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Annex: CDM MACC methodology

We estimate the GHG abatement potential for 2013-2020 based on Project Design Documentation (PDD) as the difference between the columns "Credit start to 2020 ktCO2e" and "Credit start to 2012 ktCO2e" in the UNEP Risoe's CDM Pipeline. We include only project types with emissions reduction potential of more than 50 Mt CO_2e over 2013-2020.

UNEP Risoe's CDM Pipeline database provides information on capital investments in CDM projects, as well as the Internal Return Rate (IRR) of projects with and without carbon revenues for projects that generate other revenues, e.g. from the sale of electricity generated or fuel savings due to energy efficiency measures. Using data available for 5,319 projects as of January 2014, we calculate median abatement cost by project type in order to build the marginal abatement cost curve (MACC) for registered CDM projects in 2013-2020. We use two different methods to calculate the abatement cost depending on the nature of a project.

For projects that have other sources of revenue than the sale of carbon credits, we calculate the abatement cost as the Net Present Value (NPV) of a CDM project without carbon revenues divided by the amount of emission reductions during the first CDM crediting period (usually 7 or 10 years):

$$Abatement\ cost = \frac{project\ NPV}{emission\ reductions\ over\ the\ first\ crediting\ period}$$

For NPV calculations, we assume that the positive cash flows that occur after the initial investment are similar every year throughout the project lifetime. This assumption appears reasonable, as revenues from electricity generation and energy efficiency savings are generally relatively constant. We also assume the project's lifetime as the duration of the first CDM crediting period (usually 7 or 10 years). Accordingly, with $_n$ the duration of the first crediting period:

$$Initial\ investment - \ annual\ cash\ flow \times \sum_{i=1}^{n} \frac{1}{(1+IRR)^n} = 0$$

$$<=> annual\ cash\ flow = \frac{Initial\ investment}{\sum_{i=1}^{n} \frac{1}{(1+IRR)^n}}$$

Then we use the latest available central bank discount rates from the World Factbook (CIA 2014). If the discount rate is not available we use 5% discount rate as a reference. This is the case for 137 of 4,968 projects, for which this method is applied, and therefore does not significantly influence the analysis:

$$NPV = Initial\ investment - \ annual\ cash\ flow \times \sum_{i=1}^{n} \frac{1}{(1+discount\ rate)^n}$$

Note that we do not take into account the benchmark IRR (opportunity cost approach): although a private investor may consider the risky carbon intensive alternative, implicitly assumed to be as risky as the "green project", and price the opportunity cost he bears by investing in the less profitable "green" project, this logic would not apply to public financing vehicles, such as the Montreal Protocol Fund. Moreover, most MACCs published so far adopt the same approach – that is neglecting the risk of abatement projects by using the "safe" central bank discount rate.

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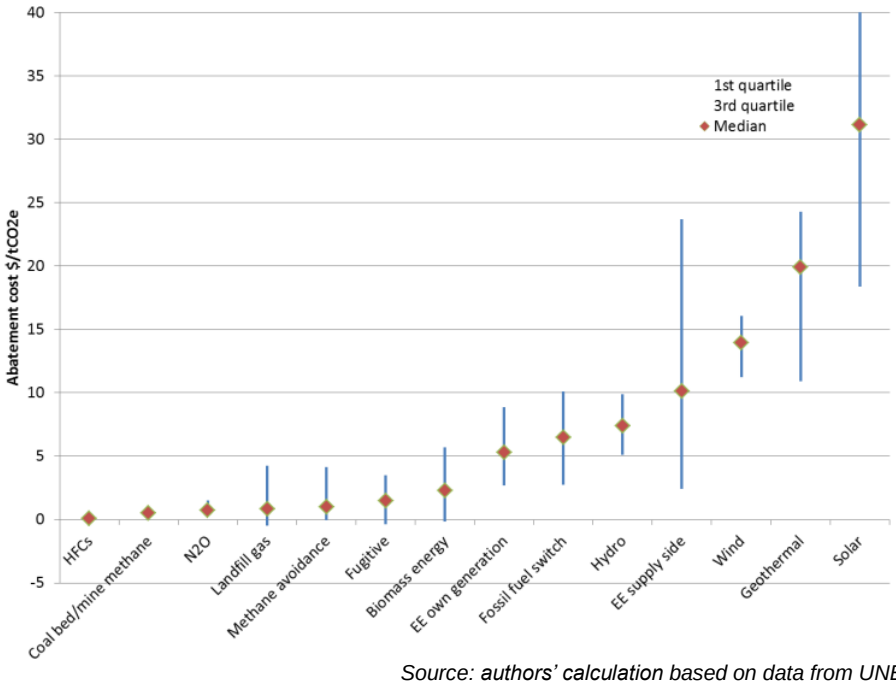
For projects that do not generate other revenues and do not provide IRR data, which was the case for 351 projects, we calculate the abatement cost as capital investments divided by the amount of emission reductions during the first crediting period:

$$Abatement\ cost = \frac{capital\ investments}{emission\ reductions\ over\ the\ first\ crediting\ period}$$

Using the two methods described above we obtain median abatement costs by project type (Figure 1).

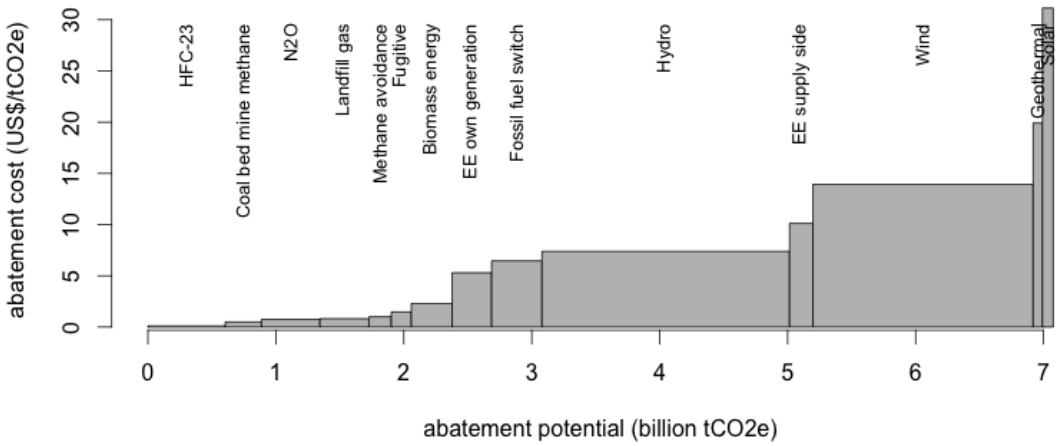
Figure 1 – GHG abatement cost under the CDM



Source: authors' calculation based on data from UNEP Risoe (2014).

We then use the abatement potential and the median abatement cost by project type to build the MACC (Figure 2).

Figure 2 – Marginal abatement cost curve in 2013-2020 for registered CDM projects



Source: authors' calculation based on data from UNEP Risoe (2014).