready boards, cheap DIY-power plants (e.g. DIY wind turbines), ...) the household expenditure can be extremely low-cost. In fact, Practical Action mentions that many households in farming communities in the developing world spend less than $1 for electricity per month. .[16] However, if matters are handled less economically (using more commercial systems/approaches), costs will be dramatically higher. In most cases however, financial advantage will still be done using microgeneration on renewable power plants; often in the range of 50-90% [17]

In the UK, the government offers both grants and feedback payments to help businesses, communities and private homes to install these technologies. Businesses can write the full cost of installation off against taxable profits whilst homeowners receive a flat rate grant or payments per kW h of electricity generated and paid back into the national grid. Community organisations can also receive up to £200,000 in grant funding.[18]

Government policy

There is considerable resistance to microgeneration from many governments, local authorities and energy companies. Current incentives discourage energy suppliers and grid operators from bringing energy generation to the point of demand.[citation needed]

Policy-makers are accustomed to an energy system based on big, centralised projects like nuclear or gas-fired power stations, and it will require a change of mindsets and incentives to bring microgeneration into the mainstream. Planning regulations may also require streamlining to facilitate the retrofitting of microgenerating facilities onto homes and buildings.

A number of countries, including Canada (Alberta), the United Kingdom, Germany, Israel[25] and USA have laws allowing microgenerated electricity to be sold into the national grid.

Alberta, Canada

In January 2009, the Government of Alberta's Micro-Generation Regulation came into effect. This regulation is a set of rules that allows Albertans to generate their own environmentally friendly electricity and receive credit for any power they send into the electricity grid. See how microgeneration works in Alberta.

United States

The United States has inconsistent energy generation policies across its 50 states. State energy policies and laws may vary significantly with location. Some states have imposed requirements on utilities that a certain percentage of total power generation be from renewable sources. For this purpose, renewable sources include wind, hydroelectric, and solar power whether from large or microgeneration projects. Further, in some areas transferrable "renewable source energy" credits are needed by power companies to meet these mandates. As a result, in some portions of the United States, power companies will pay a portion of the cost of renewable source microgeneration projects in their service areas. These rebates are in addition to any Federal or State renewable-energy income-tax credits that may be applicable. In other areas, such rebates may differ or may not be available.

United Kingdom

The UK Government published its Microgeneration Strategy[26] in March 2006, although it was seen as a disappointment by many commentators.[27] In contrast, the Climate Change and Sustainable Energy Act 2006 has been viewed as a positive step.[28] To replace earlier schemes, the Department of Trade and Industry (DTI) launched the Low Carbon Buildings Programme in April 2006, which provides grants to individuals, communities and businesses wishing to invest in microgenerating technologies. These schemes have been replaced in turn by new proposals from the Department for Energy and Climate Change (DECC) for clean energy cashback via Feed-In Tariffs [29] for generating electricity from April 2010 and the Renewable Heat Incentive [30] for generating renewable heat from September 2011.

Feed-In Tariffs are intended to incentivise small-scale (less than 5MW), low-carbon electricity generation. These feed-in tariffs work alongside the Renewables Obligation (RO), which will remain the primary mechanism to incentivise deployment of large-scale renewable electricity generation. The Renewable Heat Incentive (RHI) in intended to incentivise the generation of heat from renewable sources. They also currently offer up to 43.3p per kWh (21p per kWh from December 2011) in the Feed-in Tariff plus another 3p for the Export Tariff - an overall figure which could see a household earning back double what they currently pay for their electricity.[31]

On 31st October 2011, the Government announced a sudden cut in the feed-in tariff from 43.3p/kWh to 21p/kWh with the new tariff to apply to all new solar PV installations with an eligibility date on or after 12th December 2011.[32]

Prominent British Politicians who have announced they are fitting microgenerating facilities to their homes include the Conservative party leader, David Cameron, and the Labour Science Minister, Malcolm Wicks. These plans included small domestic sized wind turbines. Cameron, before becoming Prime Minister in the 2010 general elections, had been asked during an interview on BBC One's The Politics Show on the October 29th 2006 if he would do the same should he get to 10 Downing Street. "If they'd let me, yes," he replied.[33]

In the December 2006 Pre-Budget Report[34] the Government announced that the sale of surplus electricity from installations designed for personal use, would not be subject to Income Tax. Legislation to this effect has been included in the Finance Bill 2007.[35]

Microgeneration could rival nuclear power, report shows

The Guardian, John Vidal, guardian.co.uk, Monday 2 June 2008 10.37 EDT

British buildings equipped with solar, wind and other micro power equipment could generate as much electricity in a year as five nuclear power stations, a government-backed industry report showed today.

Commissioned by the Department for Business, Energy and Regulatory Reform (DBERR), the report says that if government chose to be as ambitious as some other countries, a combination of loans, grants and incentives could lead to nearly 10m microgeneration systems being installed by 2020.

Such a large scale switch to microrenewable energy could save 30m tonnes of CO2 – the equivalent of nearly 5% of all UK electricity.

The report estimates that there are nearly 100,000 microgeneration units already installed in Britain. Nearly 90,000 of these are solar water heaters, with limited numbers of biomass boilers, photovoltaic panels, heat pumps, fuel cells, and small-scale hydroelectric and windpower schemes.

If no action is taken, says the report, Britain can expect about 500,000 microunits to be installed by 2015 and 2-3m by 2020. But, with the right incentives, nearly one in five buildings in Britain would effectively become mini power stations, feeding electricity into the grid, or generating enough to be largely self-sufficient. Some of the greatest gains would be in combined heat and power units which are suitable for large blocks of flats, estates and businesses.

Britain has been widely criticised for not doing as much as other countries to encourage a mass market for small-scale renewables. The few existing schemes have failed to kick-start the industry. But the report says this could be swiftly changed: Germany has invested nearly £10bn in photovoltaic technology and Sweden has made it very attractive for consumers to install heat pumps.

The small-scale energy revolution will depend on the government stimulating the market with a range of consumer-friendly financial incentives schemes. "For widespread uptake of microgeneration to occur in the UK, sustained policy support will be required," says the report.

Top of the proposed incentive list is a "feed-in" tariff scheme which would reward people who invest in making their own electricity for feeding excess power into the national gird. This has been introduced in most European countries and is now a part of the Conservative party's energy policy.

Other possible incentives include 50% grants to help people meet the high initial cost of equipment and installation. If the government subsidised 50% of the cost of the some of the technologies, Britain would save 14m tonnes of CO_2 a year, or 3% of all emissions for a cost rising to £2.2bn a year by 2030.

A third option would be to provide mortgage-style discounted low-interest "soft loans" payable over 25 years. This, suggests the report, would lead to a massive 8m units being installed by 2020. But it cautions that the life of the loan would probably exceed the life of most power units.

It also proposes a scheme where consumers put up some of the cost of a new electricity generating boiler in return for a long-term guaranteed cut in their power bills.

The report comes at a critical point, with the government's energy strategy due to be published soon and microgeneration targets due to be decided later in the year. The outlook it thought to be favourable because energy prices are expected to continue rising steeply as oil and gas prices soar.

The energy minister, Malcolm Wicks, welcomed the report: "Microgeneration has the potential to make a significant contribution to overall energy use in the UK and, combined with energy efficiency measures, will help towards reducing our carbon emissions. The concerned individual can take an active role in the battle against climate change."

The industry has called for binding targets which it said would lead to greater certainty for investors and lower costs for consumers. "This shows that with the right policies in place, citizens can save money and make make a marked difference to tackling UK emissions and future-proof their homes," said Dave Sowden, chief executive of the Micropower Council.

One problem was not considered by the report, however. Conservative leader David Cameron, Gordon Brown and Malcolm Wicks have all had applications to erect wind turbines on their roofs turned down by planning officers.

New Microgeneration report - what it actually says

Home fires burning won't keep the lights on

The Register, Posted in Environment, 4th June 2008 07:52 GMT, By Lewis Page,

Analysis

A new report on possibilities for deployment of low-carbon microgeneration machinery in British homes was published yesterday, and has scored big ink [1]. But most of the coverage has ignored the three main messages of the report.

These are fairly simple. Firstly, according to the report, microgeneration in the UK is going absolutely nowhere without massive government backing - in the form of multibillion-pound subsidies, or regulations which would in effect place multibillion-pound levies on homeowners. Secondly, the report's authors conclude that with such massive backing microgeneration might reduce the UK's carbon emissions by as much as a few per cent; though in most scenarios the saving would be less than 1 per cent.

Finally and most importantly, however, the report notes that any success in delivery of lower-carbon national grid electricity would render most forms of microgeneration pointless. Given a halving of the carbon burden of grid 'leccy, widespread takeup of home power machinery would no longer reduce the UK's carbon emissions but actually increase them. (It's important to note that headline-worthy but marginally useful microgen kit such as rooftop wind turbines and solar cells formed only a small part of the calculations.)

The document in question is called The Growth Potential for Microgeneration in England, Wales and Scotland, and it can be downloaded in full here (big pdf) [2]. It was produced by consulting engineers Element Energy and was paid for by UK national and local government, the Micropower Council, several power companies, the Energy Saving Trust and the Renewable Energy Foundation.

It won't pay unless we all pay

The report's authors, having done their economic projections into the future, don't see any serious takeup of microgeneration without heavy government backing - to the tune of billions each year.

Subsidy schemes which achieve a widespread penetration of microgeneration have cumulative subsidy costs in the tens of billions by 2030 ... expectations of technology cost reductions appear necessary but insufficient to promote substantial consumer uptake of microgeneration. In the absence of changes to the fundamental energy economics, microgeneration technologies will require a supportive policy framework ... Even with relatively optimistic cost reduction projections up to 2050, microgeneration technologies will struggle to compete for consumers without policy support.

In particular, the most pure and righteous green home power technologies - rooftop wind turbines and solar-electric panels - require huge subsidies, several times the consumer price of electricity, to make them worth installing. Even then, most home users need loans to afford them; and the loans must be cheap or the revenue from selling high-priced subsidised power to the grid still won't cover the payments. Home windmills and solar-cell panels didn't produce enough power to seriously affect carbon emissions in any of the scenarios modelled. But there are many other kinds of microgen equipment, and it was these which seemed likeliest to be successful.

Keeping the home fires burning

Especially attractive in some scenarios are Combined Heat and Power (CHP) installations. Many Brits nowadays heat their homes and water using gas boilers, wasting a good deal of the energy they buy even with the most modern kit. Gas CHP plants cost a lot more than a combi boiler, but generate 'leccy as well as heat; wasting less overall, and so saving money over time. In future, CHP plants might use fuel cells rather than relatively ordinary options such as gas motor or Stirling-engine powered generators.

Making "cautious" assumptions about fuel-cell CHP - which isn't yet available for home use - the report's authors thought it could be brought down to the same kind of price as a combi boiler by using a within-the-realms-of-possibility subsidy regime. This meant that CHP, and particularly fuel-cell CHP, tended to dominate the future microgen projections. Like windmills or solar cells, CHP plants would sell electricity back to the grid if it wasn't immediately required. The difference is that CHP generates a lot more power.

Another crafty option for the parsimonious home owner is heat pumps, which work just like a fridge. Instead of making their insides cold and dumping heat into the kitchen, however, they make the air outside a house (or the ground beneath it) colder, and dump the heat into your radiators or your hot water system. The electricity required to drive the heat pumps is potentially much cheaper than a normal heating bill; but, again, the upfront costs are so large as to discourage most people.

A variant on heat pumps is solar thermal, which accounts for nearly all the microgeneration kit now installed, largely because it's comparatively cheap and simple. A typical home solar-thermal setup uses the sun's heat to warm up domestic hot water before the boiler starts on it, saving a good deal of energy. This is normally done by simply piping the water through rooftop panels, sometimes nothing more complex than old radiators painted black. Kit of this type obviously isn't much use on overcast, freezing winter days, but can yield cheaper showers and laundry during the summer. However, the scope for home solar-thermal is limited in the UK. The report's projections didn't show it becoming a big factor.

Finally, of course, there's our old friend biofuel. In the case of home microgen, you're normally talking about burning sustainably-produced wood in a furnace, which is potentially low-carbon provided you aren't burning rainforest to clear land for cows or something. This doesn't necessarily have to be a case of heaving logs about every day, either; there are pellet-fuelled jobs available now which just need their feed bin topping up from time to time.

Keeping up with the neighbours

Many of these things are already widely used abroad, and various people frequently suggest that they'd be a good fit for the UK. Colossal German subsidies (£10bn and counting) have seen up to a gigawatt of solar-electric installed there every year of late, for instance; but there are signs that even the green Germans are finding this unaffordable, and it's early days yet. (One should note that each gigawatt of installed solar capacity satisfies less than half a percentage point of Germany's electric demand - and electricity is only a portion of overall energy use). The cheap government-backed loans which make it possible for ordinary Teutons to start selling electricity to the grid at hugely subsidised prices have been discontinued, and it seems that the German home-solar gravy train is no longer easy to get onto.

In Germany, where [a subsidised, very high payment for electricity sold back to the grid] has stimulated installation of [solar cells] ... uptake by domestic consumers was largely dependent on the availability of soft loans. This ... overcomes the capital cost barrier, and the value of [the money made selling expensive 'leccy to the government] in Germany is sufficient to offset the loan repayments. Since soft loans were discontinued in Germany, purchases by domestic consumers have fallen significantly and most uptake is now by commercial and industrial consumers who have access to low-cost finance ...

The big obstacle to takeup of heat pumps or wood burning in Blighty is the fact that we have a widespread gas grid as well as our electric one. Scandinavians use heat pumps and Austrians use wood furnaces largely because they can't get gas, according to the report's authors.

In Sweden, the heating market is dominated by direct electric systems whose running costs have risen significantly in the last few years. This makes the installation of heat pumps a natural transition ...

Pellet boiler sales in Austria followed two decades of R&D that delivered a product that was much more attractive and easy to use than the wood and oil boilers that they replaced.

In the UK, the convenience and low cost of gas-fired central heating provides a strong barrier to microgeneration uptake ...

In Austria, despite the high sales of modern pellet boilers, there has also been a transition from biomass and oil to gas as the dominant fuel ...

Microgen through green-tinted spectacles

So getting us Brits to start using microgeneration is going to take major subsidy, as it has in Germany. The report's authors consider a range of options here. The headline grabber, gleefully seized upon by the UK microgeneration industry [3] and reprocessed hastily by hard-green zealots [4], would see £21bn in new subsidies handed out by 2020. This would result in around 9 million microgeneration units in service by then, seven million of them the notional CHP fuel cells which aren't even for sale yet.

This scenario would see 16 renewable (eg, low or zero carbon) terawatt-hours of heat and another two or four of leccy produced, equivalent to 1 per cent of the UK's total energy consumption turning green. In total, microgen would be delivering 118 terawatt-hours of heat and 30 of electricity. (Tables 3, 4 and 28 in the report).

This is said by the microgeneration industry and the Guardian to represent "as much energy as 5 nuclear power stations", though Element Energy confirmed to the Reg yesterday that they never said that.

Just for reference, Sizewell B - the only existing UK nuke station planned to last beyond 2023 - produces a little less than nine electric terawatt-hours annually and no useable heat.

The £21bn-subsidy microgen plan would produce as much clean electricity as half a nuclear power station, then, or as much clean energy all up as two nuke stations. Not five. Including dirty carbon-smeared CHP production, the whole £21bn microgen base would be about equal to seventeen Sizewell Bs - not five.

This subsidy plan would continue to cost the taxpayer £5.5bn each year forever, according to the report - that's as much as we currently spend on defence procurement, or enough money to buy 55 terawatt-hours of electricity every year at consumer prices, well over 15 per cent of the national leccy bill. And of course, we'd all still be paying our normal energy bills as well, and we'd still have done nothing to clean up the other 99 per cent of our energy usage.

By comparison, a nuclear power station half again as big as Sizewell B is said by French makers EDF [5] to cost about £2bn and by most other people to cost about £3bn. Four billion quid's worth of nuke stations would produce as much low-to-zero-carbon electricity as the headline microgen plan, which would cost conservatively five times as much just in subsidies - forget about the costs to the users. Even given swingeing regulatory, maintenance, staffing, decommissioning and waste-management costs (plus some pocket change for fuel) it's not surprising that the nuclear energy industry - unlike the microgeneration one - does not consider that it needs any subsidy at all in the UK.

Locking us in to carbon

And there's the rub. Microgeneration will only happen if it's subsidised; and it only makes sense to subsidise it if this does something good, like seriously reducing our carbon emissions or freeing us from the need to buy gas from Russia. But microgeneration reduces our carbon emissions by a few per cent at the absolute outside - more probably by less than 1 per cent - and it certainly doesn't wean us off gas.

Overall, no policy scenario leads to a dramatic decline in reliance on imported natural gas and hence security of supply by 2050.

And it gets worse. If grid electricity can be decarbonised even partially - by building wind farms or nuclear stations, say - the eco benefits of microgeneration disappear. We would find ourselves subsidising people to spew carbon unnecessarily, in fact. The report shows quite clearly that if the carbon burden of grid power can be halved, then burning gas in the home becomes a very eco-unfriendly thing to do, no matter how cunning the machinery used. Subsidies for CHP et al would then be highly un-green, as they would actually drive up carbon emissions rather than reduce them. Only heat-pumps, and perhaps some biomass kit, would be eco-worthwhile if grid electricity were less dirty.

The report's authors offer a stark warning to anyone fancying that micro-CHP plant.

> *There are reasons to believe ... that the grid will decarbonise rapidly. Key factors are:*
> *• Possible expansion of nuclear capacity*
> *• The EU's 2020 target*
> *• The Large Combustion Plant Directive ... expected to lead to a reduction in the number of coal plants connected to the grid*
> *• Implementation of Carbon Capture*
> *If a rapid decarbonisation and expansion (to cope with new heating demand) of the grid is possible then it may be prudent to encourage uptake of efficient electric heating technologies (essentially heat pumps) instead of, for example, micro-CHP ... it is important that this issue is tackled before substantial microgeneration support schemes are put in place. It would be possible to 'lock-in' UK consumers to the wrong microgeneration technology ... if overall energy policy is not thought through in a joined up and long-term fashion.*

Or in other words, microgen subsidies would be stupid if we have any aspirations toward decarbonising the grid.

Did anyone actually read this?

In the end, everyone's drawing their own conclusions about this report. The microgeneration makers see it as an ironclad case for big subsidies. At least one other of the report's backers vehemently disagrees [6], headlining their release "Subsidy Unnecessary as Rising Fuel Prices will Make Microgeneration Attractive". This seems to be flying in the face of the report, to say the least of it:

> *Annual fuel prices rises have very small short-term effects ... By 2030, the combination of fuel price rises and reductions in capital costs are sufficient to increase the microgeneration stock ...*
>
> *More abrupt price changes have a much larger effect ... doubling of fossil fuel prices drives uptake in nearly 10 million homes by 2030. The vast majority of this is CHP ... Biomass uptake remains comparatively low ... A 50 per cent decrease in fuel prices leads to a substantial reduction of microgeneration ...*
>
> *A doubling of biomass prices [as might occur if lots of people used biomass] is sufficient to make wood chip and pellet boilers extremely unattractive ...*
>
> *Conclusion – moderate fuel price rises lead to a large increase in microgen uptake relative to the base case by 2050, but overall numbers remain small compared with conventional technologies such as condensing boilers.*

Most of the press so far are parroting the microgeneration makers' five-nuke-stations release.

As far as we at Vulture Central can see, what this report actually suggests is that lower carbon emissions and energy security are both a lot easier to achieve nationally using the electric grid than in the home using the gas network. As for trying to achieve these aims in the home without burning stuff - eg, using rooftop solar electric, wind turbines etc - that barely made a difference in any scenario, though it did offer the chance to piss away a lot of cash.

Given that Element Energy and most of the people who funded them are either well-disposed or at worst neutral to the general idea of microgeneration, that's actually a pretty damning indictment.®

What is Microgeneration? And what is the most cost effective in terms of CO2 reduction

Claverton Energy Research Group, November 6, 2008

3 Microgeneration benefits

Microgeneration can, in its own right, deliver carbon savings, contribute to long term security of supply and help tackle fuel poverty. It can help avoid single fuel dependency and add diversity to complement large scale intermittent sources, acting as an enabler for high penetration levels of, for example, large scale wind. It will also help to minimise system losses, although that is of less relevance if Microgeneration is significantly less efficient than large scale RE.

So, although Microgeneration is no silver bullet, it does have a significant role to play as part of a mix of heat and power producing solutions. A number of studies, with a particular focus on micro CHP, have shown how Microgeneration can help deliver all four of the key policy objectives in UK Energy Policy. The results are surprising, in that the benefits identified generally exceed the earlier claims made by manufacturers. Three studies in particular show that micro CHP makes a substantial contribution to fuel poverty, carbon mitigation and diversity of supply targets.

3.1 Fuel Poverty

A Policy Studies Institute paper[11] shows that mCHP contributes almost as much to fuel poverty as all other measures put together including mCHP. This paradox is explained by the fact that, if homes are well insulated, the reduction in thermal load leads to a reduction in electricity production and hence makes it unlikely that micro CHP would be installed in as many homes: *"Micro CHP can do almost as much for fuel poverty as making all possible energy efficiency improvements, including micro CHP."*

3.2 Carbon mitigation

A report by the consultancy Ilex, shows that appropriate emission factors to be used for calculating CO_2 displacement for the next 10 years[12] are actually higher than both that of the average generation mix and of current marginal generation emissions. Current government policy is based on 0.43kg/kWh which is the average mix, a somewhat arbitrary and in this case, inappropriate measure. Micro CHP is shown to displace marginal plant and the study, which matches actual generation profiles for installed WhisperGen units against marginal plant, shows a displacement of 0.54 rising to 0.67kg/kWh by 2010. This counter-intuitive result is the consequence of the increasing cost of coal-fired generation which, although it reduces the total amount of coal generation in the overall mix, shifts all coal generation into the margin. The CO2 displaced by Microgeneration is recognised in SAP (Standard Assessment Procedure) based on studies of profiled grid emissions undertaken by Christine Pout[13], which uses a figure of 0.568kg/kWh for all Microgeneration, (regardless of type) conflicting with the assumption of 0.43kg/kWh for consumption (import).

3.3 Support of intermittent renewable generation

Further indirect benefits accrue to micro CHP as it has a profile which supports intermittent wind resources and, by nature of its diversity, reduces the need for back-up capacity. The ECI study[14] based on 20 years of wind and consumption data, concludes that only 400MWe back-up capacity would be required if micro CHP were to support 10GWe of wind generation.

3.4 Reduction of network costs

The SIAM[15] (System Integration of Additional Microgeneration) study was expected to identify adverse impacts of large-scale implementation of micro CHP on Distribution Networks, potentially requiring significant investment in network upgrades. In fact, the study showed that in only a few extreme cases would integration of micro CHP incur additional short term costs, that in the majority of cases it would have beneficial impacts and the overall benefit to the UK distribution network was substantial; savings in deferred network upgrades and improved operational efficiency were estimated at up to £1.2 billion by 2020 assuming a high penetration level of Microgeneration.

3.5 Incremental, low risk investment

A fundamental attribute of Microgeneration is that it will, by definition, be introduced incrementally, avoiding catastrophic financial and technical risks and delivering real carbon and financial savings from day one. Other potential carbon mitigating solutions, such as nuclear, involve step changes in capacity and will not deliver any benefits for as much as a decade; it is a substantial risk to attempt to anticipate what market conditions might pertain in 10 years when it comes on line, still less over the subsequent 40 years or so life of such plant.

3.6 High value generation profile

It is, therefore, inappropriate to consider Microgeneration as just another generation option in the same way as central plant alternatives. If we invest in a CCGT plant to replace an existing obsolete plant, that is not the same as incrementally eroding the demand for marginal plant. The former may (as in the case of nuclear) demand to be run as baseload and will thus displace baseload or "must run" plant such as renewable wind; in this context nuclear is displacing zero carbon generation. Microgeneration by contrast (specifically micro CHP which is largely peak-following) will displace marginal plant, with consequently high financial and carbon benefits.

3.7 Public engagement and empowerment

Some advocates of Microgeneration cite the benefits of public engagement, and it is clear that householders who invest in Microgeneration do become more conscious of their overall carbon footprint and tend to modify their lifestyles to further reduce their environmental impact. However, there is a limit to how much value should be attributed to this, particularly if the technologies in which they invest are subsequently shown to be significantly less effective than larger scale alternatives. An example of this is the current fad for micro wind which, even at the optimistic cost of £1500 for a 1kWe unit is far less effective than investing a similar amount in a large scale, say 2MWe, product which will have a yield of an order of magnitude higher, even accounting for transmission & distribution losses.

3.8 Lower cost to Government

A significant difference between Microgeneration and central generation for the government is that whilst the former is funded from taxed income and will have a positive socialised cost impact (i.e. it will add tax income to the Treasury), central plant investments will result in a reduced tax income (as they are tax deductible), and will have the further impact of being spread across all households in the form of higher energy bills!

When Energy Efficiency Sullies the Environment

The New York Times, By JOHN TIERNEY, March 7, 2011

For the sake of a cleaner planet, should Americans wear dirtier clothes?

This is not a simple question, but then, nothing about dirty laundry is simple anymore. We've come far since the carefree days of 1996, when Consumer Reports tested some midpriced top-loaders and reported that "any washing machine will get clothes clean."

In this year's report, no top-loading machine got top marks for cleaning. The best performers were front-loaders costing on average more than $1,000. Even after adjusting for inflation, that's still $350 more than the top-loaders of 1996.

What happened to yesterday's top-loaders? To comply with federal energy-efficiency requirements, manufacturers made changes like reducing the quantity of hot water. The result was a bunch of what Consumer Reports called "washday wash-outs," which left some clothes "nearly as stained after washing as they were when we put them in."

Now, you might think that dirtier clothes are a small price to pay to save the planet. Energy-efficiency standards have been embraced by politicians of both parties as one of the easiest ways to combat global warming. Making appliances, cars, buildings and factories more efficient is called the "low-hanging fruit" of strategies to cut greenhouse emissions.

But a growing number of economists say that the environmental benefits of energy efficiency have been oversold. Paradoxically, there could even be more emissions as a result of some improvements in energy efficiency, these economists say.

The problem is known as the energy rebound effect. While there's no doubt that fuel-efficient cars burn less gasoline per mile, the lower cost at the pump tends to encourage extra driving. There's also an indirect rebound effect as drivers use the money they save on gasoline to buy other things that produce greenhouse emissions, like new electronic gadgets or vacation trips on fuel-burning planes.

Some of the biggest rebound effects occur when new economic activity results from energy-efficient technologies that reduce the cost of making products like steel or generating electricity. In some cases, the overall result can be what's called "backfire": more energy use than would have occurred without the improved efficiency.

Another term for backfire is the Jevons Paradox, named after a 19th-century British economist who observed that while the steam engine extracted energy more efficiently from coal, it also stimulated so much economic growth that coal consumption increased. That paradox was mostly ignored by modern environmentalists, who have argued that rebound effects are much smaller today.

But economists keep finding contrary evidence. When Britain's UK Energy Research Center reviewed more than 500 studies on the subject, it rejected the assumption that rebound effects were small enough to be disregarded. The author of the 2007 report, Steve Sorrell, noted that these effects could, in some circumstances, "potentially increase energy consumption in the long term."

A similar conclusion comes from a survey of the literature published last month by the Breakthrough Institute, an American research group that studies ways to slow global warming. Its authors, Jesse Jenkins, Ted Nordhaus and

Michael Shellenberger, warn that “rebound effects are real and significant,” and could sometimes erode all the expected reductions in emissions.

“Efficiency advocates try to distract attention from the rebound effect by saying that nobody will vacuum more because their vacuum cleaner is more efficient,” Mr. Shellenberger said. “But this misses the picture at the macro and global level, particularly when you consider all the energy that is used in manufacturing products and producing usable energy like electricity and gasoline from coal and oil. When you increase the efficiency of a steel plant in China, you’ll likely see more steel production and thus more energy consumption.”

Consider what’s happened with lighting over the past three centuries. As people have switched from candles to oil-powered lamps to incandescent bulbs and beyond, the amount of energy needed to produce a unit of light has plummeted. Yet people have found so many new places to light that today we spend the same proportion of our income on light as our much poorer ancestors did in 1700, according to an analysis published last year in The Journal of Physics by researchers led by Jeff Tsao of Sandia National Laboratories.

“The implications of this research are important for those who care about global warming,” said Harry Saunders, a co-author of the article. “Many have come to believe that new, highly-efficient solid-state lighting — generally LED technology, like that used on the displays of stereo consoles, microwaves and digital clocks — will result in reduced energy consumption. We find the opposite is true.”

These new lights, though, produce lots of other benefits, just as many other improvements in energy efficiency contribute to overall welfare by lowering costs and spurring economic growth. In the long run, that economic growth may spur innovative new technologies for reducing greenhouse emissions and lowering levels of carbon dioxide.

But if your immediate goal is to reduce greenhouse emissions, then it seems risky to count on reaching it by improving energy efficiency. To economists worried about rebound effects, it makes more sense to look for new carbon-free sources of energy, or to impose a direct penalty for emissions, like a tax on energy generated from fossil fuels. Whereas people respond to more fuel-efficient cars by driving more and buying other products, they respond to a gasoline tax simply by driving less.

A visible tax, of course, is not popular, which is one reason that politicians prefer to stress energy efficiency. The costs and other trade-offs of energy efficiency are often conveniently hidden from view, and the prospect of using less energy appeals to the thrifty instincts of consumers as well as to the moral sensibilities of environmentalists.

But if the benefits of energy efficiency have been oversold, then that’s more reason to consider alternatives like a carbon tax, and to look more carefully at the hidden costs and trade-offs involved in setting rigid standards for efficiency. Unlike a carbon tax, which gives consumers and manufacturers an incentive to look for smart ways to save energy, a mandated standard of efficiency can reduce flexibility and force people into choices they wouldn’t ordinarily make — including ones with consequences more serious than dirty clothes.

Because of the smaller and consequently less safe cars built to meet federal fuel-efficiency standards starting in the 1980s, there were about 2,000 additional deaths on the highway every year, according to the National Research Council. And now the federal government is imposing even more stringent standards, with little objection except from a few critics like Sam Kazman of the Competitive Enterprise Institute, a free-market-oriented nonprofit research group.

“Efficiency mandates have become feel-good mantras that politicians invoke,” Mr. Kazman said. “The results of these mandates have ranged from costly fiascos, such as once-dependable top-loading washers that no longer wash, to higher fatalities in cars downsized by fuel-efficiency rules. If the technologies were so good, they wouldn’t need to be imposed on us by law.”

No matter what laws are enacted, people are going to find ways to use energy more efficiently — that’s the story of civilization. But don’t count on them using less energy, no matter how dirty their clothes get.

Before Adding, Try Reducing

The U.S. government offers a lot of subsidies to expand renewable energy. Should it be doing more to subsidize conservation?

The Wall Street Journal, JUNE 15, 2009, By SARI KRIEGER

The U.S. government is committing billions of dollars to support renewable energy such as wind- and solar-power plants. Some say it should use more of that financial clout to encourage less energy consumption in the first place.

Advocates of conservation, including businesses that help homeowners and companies save energy, think there should be more subsidies and tax incentives for basics like insulation and window shading, and for newer, more costly products like light-emitting-diode lamps and building-automation systems. LEDs cost more but use less energy than incandescent bulbs. The new automation systems help buildings waste less energy on cooling, heating and lighting.

Projects that improve efficiency pay for themselves quickly, the advocates say, and help people and businesses save money. Renewables, meanwhile, cost more money to achieve the same reductions in carbon-dioxide emissions.

By the Ton

A study by New York-based management consulting firm McKinsey & Co. earlier this year compared the cost of eliminating one ton of CO_2 emissions using different means: Wind power cost about $38 per ton of CO_2 saved; solar cost about $30. But replacing incandescent lights in a home with light-emitting diodes saved about $159 per ton of CO_2, and using energy-efficient appliances saved about $108 per ton.

Some say it makes more sense to retrofit buildings for energy efficiency before adding renewable technologies like solar and geothermal power, because buildings account for about half of the CO_2 emissions in the U.S. Efficiency improvements, these sources add, are often an easy, cheap fix in the struggle to reduce CO_2 emissions.

“No matter how you cut this, it is always better to reduce, then produce,” says Matt Golden, founder of Sustainable Spaces Inc., a San Francisco-based home-retrofit company and president of Efficiency First, a home-retrofit trade group based in Washington, D.C., with about 300 members. But, Mr. Golden adds, “it turns out the incentives are absolutely backwards. The things that save the most energy and create the most jobs get the least incentives.”

The recently passed stimulus package provided about $40 billion of funding in the form of grants, tax credits and research money for renewable technologies. But it had only about $20 billion for energy-efficiency measures, such as better insulation and highly efficient windows in homes, and automation systems in commercial spaces. These figures are based on government and industry-group calculations.

In the tax-credit portion of the bill, renewable technologies get a credit of 30%, with no cap on the amount, while the credit for energy-efficiency technologies is capped at $1,500, according to the Environmental Protection Agency. A hypothetical $40,000 solar-panel installation on a home would be eligible for a $12,000 tax credit. But a $20,000 energy-efficiency job on a home would be eligible for only a $1,500 credit.

Even the solar industry recommends starting with energy-efficiency steps. “It’s silly to invest in solar energy if the extra power is blowing out the window,” says Monique Hanis, a spokeswoman for the Solar Energy Industries Association in Washington, D.C. “We believe they work together.”

So why do lawmakers provide more incentives for renewable energy? Natalie Mims, an energy consultant at the Rocky Mountain Institute, Snowmass, Colo., says it’s because renewables tend to cost more and take longer to pay for themselves than most efficiency measures. “Renewable energy has historically received higher subsidies than energy efficiency, particularly in research and development,” Ms. Mims says.

But new efficiency technologies, while cost-effective, have yet to be embraced by a wider public; some are unfamiliar and may have a high initial cost, like LEDs, while others are older technologies that aren’t as interesting compared to solar panels, such as insulation. Subsidies, Ms. Mims says, could help these technologies spread.

Some energy-efficiency advocates say renewables get more government subsidies because wind farms and solar power are more glamorous and easier to understand than, say, building-automation systems and LEDs, and because the renewable industries are larger and more organized.

Clark Wilson, chief executive of Green Builders Inc., an Austin, Texas, home builder and retrofit company, adds, “The solar-panel industry has a great lobby and a unified story, while the efficiency industry spans several heretofore competing trades and [has] no one champion of the group.”

House Bill

One efficiency advocate in Congress is Rep. Peter Welch, a Democrat from Vermont. Mr. Welch supports renewables but says efficiency is his primary focus because it’s more cost-effective and creates more jobs. He introduced a bill in March that would create $10 billion of incentives over four years for homeowners and businesses that adopt efficiency measures. His bill has since been rolled into the energy bill now working its way through Congress.

“When you look at the stimulus tax rebates, the amount that goes to insulation is the least, but it’s the most effective,” Rep. Welch says. “Your first dollar spent you’d want to spend on what would give you the most return. I have been astonished about how neglected efficiency is when it’s the low-hanging fruit.”

Incentives in Rep. Welch's bill are performance-based, offering homeowners rebates of $1,000 to $3,000 for achieving a 10% to 20% increase in efficiency, with $150 more for every additional percentage point of energy savings achieved. Businesses could qualify for 15 cents per square foot for the first 20% to 30% increase in efficiency, and as much as $2.50 per square foot for energy reductions of more than 50%.

The bill has 30 co-sponsors and is supported by environmental groups like the New York-based National Resources Defense Council.

"We should have the policy of efficiency first," says Mr. Welch.

Turn On the Server. It's Cold Inside.

The New York Times, November 26, 2011, By RANDALL STROSS

TO satisfy our ever-growing need for computing power, many technology companies have moved their work to data centers with tens of thousands of power-gobbling servers. Concentrated in one place, the servers produce enormous heat. The additional power needed for cooling them — up to half of the power used to run them — is the steep environmental price we have paid to move data to the so-called cloud.

Researchers, however, have come up with an intriguing option for that wasted heat: putting it to good use in people's homes.

Two researchers at the University of Virginia and four at Microsoft Research explored this possibility in a paper presented this year at the Usenix Workshop on Hot Topics in Cloud Computing. The paper looks at how the servers — though still operated by their companies — could be placed inside homes and used as a source of heat. The authors call the concept the "data furnace."

They acknowledge that it is more likely that data furnaces, if adopted, would be placed first in basements of office and apartment buildings, not in individual homes. But as a "thought-provoking exercise," the authors give homes the bulk of their attention.

If a home has a broadband Internet connection, it can serve as a micro data center. One, two or three cabinets filled with servers could be installed where the furnace sits and connected with the existing circulation fan and ductwork. Each cabinet could have slots for, say, 40 motherboards — each one counting as a server. In the coldest climate, about 110 motherboards could keep a home as toasty as a conventional furnace does.

The rest of the year, the servers would still run, but the heat generated would be vented to the outside, as harmless as a clothes dryer's. The researchers suggest that only if the local temperature reached 95 degrees or above would the machines need to be shut down to avoid overheating. (Of course, adding a new outside vent on the side of the house could give some homeowners pause.)

According to the researchers' calculations, a conventional data center must invest about $400 a year to run each server, or about $16,000 for a cabinet filled with 40 of them. (This includes the costs of building a bricks-and-mortar center and of cooling the machines.)

Having homes host the machines could reduce the need for a company to build new data centers. And the company's cost to operate the same cabinet in a home would be less than $3,600 a year — and leave a smaller carbon footprint, too. The company's data center could thus cover the homeowner's electricity costs for the servers and still come out way ahead financially.

THE machines would remain under the remote control of the company's centralized data center, and their workings would remain opaque. Network traffic and data would have to be encrypted. Sensors would warn if the cabinet was opened. If a server failed, its tasks would be automatically reassigned to another — in cloud computing, software is built with the expectation that an individual machine can break at any time.

A data furnace would be best suited for computing tasks that aren't time-sensitive and can be broken into chunks performed by thousands of machines — say, for scientific research.

The idea awaits one big-name Internet company to give it a try — and to be willing to give prospective users enough financial incentive so they'll consent to have servers take the place of their furnaces in the basement.

I asked Kamin Whitehouse, an assistant professor of computer science at the University of Virginia and a co-author of the research paper, how the computer science world had reacted to the idea. "We've gotten a very strong response, more than I usually get after publishing a scientific paper," he said. "We heard from several people who are already heating their homes with computer systems, which shows that it works. Our contribution is to show that the data furnace also has lower cost and lower energy than a conventional data center."

Winston Saunders, a physicist who serves as an alternate board member of the Green Grid, a nonprofit industry group that promotes environmentally friendly data centers, read the data furnace paper and is enthusiastic about the concept. Mr. Saunders is director of data center power initiatives at Intel, but spoke on behalf of the Green Grid.

"I've got a little house in the middle of the Oregon mountains." he said. "I have baseboard electric heaters in it right now that cost me a fortune to run. What if I had a 'baseboard data center'? It would just sit there and produce the same amount of heat with the same amount of electricity. But it would also do computing, such as decoding DNA, analyzing protein structures or finding a cure for cancer."

I.B.M. Research-Zurich is designing water-cooled servers whose waste heat can be carried in pipes to nearby buildings. Next year, it plans to demonstrate the technology with SuperMUC, a supercomputer under construction in Munich that will be more powerful than 110,000 PCs.

Many cities in Europe already have insulated pipes in place for centralized "district heating." Heat generated by data centers is beginning to be distributed to neighboring homes and commercial buildings — in Helsinki, for example. But for the rest of us, without such pipes near our homes, the computing would need to be done under our own roof to put the heat to good use.

If tech companies with data centers like the economics of home-based data furnaces, they could offer heating for homeowners at an irresistible price: free.

Randall Stross is an author based in Silicon Valley and a professor of business at San Jose State University. E-mail: stross@nytimes.com.