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Seeing the forest from the trees: Infrastructure Investment and "systemic" GHG impacts
Lessons from the Keystone XL

To achieve the "energy transition" it is necessary to ask how individual investments support or hinder progress towards a low-carbon, energy-efficient future. The contested Keystone XL pipeline in North America illustrates how seeing only one tree – construction and operational GHG emissions – leads to missing the forest – the link with the carbon intensity of the larger economy. A "systemic" or "Scope 4" analysis can link individual projects with the larger economic model that they support. Even when individual pieces of infrastructure produce relatively low levels of direct greenhouse gas emissions, they can foster the continuation of system that will continue to favor, and financially reward investments supporting a fossil fuel-based economy. This analysis can be useful for both the public and private sector to improve public policy coherence as well as financial risk perception.

Background: integrating systemic GHG impacts to achieve the transition to a low-carbon future

A key part of the energy transition hinges on the investment choices concerning both existing and future infrastructure projects. Infrastructure, or the ensemble of physical and organizational structures needed for the operation and functioning of a society, sets the stage upon which both social and economic activity occurs. Due to infrastructures' longevity and central role in economic activity, investment decision making in infrastructures must be seen within a larger socio-economic context. Choices concerning infrastructure development have impacts not only on present-day greenhouse gas (GHG) emissions, but equally lock society into long-term development pathways. The IEA (2012) thus estimates that without strong action, the infrastructure expected to have been constructed by 2017 will have already locked-in the totality of the carbon budget allowable by 2035 to limit global mean temperature increase under 2°C. Asking the 'right' questions appears essential to understand their link with continued dependence on fossil fuels.

Low-carbon, resilient infrastructure in an age of constrained resources

Governmental policy has a key role to play in creating an investment environment that facilitates the development of low-carbon projects.[1] Nevertheless, ensuring that available

[1] Work by the OECD has laid out many of the changes in policy needed to foster investment in "green" or low-GHG rather than "brown" or fossil-fuel supporting infrastructure. Two of the largest steps needed to reduce investment in brown infrastructure hinge on removing public support, particularly fuel subsidies, for fossil fuels combined with putting a clear price signal on carbon – whether through fiscal or market-based policies (DellaCroce et al., 2011). A recent study of 24 OECD countries has found that fossil fuel production and use was supported by about USD 45-75 billion per year between 2005 and 2010 (OECD, 2013). Finally, the OECD suggests that these policies should be combined

By Ian Cochran, Program Manager and Romain Morel, Research Fellow – Climate, Investment and Decision-Making Support
Contact: ian.cochran@cdcclimat.com

financing is channeled into infrastructure projects that are both low-carbon themselves as well as support larger low-emission development pathways may necessitate changes in how individual projects are analyzed.

In an age of tightly constrained public and private resources, choices made in terms of investment have both direct social, economic and environmental impacts, but equally carry an opportunity cost in terms of what is not built and the potential for emission lock-in. As such, integrating the direct and systemic impact of individual projects into decision-making can be a lever to drive low-carbon investment when paired with an enabling regulatory environment.

Evaluating the GHG impact of infrastructure projects: from an evaluation of direct to systemic impacts

Evaluating the impacts of a project on greenhouse gas emissions can vary greatly depending on the methodology for calculation and the boundary of analysis used (see Box 1). The most basic level of analysis is a calculation of the direct emissions of a project, or those stemming directly from its operation or construction. However, the ambitious objectives of achieving an “energy transition” may require a widening of the scope of analysis to include indirect and systemic impacts in order to understand how an individual project supports a business-as-usual (BAU) status-quo or fosters low-carbon development.

Ensuring the transition to a low-carbon energy future requires going beyond the analysis of the direct emissions of the infrastructure itself…

The extent to which direct emissions of an infrastructure project are quantified can vary: this can include a combination of operational emissions – related to the functioning of the infrastructure (on-site combustion, imported energy use) – as well as those related to its construction, e.g. emission stemming from the use of equipment and land use changes. In most cases, this analysis is widened to include a limited amount of indirect emissions such as the carbon content of the materials employed as well as future direct emissions such as those related to future planned improvements and maintenance[2].

At the scale of an individual project, this analysis is useful to help identify improvements and means of reducing greenhouse gas emissions through the comparison of different configurations (technology, choice of route, materials, construction techniques, etc.). However, this may present only a limited picture of the GHG impact of a given infrastructure as the larger socio-economic activity it supports is not addressed. For example, in the case of a road, this approach would most likely not include the GHG emissions of the vehicles that use the roadway. As such, the opportunities to reduce emissions may remain marginal (Jowitt et al., 2012) given that the choice between the construction of a road versus rail project or a gas-fired vs. concentrated-solar power plant may have a larger overall impact on future economy-wide emissions than the technical characteristics of a single project itself.

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with a clear, long-term political commitment to prioritize low-carbon development in order to make “green” low-carbon investment both desirable and viable for public and private actors (Kaminker and Stewart, 2012).

[2] See Jowitt et al. (2012) for a detailed description of the direct emission accounting for infrastructure projects.

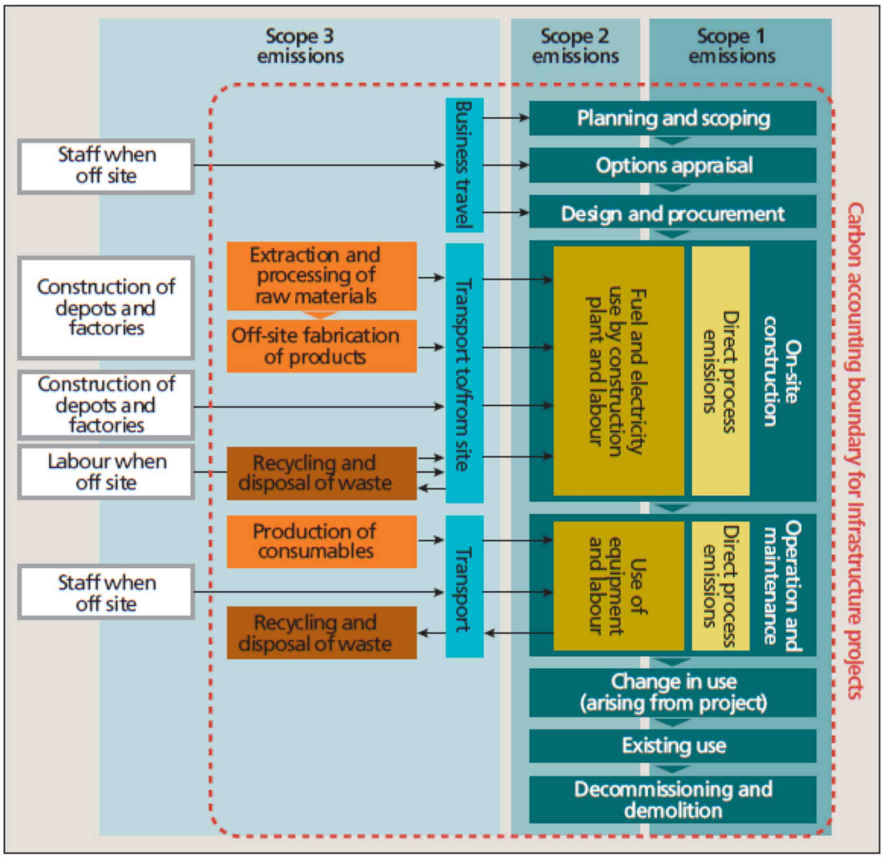
Box 1: Understanding Infrastructure GHG Emission Analysis

As seen in the below figure, at the different phases of the lifespan of an infrastructure project (construction, operation, maintenance / decommissioning), GHG emissions can come from both direct sources or indirect sources. The perimeter of analysis may also choose to look at operational-phase emissions, construction-phase or, potentially, the impacts of future phases of the project (renovation, decommission, etc.).

Direct emissions are those "directly" emitted by a project, either through the combustion of fossil fuels, fugitive emissions, discharge of methane, etc. (referred to as Scope 1 emissions).

Indirect emissions are those emissions related to the different inputs or operations of the project, either through the use of electricity or other forms of energy generated offsite (Scope 2) or emissions embodied within materials used as well as transport to and from the site during construction phases (Scope 3).

Direct and Indirect Project GHG Emissions



Source: Jowitt et al. 2012

Over the last two decades, a number of different methodological approaches and guidelines have been developed to quantify greenhouse gas emissions. The *Greenhouse Gas Protocol* elaborated by the World Resources Institute and the World Business Council on Sustainable Development and the *Bilan Carbone*® elaborated by the ADEME (the French Environment and Energy Agency) are examples. Given the large number of other quantification protocols and guidelines that have emerged, the International Organization for Standardization has issued a number of guidelines for Greenhouse gas management and related activities including ISO 14064:1 for organization emissions and ISO 14064:2 for project-scale emissions.

…to an analysis of the means of performing given socioeconomic activity

A second approach to understanding the GHG impact of an infrastructure project focuses on an analysis of the different options available to achieve a given 'objective' or perform an activity (i.e. mobility, energy generation, food production). The total greenhouse gas emissions related to an activity would be included in the analysis. This approach includes a comparison of the direct greenhouse gas emissions related to the construction of the different options of performing a given socio-economic activity as well as the operational – and in some instance maintenance – emissions. This method allows for the identification of the least-emitting option. For example, this approach can be used to compare the GHG emissions related to the construction and use of motor vehicles to move goods and services compared to different options of using rail infrastructure capable of achieving the same objective.

Achieving the low-carbon energy transition: a 'scope 4' analysis questioning the very need for an activity itself

The analysis of the direct and indirect emissions of individual infrastructure projects as well as their comparison to different options for achieving a desired objective or activity are important steps to mitigating future emissions. The state goal, however, of achieving a low-carbon, energy-efficient "transition" may require taking further steps; i.e. rethinking the activities that the infrastructure itself fosters. As such, both the proposed infrastructure project as well as the linked socio-economic objectives may need to be analyzed in terms of their coherence with a low-carbon development pathway.

A systemic or 'scope 4' analysis based on an evaluation of each project in terms of its coherence with low-carbon development objectives goes beyond what currently is a piece-meal project by project approach. Potential exists in linking this quantification and analysis of GHG impacts with long-term planning exercises focusing on national infrastructure strategies as well as territorial planning.[3] This analysis is both pertinent and increasingly critical for understanding how small-scale choices contribute and support large-scale emission trends.

News: The Keystone XL Pipeline "has limited impacts on greenhouse gas emissions"

In March 2013, the U.S. State Department released a *Draft Supplemental Environmental Impact Statement*[4] concerning the most recent incarnation of the Keystone XL pipeline project (see Box 2 for more detail concerning the pipeline project). As per US regulations, the pipeline project is subject to increased scrutiny compared to other infrastructures due to its crossing of an international border.[5] As part of this process, the *Draft Environmental Impact Statement (EIS)* evaluates the purpose and need of the proposed project in light of its impacts on a number of environmental and socioeconomic criteria[6] including greenhouse gas emissions.

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[3] For instance, in France, these planning documents would include the National Transport Schema (SNIT), the territorial planning framework (SCoT), local transport plans (PDU), local urban planning and zoning documents (PLU) as well as a number of other strategic and statutory planning documents.

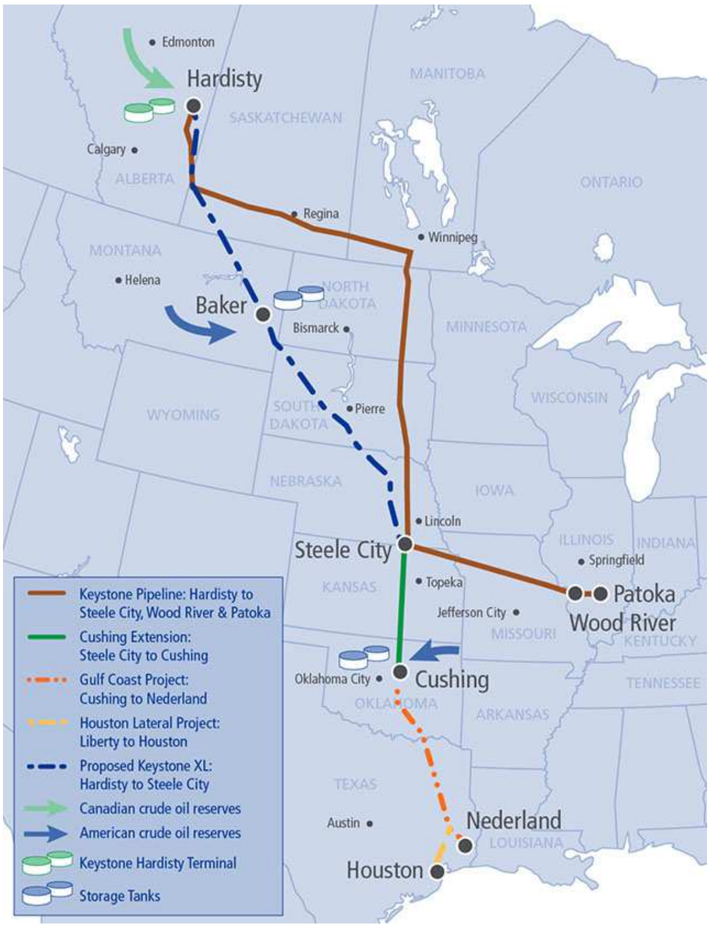
[4] This EIS is considered as supplemental as it based upon the initial 2011 Draft EIS addressing an earlier version of the Keystone XL project.

[5] Under Executive Order 13337, the project must receive a Presidential Permit and be deemed within "national interest" by the Secretary of State.

[6] Notably: soils, water resources, threatened and endangered species, socioeconomic and environmental justice; air quality, including greenhouse gas emissions and climate change; noise; potential releases; wildlife and fisheries; and cultural resources.

This report suggests that the pipeline project would have a limited overall impact on the climate as the oil from the tar sands project would most likely find a way to market with or without the project. There has however been discussion concerning how the short-, medium- and long-term impacts of the pipeline project have been estimated and weighed (Parformak *et al.*, 2013).

Box 2: The Keystone XL Pipeline Project



The Keystone XL Pipeline is a new 875-mile long project designed principally to connect the tar-sand crude oil extraction project in Alberta, Canada to existing pipeline facilities near Steele City, Nebraska for onward delivery to refinery sites in Oklahoma and the Gulf Coast. The pipeline would equally provide a means of transport for crude oil production from Montana and North Dakota, notably from the Bakken Shale formation. Designated as the blue dotted line in the graphic, the proposed project is the fourth phase and an extension of the larger Keystone Pipeline System.

The proposed pipeline would include the installation of the pipeline itself as well as the construction of 20 pump stations in Montana, South Dakota, Nebraska and Kansas. The XL pipeline extension would allow the transport of 830,000 barrels per day of heavy and light crude oil, facilitating the transport of existing and future fuel production.

The project and pathway initially proposed in 2008 has undergone a number of modifications since which has lead to the publishing of the *Draft Supplemental Environmental Impact Statement* in March 2013 presenting an analysis of the most recent version of the proposed pipeline.

Source: Draft Environmental Impact Statement 2013

Image Source: www.keystone-xl.com

An impact analysis based on a restrained scope of GHG emissions

The National Environmental Policy Act (NEPA) Guidance describes ways in which federal agencies can improve their consideration of GHG emissions and climate change activities during the evaluation of actions subject to review. The proposed pipeline project would result in direct GHG emissions that exceed the threshold of 25,000 metric tons of CO_2e (direct emissions). Thus as per regulations, the Draft EIS incorporates an analysis of GHG emissions for the proposed project and alternatives, a comparison of these emissions to global and national GHG emission levels, as well as a discussion of global and regional climate change impacts, climate risk, and adaptation.

An analysis of construction and operational emissions…

The analysis of greenhouse gas emissions of the pipeline project focuses principally on the direct (scope 1) and limited indirect (scope 2 emissions) GHG emissions stemming from the construction and operation of the proposed project. Construction-phase sources have been identified as: the clearing of land in the proposed pathway via open burning; electricity usage and emergency generators at construction camps; and construction vehicles, worker transports, and other mobile sources. Operations-phase sources were identified as including fugitive methane emissions at connections; maintenance vehicles; aircraft used for aerial inspection; and electrical generation for pump station power (USDS, 2013). In total, construction emissions are estimated at 240,000 metric tons of CO_2e with operation-phase emissions totaling 3.19 million metric tons of CO_2e per year principally due to power generation.

…paired with a comparison of alternatives for crude oil transport…

The analysis of direct and construction-related GHG emissions of the pipeline project were then compared to the estimated impacts of alternative means of transporting the crude oil from Canada and the Northern United States to the Gulf Coast. Three principal scenarios were developed:

- No action taken (status-quo and thus continued use of existing road transport capacity and pipelines);
- Rail transport to Oklahoma; use of existing pipeline to Gulf Coast;
- Rail transport to British Columbia; ocean tanker transport to Gulf Coast.

The analysis of the two alternatives to transport the crude oil, comparing direct (scope 1) and indirect (scope 2) emissions, indicates that the construction and operation of the Keystone XL pipeline is the least-emitting option in terms of GHG emissions (Table 1) to facilitate an increase in transport capacity from the status quo.

Table 1: Direct GHG Emissions (Scope 1 & 2) and Impact of Alternative Scenarios

Scenario	Construction (metric tons CO_2e)	Operational (metric tons CO_2e)	Percentage Increase Compared to Project
Keystone XL	240,400	3,200,000	NA
Rail/Pipeline	Comparable to Keystone XL Project	3,447,000	+ 8%
Rail/Tanker	Comparable to Keystone XL Project	3,757,000	+ 17%

Source: USDS 2013, Section 5.1

….resulting in a number of marginal mitigation options identified

The analysis of the greenhouse gas emissions of the Keystone XL pipeline project has allowed project developers to better understand the impacts on greenhouse gas emissions and compare the proposed project to other means of achieving the same objective: the transportation of heavy crude oil. A range of mitigation options have been identified to reduce both construction- and operation-related GHG emissions, ranging from minimize extent of land clearing for pathway to using of low-emission generator engines for the construction camps and consider the purchase of "green" electricity from the grid.

However, the mitigation actions identified could be termed as "marginal" given their limited ability to reduce the total GHG emissions of the project. Further, without calling into question the overarching socioeconomic model that the project itself supports, the analysis of the Keystone XL pipeline misses the systemic impact on GHG emission: the facilitating of the tar sands project and the enlarging the supply of fossil fuels.

Analysis: towards a low-emission future by removing the "keystones" supporting continued climate change

At the heart of achieving a transition to a low-carbon, energy-efficient economy is fostering and prioritizing the investments necessary to support such a system. As such, the evaluation of individual infrastructure projects may need to go beyond an analysis of the direct climate and energy-related impacts of the projects to understanding their role within the underlying structure of the larger economy and their economic dependence or "addiction" to fossil fuels.

A first step: accounting for the broader GHG impact of a project

A first step within a broader accounting of the impact of a piece of infrastructure on the larger stakes of climate and energy is to understand a project's indirect impacts. The Keystone XL pipeline project would exist to transport crude oil from Canada and the Northern United States to refineries and eventually to market (either domestic or export). As such, a life-cycle analysis of the product being transported from "well to wheels" is essential in understanding the larger system that the infrastructure will support.

Estimates in terms of the greenhouse gas impacts of the heavy crude transported by the project vary. The United States Environmental Protection Agency (EPA) initially estimated in 2010 that the crude oil produced from the Tar Sands is up to 82% more GHG-intensive than the average crude refined and currently supplying the US market on a well-to-tank basis[7]. As such, they suggest that the fuel transported annually by the pipeline would lead to an overall increase in GHG emissions of 27 million metric tons of CO_2 equivalent compared to an equivalent amount of average crude, or the rough equivalent of annual emissions from seven coal-fired power plants (USEPA, 2010). The US EPA has more recently that this could represent up to 935 million metric tons CO_2e over the 50-year lifespan of the project.

This issue is briefly addressed in the *Draft Supplemental Environmental Impact Statement* which estimates that the heavy crude produced from the tar sands project is 17% more GHG-intensive in terms of the well-to-wheels life-cycle emissions than the average barrel of crude oil currently refined in the United States in 2005. While differences exist in terms of estimates, what is nevertheless apparent is that the proposed pipeline project not only facilitates continued fossil fuel production, but also supports a more GHG-intensive form of fossil fuels than the status quo average in the United States.

Evaluating the Keystone XL as a lynch pin in a larger system

The official analysis of the Keystone XL project to date has focused principally on its impact as a "discrete" piece of infrastructure rather than an enabling part of a larger system. However, beyond the direct impacts of the Keystone XL project, the larger issue at hand is the future development of the tar sands in Canada.

In 2010, the International Energy Agency estimated that Canadian tar sand oil production should remain just over 3 million barrels a day in 2030 (well under current production goals for 2030) in order to achieve global climate change objectives (IEA, 2010).

Proponents of the project often cite however that if this pipeline is not built, a different project would eventually allow the tar sands' crude oil to reach a market – whether in North America or in Asia. However, in the short-term the Keystone XL pipeline stands to quicken

[7] This is principally due to the energy-intensive extraction and processing steps needed to transform the tar sands into transportable, and later useable, petroleum products.

development through connecting the tar sands to the necessary refinery capacity, thus reducing the production cost per barrel, and fostering further extraction.[8]

Evaluating the systemic impacts of the project has an impact for both public and private actors. In a policymaker perspective, this discussion is part of a larger reflection: the coherence and compatibility between energy and climate policies. In a private investor perspective, this discussion should highlight existing and future risks that could weaken returns on investment such as implementation of a price on carbon and other policies that could lead to the decrease or penalization of fossil fuel consumption.

Next steps: integrating systemic "Scope 4" impact information into investment decision making

The Keystone XL pipeline project is estimated to cost upwards of 7 billion US dollars. A key part of achieving the energy transition will be redirecting investments in fossil-fuel related infrastructure to low-carbon alternatives. This will require putting in place the needed regulatory frameworks, an analysis of projects in terms of their coherence with low-carbon objectives as well as understanding who is providing the capital beyond public actors. An analysis of the financing of TransCanada, the Keystone XL project developer, provides a number of insights.

TransCanada's principal shareholders are financial institutions that are not in practice "pure investors" in the fossil fuel industry, including a mix of banks, mutual funds and large-scale asset managers.[9] Further, TransCanada's subsidiary, TransCanada Pipeline Limited which builds and operates the group's oil and gas pipeline infrastructure, reported in the group's 2012 annual report close to 16 billion Canadian dollars of debt, principally in different forms of medium- and long-term bonds (TransCanada, 2013). Information on a 2012 bond issued by the company for approximately one billion US dollars reveals that institutional investors – principally pension funds, insurance companies, and mutual funds – are some of the largest buyers of these bonds[10].

These investors are most likely principally interested in how TransCanada and its subsidiaries have historically performed and the relative levels of risk and potential for return on investment (DellaCroce et al., 2012). As such, their participation in the project is linked to the historically-strong performance of fossil-fuel infrastructure when compared to low-carbon alternatives rather than a conscious or stated preference for supporting a carbon-intensive economic model.

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[8] The Draft Supplemental Environmental Impact Statement calculates that if the proposed pipeline project were denied, but other existing pipeline projects move forward, production could decrease from 0.4 to 0.6 percent of total tar sand production by 2030. It equally estimates that if all pipeline capacity were restricted, oil sands production could decrease by approximately 2 to 4 percent by 2030. Organizations, such as the Natural Resources Defense Council however contest that these estimates do not take into consideration the key role of connecting the tar sands to existing specialized refining capacity on the US Gulf Coast. As such, they assert that the denial of the Keystone XL project would have a greater impact on near-term future tar sands production (NRDC 2013). Given the importance of the market analysis to the conclusion that oil from the tar sands will find its way to market with or without the project, the US EPA has rated the analysis as insufficient and requested further review in April 2013 (USEPA 2013).

[9] Principal investors include the Royal Bank of Canada, Blackrock, BMO Financial Corporation, TD Asset Management, Fidelity Management and Research, the Bank of Nova Scotia or IG Investment Management (Bloomberg Terminal, 2013).

[10] In this case, institutional investors such as Vanguard Group, AXA Equitable Life Insurance Company, State Farm Insurance Company among others are providing the capital needed for the development of oil and gas pipelines (Bloomberg Terminal, 2013).

This raises important questions concerning how these financial institutions are integrating climate change and other energy-related criteria into the analysis of their investments whether directly as shareholders, project financers or bond purchasers. Their continued investment in these projects affects the ability to develop low-carbon alternatives in terms of capital availability as well as the lock-in of carbon-intensive infrastructure. Further, in terms of their bottom-line, this investment equally increases their exposure to climate-related regulatory risks that traditional, carbon-intensive projects would be subject to. It is especially the case for the Keystone XL project as the IEA (2012) forecasts an average decrease between 1,5% and 2.4% per year in oil demand in the USA between 2010 and 2035 in case of new climate policies. This would have a direct impact on the pipeline income and as such, private investors could then begin to see climate change and climate policies as financial risks with real impacts on the demand for fossil-based energy sources and supporting infrastructures.

Conclusions: Learning to see the forest from the trees

Given the current level of dependency of the global economy, there is little question that the construction of fossil-fuel related infrastructure will continue in the short term given the current organization of energy production and socioeconomic activity. However, to be compatible with a fight against climate change, it should occur in a way that does not lock-in long-term carbon-intensive development pathways, but rather facilitates weaning off carbon-rich energy sources and dovetails with needed investment in low-carbon infrastructure.

Effectively addressing greenhouse gas emissions and fully understanding the impact of individual projects – both as individual elements and lynch pins of a larger system – most likely requires a wider integration than currently occurs.

This may require the inclusion of GHG analysis from “macro” planning stages of territorial development to the “micro” adjustments to a given project. Investment in carbon-intensive infrastructure is most likely linked to needs as institutional investors in terms of size, liquidity, risk and returns on investment necessary to fulfill their fiduciary duties rather than a desire to support one development model over another. As such, it appears necessary to foster a regulatory framework that places low-carbon infrastructure and supporting projects on an equally competitive financial footing.

Further, the development of informational tools and analytical approaches needed to understand the systemic “scope 4” impacts of projects on achieving an economy-wide ‘energy transition’ as well as the carbon-content of investments[11] – whether in an individual project or at the scale of a portfolio of assets – represent important steps towards shifting practice.

To find out more…

- **CLIMATE CHANGE & INVESTMENT**

- 2° Investing Initiative, 2013. *Connecting the dots between climate goals, portfolio allocation and financial regulation.* http://2degrees-investing.org
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[11] See forthcoming 2° Investing Initiative report on the existing methodological approaches.

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Managing editor: Benoît Leguet

To receive regular updates on our publications, send your contact information to research@cdcclimat.com

Press contact: Maria Scolan - +33 1 58 50 32 48 – maria.scolan@cdcclimat.com