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Beyond the Numbers: Understanding the Transformation Induced by INDCs

A Report of the MILES Project Consortium – Executive Summary

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What is Innovative and Complementary About this Report?

As part of the negotiations towards a new climate agreement to be sealed in Paris in December 2015, countries have been requested to submit new 'intended nationally determined contributions' (INDCs), in particular new greenhouse gas (GHG) emissions targets for the period beyond 2020. As of October 19, the 123 INDCs, covering 150 countries, submitted to the UNFCCC represent ca. 85.8% of global GHG emissions in 2012.[1]

At the Lima Conference of the Parties (COP20) in 2014, the Secretariat of the UNFCCC was tasked with producing a synthesis report on the "aggregate effect" of INDCs. This UNFCCC synthesis report will analyse the impact of INDCs on global emissions, in the light of the goal of limiting warming to 2°C or 1.5°C. Other analysis, in particular the annual UNEP Gap Report, will perform similar assessments. These reports represent the cutting edge in terms of understanding the aggregate effect of INDCs on global emissions, in the light of the below 2°C goal.

This report aims to do something different and complementary. It is the outcome of an international research project involving 14 leading research teams from 10 countries (see authors' list). In 2015, the objective of the project has been to produce a detailed analysis of INDCs in terms of three innovative aspects:

- Understanding **the transformation of the energy sector that would result from implementing the INDCs, in particular at the national level for major economies but also at the global level.** The focus here has been on the implications of INDCs to 2025 and 2030, while taking into account the importance of embedding this understanding in the long-term perspective of the transformation required to 2050. The project has developed detailed analysis on what it would take to implement the INDCs, in terms of the roll-out of renewable energy, improvement of energy efficiency, and the deployment of other low-carbon solutions. The project is based on the participation of leading national experts, who have each analysed their country's INDC, as well as on leading global modelling teams who have assessed INDCs in aggregate.
- Understanding **options to stay on track with 2°C at the global level,** in the light of the level of transformation in the global energy system implied by INDCs by 2030.
- Understanding the **co-benefits and trade-offs** of INDCs, in particular related to local air-pollution, energy-security, investment requirements, and risks of lock-in into high emitting infrastructure.

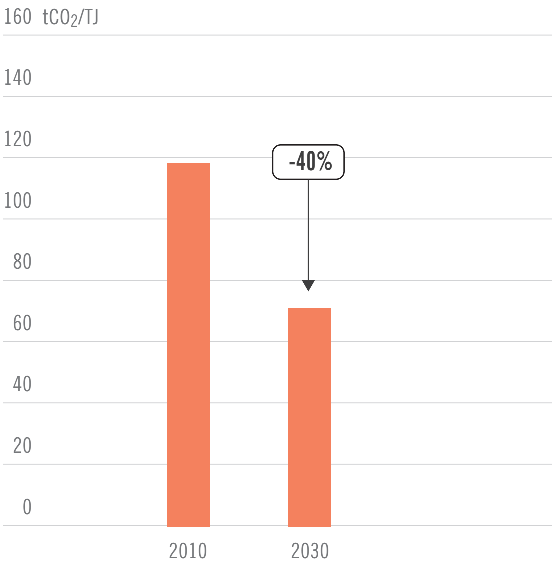
In order to perform this analysis, the report has adopted an innovative methodology:

- Detailed, sector-specific, national-level INDC scenarios are developed, which show concretely what would be required to reach INDCs (*national INDC scenarios*). These national INDC scenarios have been produced by the respective research teams for five countries and one region: the USA, China, Brazil, Japan, India[2] and the EU. Together these represent 60% of global emissions from fossil fuel combustion, and 74% of global GDP in 2012. **These countries are very different, and the transitions that will**

1. Source: WRI, CAIT Climate Data Explorer, Paris Contributions Map. Available online at: http://cait.wri.org/indc/.

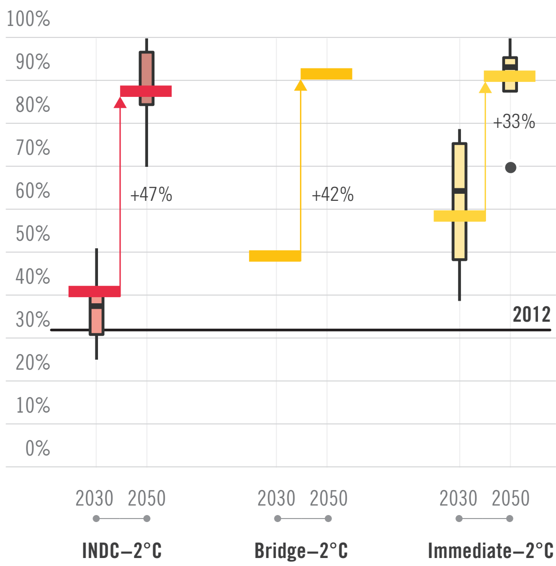
2. The India assessment is based on the previously published TERI study "Energy Security Outlook" (2015), adjusted for the headline targets of the Indian INDC.

Figure A. Aggregate reduction in carbon intensity of electricity in USA, EU, China, India, Brazil and Japan



Source: MILES project analysis (see country chapters in this report)

Figure B. Low-emissions electricity share at the global level



Source: REMIND model calculations and IPCC scenario database (box plots)

Note to Figure B: INDC-2°C assumes INDC implementation to 2030, and then a shift to a 2°C trajectory; Bridge-2°C assumes stronger policy action from 2020 towards a 2°C trajectory ; Immediate-2°C assumes an immediate global implementation of a 2°C goal after 2015

be induced by INDCs will vary between countries. Nonetheless, it is possible to see some common trends or patterns.

- In order to assess the global implications of INDCs, a global-level INDC scenario was developed integrating the headline emissions or policy targets of INDCs published by October 2 within a global modelling framework. This details transformations in the global energy sector implied by INDCs. Secondly, a global INDC-2°C scenario was developed, which implements INDCs until 2030, and then shifts to a 2°C scenario from 2030. This scenario is used to explore the implications of INDCs for the below 2°C objective. Thirdly, a 2°C- bridge scenario was developed, allowing for a more continuous transition from the INDCs to 2°C. In this scenario, policies and targets are strengthened by 2020 for 2030 and beyond, and investors respond early to this strengthened policy commitment.

INDCs Significantly Accelerate the Energy Transition in Major Economies

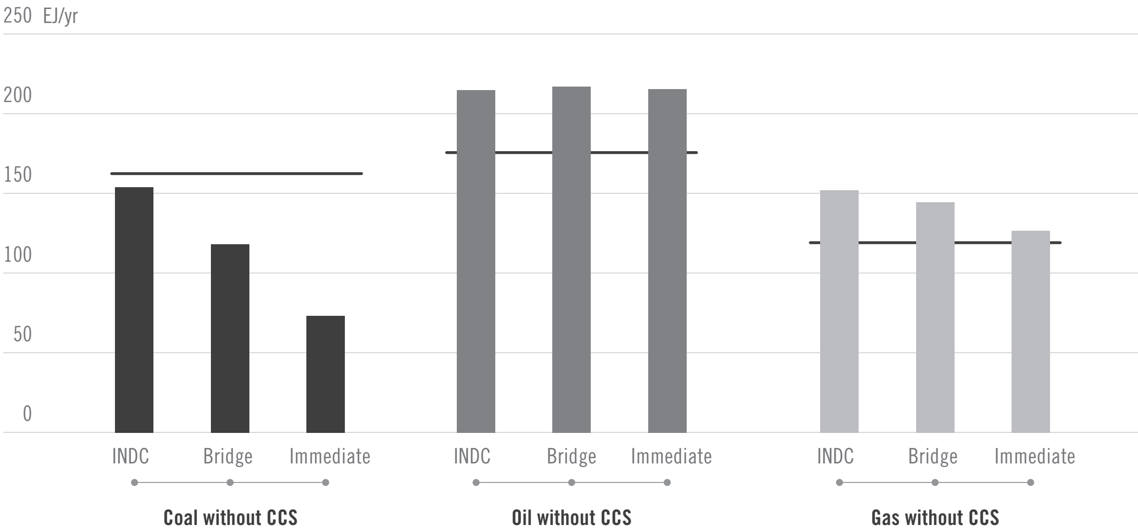
Energy resource endowments, energy supply systems and the economic drivers and the structure of energy demand differ markedly between major economies. However some robust features of the impact of INDCs on national energy transformations in Brazil, China, the European Union, India, Japan and USA, as well at the global level, can be identified.

- **Key finding:** ***the INDCs will* accelerate and consolidate *a significant transition in the electricity sector and in energy efficiency in the next 15 years, driving innovation and reduced costs.***

The INDCs imply a significant transition in the electricity sector. In aggregate from 2010 to 2030 the carbon intensity of electricity production declines by 40% in the five countries and one region assessed (Figure A). In these national INDC scenarios, renewable energy becomes the dominant source of electricity, reaching 36% in the electricity mix. At the global level, the deployment of low-carbon electricity production under the global INDC scenario is 41% in 2030, an increase of roughly 10 percentage points from 2012 levels, but still below what is seen in 2030 in 2°C scenarios (Figure B). Global investments in low-carbon electricity account for 78% of cumulative investment from 2020-2030 in electricity supply in the global INDC scenario, up from 67% in 2012.

Similar positive trends are seen regarding energy efficiency in the end-use sectors: transport, buildings and industry. Transport in particular would see significant improvements in energy intensity, falling in aggregate by 30% between 2010 and 2030 in the five countries and one region assessed

Figure C. Risks of lock-in through the deployment of unabated fossil fuels in 2030



Source : REMIND model calculations and IEA

2012 historic value, black line

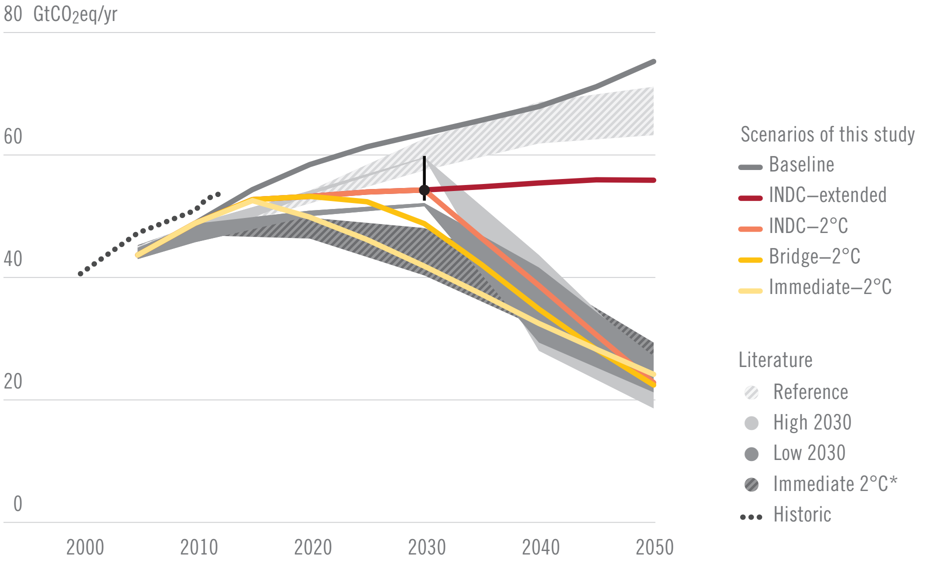
individually. In Japan and the European Union for example, the energy intensity of GDP drops a further 33% and 34% between 2010 and 2030, while it drops 48% in China over the same time period. In the USA, energy intensity of GDP drops 26% between 2010 and 2025.

- **Key finding:** *some crucial low-carbon solutions, like CCS, electric vehicles, advanced biofuels, sustainable urban planning, appear unlikely to be developed under the INDCs at the scale and speed required for a 2°C scenario, given the implied lock-in of carbon-intensive infrastructure in 2030 under the INDC scenario. Post-Paris policy efforts also need to focus on stimulating technology innovation, deployment and diffusion in order to drive down costs in such sectors where insufficient progress is being seen. This highlights also the importance of developing short-term targets in the light of long-term climate constraints, building on the development of national deep decarbonisation pathways to 2050. The Paris agreement should foster the development of national deep decarbonisation pathways by 2018.*

The INDC scenarios demonstrate little penetration of alternative technologies in the transport sector by 2030 (with the exception of Brazil and biofuels). However, 2°C scenarios suggest that alternative transport technologies, in particular electric vehicles in many scenarios, will need to be rolled out massively from 2030, with the share of electricity in transport energy consumption reaching a significant share of global transport energy demand by 2050 (about one sixth to one fifth). **To achieve this level in 2050, innovation in and deployment of alternative vehicles must start early**, with a growth rate of the alternative passenger vehicle industry of around 35-40%/year already between 2015 and 2030. It seems unlikely that INDC scenarios would support this rate of technology deployment. The national and global INDC scenarios likewise demonstrate little deployment of CCS, with a share of CCS in electricity generation of about 3% in 2030 for the USA, China, Japan and the EU, although **given the scale of fossil fuel infrastructure in 2030 under the INDC scenario it seems that CCS will need to be a crucial technology for mitigation post-2030**. The level of penetration of CCS seen in INDC scenarios raises questions of whether the technology would be deployable at scale from 2030.

The report also investigates the **risk of lock-in into high-carbon infrastructure**. In the global INDC scenario, deployment of unabated fossil fuel is significantly higher than what would be seen in a 2°C scenario. By 2030, unabated coal deployment is more than twice as high in the global INDC scenario developed for this paper than in the immediate 2°C scenario (Figure C). At the same time, as noted above, the CCS technology that could render this unabated fossil fuel capacity coherent with a 2°C scenario does not seem to be developed sufficiently under the INDCs. The INDC scenario thus implies a significant bet on CCS after 2030, without providing assurances that research, development and deployment of the CCS technology would be sufficient to rapidly assure its commercial availability.

Figure D. Greenhouse gas emissions in the scenarios of this study, compared with literature



Greenhouse gas emissions in the scenarios of this study (solid lines), compared with the 2030 range and best estimate from the country-level analysis of conditional INDCs of PBL (www.pbl.nl/indc, vertical black line and dot), and the inter-quartile ranges of the FullTech-450-OPT (Immediate 2°C), FullTech-450-LST (Low 2030) and FullTech-450-HST (High 2030) scenarios of the AMPERE study, as well as the reference policy scenarios of the AMPERE and LIMITS studies. While section 4.3 discusses the INDC-2°C scenario, section 4.4 explores the possible effect of an early announcement of 2°C compatible policies (Bridge-2°C). Total greenhouse gas emissions were calculated based on global warming potentials from IPCC's second assessment report (SAR).*

Source: REMIND model calculations, EDGAR (JRC/PBL, historical emissions), PBL INDC Tool calculations (www.pbl.nl/indc INDC range and best estimate) and IPCC AR5 scenario database

** with action starting after 2010*

It seems like there is insufficient policy focus to disincentivize fossil fuel use in the INDCs, in particular via carbon pricing and emissions performance standards. Without such policies, low carbon support policies face an uphill battle to replace fossil fuel infrastructure.

Building the Bridge from INDCs to 2°C

The number of INDCs submitted and their level of ambition constitute a significant improvement over previous policy commitments. They have initiated a broad and interlinked policy process at national and international level, giving an entry point to put the world on track to 2°C. However, by themselves INDCs as currently submitted are not yet in line with 2°C. Therefore, the report develops a 'bridge scenario', in which action is strengthened and accelerated by 2020.

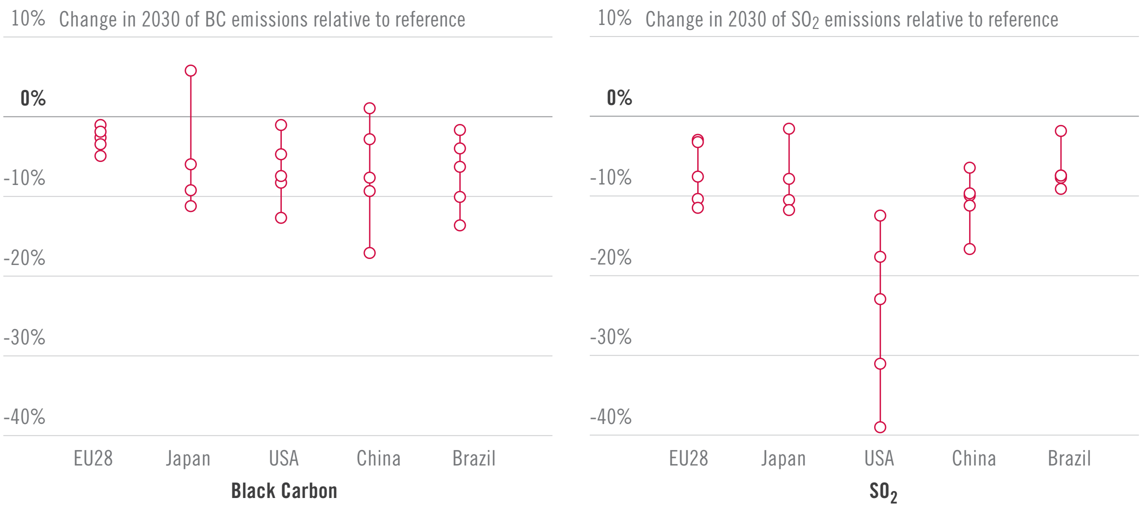
- **Key finding:** *INDCs imply an acceleration of climate action and a deviation from previous trends and policy commitments. However, they would necessitate very stringent and rapid mitigation measures post-2030 if the 2°C target is to be met. This would imply at the global level significantly higher costs and risks to feasibility compared to a scenario of earlier, stronger action. A dynamic approach to climate policy-making under the Paris agreement, with further rounds of strengthened policy commitments, is critical to keep the 2°C target in reach. This policy strengthening would need to happen rapidly after 2015.*

INDCs lead to a significant reduction of emissions compared to projections based on existing policies and commitments (Figure D). Nonetheless the global INDC scenario in this report showing emissions of 54 $GtCO_2eq$[3] in 2030 is above the emissions range of cost-effective scenarios consistent with the below 2°C goal as estimated by the IPCC's Fifth Assessment Report (30-50 Gt CO_2e in 2030). **With this level of emissions in 2030, emissions reductions would need to be extremely rapid, more than 4% per year, if the below 2°C objective is to be met.**

The bridge scenario represents a situation in which by 2020 targets and policies for 2030 are strengthened, and ideally new ambitious targets are proposed for the period after 2030. Due to this strengthening of policy commitments by 2020, energy sector and other actors perceive the long-term commitment to attain the below 2°C goal as credible, and therefore restructure their investments

3. Source: REMIND model and PBL INDC Tool.

Figure E. Assessment of local air pollution co-benefits of INDCs



Source: IIASA calculations

Each dot represents the estimate based on a different model

in the energy sector early on and reduce emissions below the level of what would be required by current INDCs in order to avoid abrupt and rapid reductions after 2030. The report shows that this can lower global emissions in 2030 substantially to around 49 $GtCO_2eq$/yr, close to the upper bound of the range of cost-effective 2°C scenarios in AR5, amounting to an overachievement of current INDCs by about 5 $GtCO_2eq$/yr in 2030. In the bridge scenario, cumulative low-carbon electricity investment exceeds that in the INDC scenario by roughly half between 2020-2030, while reducing investments into new freely emitting fossil-fuel power capacity by a third compared to today's level and the INDC scenario. The bridge scenario can play a major role in avoiding a carbon investment bubble and stranded assets in the energy sector.

If the provisions for such continuous strengthening of policy commitments in the Paris Agreement are perceived credible and backed up by strengthening national policies, it can have an **immediate and amplifying effect** on the transformation process by shifting expectation of businesses and altering investment decisions. Addressing the pre-2020 ambition gap through stronger national policies and international cooperative initiatives is also crucial. **This analysis shows the crucial importance of a system of dynamic revision and a credible long-term goal in the Paris agreement.**

Sustainable development co-benefits of INDCs can be a driver for their implementation

Governments inevitably have multiple objectives: reducing environmental damage, promoting growth and jobs, innovation and competitiveness, energy security, etc. They must assess the interaction between these objectives in defining climate policy. In this report, we have considered co-benefits and trade-offs through a quantified assessment of national model results and country case-studies.

- **Key finding:** ***INDCs can lead to significant co-benefits from climate mitigation in the countries studied, in terms of percentage reductions in energy import dependency and local air pollution. Such co-benefits can be a significant driver to develop ambitious national climate policies.***

For energy importers, INDCs can lead to significant improvements in **energy security**. The report estimates reductions in energy imports in the order of 2-12% in China, 9-17% in Japan and up to 9% in the EU in 2030, compared to a reference scenario with existing policies but no further climate action. In the Japan case study, import dependency is reduced from 94% today to 75% under the INDC scenario in 2030 (taking nuclear electricity as a domestic energy source), reducing import bills by 23% from 283 billion USD to 219 billion USD.

Implementing INDCs also implies significant co-benefits in terms of reducing **local air pollution**. In China, the report estimates a reduction of black carbon and sulphur dioxide in the order of 5-10% and about 10% respectively (mid-range of the estimates) in 2030, compared to a Reference Scenario of existing policies and no further climate action (Figure E).

Key Conclusions and Recommendations

This report has assessed the aggregate and real-economy effect of INDCs. Doing so can provide a more detailed national and sectoral picture of progress being made, and areas where further policy efforts are required. There are three key conclusions from the analysis:

- In the analysis of this report, INDCs **accelerate and consolidate** action on climate change in key major economies and at the global level. A significant transition appears in the electricity sector, with the dynamic of technology deployment approaching what is required for 2°C. The whole process towards the Paris negotiations has established a dynamic on which future policy and business strategies can build.
- There appears to be **uneven progress** on addressing the drivers of GHG emissions, when we consider what actions are projected to underpin the implementation of INDCs. Future climate cooperation and national policy must consider how to address specific barriers to certain crucial solutions, such as accelerating innovation and deployment of post-2030 mitigation options and limiting carbon lock-in.
- The INDCs are **an entry point** to put the world on a trajectory towards 2°C but as currently submitted may not be enough to keep the below 2°C goal in reach. Post-2030, the required rate of transformation is very high and potentially costly. In order to address this, the Paris Agreement should establish a clear mechanism to allow the regular, predictable and timely revision of national contributions and the global framework. New contributions should be based on a vision for the deep decarbonisation of national energy systems. **The Paris agreement should foster the development of national deep decarbonisation pathways by 2018.**

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