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RAISING THE AMBITION LEVEL OF INDCs ALLOWS FOR A SMOOTHER ENERGY TRANSITION

Assessment of the implications of INDCs for achieving the 2 °C climate goal

Note

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INDCs lead to a 53 to 56 $GtCO_2eq$ emission level by 2030

Many parties to the United Nations Framework Convention on Climate Change (UNFCCC) have recently put forward their Intended Nationally Determined Contributions (INDCs) in preparation for the negotiations on a new climate agreement in Paris in December 2015. PBL has estimated that the aggregate effect of these INDCs will lead to a global greenhouse gas (GHG) emission level of 53 to 56 $GtCO_2eq$ by 2030, compared to about 65 $GtCO_2eq$ under a baseline scenario which only includes national domestic energy policies as implemented before 2010 (Admiraal et al., 2015). This note presents preliminary calculations on the implications of the INDCs for the long-term international climate goal of keeping global temperature increase below 2 °C, compared to pre-industrial levels. We assessed two scenarios targeted at achieving this climate goal:

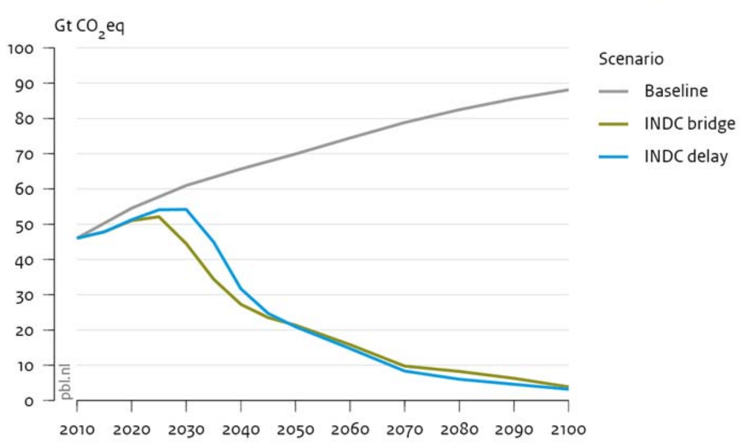
- *INDC delay*: full implementation of all unconditional INDCs by 2030 and cost-optimal policies after 2030;
- *INDC bridge*: emissions follow pathway towards conditional INDCs until 2025, after which cost-optimal policies are introduced.

Under both scenarios, the projected radiative forcing level is 2.8 W/m^2 by the end of the century, which implies a likely chance of keeping global temperature increase below 2 °C, compared to pre-industrial levels. The scenarios were developed using the Integrated Assessment Model IMAGE (Stehfest et al., 2014), including its energy system model TIMER, the climate policy model FAIR, and the coupled carbon-cycle climate model FAIR-SiMCaP. All results are presented for the world as a whole.

INDCs imply very rapid reductions after 2030

Both mitigation scenarios imply a delay compared to directly implementing (theoretical) cost-optimal policies towards achieving the 2 °C climate goal. This leads to even more rapid reduction rates between 2030 and 2050, because of two reasons. First of all, emission levels will have to be reduced rapidly in order to reach the levels of cost-optimal immediate pathways towards achieving the 2 °C climate goal. Secondly, the excess emissions compared to optimal 2 °C pathways need to be compensated, as the climate responds to the cumulative CO_2 emissions. This implies that,

Figure 1. Global greenhouse gas emissions, including land use CO_2



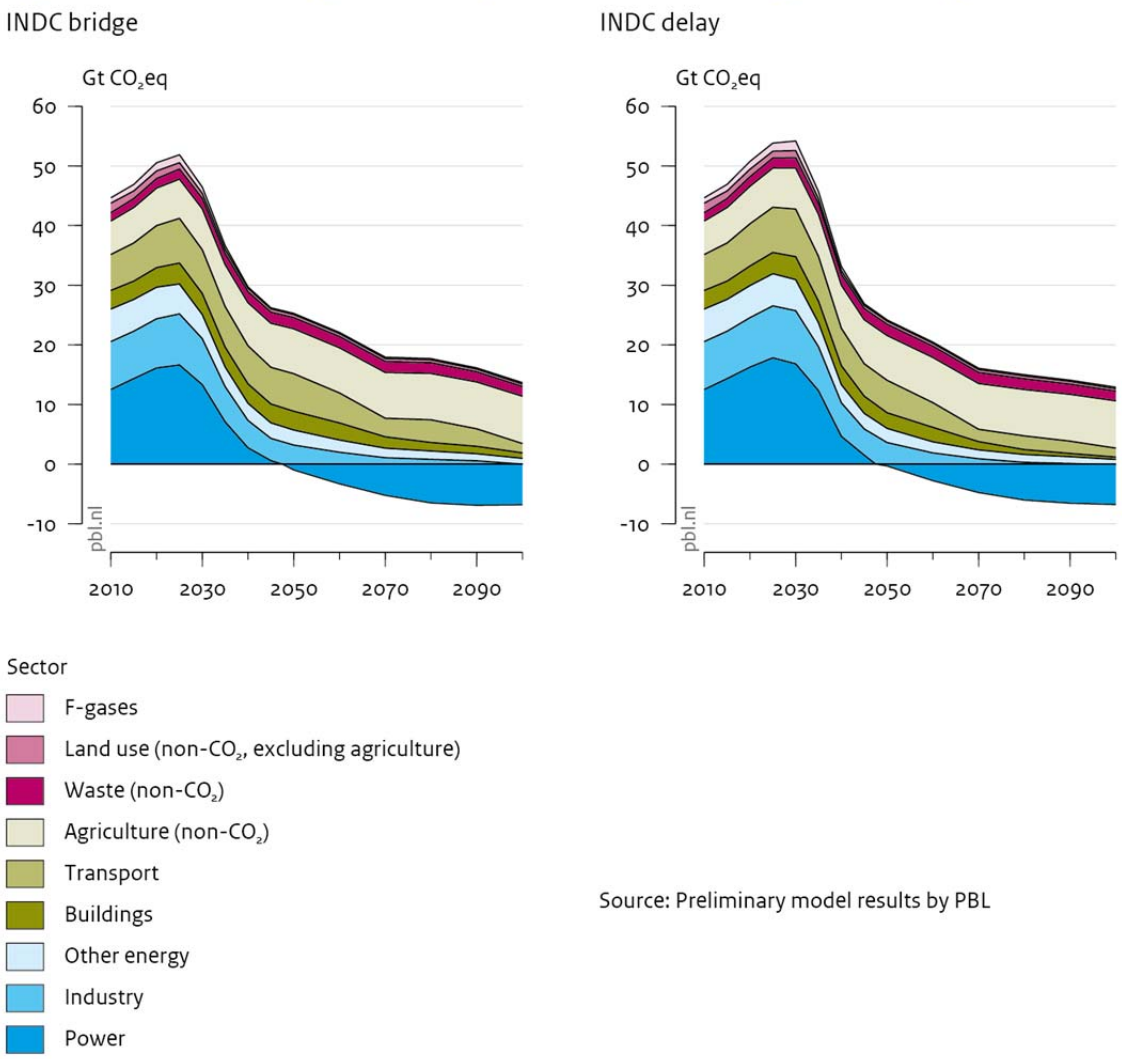
Source: Preliminary model results by PBL

between 2030 and 2050, in a period of just 20 years, greenhouse gases need to be reduced from 54 $GtCO_2eq$ to 21 $GtCO_2eq$ under the INDC delay scenario, a reduction of 61%. This requires an average decarbonisation of the global economy at an annual rate of more than 6% between 2030 and 2050. The INDC bridge scenario, as an intermediate scenario, shows a similar greenhouse gas emission level by 2050, but the decarbonisation rate is lower as emissions in 2030 start from 44 instead of 54 $GtCO_2eq$ (also requiring less compensation in the long term).

Decarbonisation of the power sector before 2050

Although all sectors contribute to reducing greenhouse gas emissions, the power sector shows the largest contribution (Figure 2). Compared to other sectors, relatively many options are available for the power sector to reduce emissions. Under the mitigation scenarios, this will result in a fully decarbonised power sector globally before 2050, after which the sector even shows negative emissions (see below). This is only possible with early

Figure 2. Global sectoral greenhouse gas emissions, excluding land use CO_2



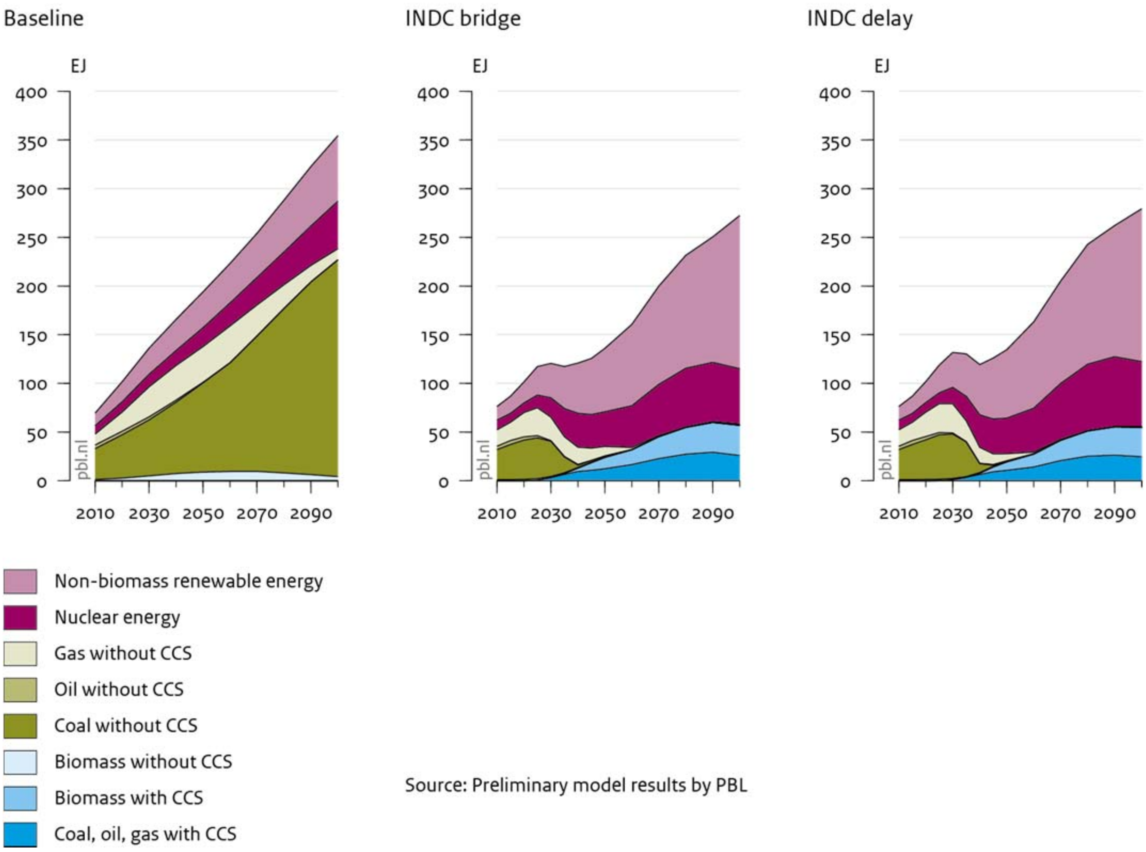
Source: Preliminary model results by PBL

retirement of existing coal-fired power plants. Under the INDC bridge scenario, practically all existing coal-fired power plant capacity is retired early between 2030 and 2040. Under the INDC delay scenario, early retirement of coal-fired power plants occurs about 5 years later, but much more suddenly; over a period of just five years, all of the existing coal-fired power plants are retired early (Figure 3).

Raising the ambition level leads to higher efficiency gains

Figure 3 shows the energy mix in the power sector, for both the baseline and the two mitigation scenarios. Improving energy efficiency contributes to lower power demand in the mitigation scenarios. Under the INDC delay scenario, electricity demand will be only 5% lower than under the baseline scenario, by 2030, while under the INDC bridge scenario, the reduction is more than 11%. Raising the ambition level of INDCs, therefore, better exploits the potential for energy efficiency improvements by providing more time for implementation. It should be noted that climate policy also leads to a further electrification of other sectors (such as transport) offsetting some of the positive impacts of energy efficiency improvements. Electrification is an interesting option for mitigation strategies, given the large potential to reduce emissions in power generation.

Figure 3. Energy mix of global power production



Source: Preliminary model results by PBL

Very rapid increase in renewable energy

Under both the INDC delay and INDC bridge scenarios, the share of renewable energy in power supply increases rapidly. This is due to a combination of a phase-out of unabated fossil fuels, as mentioned above, and an increase in investments in renewable energy. Under the mitigation scenarios, globally, about three-quarters of the power is generated by solar PV, wind, hydropower, and nuclear energy by 2050, with a slightly higher share under the delay scenario. The remainder is more or less equally divided among fossil fuels and bioenergy, both with carbon capture and storage (CCS). This means that, from 2050 onwards, the scenarios show that, globally, electricity is supplied fully by technologies without CO_2 emissions. In fact, as the combination of bioenergy with CCS creates negative CO_2 emissions (as biomass cultivation retrieves carbon from atmosphere which is later captured from the power plant and stored in geological formations) the power sector shows net negative greenhouse gas emissions from about 2050 onwards.

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