TRADE UNIONS FOR ENERGY DEMOCRACY

Working Paper No. 5

# THE HARD FACTS ABOUT COAL

## Why Trade Unions Should Re-evaluate their Support for Carbon Capture and Storage

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Published by Trade Unions for Energy Democracy (TUED), in cooperation with the Rosa Luxemburg Stiftung—New York Office and the the Murphy Institute at the City University of New York, October 2015

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Trade Unions for Energy Democracy (TUED) is a global, multi-sector initiative to advance democratic direction and control of energy in a way that promotes solutions to the climate crisis, energy poverty, the degradation of both land and people, and responds to the attacks on workers' rights and protections.

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TRADE UNIONS FOR ENERGY DEMOCRACY

# The Hard Facts about Coal

## Why Trade Unions should Re-evaluate their Support for Carbon Capture and Storage

Trade unions—especially those representing workers in power generation and energy-intensive industries—have generally supported carbon capture and storage (CCS). This paper argues that unions should reconsider this support.

CCS is an evolving technology (or, more accurately, a suite of technologies) for reducing $CO_2$ emissions from large, stationary emissions sources such as coal-fired power plants. The process involves the "capture" of $CO_2$ from power plants and $CO_2$-intensive industries, its subsequent transport to a storage site, and finally its injection into a suitable geological formation under the ground or seabed for the purposes of permanent storage. CCS technologies have the potential to capture up to 90% of the $CO_2$ produced by a typical coal-fired power plant.[1] Once captured, the gas is purified and compressed into a "supercritical" or near liquid state.

The subject addressed here is carbon capture and storage in the context of coal-fired power generation. This paper does not address CCS for industrial applications (so called Industrial CCS, or ICCS) or discuss its potential to be used in aluminum, steel, cement, ammonia, and fertilizer production. However, it is necessary to note that CCS for power generation is widely regarded as a *precursor* to industrial applications, so the prospects of CCS development in power generation will have a direct bearing on CCS development in energy-intensive industries, which underscores the importance of the issue to the entire debate on climate change mitigation.

Two sets of data, considered below, should lead unions to reconsider their support for CCS from a pro-CCS stance. These data are presented as two scenarios labeled "CCS non-deployment" and "CCS deployment." The problems associated with *either* scenario are serious enough to require a thorough re-evaluation of trade union support for CCS. In the case that CCS is not deployed on a sufficient scale—a likely scenario, as we will see below—political support for CCS from unions and others provides cover for new coal infrastructure, but the emissions generated by this new capacity will never be captured or stored. But even if CCS is deployed on a mass scale, the health impacts and environmental damage associated with extracting, transporting, and burning coal will not be eliminated and may become worse due to the "energy penalty" associated with CCS. In either of these scenarios, trade union support for CCS separates the labor movement from other communities seeking to build a "movement of movements" for climate and environmental justice.

The paper concludes by urging that unions commit to developing a *third* scenario, one that is based on a willingness to challenge the assumption that the demand for energy will continue to rise and that "growth" as traditionally understood can continue in a more or less uninterrupted fashion. A third scenario will also be anchored in public ownership and the reclaiming of energy resources, infrastructure, and options to the public sphere. The only conceivable route for truly *essential* CCS development (such as for specific industrial purposes) lies completely outside of the neoliberal framework that presently sets the parameters for what's possible within the narrow terrain of the market.

## Coal, Emissions, and Climate Change

The most recent *Synthesis Report* released by the Intergovernmental Panel on Climate Change (IPCC) in September 2014 has underscored the need for immediate and bold action to address rising greenhouse gas emissions (GHGs). The report stated that atmospheric concentrations of $CO_2$, methane, and nitrous oxide are "unprecedented in at least the last 800,000 years."[2] The health-related, climate, and broader ecological implications of "business as usual" are therefore extremely serious. Presently the world is on track for six degrees Celsius of global warming. In a November 2013 statement, 27 leading scientists warned that as much as six degrees of warming, "risks an outcome that can only be described as catastrophic, beyond anything mankind has experienced during its entire existence on earth."[3]

It is well known that coal use presents a massive challenge to any serious effort to control and then reduce emissions levels. During the last two decades there has been a dramatic increase in global coal consumption, and in 2013 coal use generated approximately 44% of the world's $CO_2$ emissions.[4] Overall emissions from fossil fuel use have risen a staggering 61% since 1990, with coal the largest single contributor to this increase.[5] Recent studies have calculated that in order to limit global warming to two degrees Celsius, no less than 80% of the world's known coal reserves must remain in the ground.[6]

## CCS and Fossil Fuel Use

It is widely accepted within the energy and climate policy mainstream that CCS is necessary to limit global warming to less than two degrees Celsius. The IEA and the IPCC have consistently argued that meeting this goal is probably not possible without high levels of CCS deployment in power generation and industry.[8] According to IPCC chairman Dr. Rajendra Pachauri, "With CCS it's entirely possible that fossil fuels can be used on a large scale," but "fossil fuel power generation without CCS (must be) phased out almost entirely by 2100."[9]

Between now and 2050, CCS is being counted on to contribute between 14% and 20% of the $CO_2$ emissions that will need to be avoided in order to stay within two degrees Celsius of warming.[10] According to the IEA, 55% of this contribution will pertain to power generation.[11] The IEA estimates that 6,000 operational CCS projects—burying approximately six billion metric tons (MTs) of $CO_2$—will be needed to produce significant climate benefits.[12] CCS also features in the EU's Roadmap for moving to a competitive low carbon economy by 2050.[13] The IPCC's 2014 *Synthesis Report* also envisages an explicit role for CCS.[14]

It is important to emphasize that, while CCS has been identified by the IEA, the IPCC, and others as an indispensable mitigation tool, no assessment suggests that CCS allows for the continuation of current growth trends in fossil fuel use, even if CCS were to be deployed to the levels the IEA and others say are required.[15] However, large-scale CCS deployment does mean that fossil fuels can still be used, and at high volumes. As of this writing, the global discussions around the United Nations Framework Convention on Climate Change (UNFCCC) reflect a growing consensus that "net zero" emissions will need to be in place by as early as 2050, which suggests that the IEA and IPCC scenarios will probably need to be revised in order to accommodate an even higher level of ambition.[16]

## Why Unions Support CCS

Trade union support for CCS falls into two categories: *active and direct* support and *passive and indirect* support.

Trade unions generally support CCS, especially those representing workers in power generation and energy-intensive industries. This support is legitimized by the fact that key bodies like the IEA and IPCC regard CCS as an indispensable mitigation tool for $CO_2$ abatement. Emissions reductions targets simply cannot be reached, they say, without CCS playing a major role.

Pro-CCS unions represent workers in coal mining, the transportation of coal by sea and rail, coal-fired and gas-fired power generation, and other carbon-intensive industries. For these unions, CCS promises to secure a future for coal in the global energy mix by capturing harmful $CO_2$ emissions. CCS appears to offer a means to protect (and also increase) jobs in coal while addressing emissions levels and climate change—from a union perspective this amounts to a "win-win" climate policy.[17] Unions in countries where domestic coal production and/or consumption is in decline (such as the U.K. and the U.S.) believe that for commercial-scale CCS to be developed in the future, it is prudent to protect the coal industry today to preserve skills and infrastructure that would otherwise fall idle.[18]

But the vast majority of unions are *not* directly involved with coal or carbon-intensive industries. For these unions, energy-related issues are often distant from their core agenda or main priorities. CCS therefore remains something of a mystery. It is likely that very few, if any, unions in this "non-coal" category have taken a clear position explicitly either in favor of CCS or in opposition to it, which stems from a reluctance on the part of non-coal unions to weigh in on matters not directly related to their industry or sector.

However, trade union centers and federations, particularly those in coal-producing countries, frequently endorse CCS as a policy option, which means many affiliated unions support CCS—probably without knowing it and, in many instances, without knowing what CCS actually entails. Many unions support CCS as a complement to renewable energy, not as an alternative to it. Both are considered necessary—a position also upheld by mainstream climate policy.[19]

## The Case for a Re-evaluation

There are a series of problems associated with CCS in the context of coal and the generation of electrical power. This paper considers two scenarios. In the first scenario, coal use continues to increase but CCS is *not deployed* on an effective scale. In the second scenario, CCS *is deployed at scale*. The problems associated with *either* scenario are serious enough that trade union support for CCS needs to be thoroughly debated and re-evaluated.

In the case of *non-deployment*, the main problem lies in two disturbing truths. First, coal use is rising dramatically and new coal-fired power generation capacity is being developed, "locking in" high emissions levels for decades to come. Secondly, CCS continues to make *extremely limited progress*, and its capacity to play a significant role in reducing emissions is now seriously in doubt. This paper documents and explains why the prospects for CCS are poor—so poor in fact that trade union support for CCS risks being interpreted as *de facto* support for the continued expansion of coal use, or "business as usual." Union support is particularly problematic in situations where CCS is considered to be the union's sole or primary climate policy.[20] CCS as a "stand alone" climate policy is presently doing nothing to impede "carbon lock in" in the form of large quantities of new coal-fired generation that is expected to come on line in the next ten or twenty years. Whether intended or not, CCS can provide political cover for the ongoing and increasing use for coal. The industry's promotion of new "CCS-ready" coal plants draws attention to this danger. In stating that a proposed new power station will be designed in such a way as to allow CCS technologies to be installed *at some unspecified time in the future*, the industry hopes to improve the chances of the proposed plant being approved and constructed. Declaring a project "CCS ready" does not significantly increase the likelihood of capture technologies ever being developed or deployed.

The prospect of large-scale *deployment* of CCS also poses several major problems, particularly those associated with the fact that CCS could substantially increase the overall volume of coal (and gas) burned. This is known as the "energy penalty." Burning additional coal threatens to exacerbate both the upstream environmental damage associated with coal mining, blasting, and transportation as well as the volume and negative impacts of post-combustion airborne pollution. This is a major problem.

Such a re-evaluation need not require that unions withdraw their support for CCS demonstration projects as a means for advancing and developing capture technologies that could play a role in emissions abatement in the future. But support for individual CCS projects (of which there are barely a dozen globally) does not negate the need for a thorough re-evaluation of trade union support for CCS as a *core policy priority* to address climate change. As will be demonstrated below, the prospects for CCS are presently so poor that continuing to regard it as a critically important solution to rising coal-related emissions risks positioning unions as *de facto* backers of business-as-usual at the risk of diverting trade union energies away from the urgent struggle for alternative solutions—political as well as technical.

## The Non-Deployment Scenario

Global coal use has risen by a staggering 60% since 2000 (2013 figures). Much of this coal is being burned in order to generate electrical power, and this is expected to continue. There are approximately 280 GW of new coal-fired generation under construction at the present time.[21] However, in 2014 the levels of coal use fell significantly (led by a 2% decrease in China's coal consumption), and the amount of new coal-fired generating capacity in the proposal pipeline worldwide fell from 1,401 GW in 2012 to 1,080 GW in 2014, a 23% reduction.[22] This has triggered hopeful speculation from environmentalists that the recent surge in coal use has ended; coal could now be facing a long-term decline, and market forces and rising political opposition to coal are now moving in the same positive direction.[23]

But this 23% reduction needs to be seen through a wider historical lens. In 1990 (the international benchmark for measuring emissions levels) the level of new coal-fired capacity added was a little over 20 GW. But from 2005 to 2013, approximately 722 GW of new capacity was added to the coal fleet, and close to 100 GW retired.[24] China has led the way in terms of retiring older coal-fired power stations and smaller coal mines, and it has taken bold measures to limit coal consumption. However, India, parts of East and South East Asia, and Turkey are emerging markets for coal. Turkey has 80 new coal-fired power plants under construction, equivalent in capacity to the UK's entire power sector.[25]

Even with the sharp 23% fall in projected new coal capacity, the annual level of new installed capacity is presently more than twice the level of 1990. Coal still supplies 75% of China's electrical power, and coal-fired generation is expected to double by 2040.[26] China is today consuming half of the world's coal and the country's coal-related emissions have grown by roughly nine percent per year in the past decade. Over half of global $CO_2$ emissions growth between 2002 and 2012 was due to increased coal burning in China, equivalent to the EU's entire emissions in 2011.[27]

When these numbers are viewed alongside those describing the growth in renewable energy, the challenge of coal is put into even sharper focus. On a percentage basis, renewable energy is growing quickly. Global wind-energy output was up 21% in 2013 and solar grew even faster, by 33%.[28] In the same year, coal use grew just three percent.[29]

But these numbers can be misleading. In absolute terms, the three percent increase in coal use in 2013 equates to about two million barrels of oil equivalent energy per day in additional consumption. Over the last decade (2003-2013), solar and wind together grew by about 620,000 barrels of oil equivalent energy per day. In other words, growth in global coal use *in one year* was more than three times larger than the combined increase in wind and solar consumption during the course of ten years.[30]

## CCS in 2015

As noted above, globally there are approximately 280 GW of new coal-fired generation currently under construction,[31] with another 1,040 GW presently in the "proposal pipeline."[32] However, virtually all this new coal-fired generation will come on line *without* CCS.[33] This is the hard reality that needs to inform trade union climate and energy policy.

In its November 2014 global status of CCS report, the Global CCS Institute stated that 22 CCS projects were under construction globally. A number of positive developments were identified, principal among them being the commissioning of a 110 MW Boundary Dam facility in Saskatchewan, Canada, which began generating CCS power in late 2014. (110 MW is large by CCS standards, but coal-fired power stations are normally 500-700 MW in size, and many new plants are even larger.) The report also pointed to two additional large-scale projects set to be commissioned before the end of 2016: the 500 MW Kemper County Energy Facility in Mississippi and the 280 MW Petra Nova Carbon Capture Project at NRG Energy's W.A. Parish power station in Texas.[34] The Institute suggested that these three projects marked the coming of age of large-scale CCS in power generation, paving the way for full-speed global deployment in the years ahead.[35]

The upbeat tone of the Global CCS Institute report cannot, however, disguise the fact that CCS is playing *no significant role whatsoever* as an abatement technology serving to help control emissions. In 2012 the IEA indicated that a two degrees scenario would require no fewer than 38 large-scale CCS projects to be operational by 2020 in the power generation sector, with many more projects needed after 2020.[36] This is simply not going to occur.[37] To further illustrate the lack of progress, we need look no further than the EU. When the CCS Directive was adopted in 2009, the European Council envisaged twelve commercial-scale demonstration projects to be in operation by 2015. But at the start of 2015, no new CCS demonstration plant has yet been built in Europe, and the last one that came into operation did so in 2008.[38]

Of equal concern is the lack of projects in the pipeline, suggesting that the present "first generation" of CCS projects may in fact turn out to be the last. Commercial-scale CCS can only occur over the long term if there are sufficient numbers of demonstration projects being developed. However, an examination of CCS Institute data over the past three years shows that the number of projects is steadily declining. In 2012, roughly 75 CCS projects were at some stage of development for both power generation and industry, but of those 75 just 12 projects were under construction.[39] From late 2012 to late 2014, twenty projects were cancelled, mostly due to the loss of public funding and cost overruns, and another nineteen remain stuck in the "evaluate and identify" stage—essentially still on the drawing board.[40] The UK is a global leader in CCS, but a recent House of Commons report noted how, "We are investigating storage at a rate that is about 100 times too slow at the moment; we need to have a literally two orders of magnitude scale-up of that investigation rate if we are to deliver CCS by mid-2020s and by 2030 at the scale we need to do it to decarbonise our electricity system."[41]

Indeed, the Global CCS Institute has noted that the number of proposed projects is indeed drying up—something it hopes is just a temporary phenomenon due to the impact of the 2008-2009 recession and cuts in public funding. It warns of the "total absence of any projects in the earliest stage of project planning, except in China [...]. This situation must be rectified if CCS is to play its full part as a mitigation option, commensurate with IEA scenarios." In power generation, the fate of nine projects is very uncertain and will be determined during the next year or two.[42]

There is concern that without an emerging portfolio of projects, investors will not be convinced that CCS has a future.[43] In terms of CCS for coal-fired power generation, some investors have apparently already made up their mind. In a May 2014 report, Goldman Sachs concluded, "The potential for coal to become a clean energy source through technological innovation is looking ever more remote [...]. the momentum behind CCS projects in the power sector is stalling. In our view, CCS may only account for 1/1000th of the global installed coal-fired capacity by 2020."[44]

Another issue concerns *where* CCS is happening, *and where it is not*. The IEA estimates that current patterns of coal consumption are such that 70% of CCS deployment will need to happen in non-OECD countries by 2050 in order to achieve the two degrees scenario.[45] At the end of 2014, there were just two projects operating outside of the OECD (one in Brazil and one in South Africa), and none of the twelve projects proposed in China had progressed past the planning stages.[46]

## "Revolutionary Changes"

From a climate protection perspective, CCS is light years away from playing any significant role whatsoever. Mainstream climate policy leaders assert that, in order to be on course to meet mitigation goals, CCS must quickly go beyond the publicly funded demonstration phase to full-scale commercial operations that can compete in energy markets on their own terms. The second "competitive" stage needs to begin no later than the 2020s.[47] According to the IEA, by 2030 CCS needs to be "routinely used to reduce emissions in power generation and industry" if the two degrees Celsius scenario is to be realized.[48] Based on present trends, there seems very little chance that CCS will be "routinely used" by 2030.

For the 27 scientists referred to on page three, the only way to stay within relatively safe levels of warming would require "all new coal plants to include CCS from the outset."[49] With 1,040 GW of new coal capacity in the proposal stage, this would mean roughly 1,250 mid-to-large power stations being equipped with CCS within a decade or so. According to the 2014 report released by the Global Commission on the Economy and Climate, a project co-chaired by Lord Nicholas Stern, staying within two degrees Celsius will also require, beginning around 2035, retrofitting *existing* coal-fired power plants with CCS technologies.[50]

Barring a sudden change in government regulations in coal-using countries, almost all of the new coal-fired power stations being constructed today or planned for the future will probably not even have the physical space on site to accommodate CCS. And where would the carbon be stored? Stern's Global Commission acknowledges the challenge but has no solution to offer. There needs to be, it states, "mechanisms to create demand, underpin investment in infrastructure, and enable the development of new business models."[51] What these mechanisms might look like or how they might be activated remains unexplained.

In the face of this data, it is hardly surprising that the IEA is becoming increasingly despondent about the prospects for containing global temperature to two degrees Celsius. The IEA is equally gloomy about the capacity of CCS to rein in emissions within the required time frame. In a September 2014 statement, IEA Executive Director Maria van der Hoeven said that limiting temperature increases to below two degrees Celsius would require "revolutionary changes" in the world's energy generation and use.[52] The IEA today believes that CCS non-deployment puts pressure on renewable energy to play an even larger role in decarbonizing electrical power generation.[53]

## Enhanced Oil Recovery

It is worth noting that of the 22 or so CCS projects under construction or in operation globally, 17 of them (roughly 70%) are engaged in "enhanced oil recovery" or EOR.[54] EOR entails using compressed $CO_2$ generated by CCS to release remaining deposits of oil from hard rock or near-depleted oil fields.[55] EOR also marks the emergence of a new acronym, CCUS, which stands for carbon capture *utilization* and storage.

According to the Global CCS Institute, "The present suite of large-scale CCS projects in operation, under construction or in advanced planning is heavily weighted towards projects in North America utilising $CO_2$ for EOR."[56] The Petra Nova facility is expected to increase oil production by more than 14,000 barrels per day. All three CCS facilities in North America mentioned above (Boundary Dam, Kemper, and Petra Nova) are engaged in EOR.

EOR means that the carbon emissions avoided through CCS are, in a sense, used to generate more $CO_2$ emissions. But proponents of CCS appear to accept that this might be the only way to make CCS "cost effective," because in these instances the costs of CCS are met, at least partially, by the "recovery" and sale of oil. The promise of EOR revenues in part explains how CCS projects in the U.S. and Canada got past the planning stages.[57] The World Bank also has high hopes for EOR and, more broadly, "enhanced hydrocarbon recovery" (which includes injecting $CO_2$ to release gas as well as oil deposits) as a means of funding CCS projects.[58] According to an industry spokesperson, with EOR "there is more of an economic incentive than just piping the $CO_2$ underground."[59] Exactly how EOR helps the world stay within two degrees Celsius of warming has, however, yet to be quantified or explained.

## CCS' Future and Public Funding

Aware that there are not enough CCS demonstration projects under construction, the IEA maintains that "governments must urgently scale up financial and policy support."[60] According to the IEA the money needed today for demonstration projects must come from public sources, "because markets do not value the public benefits of CCS demonstration (and) there is currently *little commercial incentive for private entities to invest in CCS*" (emphasis added).[61]

The IEA suggests that demonstration projects follow the "public-private partnership" or P3 model, with the public covering the majority of the costs. Private sector energy companies will eventually have, insists the IEA, an incentive to position themselves to deploy CCS as a means of hedging their investments from the purchase of carbon permits sometime in the (probably distant) future.

But financial support from governments has generally tapered off. During the period 2007-2012, $12.1 billion in public funds had been made available for CCS projects, some of it through government stimulus packages following the financial crisis of 2008.[62] In 2011, the CCS Institute calculated that $23.5 billion in public funding was pledged to support large-scale CCS.[63] But several governments have pulled back from these commitments, and many projects remain on the drawing board and starved of funds. Overall, CCS investment levels—public and private—are far lower than they need to be.[64] Under the IEA's two degrees scenario, the annual investment in CCS would need to be at least $30 billion per year by 2020, with cumulative investment reaching more than $100 billion. Actual investment in 2007–2012 averaged only $2 billion per year.[65]

Among EU countries, the U.K. government has committed approximately $1.65 billion to developing CCS technologies for power generation and industrial use.[66] The White Rose Project in Yorkshire proposes to capture about 90% of the $CO_2$ from a new super-efficient coal fired power station and to store it in a saline formation deep beneath the seabed.[67] The Peterhead Project in Aberdeenshire, Scotland, involves building a 385 MW gas-fired power station before transporting and storing $CO_2$ in a depleted gas field deep beneath the North Sea.[68] The project is expected to be operational in 2019.[69] Fully 75% of the costs of the two projects have been covered by public funds, with private corporations contributing the remaining 25%. The U.K. is a leader in CCS (relatively speaking) but the Department of Energy and Climate Change (DECC) has warned, "the current market in the U.K., and internationally, is not delivering investment in CCS on the scale needed to reduce costs and enable widespread deployment of CCS in the 2020s."[70]

There is no escaping the fact that, globally, CCS projects are far too few in number, and those that are moving forward are very dependent on public funds and/or EOR revenues to offset costs. Outside of the OECD, where most of the world's coal is being burned and emissions are growing the fastest, CCS is basically nonexistent.

## The "Missing Carbon Price"

CCS faces a number of technical challenges, but its lack of progress also speaks to the failures of dominant neoliberal and market-based approaches to energy and climate policy. Operating within the confines of standard neoliberal assumptions, bodies like the IEA have insisted that the best way to drive CCS is to "incentivize" it through a market mechanism, principally a price on carbon.[71] Several studies have tried to calculate the carbon price needed to incentivize the deployment of CCS, and the range appears to be between $60 and $80 per ton.[72] Other studies put the price as high as $150 per ton to meet the higher costs of producing electrical power with CCS when compared to conventional coal-fired generation.[73]

Today the prospects of establishing a carbon price across all major coal-burning countries at between $60 and $80 per ton are extremely poor. As of this writing (early 2015) the price of carbon under the EU's Emissions Trading Scheme (EU ETS)—the world's most developed carbon market—is fluctuating between seven and ten dollars per ton, far lower than the price needed to drive CCS.[74] The price has been suppressed by a number of factors, among them the impact of the recession and the flood of surplus allowances that numbered 2.1 billion at the end of 2013. The European Commission has pledged to reduce the number of allowances in the coming years to "ensure the orderly functioning of the carbon market," but the future of the EU ETS as a means to reduce emissions to any significant degree is today in serious doubt.[75] Meanwhile, the failure of the EU ETS to do its job means that CCS demonstration projects remain unattractive to investors who, had carbon prices risen steadily as planned, might wish to position themselves as market leaders in capture technologies.[76]

Today only a tiny percentage of the world's $CO_2$ emissions are covered by a carbon price, and these prices are usually nominal. Stating the obvious, the IEA notes that "a carbon price as a key driver of CCS remains missing (and) the deployment of CCS is running far below the trajectory required to limit long-term average temperature increases to 2°C."[77]

The IEA offers no convincing explanation as to why the carbon price is "missing." But it is well known that in recent years companies have actively resisted plans to establish new cap-and-trade schemes and have blocked efforts to institute a carbon tax—and their efforts have mostly been successful. Organized in trade associations such as the American Petroleum Institute, the Canadian Association of Petroleum Producers, the Minerals Council of Australia, the Energy Intensive Users Group in South Africa, BusinessEurope, and the European steel and chemicals associations Cefic and Eurofer, the main political goal of many large energy companies has been to weaken or halt efforts to put an effective price on carbon.[78] And as long as there no price on carbon, or carbon prices remain low, then why invest in expensive CCS technologies? Absent a major policy shift, the chances of a carbon price ever being high enough to drive CCS appear to be very small indeed.

## Corporations Are Committed to Burning More Carbon, Not Capturing It

The economic argument for large-scale private sector investment in CCS rests almost entirely on highly questionable assumptions. The first assumption is that companies investing in CCS will save money over the long-term. The second assumption is that a carbon price at the level required to drive investments in CCS is inevitable because climate change needs to be addressed.[79]

The first assumption is shaky because the costs of CCS are very high. With the costs of renewable energy falling rapidly, major investments in CCS for power generation (which would need to be in the realm of trillions of dollars cumulative) risk being "stranded." This is likely to be true even if the costs of CCS over time were to fall quite considerably. Today private companies are only willing to engage in CCS demonstration projects if public funds cover a large share of the costs. And corporate opposition to carbon pricing means there is no clear bridge between the publicly funded demonstration phase and the full deployment or competitive phase driven by the private sector.

The second assumption, that governments are serious about addressing climate change, is also very questionable given the inaction of the past two decades in the face of rapidly rising levels of emissions and increasingly dire scientific analyses. The idea that the governments of the world's major economies will introduce a price on carbon sufficient to drive the kind of technological and other changes needed to decarbonize power generation, industry, and transport is almost fanciful when viewed through the lens of either recent history or present-day politics.

Meanwhile, for-profit fossil fuel companies and large marketized state-owned companies are making vast amounts of money promoting the further extraction and burning of fossil fuels, both conventional and unconventional. This is happening in the face of warnings from bodies like the IPCC, the IEA, and the World Bank that business-as-usual levels of fossil fuel use will put the world on course for a disastrous temperature increase of between 3.7 and 6 degrees Celsius by 2100, and that energy-related emissions will be chiefly responsible for what could turn out to be a crisis of civilizational proportions.

The scientific consensus with regard to the anticipated impacts of climate change has thus far had no significant bearing on profit-seeking energy companies' investment practices or overall behavior. The IEA's own data illustrates this clearly. For every dollar invested in renewable energy in 2013, more than four dollars were invested in fossil fuels.[80] A recent study calculated that G20 governments are spending roughly $88 billion per year subsidizing exploration for fossil fuels. Total subsidies for fossil fuels are around $750 billion annually.[81] According to the IEA, "Annual capital expenditure on oil, gas and coal extraction, transportation and on oil refining has more than doubled in real terms since 2000 to surpass $950 billion in 2013." Meanwhile in 2013 total investment in renewable energy was only $250 billion, falling from a peak of almost $300 billion in 2011.[82]

Not surprisingly, the IPCC and the IEA's declaration that massive amounts of CCS need to be fully deployed and operational in order to meet climate goals is having no significant effect on energy investments and other key decisions.[83] Without a dramatic change of course, the likelihood of CCS being able to play any significant role in impeding business as usual before 2050 seems to be virtually zero.

## The Deployment Scenario

The extremely poor prospects for adequate levels of CCS deployment present a number of serious challenges for existing trade union climate policy. But the deployment of CCS at the scale required to reduce global carbon emissions to any significant degree would, if it ever occurred, also generate its own set of challenges. These challenges have not been sufficiently debated and discussed among trade unions due to the fact that CCS remains very limited and largely undeveloped. But if unions are to remain seriously committed to CCS deployment, then the likely impacts of CCS deployment need to be thoroughly assessed.

### Financial Costs

There has been much discussion about the costs associated with CCS—although for unions the costs of socially and environmentally necessary energy options are not always paramount, certainly not when the future of human civilization is at stake. Nevertheless, the costs of CCS pilot projects have certainly been high,[84] and a number of studies have suggested that CCS construction, transport, and storage costs will continue to keep the cost of CCS "expensive" compared to conventional coal-fired generation. Citing European Commission data, a 2013 study examining the employment effects of the EU's *Energy Roadmap 2050*[85] notes how "upfront investment for CCS-equipped plants is currently 30% to 70% higher than for standard plants."[86] Operating costs are also "currently 25% to 75% more than in non-CCS coal-fired plants, mostly due to efficiency losses and costs of capture and transportation of $CO_2$."[87] Other reports have also drawn attention to significant legal costs associated with siting and building pipelines to link power plants to $CO_2$ storage sites.[89]

Just a few years ago it was estimated that, taken together, the extra costs associated with CCS amount to an increase in power generation costs by as much as 30%.[90] But this estimate has since been revised upward. In the U.S., the Department of Energy's *CCS Roadmap* (released in 2010) stated that the cost of deploying available CCS post-combustion technology on a supercritical pulverized coal-fired power plant would increase the cost of electricity by 80%.[91] The U.K. Parliament report referred to above notes that, "a power plant with CCS costs 50% to 80% more to generate electricity than power plant without CCS."[92]

Some of these studies are surprisingly vague in terms of making a distinction between the costs of a CCS pilot project and the costs of CCS that are more or less intrinsic to the use of the technologies. In any industrial process, the costs associated with the pre-commercial phase of development are almost invariably higher than might be expected over time, when "learning by doing" and economies of scale begin to change the cost equations. It is therefore reasonable to assume that, in the event of a large-scale deployment of CCS, at least *some* of the component costs would fall over time.

The UK's CCS Cost Reduction Taskforce (CRT) has examined this question. According to its findings, the first set of CCS projects may have costs in the range of $225–$300 per megawatt hour (roughly three times as expensive as a fossil fuel plant without CCS). However, the CRT concluded that there is "potential for significant cost reductions and for CCS to be cost competitive with other forms of low carbon power generation at around £100 ($150) per megawatt hour by the early 2020s, and at a cost significantly below £100 per megawatt hour soon thereafter."[93] However, these cost projections are based in part on the availability and scale of high-quality geological storage beneath the UK continental shelf in the North Sea and East Irish Sea, and the U.K.'s well-established offshore oil and gas expertise, which are, states the CRT, "unique within Europe." And the projections of future costs are also based on a number of "Big Ifs," such as realizing EOR potential (discussed above), improving investor confidence in CCS, reducing storage risk, etc.

In its *Energy and Climate Change: World Energy Outlook Special Report* (July 2015) the IEA projected that CCS could become a "competitive abatement option by 2040" but, until then, costs and problems of $CO_2$ storage (discussed below) are such that CCS is expected to achieve "no more than marginal penetration to 2030."[94]

## Where to "Store" the Carbon?

The phrase "carbon capture and storage" is a somewhat misleading term, when what is actually being proposed is the disposal or dumping of carbon. The IEA estimates that 6,000 CCS projects will be needed to produce significant climate benefits—involving the burying of approximately six billion tons of $CO_2$.[95]

Aside from the costs associated with separation and transport of $CO_2$ in a supercritical state, finding appropriate underground geological structures also poses major challenges. The IPCC has acknowledged that while the earth's geological storage capacities are sufficient to accommodate many billions of tons of $CO_2$, regulatory hurdles, permits, and legal liability issues have not been properly addressed and may preclude storage at many locations. [96] According to one source,

> *While some $CO_2$ will be stored in depleted oil and gas reservoirs, salt caverns and coal seams, the overwhelming majority of it will need to be injected deep beneath the earth's surface in pore*

*space or deep aquifers, or potentially offshore. This poses the fundamental question of who owns and controls the target pore space and aquifers.*[97]

Concerns have also been raised regarding the safe and permanent storage of $CO_2$ and there has been some debate regarding the potential health and environmental impacts of $CO_2$ leakage from sequestration sites.[98]

The EU's 2009 CCS Directive[99] attempted to begin the process of establishing a robust legal framework for the safe geological storage of $CO_2$. In order to be granted a "storage permit," the directive requires operators to take a series of steps including the development of computer models and simulations of $CO_2$ injection, risk assessment, and identification of all potential hazards, especially leakage of $CO_2$. "Potential developers will have to take account of people living in the surrounding area and the interests of local species and habitats, and draw up an analysis of potential environmental and health impacts."[100] In early 2014 the European Commission stated that the implementation of the directive had produced a mixed response from EU member states, with some states deciding to ban or restrict $CO_2$ storage in their territories.[101]

CCS demonstration projects used for EOR (such as the ones in Saskatchewan, Mississippi, and Texas discussed above) have been constructed around known storage locations. The same is true of the projects in the U.K., which is a country with plenty of offshore storage options. But how many of the estimated 1,040 new coal-fired power stations have, or will have, a suitable place for $CO_2$ storage? CCS-equipped power plants will need to be constructed near a suitable location for "geo-sequestration" in order to avoid the costs associated with building $CO_2$ pipelines that could conceivably be hundreds of miles long. The CCS Institute notes that the sheer volumes of $CO_2$ involved will require a massive expansion in transportation infrastructure in order to move $CO_2$ to suitable locations for storage.[102]

The IEA examined the challenges associated with storing $CO_2$ in a 2014 paper titled *What lies in store for CCS?* It warned that "The final investment decision for a large capture facility cannot be taken without a very high level of confidence that the resulting $CO_2$ can actually be stored in the envisaged site or sites." It also stated, "Storage is critical to any project design and must be addressed up front. While storage is the last of the three steps of a CCS project, it should be developed simultaneously with capture and transport from the very beginning." The IEA concluded that the biggest risks, both technical and non-technical, facing CCS projects, "is dominated by storage availability and performance."[103]

$CO_2$ storage is therefore a huge challenge to large-scale CCS. The problem is acknowledged, but there are at this point in time no convincing answers. However it is clear that few if any of the new coal-fired power stations under construction or in the proposal pipeline are being designed with $CO_2$ underground storage in mind. Retrofitting these coal plants in the future will, in many instances, be impossible due to the lack of suitable storage options within proximity of the plants.

## The Energy Penalty

Another challenge to CCS is the "energy penalty." When compared to a traditional power plant, the process of capturing, purifying, and compressing carbon dioxide requires up to 20–39% more coal to generate the same amount of electricity.[104] For gas-fired power stations, the penalty is expected to be lower, at around 10–15% more gas per unit of energy generated.[105] Some studies have suggested that the energy penalty could be reduced with the introduction of supplementary technologies and processes. For example, one study claimed that

> *By maximising heat integration the energy penalty from adding CCS reduces from 39% to 24% compared to having a completely stand alone CCS plant with no heat integration. This could be improved further by pre-drying the coal, generating extra steam and maximizing the heat integration which reduces the energy penalty to 14%.*[106]

Whether 39% or 14% or somewhere in between, the energy penalty associated with CCS deployment will substantially increase the overall volume of coal (and gas) burned. Burning additional coal threatens to exacerbate the upstream environmental damage associated with coal mining, blasting, and transportation. It also increases the volume and negative impacts of post-combustion airborne pollution. This is a major problem.

## CCS and Coal-related Pollution

According to World Health Organization (WHO) data, in 2012 around seven million people died as a result of air pollution exposure—one in eight of all deaths globally. The WHO concluded that, "the risks from air pollution are now far greater than previously thought or understood, particularly for heart disease and strokes."[107] Epidemiological studies attribute the most severe health effects of air pollution to particulate matter (PM). The WHO has concluded that long-term exposure to fine particles with cardiovascular and respiratory deaths and increased levels of respiratory illness among children.[108]

Coal pollutants such as sulfur dioxide, nitrogen oxides, particulate matter, arsenic, cadmium, mercury, and hydrogen fluoride are known to affect major body organ systems and contribute to a wide range of both acute and chronic health conditions.[109] The process of burning coal to generate electricity leaves behind a host of toxic substances.[110] One serious problem is coal ash—estimated to be 780 million metric tons in 2011—almost half of which is stored in large ponds, buried in landfills, or in some cases released into local waterways.[111]

Coal is clearly a major contributor to what is a grave planetary health crisis.[112] The impact of growth in coal use is already showing up in large developing countries' life expectancy statistics.[113] In India, coal-fired power generation may cause more than 100,000 premature deaths annually.[114] A study by the National Institute of Environmental Health and Sciences found that nations that relied more heavily on coal for electricity generation had higher infant mortality rates and reduced life expectancy.[115] "Among developing nations, China had the highest years of life lost to coal-related air pollution (6.3 years on average) during the study period."[116]

Coal's health effects have enormous economic costs, and it has been argued that if these costs were monetized and added to the existing price of coal used in electrical power generation, the true cost of coal would increase dramatically. For example, the cost of coal-fired power in large parts of Southeast Asia is $60–70 per MWh. Studies estimate that if the health-related damage caused by air pollution were translated into energy costs it would raise the price of coal-fired power by at least $40 per MWh.[117]

The large-scale deployment of CCS could mean more coal being used as a result of the energy deficit associated with CCS.[118] The likely health and other environmental implications of indirect or "energy penalty" emissions was acknowledged by the IPCC in 2005, when it noted CCS' "increased fuel requirement results in increased emissions of most other pollutant emissions per kWh generated relative to new state-of-the-art plants without $CO_2$ capture and, in the case of coal, proportionally larger amounts of solid wastes."[119] According to a major study conducted by the European Environment Agency (EEA) titled *Air Pollution Impacts from Carbon Capture and Storage*, increased levels of air pollutant emissions can occur because of the combustion of additional fuel, and these pollutants include nitrogen oxides ($NO_X$), sulfur dioxide ($SO_2$), and ammonia ($NH_3$). According to the EEA, these pollutants "may lead to additional localized impacts on health, crops and materials and lead to acidification and eutrophication."[120]

Also serious are the emissions generated by the extraction and transport of additional coal that could be required if CCS were fully deployed. In the U.S. alone, the process of hauling coal from mines to power plants releases 600,000 tons of nitrogen oxide and 50,000 tons of particulate matter into the air every year.[121] This largely comes from trucks and trains and the diesel engines they used to transport coal. During transit, coal dust is released into the air, exposing surrounding communities to dust inhalation. Globally the quantities released are, of course, far higher. CCS can be expected to lead to an increase in this type of upstream pollution. The global growth in surface mining relative to traditional underground mining also increases pollution levels.[122] Dust from mining operations is less effectively contained in surface mining, and the impact on the surrounding communities is greater.

CCS-equipped power plants are also estimated to use 30% to 100% more water than unabated coal-fired power plants because of the "energy penalty" and the associated need for large cooling systems.[123] A massive deployment of CCS may lead to increasing levels of water scarcity and decreasing access to water, something that is likely to negatively affect poor and rural communities in particular.

## Searching for a "Third Scenario"

This paper has offered several reasons for unions to consider re-evaluating their support for CCS. These reasons are based on concerns associated with both the non-deployment and large-scale deployment scenarios discussed above.

Unions will continue to support individual CCS projects (for power generation and industry), if and when they occur, as a means for advancing and developing capture technologies that could play a role in reducing emissions in the future. These projects also create jobs and are normally too small to appreciably contribute to levels of "upstream" or post-combustion pollution.

But support for individual CCS projects (of which there are little more than a dozen globally) does not negate the pressing need for a thorough re-evaluation of trade union support for CCS as a *policy priority.*

As explained above, CCS for coal-fired generation faces severe and perhaps insurmountable problems.

⇒ The prospects for any significant level of CCS deployment are extremely poor. Meanwhile, rising coal use is making a big contribution to a business-as-usual scenario that puts the world on course for a disastrous six degrees Celsius of global warming and tens of millions of deaths through exposure to fossil fuel pollution. This amounts to a health and climate emergency of planetary proportions.

⇒ As noted by the IEA,[124] the technical as well as financial challenges associated with sequestering and transporting massive quantities of $CO_2$ are formidable. CCS demonstration projects have normally been built around known storage options, usually within a few miles of the site of the project. Many of the new coal-fired power stations that are expected to come on line in the next few decades will probably not have similar storage options.

⇒ Large-scale deployment of CCS, while unlikely, means that the "energy penalty" (more coal used per unit of energy generated) could lead to more coal being mined, transported, and burned. This increases pollution levels, exacerbating already very serious health impacts, and potentially contributes to problems of water scarcity and contamination. Working class people will disproportionately feel these impacts in the form of poor health and reduced quality of life.

⇒ The economics of CCS today stand on very shaky ground. The need for large quantities of additional coal and the costs of CCS technology and $CO_2$ transport and storage infrastructure are likely to make CCS a very expensive proposition. The prospects for private sector investments in commercial-scale CCS are dismal, and the costs to the public of demonstration projects are likely to be high. The costs of CCS will probably increase the cost of electricity quite substantially, although these could fall over time as a result of economies of scale, improvements in capture processes and technologies, and "learning by doing."

Given these problems with CCS, there are serious political implications for unions that continue to support CCS.

⇒ Trade union support for CCS risks being interpreted as *de facto* support for business as usual. This support is particularly problematic in situations where unions regard CCS as *the* sole or primary climate policy.[125] CCS as a "standalone" climate policy does nothing to impede "carbon lock in" in the form of large quantities of new coal-fired generation, transportation, and export infrastructure—which are all presently proceeding at great speed. The point made above bears repeating: while CCS is regarded by mainstream climate policy as an indispensable mitigation tool, no assessments suggest that CCS allows for continuation of current trends in fossil fuel use, even if CCS were deployed to the levels the IEA and others say are required.[126]

⇒ The idea that CCS is *indispensable* as a mitigation tool can create the impression among unions that commercial-scale CCS is also *inevitable*. This risks generating a false sense of security about the world's capacity to control and reduce emissions. Once the truth about CCS' prospects is fully grasped, repeating the need for CCS in a routine or *pro-forma* manner becomes misleading.

⇒ Union support for CCS also risks alienating unions from "front-line" communities and constituencies that are actively fighting fossil fuels because of the impact on health and quality of life—which is often very serious, especially in the case of children. These struggles are essential to the long-term effort to build a social movement that can fuse together traditional worker concerns with the need to protect the environment and the climate.

⇒ Any large-scale deployment of CCS means that opposition to coal could grow as a result of more upstream coal-related activities such as mining, blasting, and the movement of large volumes of coal by road and rail, as well as coal-induced environmental degradation and threats to water access and public health. Union support for CCS therefore has implications in terms of trade union relationships with organizations and communities fighting the negative "upstream" impacts of coal.

⇒ Upstream fights are not confined to coal. Resistance to fossil fuel use, including so-called unconventional fuels or "extreme energy," seems to be growing in parallel with rising levels of repression, land seizures, spills, explosions, illegal flaring, and contamination of and restricted access to water. Public awareness of the threat of climate instability is also on the increase and climate activism is growing.[127] Unions cannot afford to be seen on the side of the companies or simply sitting on the fence as these struggles unfold.

## Movement Building around a New Narrative

The problems associated with CCS raises a fundamental question: is there a third scenario? Can unions and their allies reframe the discussion on the challenge posed by coal and fossil fuel expansion in a way that can offer a different approach to controlling and reducing emissions and pollution?

Today it is clear that the transition to a truly sustainable and equitable low-carbon economy in a manner consistent with scientific necessity will require two things. First, a deep restructuring of the global political economy is required because incremental changes will not be enough. Second, changes of this nature will require a global social movement that is committed to articulating and implementing the changes that are needed.

A growing number of unions accept that deep restructuring is not only necessary but will be contingent upon both waging and winning a struggle for social ownership and democratic control over energy resources, infrastructure, and options. The business-as-usual or six-degrees-Celsius scenario, accompanied by the non-deployment of CCS, leave unions with no alternative but to engage in this fight in a determined manner.

By accepting the need for both transformative movements *and* social ownership and democratic control, unions will be tackling the "ambition deficit" in our own movement and be better placed to organize internally and externally around real solutions, however difficult they might be to implement in the short term. The question of who owns and controls energy and other strategic economic resources is therefore crucial. The present "green economy" narrative, completely avoids this question.

The only conceivable route for truly *essential* CCS development lies completely outside the neoliberal framework that presently sets the parameters for what's possible within the narrow terrain of the market. The fight for social ownership and democratic control allows unions to reframe the discussion on CCS and emissions reductions more generally. CCS deployment will almost certainly be contingent on the availability of large amounts of public money spread over a period of a decade or more, but attempts to engage the private sector by using the P3 model are falling short and will continue to do so. There may be a role for CCS for essential industrial processes that renewable sources of power seem less suited for, but the P3 model, defined by the profit-driven motives of the energy companies, is failing to deliver.

But public ownership also opens the door to alternative scenarios for the generation, transmission, distribution, and use of electrical power and energy more generally. It can allow for a rigorous and fact-based investigation aimed at redefining the role of energy so that it can be truly sustainable and needs-based. Therefore a re-evaluation of CCS is inseparable from a full re-evaluation of neoliberal approaches to energy transition and climate protection, approaches that have clearly failed workers, consumers, and the environment.

A third scenario, shaped by meeting basic needs and protecting the health and integrity of our ecosystems, might involve some level of CCS, particularly for essential industrial processes. These can be developed and deployed in a manner concurrent with a planned reduction of energy demand through energy conservation and a decarbonization of supply through publicly owned and deployed modern renewables.

## Beginning the Re-evaluation

Under the auspices of bodies like the ITUC, Global Union Federations, national trade union centers in coal producing countries, and research groups with close ties to the trade union movement, a *representative* "third scenario" global working group could be established to look critically and carefully at the emissions mitigation scenarios developed by the IEA and other global bodies—because it is these scenarios that have declared CCS technologies indispensable. It is well known that these scenarios rest on the assumption of continued economic growth and also on the idea that such growth is necessary and desirable in order to advance economic and human development.

The group could be tasked to carefully scrutinize studies that point to the potential for the massive deployment of renewable energy generation. Some of the studies challenge the dominant view, as projected by the IEA, that CCS is essential, and these same studies claim that renewable energy can meet 100% of the world's energy needs. If 100% renewable energy is indeed feasible from a technical standpoint, it can help shift trade union policy toward policies to ensure that renewable energy is deployed at the appropriate speed and scale as a public good, driven by the public sector.

A "third scenario" may entail carving out space for CCS based on the fact that renewable energy has limitations, particularly in terms of providing energy for certain industrial processes. If some level of CCS is indeed needed then it must be fast-tracked and adequately funded. Any public funds committed should be tied to an equity stake in the company or project. In the case of CCS as applied to coal, any increase in upstream and post-combustion pollution brought about by the "energy deficit" can be more than offset by reducing the use of coal for power generation and replacing it with renewable energy. The working group can thoroughly explore the question of "essential CCS" and how it can be developed.

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SYRIZA's Program and the Transition to Renewable Power

**No. 4: Power to the People**
Toward Democratic Control of Electricity Generation

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