Summary of PBL Netherlands Environmental Agency (2020)  
Author: Ema Gusheva

**Summary**

This report is focused on the effect of the pandemic on efforts to reach the climate goals. It presents a model of the impact of COVID-19 on emissions with an assessment of scenarios and uncertainties. Next, it introduces the debate between ‘green’ and ‘grey’ recovery with a thorough literature review of policy studies applying any kind of index of greenness measure. An example case study of the recovery policies of Germany are given and a final not on how higher green investments and low-carbon assets lower the impact of recovery policies on GHG emissions and lead the way to zero-emissions societies. Lastly, different modeling methods and their suitability to making long-term and short-term recommendations are discussed.

**Implications for infrastructure**   
Infrastructure companies can benefit from the discussion of possible rebound behavior (p. 22). The uncertainty of behavior changes as well as how long those changes will last is a key topic in this report as it drives demand for energy and infrastructure as well as the profitability of ‘green’ and ‘grey’ investments. An example is given on how low energy demand has driven down price and ultimately investments in fossil fuels. Interestingly, investments in renewable energy have been found to be more resilient to the current economic crisis.

**Stock-and-flow diagram**

The model portrays a clear difference between high-carbon and low-carbon assets and tells the story of how these assets change as a result of consumer behavior, investments and government policy (see Figure 1). Investments in renewable energy drive the conversion of high-carbon assets to low-carbon assets as well as increase the rate at which low-carbon assets are built. On the other hand, investments in fossil fuels increase the rate at which high-carbon assets are built locking-in Dutch society to a carbon future.

The amount and types of assets available and the energy demand determine the carbon intensity of economic activity, which together with the GDP results in GHG emissions (see Table 1). Then, GHG emissions are compared with the NDC forming the Implementation gap, which is assumed to drive green policy thus increasing investment in renewables. Notably, investments are also decided upon by the Anticipated energy demand which, along with the Energy market price, is representative of their respective profitability assuming equal costs.

Last, Energy demand is influenced by changes in behavior (Degree of lifestyle change, Degree of change in mobility and Degree of change in global trade) as well as the Time it takes to develop a vaccine since it is uncertain how many of these changes are permanent and how many might develop in the opposite direction once the pandemic is over. Apart from Energy demand, these changes impact GHG emission rates (see Table 2) in an additional way - through influencing the GDP.

The limitation of this model is that it fails to endogenize behavior change or vaccine development.



Figure 1. Stock-and-flow diagram based on PBL Netherlands Environmental Assessment Agency (2020)

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| --- | --- | --- | --- |
| **Variable name** | **Description** | **Quote** | **Page** |
| GHG emissions | Amount of emissions per year | Global emission levels in 2020 will, by most accounts, show the largest annual decline in history | 8 |
| Degree of lifestyle change | The extent to which people will change their behavior in terms of demand for infrastructure | The collective understanding is that projections for 2020 (and 2021) heavily depend on … the degree to which life will resume its pre-confinement course | 13 |
| Carbon intensity | The emission rate per GDP | The collective understanding is that projections for 2020 (and 2021) heavily depend on … carbon intensity of economic activity | 13 |
| Demand for renewable energy | Cumulative Kw/H demanded | Demand for renewable electricity has been largely unaffected by the overall fall in energy use | 13 |
| Anticipated energy demand | Projections for energy demand | Historical data show that a decrease in emissions caused by a crisis is often followed by an increase in emissions during and after economic recovery. | 14 |
| NDC | National determined contribution to the Paris agreement | The pandemic will likely affect NDC emission projections through its effects on GDP growth | 18 |
| Emissions gap | The difference in emissions between the NDC and the least-costs pathway. | Thus, the emissions gap in 2030, defined as the difference between projected global GHG emissions in 2030 under the NDC scenarios and emissions under least-costs pathways limiting warming to below 2 °C and 1.5 °C, is expected to remain the same. | 19 |
| Implementation gap | The difference in emissions between the NDC and current policies. | Thus, the pandemic is expected to slightly reduce the implementation gap, i.e. the difference between estimated total global emissions in 2030 under the NDC scenarios versus emissions under current policies. | 19 |
| Time needed to develop a vaccine | The time needed to develop a vaccine for COVID-19 | The full impact of the pandemic on emissions is yet unknown, and will depend on many factors, including the time needed to develop a vaccine | 21 |
| Investments in renewable energy | Total amount of money invested in renewable energy | Investments in renewable energy are also uncertain. | 21 |
| Anticipated investments in renewable energy | Projections for total amount of money invested in renewable energy | investments in renewable power projects are still expected to fall by 10% in 2020 compared to 2019 | 21 |
| Investments in fossil fuels | Total amount of money invested in fossil fuels | While this decrease is smaller than the decline observed for fossil fuel investments, which witnessed the largest annual fall in history (around 20%, a decline of about $400 billion, see IEA, 2020c), | 21 |
| Investments in renewables needed to reach a sustainable pathway | Total amount of investments in renewables needed to reach sustainability goals | The flat trend in investments in clean energy and efficiency since 2015 is far from enough to put the world on a more sustainable pathway and bring a lasting reduction in emissions (IEA, 2020c). | 21 |
| High carbon assets | The amount of high carbon-emitting physical assets | Greener investments are needed now to avoid a lock-in to carbon intensive energy sources and potential future stranding of high-carbon assets. | 23 |
| Energy demand | Cumulative Kw/H demanded | This would require in-depth analyses of the impact of national government policies on energy demand and activity changes. | 32 |
| Effect of energy demand on price | The effect of energy demand on energy market price | The sharp reduction in demand for these fuels due to COVID-19 containment measures led to a decline in market prices that, in turn, led to a significant decrease in fossil fuel investment projections. | 32 |
| Degree of change in global trade | The extent to which people will change their behavior in terms of demand for non-local goods | Structural changes that can be expressed in terms of … changes in global trade and consumption patterns, and changes in surface transport due to a greater percentage of the population working from home | 33 |
| Degree of change in mobility | The extent to which people will change their behavior in terms of transport usage | Structural changes that can be expressed in terms of … changes in surface transport due to a greater percentage of the population working from home | 33 |
| Effect of time needed to develop a vaccine on behavior change | A variable portraying to what extent the behavior change is permanent vs there being a rebound effect | These factors will determine whether rebound effects at the sector level will be positive or negative in terms of their climate impact. | 21 |

Table 1. A description of the most important variables in the model.

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| --- | --- | --- | --- |
| **N.** | **Page** | **Quote** | **Causal link** |
| 1 | 21 | These factors will determine whether rebound effects at the sector level will be positive or negative in terms of their climate impact. | Time needed to develop a vaccine -> Degree of lifestyle change  Time needed to develop a vaccine -> Degree of change in mobility  Time needed to develop a vaccine -> Degree of change in global trade  Effect of time needed to develop a vaccine on behavior change -> Degree of lifestyle change  Effect of time needed to develop a vaccine on behavior change -> Degree of change in mobility  Effect of time needed to develop a vaccine on behavior change -> Degree of change in global trade |
| 2 | 21 | In the current crisis, emissions have been reduced in almost every sector except the residential sector | Degree of lifestyle change -> Energy demand |
| 3 | 23 | Greener investments are needed now to avoid a lock-in to carbon intensive energy sources and potential future stranding of high-carbon assets. | Investment in fossil fuels -> High-carbon assets |
| 4 | 23 | Emissions could bounce back and even overshoot previously projected levels by 2030, despite lower economic growth | High-carbon assets -> Carbon intensity -> GHG emissions  Low-carbon assets -> Carbon intensity -> GHG emissions |
| 5 | 32 | the COVID-19 containment policies of national governments led to large reductions in global energy demand and CO2 emissions in the first half of 2020. | Energy demand -> Carbon intensity -> GHG emissions |
| 6 | 32 | the sharp reduction in demand for these fuels due to COVID-19 containment measures led to a decline in market prices that, in turn, led to a significant decrease in fossil fuel investment projections. | Degree of lifestyle change -> Energy demand -> Energy market price -> Investment in fossil fuels |
| 7 | 33 | Structural changes that can be expressed in terms of emissions over longer time periods, such as long- term governmental policies, changes in global trade and consumption patterns, and changes in surface transport due to a greater percentage of the population working from home, | Degree of change in mobility-> Energy demand-> Carbon intensity -> GHG emissions  Degree of change in global trade -> Energy demand-> Carbon intensity -> GHG emissions |

Table 2. Causal links found within PBL Netherlands Environmental Assessment Agency (2020)

**References**

PBL Netherlands Environmental Assessment Agency (2020) *Exploring the impact of the COVID-19 pandemic on global emission projections: Assessment of green versus non-green recovery* https://www.pbl.nl/sites/default/files/downloads/pbl-new-climate-institute-2020-exploring-the-impact-of-covid-19-pandemic-on-global-emission-projections\_4231.pdf, accessed on 8 October 2020.