CDM-MP83-A09

# Concept note

# Consistent use of market penetration metrics for additionality, common practice and FOIK

Version 01.0



**United Nations** Framework Convention on Climate Change

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## 1. Procedural background

- 1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its 101<sup>st</sup> meeting, considered the concept note "Proposed work on market share, market saturation and penetration rate" and requested the Methodologies Panel (MP) to initiate the work and prepare a concept note. The Board requested that the new concept note should build on the experience of the CDM in this area and take into account the guidance from the Board at this meeting, including:
  - (a) The **consistency of the approach** for setting thresholds;
  - (b) The **criteria and rationale** for setting thresholds;
  - (c) **Options for other approaches to setting** thresholds (e.g. graded thresholds, **use of more than one criterion such as market share and rate of change thereof**, or use of more objective criteria for defining the market);
  - (d) Road testing of the proposed approaches with practical examples.
- 2. The Board, at its 105<sup>th</sup> meeting, considered an update on the progress made and provided guidance for further work. While the Board welcomed the effort to standardize and harmonize the definitions of various terminologies, such as market share and market penetration used in additionality demonstration, the Board emphasized that due care should be taken to ensure that observed data are used to compute the thresholds and not projections or assumptions on future developments. The Board requested the MP to:
  - (a) Verify whether the Rogers distribution model assuming normal distribution and representing the diffusion of technology is an appropriate model, or whether there are other models that may be more relevant for the purpose;
  - (b) Road-test the proposed approaches, building on past work (e.g. analysis of the levelized cost of electricity generation and penetration rates of grid-connected solar photovoltaics and on-shore wind technologies as referred to in paragraph 23 of the 104<sup>th</sup> CDM Executive Board meeting report) and identify the types of cases for which the proposed new approaches may not apply;
  - (c) Further clarify the rationale of any thresholds proposed with regard to their ability to reliably demonstrate additionality or test common practice and implications on false positives and false negatives;
  - (d) Ensure that the proposed approaches (i.e. first of its kind, additionality or common practice) do not only address false negatives but also address false positive outcomes in the current approaches.
- 3. This work is carried out under "Response to methodological requests from the Board" of the CDM two-year business and management plan 2020–2021 (EB104, annex 1).

## 2. Purpose

4. The purpose of this concept note is to address issues raised at EB 101 and EB 105 and make a recommendation to the Board.

## 3. Key issues and proposed solutions

#### 3.1. Current use of the concept of market share under the CDM

- 5. Standardisation and simplification of approaches, based on objective criteria, to enhance the credibility of outcomes for the requirements in the CDM methodologies and methodological tools is a key focus of the work of the CDM Executive Board. Using indicators based on market penetration rates of a technology to demonstrate additionality is one such area. While its use under the CDM or other emission reduction regimes<sup>1,2</sup> is not new and several CDM methodologies and methodological tools have already applied the concept, further improvements to the approach may allow broader use to offset some of the shortcomings observed in the current practices.
- 6. In that context, existing provisions in the various large scale or small-scale methodologies, tools and guidelines are reviewed to assess the criteria and rationale used for diffusion thresholds for applying market penetration rates (i.e. CDM methodologies and methodological tools referring to market share, market saturation, market penetration and penetration rate are tracked). Consistency of definitions and data requirements among these documents is also assessed. Also, in some cases, the terms market share or penetration rate are used interchangeably. **Appendix 1** provides the details regarding extract of the provisions contained in approved CDM methodologies and methodological tools where the demonstration of additionality and common practice analysis makes reference to market share, market penetration and penetration rate.
- 7. **Table 1** summarises the information differentiating between distributed unit type of technologies and others. The following observations can be made with regard to area of application, types of technologies covered, definitions used, thresholds used and requirements for data sources and vintages:
  - (a) **Application area**: market penetration or market share thresholds varying from 2% to 20% are specified for additionality, and 20% to 50% for common practice. Some thresholds cover products (e.g. solar water heating system) while others address services (e.g. public transport or electricity service).
  - (b) **Technology/measure**: in some CDM methodologies and methodological tools, a specific technology (e.g. energy efficient cookstove) is defined to carry out the penetration test, while in others a class of technologies are defined (e.g. all grid connected technologies for renewable energy generation, all public transport

<sup>&</sup>lt;sup>1</sup> For example, the Government of Canada's Federal Greenhouse Gas Offset protocols aim to set out a consistent approach for quantifying GHG emissions reductions for any given project type. The protocols will be partially based on "additionality", which is deemed to exist when GHG emissions reduction results from an activity or action that goes beyond the legal requirements and business-as-usual expectations. A proposed project is asked to assess if penetration rate would be a good indicator to assess the additionality in a first step, if the answer is yes it is assessed if there is reliable data on penetration rates in a second step, if the answer is in the affirmative thresholds below 40% are considered automatically additional.

<sup>&</sup>lt;sup>2</sup> VERRA methodology on Agricultural land management under development (available at <https://verra.org/wp-content/uploads/2020/10/VM0042\_Methodology-for-Improved-Agricultural-Land-Management\_v1.0.pdf>) uses weighted average adoption rate to know common practice within the region.

modes, all technologies for rural electrification is taken into consideration while defining the market).

- (c) **Definitions of terminology**: The terms "market penetration", "market share", "market saturation" and "penetration rate" are used interchangeably in the CDM tools and methodologies. In some cases, technology (products/services) currently in use by consumers is used as the basis, while in others the annual sales are considered.
- (d) **Data vintage**: CDM methodologies and methodological tools related to transport, cement and distributed units (such as high efficiency cookstoves) specify that the data should not be older than 3 years from the start of validation, while others specify start date of the project if this date is earlier than start date of validation. In some cases, no details are specified.
- (e) **Geographic boundary:** Some methodologies/tools simply state the boundary of analysis is the 'region' without providing further details, while others specify the entire country as the boundary allowing the project proponents to specify smaller 'regions' with justifications.
- (f) **Data sources:** A range of data sources are included, from official statistics, peerreviewed journals to data from a survey conducted as per CDM requirements by the project proponent or independent third parties. Some CDM methodologies and methodological tools allow the use of data from registered projects, data from third party sources and reports from international agencies (e.g. IEA). Data from industry associations are included and some CDM methodologies and methodological tools indicate that information should be publicly available. There is considerable heterogeneity in the specifications. Moreover, the criteria to be applied when multiple sources of data is allowed/possible (with differing information) are not included.
- (g) Thresholds: Thresholds applied to demonstrate additionality include 2%, 5%, 10% and 20%. Thresholds applied for common practice include 20%, 33%, 50%. In some cases, the rationale for thresholds is indicated in the body of the methodology (e.g. AM0044 cites 'Everett M. Rogers, 2003, Diffusion of Innovations, Fifth Edition, Simon & Schuster Inc. for the 33% threshold specified for the common practice), while in other cases either the information is not provided or it may have been provided in the background documentation at the time of approval. For additionality demonstration, projects involving distributed units generally have applied 5% threshold, whereas grid connected renewable energy projects applied 2% threshold. Practice in transport sector methodologies is varied, i.e. 20% threshold is applied to exclude that a project activity is common practice in some cases, while in others it is used for an initial screening to apply other tests for additionality or ascribe automatic additionality. Although it makes reference to market penetration<sup>3</sup>, the "TOOL23: Additionality of first-of-its-kind project activities" that currently governs the determination of first-of-its-kind (FOIK) projects allows only the very first project in the applicable geographical area applying the technology to qualify.

<sup>&</sup>lt;sup>3</sup> Footnote 2 of Tool 23 reads: While identifying other technologies, project participants may also use publicly available information, for example from government departments, industry associations, international associations on the market penetration of different technologies etc.

No.	Category	Technologies/measures	Threshold value	CDM tools and methodologies	Threshold applied for
1.	Small sized distributed unit technologies	Solar Water Heaters High efficiency biomass fired system Solar lamps Electric and hybrid vehicles E-bikes Improved efficiency of vehicle fleets	≤ 5%	TOOL19 AMS I.E AMS II.G AMS III.C AMS III.BC AMS III.BM	Additionality
2.	Others	Renewable energy power generation in national grids or isolated grid	≤ 2%	TOOL32	Additionality
		LNG buses Increasing composition of blend in cement production	≤ 5%	AMS III.AY ACM0005	Additionality
		Agricultural waste as feed stock for paper, cardboard and bio oil production	< 10%	AM0057	Additionality
		Electric taxiing in airports	≤ 20%	AM0116	Additionality
		District cooling system	≤ 20%	AM0117	Additionality
		Rural electrification through renewable energy source Rural electrification through grid extension Alternate waste treatment processes	≤ 50%	TOOL32 ACM0022	Additionality
		Energy efficiency improvements in boilers	> 33%	AM0044	Common practice
		Commercial refrigeration Domestic refrigeration Conversion of single cycle to combined cycle power generation Utilizing waste heat to pre heat the raw materials	> 50%	AM0071 ACM0007 AM0066 AM0113	Common practice
		Establishing high voltage direct current transmission line	>50%	AM0097	Common practice

#### Table 1. Diffusion threshold ranges for additionality and/or common practice

No.	Category	Technologies/measures	Threshold value	CDM tools and methodologies	Threshold applied for
		High speed passenger rail system Mass rapid transit system Bus Rapid transit system	≥20%	AM0101 ACM0016 AM0031	Common practice

8. In conclusion, based on the above discussion, there are some areas that are best dealt in specific CDM methodologies and methodological tools (e.g. applicability to specific technology/measures or class of technologies), while there are other conditions that could be standardised across CDM methodologies and methodological tools. The latter includes definition of penetration rate terminology, data vintages to consider, boundaries/regions to consider, acceptable data sources and thresholds.

#### 3.2. Recommendations

9. Under this section, recommendations are included for improvements for clearer definitions of terminology, and for standardised requirements for data vintage, data sources and thresholds. Options for other approaches for setting thresholds (e.g. graded thresholds, use of more than one criterion such as market share and rate of change thereof, or use of more objective criteria for defining the market) was a specific analysis requested by EB 101. Therefore, a detailed consideration is included in this concept note on that aspect besides the recommendation on other areas. In any case, it may be noted that the new approaches proposed (e.g. accelerating growth rate approaches to add to the existing portfolio of approaches and are not meant to replace existing approaches and methods.

#### 3.2.1. Definition

- 10. The following definitions are recommended. These may be determined for example based on the stock in place with consumers or the annual sales of the technology, depending on the circumstances.
  - (a) **Total market size:** It is the expected total market for a technology and is equal to the total population or capacity (e.g. households, light vehicles fleet or end consumers) in the geographic region under study;
  - (b) **Target market size:** It is the potential market for a technology out of the total population or the capacity (e.g. households that can implement the technology, category of light vehicles that may be replaced or adopt the new technology, or end consumers with conditions to invest in a new product) in the geographic region under the study;
  - (c) **Market share:** It is the percentage of the market that the technology measures captures out of the total market size of all the technologies providing similar services/products in the same period;
  - (d) **Market penetration:** It is the percentage of the total market value that the technology captures out of the target market size for that technology over a defined period of time. For instance, it may be the ratio, in the country or region where the

project will be implemented, between (i) the sales volume of the project product/ technology over a period of time and (ii) the sales volume of all the products/technologies providing similar services in the same period;

(e) **Market saturation**: It is the condition where a technology has been completely diffused throughout a market (i.e. market penetration is 100%).

#### 3.2.2. Data vintage and Data sources for demonstration of thresholds

- 11. Requirement may be standardised, for example by including the following general guidance: "unless specifically mentioned in the CDM methodology or methodological tool, data not older than 3 years from the start of validation or before the start date of the project, if this date is earlier than start date of validation. In cases of data gaps due to lack of published official data, data vintage up to 5 years may be accepted.
- 12. Unless otherwise specified in the CDM methodology or methodological tool, the following data sources may be generally acceptable:
  - (a) Official statistics;
  - (b) Peer-reviewed journals;
  - (c) Data from a sampling survey conducted as per CDM requirements by the project proponent or independent third parties;
  - (d) Data from existing registered CDM project activities or PoAs; and
  - (e) Published data from third party sources, such as international agencies (e.g. IEA) or data from industry associations.
  - (f) Alternatively, the requirements may be standardised in tune with the standard "Determining coverage of data and validity of standardized baselines". A period of data currentness defined<sup>4</sup> in the above-mentioned standard may give more flexibility for project developers as reflected in figure 1 below.

#### Figure 1. Data currentness for 2013-2015 data vintage according to Standard on "Determining coverage of data and validity of standardized baselines"



<sup>&</sup>lt;sup>4</sup> The standard referred defines data currentness in the context of SB as; the time gap between the end of the data coverage period and: (i) The date on which the initial assessment of the proposed new, revised, or updated standardized baseline is successfully concluded under the bottom-up process referred to in the SB procedure; or (ii) The date on which the development plan is finalized under the top-down process referred to in the SB procedure.

13. Also, guidance in paragraph 23 (a) and (b) of general guidelines SSC CDM methodologies<sup>5</sup>, pertaining to reconciling data from different sources may be referred.

#### 3.2.3. Accelerating growth rate approach

- 14. As stated in paragraph 7 above, the rationale for thresholds is specified in some cases while it is not explicit in others. Therefore, there is a scope for harmonising the approaches to thresholds with more objective criteria. It is generally seen that the majority of the thresholds are applied parallel with product diffusion models, with the Rogers model being the most popular.
- 15. The figures below present the Rogers' (1962) diffusion model using both the typical normal distribution, which displays **new consumers** of an innovation at a static period in time (figure 2), and the cumulative normal distribution, which displays the **total amount of consumers** of an innovation (figure 3).
- 16. For example, according to Rogers (2003), a technology is considered to face significant market barriers until it reaches the 16% diffusion level. At the same time, the growth rate of market penetration of the technology will be accelerating up to this 16% threshold as per the normal statistical distribution behaviour (See appendix 2 for details). Once diffusion crosses the 16% threshold, there will still be growth in the market share (until reaching 50% diffusion level), but the acceleration rate will start to decrease. A new approach named" the accelerating growth rate approach" as well a new application of the normal distribution thresholds (e.g. 2.5%) to first of its kind approach are proposed hereby. This is applicable for technologies/initiatives where it can be assumed or established that its diffusion follows a normal distribution curve. For equipment/devices/technologies generating product/services with a lifetime of several years, the sales in the first years of diffusion correspond all recorded to new consumers and the two curves represented in figures 2 and 3 are identical during this period. For products or services with a lifetime smaller than the period of analysis, replacement sales must be discounted from sales volumes to assure only new consumers are being accounted for.

<sup>&</sup>lt;sup>5</sup> Paragraph 23 (a) and (b) of the General guidelines for SSC CDM methodologies reads as: "(...)(a) The project participants shall transparently list and describe the sources of values considered (e.g. peer-reviewed literature, test results, official reports/statistics). Original sources should be referenced using a standard method of referencing rather than quoting a secondary publication that refers to the sources. When more than one source is used to aggregate the data to derive the value, the sources used should be clearly indicated. The project participants shall provide justification as to why the values selected, and their sources, are appropriate, applicable and conservative; and (b) The designated operational entities (DOE) shall determine whether the sources listed by the project participant are comprehensive and, based on their review and analysis as well as professional judgment, confirm whether the sources selected are appropriate and conservative based on the hierarchy of the documents, suitability of the data vintage, relevance of the source to the baseline and project scenario, and availability of relevant resources, among other criteria."





Figure 3. Rogers (1962) cumulative diffusion model



17. Given that the evaluation of indicators like "market share" or "market penetration" will vary from technology to technology and in some cases achieving the required vintage of data may be challenging (e.g. as communicated by stakeholders, it is difficult to get data on

number of cookstoves in use particularly in large countries due to the diverse type of equipment used, and some of the national surveys may be conducted once in 5 or even 10 years), an alternative or complementary approach could be used to address this issue. Testing of the accelerating growth rate in the market (i.e. year on year increase in sales) as a measure to demonstrate technology diffusion may be used.

- 18. A technology is considered to be in innovation stage until reaching the 2.5% diffusion level. It is proposed that a technology in this stage may potentially be considered as the "firstof-its-kind" under the CDM context, to complement the current FOIK test. A project developer will first check if data is available to reliably demonstrate that 2.5% threshold is not reached at validation, based on credible determination of the target market size. In some cases, this may be feasible as manufacturers estimate the target market size to dimension the producing plant when introducing a new product line, which may be a concrete demonstration of the target market size.
- 19. Both the FOIK and accelerating growth rate approaches use the actual historical data of sales or the product or technology usage to estimate the sales volume of the project product/ technology over a period of time.
- 20. When the technology diffusion is shown to be within 16% threshold via the accelerating growth rate approach, a simpler route to demonstrate additionality may be undertaken i.e. the barrier analysis would be applied.





#### 3.2.3.1. Road Testing of accelerated growth rate approach

- 21. Road testing of accelerated growth rate approach was carried out as detailed in **appendix 3** for different sectors in different countries and it was observed that:
  - (a) The accelerating growth rate approach rightly captures the market condition where a specific technology is just emerging with the diffusion level of less than 16% and faces several barriers. Thus, it may be possible to use it to demonstrate the additionality of a technology in a number of situations. The accelerating growth rate approach may be applicable to most of the technologies covered in relevant tools and methodologies under the CDM that currently use the concept of market penetration or market share to demonstrate the additionality.
  - (b) The trend in accelerating growth rate of technology may be distorted when there is strong external influences such as, for example, policy changes impacting availability of funds or incentives as was evident from the case on solar thermal electricity technology in India. Therefore, a screening test will be needed to eliminate such cases from the use of accelerated growth rate approach.

#### **3.2.4.** Potential changes to the CDM tools and methodologies

22. Thresholds of 2%, 5%, 10% and 20% are used to demonstrate additionality and 20%, 33%, 50% are applied for common practice analysis in CDM methodologies and methodological tools, as indicated in **table 1**. They may be harmonised/standardised using trusted scientific information on product diffusion threshold found in **figure 2**, i.e. innovator (2.5%), early adopters (16%) and early majority (50%). In addition, accelerated growth rates or attrition rates below or values between these thresholds may be used to demonstrate additionality or common practice or FOIK. A separate methodological tool may be developed to define the terminology, additionality testing methods and to include standardised requirements for data vintage, data sources and boundary of the analysis.

#### 3.3. Implication on false negatives and false positives

- 23. EB 105 also requested to ensure that the proposed approaches (i.e. first of its kind, additionality or common practice) do not only address false negatives but also address false positive outcomes in the current approaches. The proposed new approaches can complement the existing ones in some cases and may help remove the shortcomings of the existing methods, i.e. currently practiced financial analysis can be affected by using substantiable inputs that may not truly represent the project situation, the common practice analysis can be affected by limiting the definition of "similar" activities so much that the existing activities for comparison are limited.
- 24. As already explained above in para 24, the proposed approaches do not, however replace the existing methods and are not applicable in some cases. It is recognised that not all CDM project activities and project of activities (PoAs) are for innovation, and in some cases it cannot be ruled out that the late adopters are not additional (for instance, diffusion of wind energy in a country, the best sites may have been used first while the sites with a poor wind resource may only be equipped if CERs are obtained).

#### 3.4. Other models for product diffusion

25. **Appendix 2** includes a detailed description of Rogers Model but also a critique of the model over the decades. While other distributions such as spiral distribution may be considered in place of normal distribution for some products for better accuracy; nevertheless, they all carry drawbacks, often much more than the approach based on normal distribution.

#### 4. Impacts

- 26. The proposed work will:
  - (a) Improve the understanding of market penetration rate, market share, market saturation in the context of the CDM project activities/Programme of Activities and its application when demonstrating additionality and conducting common practice analysis;
  - (b) Lead to consistent use of the criteria and thresholds across methodologies/tools where these values will be based on relevant references/sources;
  - (c) Ensure consistency amongst the various methodologies and tools, when demonstrating additionality.
  - (d) Expand the universe of projects applying to the CDM with reduced risks to environmental integrity. Statistical results, when available will strengthen the CDM process.

## 5. Subsequent work and timelines

27. Subject to the mandate from the Board, the MP will revise the CDM guidelines, methodologies and tools to include relevant definitions and new/additional approaches.

## 6. Recommendations to the Board

- 28. The MP recommends the Board agree to:
  - (a) The definitions outlined in paragraph 10 above;
  - (b) The use of accelerating growth rate approach as an additional option to demonstrate additionality. Particularly, if the market share of the technology applied by the CDM project activity or PoA, as defined in paragraph 10 above, is:
    - (i) Within the 2.5% threshold, the project activity or PoA/CPA is the first-of-itskind in the applicable geographical area and is, therefore, additional;
    - (ii) Within the 16% threshold, the additionality can be demonstrated using only the barrier analysis;
    - (iii) Greater than 50% threshold, the CDM project activity or PoA/CPA may be considered a common practice in the applicable geographical area; however, it may be noted that if it is less than or equal to 50%, it does not necessarily translate to it being "not" a common practice.

- 29. The MP further seeks a mandate from the EB to:
  - (a) Develop a separate methodological tool that defines the terminology and methods and includes standardised requirements for data vintage, data sources and identify the technologies/services whose diffusion follow a normal distribution curve and may use the accelerating growth rate approach to demonstrate additionality;
  - (b) Revise CDM methodologies and methodological tools to ensure consistency among them where the definitions contained in paragraph 10 of this concept note are used.

## Appendix 1. Additionality and common practice related requirements that used thresholds based on market penetration or market share in identified methodologies and tools

#### 1. TOOL19: Demonstration of additionality of microscale project activities

- (a) The penetration<sup>1</sup> of the proposed technology (i.e. Solar water heating system, Clean and energy efficient cookstoves, High efficiency biomass fired devices (e.g. energy efficient cookstoves<sup>2)</sup> and Solar lamps) is equal to or less than 5 per cent of the technologies/measures (providing similar services) in the region<sup>3</sup> in order to be considered as automatically additional.
- (b) The penetration shall be determined using one of the following options:
  - (i) **Official statistics or reports**, relevant industry association reports or peerreviewed literature;
  - Results of a sampling survey conducted by project participants or a third (ii) party as per the latest version of "Standard: Sampling and surveys for CDM activities"; project activities and programme of covering technologies/measures providing similar project services as the technology/measure.
- (c) To determine the penetration using the above paragraph, the most recent data available at the time of submission of the CDM-PDD or CDM-CPA-DD for validation/inclusion, shall be used, and the data vintage used shall not include data older than three years prior to: (a) the start date of the CDM project activity; or (b) the start of validation/inclusion, whichever is earlier.

#### 2. TOOL32: Positive lists of technologies

- (a) A specific technology listed in paragraph 1 is defined as automatically additional if at the time of PDD submission<sup>4</sup> any of the following conditions is met:
- (b) The **percentage share of total installed capacity** of the specific technology in the total installed grid connected (or isolated grid) power generation capacity in the host country **is equal to or less than two per cent**; or

<sup>&</sup>lt;sup>1</sup> Refers to proportion of stock of functional equipment at the user end, also termed as market saturation.

<sup>&</sup>lt;sup>2</sup> All single pot or multi pot portable or in-situ cookstoves with rated efficiency of at least 20 per cent or higher.

<sup>&</sup>lt;sup>3</sup> Region/Applicable geographical area should be the entire host country. If the project participants opt to limit the applicable geographical area to a specific geographical area (such as province, region, etc.) within the host country, then they shall provide justification on the essential distinction between the identified specific geographical area and rest of the host country.

<sup>&</sup>lt;sup>4</sup> For registration of the project activity or inclusion of the component project activity (CPA) in a programme of activities.

## (c) The total installed capacity of the technology in the host country is less than or equal to 50 MW.

- (d) Rural electrification<sup>5</sup> project activities using renewable energy sources in countries with **rural electrification rates less than 50 per cent**; the most recent available data on the electrification rates shall be used to demonstrate compliance with the 50 per cent threshold. In no case, data older than three years from the date of commencement of validation of the project activity shall be used.
- (e) **Rural electrification project activities by grid extension** are automatically additional when all the following criteria are met:
  - (i) Rural electrification rate in the **country is below 50 per cent**;
  - (ii) Recent trends: rural electrification rate has increased by less than 20 per cent over the past 10 years;
  - (iii) The extension of a grid for rural electrification of a community involves at least a distance of 3 km from the point of grid extension to the rural community at which the CDM project is implemented.

#### 3. AM0031: Bus rapid transit projects

- (a) This step aims to determine whether the proposed project activity is common practice in the host city where the proposed CDM project activity is intended to be implemented. For this purpose, project participants shall assess whether the share of trips realized on the existing public transport system(s) in the host city, which belong to the same public transport category as the proposed CDM project activity, is **less than or equal to 20 per cent** of total public transport trips in the host city.
- (b) If the share of motorized trips realized on the existing BRTs exceeds 20 per cent of total motorized public transport trips in the host city, then the proposed CDM project activity is not additional. If the share of trips is less than or equal to 20 per cent, then project participants should proceed to Step 3.

# 4. AM0044: Energy efficiency improvement projects - boiler rehabilitation or replacement in industrial and district heating sectors

(a) The common practice assessment shall determine whether or not existing boilers should be replaced during the project activity period and when. The control group for the common practice analysis shall be defined as plants, factories and/or buildings where thermal energy is generated for internal use or for sale to surrounding customers, excluding the projects implemented under the CDM, in the region where the project is located. The region of the control group is defined as the geographic area around the project activity that has similar legal compliance

<sup>&</sup>lt;sup>5</sup> Rural electrification for the purpose of this document is defined as a project activity for supplying renewable electricity to facilities and energy consumers that do not have access to any electricity distribution system/network such as a national grid or regional grid. Such electricity end-use facilities may include but are not limited to households, public buildings, and/or small, medium and micro enterprises. Electricity uses may include but are not limited to interior lighting, street lighting, refrigeration, or agricultural water pumps. Rural electrification rate is the percentage of rural population having access to electricity.

requirements as for the project activity. The common practice analysis shall be undertaken using documented information on the prevailing thermal energy generation technologies in use by plants, factories and/or buildings where thermal energy is generated for internal use or for sale to surrounding customers in the region or in the country where the project is located. If such information is not readily available, a survey of these plants, factories and/or buildings shall be conducted to obtain information on thermal generation technologies. The common practice threshold shall be applied to the control group selected prior to the start of the project and at each renewal of the crediting period.

(b) If more than 33 per cent<sup>6</sup> of the control group uses improved boilers that are similar to the project activity, then the project is not additional. The designated operational entity shall verify the documented evidence for the purpose of common practice evaluation.

# 5. AM0057: Avoided emissions from biomass wastes through use as feed stock in pulp and paper, cardboard, fibreboard or bio-oil production

#### Additionality

The barriers may include the following:

- (a) The use of agricultural waste may face technological barriers;
- (b) The raw material is either not used or, in the case of pulp and paper, cardboard or fibreboard, **less than 10% of production in the region** is based on agricultural waste.

#### 6. AM0066: GHG emission reductions through waste heat utilisation for preheating of raw materials in sponge iron manufacturing process

(a) If **at least 50% of sponge iron plants** in the geographical area have a pre-heater installed, the project activity shall be considered a common practice and as such is not additional. Provide documented evidence and quantitative information on the above analysis in the CDM-PDD.

# 7. AM0071: Manufacturing and servicing of domestic refrigeration appliances using a low GWP refrigerant

(a) In case of small commercial refrigeration appliances: The market share of small commercial refrigeration appliances, which are produced and sold in the host country and charged with low GWP refrigerants, is below 50 per cent at the time of validation of the project activity;

#### 8. AM0097: Installation of high voltage direct current power transmission line

(a) The information shall comprise of transmission lines that carry amount of power similar to that in the project activity (within +/-50% threshold of the power supplied by HVDC transmission line constructed under CDM project

<sup>&</sup>lt;sup>6</sup> This threshold is referenced from Everett M. Rogers, 2003, Diffusion of Innovations, Fifth Edition, Simon & Schuster Inc. This value is subject to further guidance from the CDM-EB and sets no precedent.

**activity)**, over a distance similar (within +/-50% threshold of the distance for which HVDC transmission line constructed under CDM project activity) to that in the project activity, and within an investment and regulatory environment as that of the project activity. After collection and analysis of data, the project participants shall have a set of transmission line projects that are similar to the proposed CDM project activity.

(b) If no activities similar to the proposed CDM project activity are found in a period of five years preceding the project activity, the project participants can refer to a tenyear data vintage for analysis. If no similar project activities are found in the tenyear data as well, the project participants can conclude that the project is not a common practice in the geographical region.

#### 9. AM0101: High speed passenger rail systems

- (a) This step aims to determine whether the proposed CDM project activity is common practice in the host country where the project is proposed to be implemented. This analysis shall be limited to domestic inter-urban rail-based transport and shall not include urban and sub-urban rail-based transit systems. For this purpose, project participants shall assess whether the share of domestic passenger km travelled in all HSR systems, which existed at the point of submission of the CDM-PDD for validation to the DOE or prior to the implementation of the project activity (whatever is earlier) in the host country, is equal to or less than 20 per cent of the total domestic inter-urban passenger km travelled in the rail systems in the host country in the most recent three calendar years.
- (b) If the share of domestic passenger km travelled in the existing HSR systems exceeds 20 per cent, then the proposed CDM project activity is not additional. If the share of domestic passenger km is less than or equal to 20 per cent, then project participants should proceed to Step 2.

# 10. AM0109: Introduction of hot supply of Direct Reduced Iron in Electric Arc Furnaces

(a) Monitoring parameter MSy - DRI plants and EAFs within the applicable geographic area, as identified according to the "Identification of the baseline scenario and demonstration of additionality" section of the methodology and with a comparable capacity from 50% to 150% of the EAFs, shall be evaluated. The parameter shall be the fraction of EAF plants which have Hot DRI implemented (irrespective of hot DRI transportation method), excluding activities implementing Hot DRI as a CDM project activity. If the market share of hot DRI technology is higher than 50% (i.e. MSy is greater than 0.5), the parameter value shall be set at 1.

## 11. AM0113: Distribution of compact fluorescent lamps (CFL) and light-emitting diode (LED) lamps to households

If the project lamp sold or distributed to a household by the project coordinator is self-ballasted CFLs,

(a) For other countries, additionality shall be demonstrated using the latest version of the "Tool for the demonstration and assessment of additionality" that is available on the UNFCCC web site. Step 2 (Investment analysis) shall be used to demonstrate

additionality. The investment analysis shall be applied from the perspective of the project coordinator undertaking the project activity.<sup>7</sup> Step 4 (Common practice analysis) shall be assessed from the perspective of the users of the project lamps. The proposed project activity is considered as "common practice", if the **market penetration of CFLs for households in the geographical area of the project activity is greater than 20 per cent.** 

#### 12. AM0116: Electric taxiing systems for airplanes

(a) In addition, the **percentage share of commercial airplanes operating an e-taxi system is equal to or less than 20 per cent** in the total number of commercial airplanes registered in the host country.

#### 13. AM0117: Introduction of a new district cooling system

(a) The project activity is deemed to be additional if:

The **share of the district cooling technologies** at the moment of the project registration is **less than 20 per cent** of all cooling technologies within the benchmark boundary in terms of cooling output. **The share of technologies can be derived from official country reports,** third party surveys and/or credible international sources (e.g. International Energy Agency).

#### 14. ACM0005: Increasing the blend in cement production

- (a) First-of-its-kind In order to demonstrate additionality using "First of its Kind" barrier, the applicable geographical area shall include the entire domestic market in the host country and the methodology requires information concerning the market share for blended cement sold in the domestic market in the host country. The project activity shall be considered as the one that applies a technology that is different from any other technologies able to deliver the same output (blended cement) if the market share for blended cement in the host country is below 5%.
  - (b) The market share shall be calculated as the percentage of the amount of blended cement in the total amount of all cement types produced in the host country (tons blended cement/total tons cement production x 100%) during the last three years prior to: (a) the start date of the CDM project activity; or (b) the start of validation, whatever is earlier. The market share value must be based on reliable and publicly available data sources (e.g. cement manufacturers associations or governmental agencies). Other CDM projects shall be included in this assessment.

#### 15. ACM0007: Conversion from single cycle to combined cycle power generation

Procedure for the selection of the baseline scenario and the demonstration of additionality

When undertaking the common practice analysis for the operation of the project power unit(s) in combined cycle mode:

(a) *Similar activities to the project activity* shall mean all single cycle and combined cycle power plants that have an installed capacity **within a range of ±50% of the** 

<sup>&</sup>lt;sup>7</sup> A simple cost analysis may be applied according to EB 59, para. 36.

**project power plant** and that are using one the fossil fuel types used by the project power unit(s) (except start-up and auxiliary fuels)

- (b) Relevant geographical area shall in principle be the host country of the proposed CDM project activity. A region within the country could be the relevant geographical area if the framework conditions vary significantly within the country. However, the relevant geographical area should include preferably ten or more such power plants. If less than 10 power plants are found in the region the geographical area may be expanded to an area that covers, if possible, ten such power plants within the national grid boundary. In cases where this definition of geographical area is not suitable, the project participants should provide an alternative definition of geographical area;
- (c) The project activity is regarded common practice if **more than 50% of the assessed power plants** operate in combined cycle mode. A power plant is considered to operate in combined cycle mode if any of its units operate in combined cycle mode.

#### 16. ACM0016: Mass Rapid Transit Projects

- (a) This step aims to determine whether the proposed project activity is common practice in the host city where the proposed CDM project activity is intended to be implemented. For this purpose, project participants shall assess whether the share of trips realized on the existing public transport system(s) in the host city, which belong to the same public transport category as the proposed CDM project activity, is **less than or equal to 20 per cent** of total public transport trips in the host city.
- (b) If the share of motorized trips realized on the existing systems which belong to the same public transport category as the proposed project activity exceeds 20 per cent of total motorized public transport trips in the host city, then the proposed CDM project activity is not additional. If the share of trips is less than or equal to 20 per cent, then project participants should proceed to Step 3.

#### 17. ACM0022: Alternative waste treatment processes

- (a) Note that in the case that applicable laws or regulations require the use of the waste treatment option(s) implemented under the project activity, the compliance rate of such laws and regulations should be **below 50 per cent** in the period for which issuance of CERs is requested in order to claim emission reductions for that period.
- (b) Project activities to implement a Greenfield composting facility to treat MSW are deemed automatically additional, if any of conditions below is fulfilled:
  - (i) **If MSW collection coverage is below 50 per cent** for the applicable geographical region; or
  - (ii) **If MSW collection coverage is 50–80 per cent** for the applicable geographical region and if the waste received by the project composting facility does not have formal (i.e. excluding recycling by the informal sector) segregation of wet and dry waste; or

# 18. AMS I.E: Switch from non-renewable biomass for thermal applications by the user

(a) Demonstrate ex-ante that the penetration<sup>8</sup> of renewable energy based thermal energy technologies (e.g. biogas stoves, solar cookers) is equal to or less than 5 per cent of the technologies/measures providing similar services in the region<sup>9</sup> in order to be considered as automatically additional.

#### 19. AMS II.G: Energy efficiency measures in thermal applications of nonrenewable biomass

(a) Demonstrate ex ante that the penetration<sup>10</sup> of high efficiency biomass fired devices (e.g. energy efficient cookstoves<sup>11</sup>) is equal to or less than 5 per cent of the technologies/measures providing similar services in the region<sup>12</sup> in order to be considered as automatically additional.

#### 20. AMS III.C: Emission reductions by electric and hybrid vehicles

(a) Demonstrate ex ante that **the market share of project electric/hybrid vehicles is equal to or smaller than 5 per cent** of the vehicles of the same category (e.g. if project vehicles are electric scooters, market share of electric two wheelers is equal to or smaller than 5 per cent of all motorized two wheelers, irrespective of the manufacturer) in the region.

#### 21. AMS III.AY: Introduction of LNG buses to existing and new bus routes

- (a) Additionality is demonstrated using one of the options below:
  - (i) **Option 2**: Demonstrate ex ante that the **market share of project buses is less than or equal to 5% of the buses** (not only public transport bus) in the region.

# 22. AMS III.BC: Emission reductions through improved efficiency of vehicle fleets

(a) Additionality may be demonstrated based on typical barriers faced by energy efficiency projects, including but not limited to:

<sup>&</sup>lt;sup>8</sup> Refers to proportion of stock of functional equipment at the user end, also termed as market saturation.

<sup>&</sup>lt;sup>9</sup> Region/Applicable geographical area - should be the entire host country. If the project participants opt to limit the applicable geographical area to a specific geographical area (such as province, region, etc.) within the host country, then they shall provide justification on the essential distinction between the identified specific geographical area and rest of the host country.

<sup>&</sup>lt;sup>10</sup> Refers to proportion of stock of functional equipment at the user end; also termed as market saturation.

<sup>&</sup>lt;sup>11</sup> In accordance with paragraph 3, consider all single pot or multi pot portable or in-situ cookstoves with rated efficiency of at least 20 per cent or higher.

<sup>&</sup>lt;sup>12</sup> Region/ Applicable geographical area - should be the entire host country. If the project participants opt to limit the applicable geographical area to a specific geographical area (such as province, region, etc.) within the host country, then they shall provide justification on the essential distinction between the identified specific geographical area and rest of the host country.

(i) Common practice barrier: energy efficiency technologies are often not common practice. Fleet owners are often sceptical of such practices and resistant to adopt them. A project activity is considered to be additional if the market penetration rate of each of the planned project measures is less than 5 per cent for the types of vehicles included in the fleets.13 Sources of data for the market penetration rates may include independent studies, information from business associations, analysis of publicly available information demonstrating the "penetration rate" of the measures proposed by the project within the host country, sample surveys of comparable fleets that ask fleet managers to identify vehicles in which the identified efficiency measures have been implemented in the absence of the CDM, or random sample surveys of the same vehicle categories, carried out, for example, at bus/truck/taxi depots in major cities.

#### 23. AMS III.BM: Lightweight two and three wheeled personal transportation

Other activities that do not satisfy the conditions under paragraph 1 are considered additional if:

- (a) Activities that are type 7 (i.e. introduction of e-bikes) and the share (penetration) of e-bikes in bicycle in use in the city is below or equal to 5% based on number annual bicycle trips undertaken in the city or based on market share; or
- (b) It is demonstrated, through the application of the methodological tool "Demonstration of additionality of small-scale project activities" (TOOL21), that at least one barrier would prevent the implementation of the project activity

<sup>&</sup>lt;sup>13</sup> Penetration rates are assessed for the specific categories of vehicles in which the measures are implemented, and not for the fleet as a whole, because a project may implement specific measures only on some vehicles and not the entire fleet. To assess the penetration rate for the fleet, a weighting based on the number of each type of vehicle is made. Each planned measure must fulfil the threshold value of 5 per cent individually if this barrier is used.

## Appendix 2. Roger's theory of diffusion

#### 1. What constitutes an innovation?

- 1. Defining an innovation is crucial when analysing how it penetrates a market. For example, a small positive change in a product that leads to an efficiency gain or a fall in prices may affect the adoption of that product, but it can be argued whether or not the product development counts as an innovation or as a simple development of an existing product.
- 2. The economist Joseph Schumpeter (1939) distinguishes innovation as a process that establishes a new production function (unlike invention, which he describes as a static process), through "the construction of new plants and equipment, the introduction of new plants and equipment and the rise to leadership of new men".
- 3. Meanwhile, anthropologist Homer Barnett (1953) and sociologist Everett Rogers (1962), author of "Diffusion of Innovations", have less precise definitions of the concept of innovation. Barnett defines innovation as "any thought, behaviour or thing that is new because it is qualitatively different from existing forms", whilst Rogers defines innovation as "an idea perceived as new by the individual".
- 4. Thomas Robertson (1967) breaks innovation into three separate classifications: (1) continuous innovation, (2) dynamically continuous innovation and (3) discontinuous innovation. Continuous innovation involves the "alteration of a product, rather than the establishment of a new product"; dynamically continuous innovation "does not generally alter established patterns. It may involve the creation of a new product or the alteration of a new product". Whilst, discontinuous innovation "involves the establishment of a new product".
- 5. This paper will follow Joseph Schumpeter's definition of innovation as a process that establishes a new production function through "the construction of new plants and equipment, the introduction of new plants and equipment and the rise to leadership of new men" or women.
- 6. Rogers' diffusion of innovations model will be adhered to throughout the paper, but with consideration of the effects that income and geopolitical and economic events pose to the potential diffusion of innovations. Further, in order to embrace Rogers' theory, this paper will focus upon market penetration, which is more likely to achieve 100% adoption.
- 7. The Meth Panel is of the view that the concept of innovation can be adapted to CDM by referring to innovation as lower carbon technologies resulting in lower GHG emissions as opposed to current common practices.

#### 2. The diffusion of innovation

8. The diffusion of innovation, developed by Rogers, demonstrates how a new product or technology spreads through a specific population or social system. He theorises that the adoption of an innovation does not happen simultaneously in a specific population, but it is a process whereby consumers embrace innovation in an orderly fashion depending on their personal preferences for innovation and the experience of society.

- 9. The diffusion process of an innovation is considered by Rogers as an orderly series of events following a normal distribution, as shown in Figure 1 below. He initially considered other statistical functions as representative of some specific cases, but later discarded this option focusing only on cases that can be represented by the normal distribution.
- 10. According to Smith (2011), "the adoption of an innovation usually follows a normal, bellshaped curve when plotted over time on a frequency basis. We can expect a normal adopter distribution for an innovation because of the cumulatively increasing influences upon an individual decision-maker to adopt or reject an innovation, as a result of the activation of peer networks, for instance, about the innovation in a system. Adoption of a new idea comes from information exchange in interpersonal networks within the given social system. If the first adopter of the innovation discusses it with two other members of the system, and each of these two adopt the idea and pass along their success to two more members, the resulting distribution follows a binomial expansion that results in the normal shape when plotted."
- 11. Rogers divides the population into five distinct groups: innovators, early adopters, early majority, late majority and laggards to describe the order in which they embrace innovation. In his theory, Rogers does not consider the size of a population, but rather the proportion of the population that has embraced the innovation.
- 12. In Rogers's theory, the "Innovators" (separate from the creators of an innovation) represent 2.5% of the population (or two and above standard deviations below the mean under the normal distribution when considering a 95% confidence interval) and are the first to adopt an innovation. They are typically "risk takers, price insensitive and are able to cope with a high degree of uncertainty. Innovators are crucial to the success of any new product as they help gain market acceptance" (CFI, 2015). The Meth Panel considers that this definition aligns very well with the "first of its kind" concept.
- 13. 'Early adopters' represent the next 13.5% of the population (or one to two standard deviations below the mean under the normal distribution). They are less risk-taking than innovators, but still enjoy technological innovation. They typically wait for some analysis into a new product but are quick to act thereafter. Early adopters may be considered as 'influencers', 'opinion leaders' or 'role models' as they are fundamental in helping an innovation to achieve critical mass. "If early adopters of a product or service are small, the total number of people who adopt the product or service will likely be small" (CFI, 2015). Once it reaches the 16% diffusion, this group ends at the first inflection point of the curve (when growth acceleration becomes zero and following, becomes negative). This point represents 16% of the total consumers and it can be determined by monitoring the variation of the velocity of growth of sales of a product dismissing the requirement of knowing the potential size of a market for that given product. **The Meth Panel considers that this point can be associated with the threshold for additionality.**
- 14. The 'early majority' and 'late majority' represent the bulk of the population: 34% each (or one standard deviation above and below the mean under the normal distribution). Neither the 'early majority' nor the 'late majority' are risk taking and are unlikely to adopt an innovation until proven by a trusted peer. The 'late majority' will take longer to adopt an innovation due to higher levels of technophobia, scepticism and price sensitivity. When sales of a product reach stability (50% or the late majority category), the normal distribution will be at its peak (first derivative equals zero). The Meth Panel considers that this may represent a ceiling for the common practice threshold i.e. a product with a market penetration above 50% is considered as common practice.

- 15. Finally, 'laggards' constitute 16% of the population (or one and above standard deviations above the mean under the normal distribution) and are the last to adopt an innovation, if at all. Laggards typically resent change and may refuse to change their behaviour until traditional products are no longer available.
- 16. In a later version of the "Diffusion of Innovations", Rogers (1971) explains that a consumer's degree of innovativeness is relative in that consumers have unique and dynamic behaviours being more or less innovative than their peers. Essentially, there is no static measure of an individual's level of innovativeness; an individual's degree of innovativeness is more a sliding scale of their risk appetite. Further, a consumer's degree of innovativeness may differ between various innovations in that some innovations may have greater appeal than others.
- 17. Present Rogers'(1962) diffusion model using both the typical normal distribution, which displays new consumers of an innovation at a static period in time, and the cumulative normal distribution, which displays the total amount of consumers of an innovation.



Figure 1. Rogers (1962) diffusion model

Source: Rogers, 1962



Figure 2. Rogers (1962) cumulative diffusion model

Source: Rogers, 1962

- 18. Rogers (2003) later explains that between 49-87% of the degree and speed of infusion, in each consumer group can be explained through five characteristics of the innovation: relative advantage, compatibility, complexity, triability and observability the definitions are presented below.
  - (a) **Relative advantage** captures the extent to which an innovation is seen as superior to the product that it replaces; an innovation may be superior in terms of economic advantage, social prestige, convenience or satisfaction;
  - (b) **Compatibility** captures whether the innovation is consistent with the needs and values of its consumers;
  - (c) **Complexity** captures how easy the innovation is to use;
  - (d) **Triability** captures the extent to which an innovation can be tested before use; greater triability reduces the uncertainty to the final consumer;
  - (e) **Observability** captures the tangibility of the results from a test of the innovation; visible results from an innovation also reduce the uncertainty to the end consumer.
- 19. The greater the relative advantage, compatibility, complexity, triability and observability of an innovation, the faster the likely diffusion and uptake of that innovation.
- 20. In a study analysing the diffusion of new innovations, or the adoption of new technology, across the US coal, iron, steel, brewing and railway industries, Edwin Mansfield (1961) largely confirmed Rogers's diffusion of innovation theory in the context of private companies in industry. Further, by his 2003 edition, Rogers cited eight randomised controlled trials that confirmed not just his diffusion of innovation theory with regards to individuals uptake of new products, but also the importance of opinion leaders (early adopters) in producing behavioural changes to a society. In that latter edition Rogers

adopts the normal distribution as the single statistical representation for market penetration of new products.

#### 3. Critiques of the theory

- 21. Since the introduction of the Diffusion of Innovation in 1962, the theory has been largely adopted by marketers, but also critiqued by researchers and economists. Some of the key criticisms, related to the purpose of eventually relating market penetration to additionality, are presented below.
- 22. Robertson (1967) questions 'is 100% adoption of an innovation likely?' Indeed, Dearing and Cox (2018) follow this train of thought to continue that "diffusion is an atypical outcome, since the vast majority of innovations fail to diffuse". Figure 3 below presents the Dearing and Cox's (2018) assessment of Roger's Diffusion of Innovation theory. It provides an argument that in Rogers' model the innovations are only likely to succeed once they reach the market penetration level of early adopters or the early majority. Given that innovators are naturally highly risk-loving, the initial uptake of innovators does not prove that an innovation is competitive and thus will be popular with the majority of the population. Indeed, Rogers accepts that innovators are 'marginal' members of the community and the least socially integrated. Whilst Rogers directs this argument towards individuals consumption behaviour, it may also be applied to the uptake of new technologies by businesses; more risk-loving businesses are likely to be start-ups looking for a unique market entry point and thus will have invested less in research and development and are less likely to be market influencers. While this is a critique of the universality of diffusion, at the same time it is supportive of the Meth Panel's consideration that the "innovator" and "early adopter" thresholds of the Rogers's Diffusion of Innovation theory align well with the "first of its kind" and "additional" thresholds.
- 23. By this, Rogers implies that the ability of innovators to encourage early adopters to embrace an innovation is limited. However, whilst this may result in some productive innovations failing to take off, this also supports the argument that early adopters act analytically when deciding whether or not to embrace an innovation and are therefore more likely to positively influence the larger population.
- 24. The works of Robertson and Dearing and Cox actually strengthen the idea that innovators and early adopters characterize the space of additionality since in many cases there is no guarantee that the initial growth will revert into massive adoption. The whole idea of the CDM is to provide an incentive to make sure that a higher proportion of innovative product and services can find their way to become a common practice.
- 25. Packey (1993) questions whether diffusion of innovation should follow a normal distribution. Whilst he agrees with the theory of a bell-shaped distribution, he reflects that there is no reason why there should be symmetry between the rate of adoption of innovators, early adopters and the early majority, with that of the late majority and laggards. However, this is unimportant for our analysis as additionality may only be demonstrated in the first half of the distribution.
- 26. There is also a chance that some early adopters may mistakenly judge an innovation as performance enhancing and thus it may be argued that an innovation is only likely to achieve market penetration once adopted by a majority of early adopters, after that the snowball effect may materialise.





- 27. However, Robertson's question of 100% adoption may still stand. Even if an innovation is seen to be performance enhancing and economically competitive, it may still not be adopted by all consumers in a specific society. According to Jerry Yudelson (2018), "10 years after Apple introduced the iPhone in 2007, only 67% of the US population owned a smartphone from any maker". Yet, by contrast, Horace Dediu (2013) estimates that the adoption of smartphones in the US was above 90% of the available audience by 2017. Therefore, it is important to distinguish between the total market for an innovation and the potential available market (or target market) that is likely to adopt the innovation (bearing in mind that both market sizes may change over time). Dearing and Cox concur that "to address this critique, and to apply Rogers's Diffusion of Innovations theory, this analysis will consider the market penetration of a technology; because market penetration is a measure of an innovation will strive for 100% market penetration.
- 28. In his theory, Rogers does not consider the size of a population, but rather the proportion of the population that have embraced the innovation. This may provide very different results when considering the diffusion of innovation across geographical areas. For example, 2.5% of the Chinese population equates to 34.65 million individuals, which is larger than the entire population of 177 countries globally (World Bank database, 2017). The view of the Meth Panel in this regard is that the total market (the denominator) should be established as the proportion of the population that may embrace the innovation.
- 29. Les Robinson (2009) notes that "the Diffusion of Innovation does not consider a consumer's resources or social support available to adopt the innovation", which is agreed by Dearing and Cox that "resource rich communities with greater concentrations of professionals exhibit greater capacity to acquire and make use of innovations". Indeed, it

Source: Dearing and Cox, 2018

is possible that in certain populations (in particular low-income economies), an innovation that may otherwise diffuse may be constrained by lack of capacity to adopt it; similarly, the CDM denotes greater additionality in low-income economies. For the same reason, it is likely that the diffusion of innovation will happen more quickly in high to middle income economies due to their greater capacity to adopt an innovation. In such circumstances, supportive policies may boost the diffusion of innovation and the Government may become more of an influencing factor than the early adopters.

30. Finally, Horace Dediu (2013), through presenting the diffusion of a number of new technologies in the US, demonstrates that geopolitical and economic events may also affect the diffusion of innovation. For example, the Great Depression and World War II slowed, and in some cases reversed, the adoption of innovations in the US, including landline telephones, cars and clothes washers. The view of the Meth Panel is that external factors need to be monitored and their impact weighed on the determination of whether or not innovation theories may still apply to a CDM project. The adoption of dynamic baselines as we have in AM0030 may constitute an interesting case to explore giving a temporal limit to additionality and greatly reducing the risks associated with false positives.

## Appendix 3. Road testing of growth rate approach

#### 1. Road testing of the accelerating growth rate approach

- 1. To test the potential approach, the steps as per flow chart in **Figure 3 and 4** in the concept note were applied on the selected technologies. The results achieved by this approach were then validated against the approach stated in the existing conditions for that technology in the CDM tools and methodologies.
- 2. For this, the list of technologies that use the market penetration or market share condition were identified from the study of the existing conditions as given in Table 1. Next the number of registered projects and under validation using these technologies were collected from the CDM PA and PoA database.
- 3. The selection also considered technologies of different types such as grid connected power generation, distributed units, energy efficient products, etc., for the better representation purpose. Further, the available market data were collected for these technologies. Accordingly, the following technologies were selected for road testing based on best available market data.
  - (a) Solar water heating (SWH) systems;
  - (b) Electric vehicles (EV);
  - (c) Solar Photo Voltaic (PV) (grid connected);
  - (d) Concentrated solar power (CSP) (grid connected);
  - (e) Off-shore wind (grid connected).
- 4. Following are the key observations from the road testing of accelerating growth rate approach with few sample technologies:
  - (a) The accelerating growth rate approach rightly captures the market condition where a specific technology is just emerging with the diffusion level of less than 16% and faces several barriers due to baseline practices. Thus, it may be possible to use it to demonstrate the additionality of a technology;
  - (b) The trend in accelerating growth rate of technology may be distorted by several external influences such as policy changes, availability of funds or incentives, etc. In such cases, the project developer shall demonstrate the additionality through the existing Tools for demonstration and assessment of additionality;
  - (c) The definition for the first-of-its-kind condition could be amended to also include a technology with <2.5% diffusion level in a region or country;
  - (d) The accelerating growth rate approach may be applicable to most of the technologies covered in relevant tools and methodologies under the CDM that currently use the market penetration or market share conditions to demonstrate the additionality;

- (e) For those technologies where the methodologies use market share or market penetration to demonstrate the common practice, the methodology could be amended to use the accelerating growth rate to prove additionality as well. The same can be done for other methodologies that do not use any market penetration or market share assessment for its technologies but refer to the tools to demonstrate additionality and common practice
- 5. The following section presents a detailed road-testing report of various technologies.

#### 2. Solar water heating systems

6. For testing the validity and applicability of the proposed approach, the SWH technology within the geographic boundary of India is considered for the analysis.

#### 2.1. Step 1: Checking if technology is in positive list or first-of-its-kind in the country

- 7. The TOOL21 or TOOL32 does not include SWH systems in its positive list of technologies.
- 8. As per TOOL19, version 9, SWH system is automatically additional only if:
  - (a) Geographic location of the project activity is in one of the LDCs/SIDS or in a SUZ of the host country <u>OR</u>
  - (b) End users are the households, communities or SMEs <u>AND</u> market penetration is  $\leq 5\%$  of the technologies/measures (providing similar services) in the region
- 9. Since the considered geographic boundary is India which is not LDC/SIDS, so condition (a) is not applicable.
- 10. The inference from condition (b) is that without "market penetration" assessment, this technology is not automatically additional under micro-scale project activity in CDM.
- 11. SWH technology has been introduced and available in India since 1980s<sup>19</sup>. Therefore, it does not come under the first-of-its-kind technology in India.

#### 2.2. Step 2. Check if there is growth of SWH technology in the country

12. Figure 1 shows the growth in SWH system installation in India from 2007 to 2016.

<sup>&</sup>lt;sup>19</sup> Solar Water Heaters Usage in India –Current Scenario and Vision 2020-Review, IJRDET, Feb 2014.



#### Figure 1. Growth of SWH systems in India<sup>20</sup>

13. As per above information, there is growth in adoption of SWH systems in India.

#### 2.3. Step 3. Check if the growth rate is accelerating

14. For this assessment, the latest three-year growth data from 2013-14 to 2015-16 is considered. Table 1 shows the assessment of growth in installations (million square meters) and the growth rate (%).

Year	Annual installation (total million sq. meters)	Growth rate (%) <sup>22</sup>	Acceleration in growth rate (%) <sup>23</sup>
	Α	B = ((A <sub>i</sub> – A <sub>i-1</sub> )x100) /A <sub>i-1</sub>	C = ((B <sub>i</sub> – B <sub>i-1</sub> )x100) /B <sub>i-1</sub>
2012-13	7	-	-
2013-14	8	14.29	-
2014-15	8.5	6.25	-56.25
2015-16	9	5.88	-5.88

	Table 1.	Growth	rate of	SWH s	svstems	in India <sup>21</sup>
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Note: Where " i" represents the year

15. The analysis of data shows that growth rate of SWH systems in India is decelerating in the assessment period of 2013-14 to 2015-16.

<sup>&</sup>lt;sup>20</sup> India's CST sector - vision 2022, MNRE, GEF-UNIDO.

<sup>&</sup>lt;sup>21</sup> India's CST sector - vision 2022, MNRE, GEF-UNIDO.

<sup>&</sup>lt;sup>22</sup> (Current year growth – previous year growth)/previous year growth.

<sup>&</sup>lt;sup>23</sup> (Current year growth rate – previous year growth rate)/previous year growth rate.

16. Therefore, the technology cannot be considered as automatically additional according to the accelerating growth rate approach. Further it needs to be confirmed that the growth of the technology/product follows a normal distribution curve and that the three years data is not influenced by any externality.

#### 2.4. Step 4. Use guidelines or tools for additionality check

- 17. The decelerating growth rate of a technology does not mean that the technology is not additional. The decelerating growth rate may be due to the market limitations such as absence of supportive policies or inadequate funds or absence of incentives to promote the technology or any other prevailing barriers.
- 18. There was a capital subsidy (30-60% of the total investment cost) provided for SWH systems by the Ministry of Non-renewable and Renewable Energy (MNRE), India from 2010. However, the subsidy was stopped in September 2014 since there were more number of installations which increased subsidy burden for the government<sup>24</sup>. This has led to fall of market growth for the SWH systems in India as observed from the Figure 1.

<sup>&</sup>lt;sup>24</sup> <https://economictimes.indiatimes.com/industry/cons-products/durables/discontinuation-of-subsidyforcing-many-solar-water-heater-makers-to-shut-down operations/articleshow/44989316.cms?from=mdr>: last accessed on 07/08/2019.

- 19. Figure 2 below.
- 20. Given the observations, the project activity using SWH systems in India must consider using the other additionality assessment conditions given in TOOL21 or other guidelines/ methodologies as applicable. The general assessment conditions as per TOOL21 include:
  - (a) Investment barrier;
  - (b) Technological barrier;
  - (c) Barrier due to prevailing practice;
  - (d) Other barriers.





#### 2.5. Validation of result through existing CDM conditions

- 21. As stated earlier in step 1, under TOOL19, version 09.0, SWH system is automatically additional only if:
  - (a) Geographic location of the project activity is in one of the LDCs/SIDS or in a SUZ of the host country); <u>OR</u>
  - (b) End users are the households, communities or SMEs <u>AND</u> market penetration is equal to or less than 5 per cent of the technologies/measures (providing similar services) in the region.
- 22. Since the considered geographical boundary is India which is not LDC/SIDS, so condition (a) is not applicable.
- 23. The analysis of market penetration of SWH system in India is carried out as per option (b). The TOOL19, Appendix. "Determination of penetration of proposed technology/measure" states that the penetration of the proposed technology must be ≤ 5% of the technologies/measures providing similar services in that region. The same option is proposed in the small-scale methodology AMS.I-J. Solar water heating systems, version 2.
- 24. In India, the technologies providing similar water heating services are electric storage, electric instantaneous, gas instantaneous and SWH. As per the "Policy opportunities for more efficient residential water heating" report<sup>25</sup>, the market share of SWH systems in India had reached around 14% in 2012 itself. Table 2 presents the market share of different water heating systems in India. Therefore, it can be considered that the technology has market share of more than 5% and is not automatically additional. However, the project participants may prove the additionality through assessment of other barriers specific to the project technology and design.

No.	Water heater type	Market share (%)
1	Electric storage	54
2	Electric instantaneous	22
3	Gas instantaneous	10
4	Solar	14
	Total	100

 Table 2.
 Market share of SWH in India

#### 2.6. Observations:

- 25. Both the approaches have identified the SWH technology is not automatically additional in India
- 26. Though the market share of SWH system is less than 16%, the growth rate has been decelerating due to the discontinuation of subsidy schemes.

<sup>&</sup>lt;sup>25</sup> Waide Strategic Efficiency Ltd, November 2015.

27. Project developer must demonstrate additionality using the prevailing barriers specific to the project activity condition.

#### 3. Electric vehicles (EVs)

28. For testing the validity and applicability of the proposed approach, the electric vehicles (EVs) technology within the geographic boundary of China is considered for the analysis.

#### 3.1. Step 1: Checking if the technology is in positive list or first-of-its-kind in the country

29. The EVs are not in the positive list of technologies (neither in TOOL19 nor in TOOL32). Since the EVs were introduced in China in late 90's, it is not a first-of-its-kind project in the country.

#### 3.2. Step 2. Check if there is growth of EV technology in the country



#### Figure 3. Growth of EV sales in China<sup>26</sup>

30. Figure 3 shows the growth in EVs in China from 2015 to 2018. As per the above information, there is growth in adoption of EV in China.

#### 3.3. Step 3. Check if the growth rate is accelerating

31. For this assessment, the latest four-year growth data from 2015-18 is considered. Table 3 shows the assessment of growth of EV sales and the growth rate (%).

<sup>&</sup>lt;sup>26</sup> Date from 2015 – 2018 from website <http://www.ev-volumes.com/news/global-plug-in-sales> - last accessed on 07/08/2019.

Voar	Net annual EV sales	Growth rate (%) <sup>27</sup>	Acceleration in growth rate (%) <sup>28</sup>
rear	Α	B = ((A <sub>i</sub> – A <sub>i-1</sub> )x100) /A <sub>i-</sub> 1	C = ((B <sub>i</sub> – B <sub>i-1</sub> )x100) /B <sub>i-1</sub>
2015	190,000	-	-
2016	351,000	85%	-
2017	606,000	73%	-14%
2018	1,182,000	95%	31%

Table 3.	Growth	rate o	of EV	in China	l
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Note: Where " i" represents the year

32. The analysis of data shows that growth rate of EVs in China is accelerating in the assessment period of 2015 – 2018. Therefore, the technology can be considered as additional according to the accelerating growth rate approach.

#### 3.4. Step 4. Use guidelines or tools for additionality check

- 33. Since the EV technology is automatically additional, this step is not required.
- 34. The Chinese government has provided several polices to encourage the EV market. This include restrictions on purchase of conventional fuel vehicles, subsidy on the EV purchase cost, one-hour free parking for EV in parking lots, building sufficient charging infrastructure, etc.<sup>29</sup> Because of these promotional activities, the EV market is undergoing an accelerating growth rate.
- 35. The checking of condition is given in Figure 4.

<sup>&</sup>lt;sup>27</sup> (Current year growth – previous year growth)/previous year growth.

<sup>&</sup>lt;sup>28</sup> (Current year growth rate – previous year growth rate)/previous year growth rate.

<sup>&</sup>lt;sup>29</sup><https://www.researchgate.net/publication/327849027\_Evaluating\_the\_Effect\_of\_Policies\_and\_the\_De velopment\_of\_Charging\_Infrastructure\_on\_Electric\_Vehicle\_Diffusion\_in\_China> - last accessed on 07/08/2019.

#### Figure 4. Flow chart of assessing additionality for EV (China)



#### 3.5. Validation of result through existing CDM conditions

36. As per the methodology "AMS III C – Emission reductions by electric and hybrid vehicles", version 15.0, additionality can be proved by using either of the following two options:

#### 3.5.1. Option 1:

37. Demonstrate that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in the "Methodological tool: Demonstration of additionality of small-scale project activities". The barrier(s) can be demonstrated for buyers/users and/or charging service providers of the electric vehicles even if the manufacturer or retailer of the electric vehicles is implementing the project.

#### 3.5.2. Option 2:

- 38. Demonstrate ex ante that the market share of project electric/hybrid vehicles is equal to or smaller than 5 per cent of the vehicles of the same category (e.g. if project vehicles are electric scooters, market share of electric two wheelers is equal to or smaller than 5 per cent of all motorized two wheelers, irrespective of the manufacturer) in the region.
- 39. The analysis for the market share of EVs in China was carried out by considering option 2 above. As per the International Energy Agency's (IEA) Global EV outlook 2018, it was

found that the market share of EVs in China were 1.3% in 2016 and 2.2% in 2017<sup>30</sup>. Therefore, it can be considered that the EV projects are automatically additional in China.

#### 3.6. Observations:

- 40. Both the approaches concluded that the technology is automatically additional in China.
- 41. As the market share of EVs in China is less than 2.5%, it may be still considered first-ofits kind in the country (in "early adoption" stage as per the Rogers theory).

#### 4. Grid connected Solar PV power generation

42. For testing the validity and applicability of the alternate approach, the grid connected solar PV power technology within the geographic boundary of India is considered for the analysis.

#### 4.1. Step 1: Checking if technology is in positive list or first-of-its-kind in the country

- 43. As per the TOOL32, a grid-connected renewable energy technology is automatically additional only if:
  - (a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent; <u>OR</u>
  - (b) The total installed capacity of the technology in the host country is less than or equal to 50 MW.
- 44. The condition (b) will not be applicable to India, since the solar installed capacity is greater than 50 MW. The solar PV technology was in operation since 2009<sup>31</sup> in India. Therefore, it does not come under the first-of-its-kind technology.

#### 4.2. Step 2. Check if there is growth of solar PV technology in India

45. Figure 5 shows the growth in solar PV technology in India from 2011 to 2018.

<sup>&</sup>lt;sup>30</sup> Battery & plug-in hybrid vehicles put together, Table A8 & A9, Global EV outlook 2018 towards cross model electrification, International Energy Agency, 2018.

<sup>&</sup>lt;sup>31</sup> <https://www.indiatoday.in/india/story/indias-first-solar-power-plant-opens-in-punjab-63048-2009-12-15> - last accessed on 07/08/2019.



#### Figure 5. Growth of solar PV technology in India<sup>32</sup>

46. As per the above information, there is a growth in adoption of solar PV technology in India.

#### 4.3. Step 3. Check if the growth rate is accelerating

47. For this assessment, the latest four-year net capacity addition from 2015 to 2018 is considered. Table 4 shows the assessment of growth of net capacity addition and the growth rate (%).

Year	Net capacity addition (MW)	Growth rate (%)	Acceleration in growth rate (%)
	Α	B = ((A <sub>i</sub> – A <sub>i-1</sub> )x100) /A <sub>i-1</sub>	C = ((B <sub>i</sub> – B <sub>i-1</sub> )x100) /B <sub>i-1</sub>
2015	1,816	-	
2016	4,134	128%	-
2017	8,040	94%	-26%
2018	8,974	12%	-88%

Table 4.Solar PV growth rate in India33

Note: Where " i" represents the year

<sup>32</sup><https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish =yes&:toolbar=no> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>33</sup><https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish =yes&:toolbar=no> - last accessed on 07/08/2019.

48. The analysis of data shows that growth rate of solar PV technology in India is decelerating in the last 3 years of 2016-2018. Therefore, the technology cannot be considered as automatically additional.

#### 4.4. Step 4. Use guidelines or tools for additionality check

- 49. The decelerating growth rate of a technology does not mean that the technology is not additional. The decelerating growth rate may be due to the market conditions such as absence of supportive policies or inadequate funds or absence of incentives to promote the technology or any other prevailing barriers.
- 50. The following are few observations on the market trend of Solar PV in India:
  - (a) The technology received a thrust through the Jawaharlal Nehru National Solar Mission (JNNSM) launched in 2010. The phase 1 of program was from 2010 – 2013. This resulted in upsurge of installation observed in 2014 (closure of projects under phase 1);
  - (b) The second phase of mission was from 2014- 2017 and third phase is from 2017- 2022;
  - (c) Few barriers restricting the rapid uptake of technology are transmission infrastructure and managing grid availability;<sup>34</sup>
  - (d) Barriers such as imposition of safeguard duty for imported cells and modules, lack of clarity on Gross Service Tax (GST) rate applicability on solar power projects, unavailability of land and evacuation facilities are also considered to slowdown solar power projects<sup>35</sup>.
- 51. The checking of condition is given in Figure 6.

<sup>&</sup>lt;sup>34</sup> <https://www.pv-tech.org/news/india-reaches-23.1gw-of-grid-connected-solar-mnre> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>35</sup> <https://www.vikramsolar.com/blog-a-decline-in-solar-growth-root-cause-analysis/amp/:> last accessed on 07/08/2019.





- 52. Given the observations, the project activity using solar PV technology in India must consider using the other additionality assessment conditions given in the guidelines/methodologies as applicable. The general assessment conditions include:
  - (a) Investment barrier;
  - (b) Technological barrier;
  - (c) Barrier due to prevailing practice;
  - (d) Other barriers.

#### 4.5. Validation of result through existing CDM conditions

- 53. As per the TOOL32, the project activity is automatically additional if "The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent".
- 54. The total installed grid power capacity in India is around 357 GW<sup>36</sup>. The total installed grid connected solar PV power capacity is 26 GW<sup>37</sup>. Thus, the market penetration for grid connected solar PV technology in India is 7.83% as of 2018<sup>38</sup>. Therefore, the grid connected solar PV power generation in India cannot be considered as automatically additional.

#### 4.6. Observations:

- 55. Both the approaches have identified that the grid connected solar PV technology is not automatically additional in India.
- 56. Though the market share of grid connected solar PV is less than 16%, the growth rate has been decelerating due to the additional duty imposed and the limitations in the transmission network.
- 57. Project developer must demonstrate additionality using the prevailing barriers specific to the project activity condition.

#### 5. Grid connected Concentrated Solar Power (CSP) generation

58. For testing the validity and applicability of the proposed approach, the grid connected CSP technology within the geographic boundary of India is considered for the analysis.

#### 5.1. Step 1: Checking if technology is in positive list or first-of-its-kind in the country

- 59. As per the CDM methodology TOOL32, a grid-connected renewable energy technology is automatically additional only if:
  - (a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent; OR
  - (b) The total installed capacity of the technology in the host country is less than or equal to 50 MW.
- 60. The condition (b) will not be applicable to India, since the installed CSP is greater than 50 MW. The CSP technology-based power plants have been in operation since 2011<sup>39</sup> in India. Therefore, it does not come under first-of-its-kind technology.

<sup>&</sup>lt;sup>36</sup> <https://en.wikipedia.org/wiki/Electricity\_sector\_in\_India> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>37</sup> <https://mercomindia.com/solars-share-indias-total-installed-capacity-7-9-end-2018/> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>38</sup> Estimated using the data obtained from the IRENA database.

<sup>&</sup>lt;sup>39</sup> <http://helioscsp.com/indias-concentrated-solar-power-csp/> - last accessed on 07/08/2019.

#### 5.2. Step 2. Check if there is growth of CSP technology in India

61. Figure 7 shows the growth in grid connected solar CSP technology in India from 2011 to 2018.



Figure 7. Growth of solar CSP technology in India<sup>40</sup>

62. As per above information, there is no growth in adoption of CSP technology in India after 2015.

#### 5.3. Step 3. Check if the growth rate is accelerating

- 63. Since there is no growth in last 4 years, this checking is not needed.
- 64. The analysis of data shows that the technology growth rate is not accelerating. Therefore, it cannot be considered as automatically additional.

#### 5.4. Step 4. Use guidelines or tools for additionality check

- 65. The decelerating growth rate of a technology does not mean that the technology is not additional. The decelerating growth rate may be due to market conditions such as absence of supportive policies or inadequate funds or absence of incentives to promote the technology or other prevailing barriers.
- 66. The following are few observations on the market trends of CSP in India:

<sup>&</sup>lt;sup>40</sup><https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish =yes&:toolbar=no> - last accessed on 07/08/2019.

- (a) The technology received a thrust through the Jawaharlal Nehru National Solar Mission (JNNSM) launched in 2010. The phase 1 of program was from 2010 – 2013.
- (b) But the further up-take of technology or commissioning of planned projects faced challenged due to the barriers faced in installation and operation of initial installed plants in phase 1. The barriers included<sup>41</sup>:
  - (i) Unreliable solar data;
  - (ii) High cost compared to PV;
  - (iii) Low availability of skilled labour.
- 67. The checking of condition is given in Figure 8.





- 68. Given the observations, the project activity using CSP technology in India must consider using the other additionality assessment conditions given in the guidelines/methodologies as applicable. The general assessment conditions include:
  - (a) Investment barrier;

<sup>&</sup>lt;sup>41</sup> <https://www.currentscience.ac.in/Volumes/115/02/0222.pdf >- last accessed on 07/08/2019.

- (b) Technological barrier;
- (c) Barrier due to prevailing practice;
- (d) Other barriers.

#### 5.5. Validation of result through existing CDM conditions

- 69. As per the TOOL32, the project activity is automatic additional if "The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent"
- 70. The analysis of market share of CSP technology in India was carried out. It is found that the share of CSP generation in India is only 0.07% as of 2018<sup>42</sup>. Therefore, the CSP technology in India can be considered as automatically additional.

#### 5.6. Observations:

- 71. As per the accelerating growth rate approach, the technology is not automatic additional;
- 72. As per the market share approach of current CDM conditions, the technology is automatically additional;
- 73. There are only five CSP power plants installed in India<sup>43</sup>. Therefore, the growth rate shows varying trends based on commissioning of each plant. This can be an example condition for the "Early adoption" where the market diffusion is < 2.5% and it is difficult to predict growth rate trend in that region of diffusion curve;
- 74. If a technology with < 2.5% market diffusion is considered as first-of-its-kind in the country, then the CSP technology will be automatically additional in India.

#### 6. Grid connected off-shore wind power generation

75. For testing the validity and applicability of the proposed approach, the grid connected concentrated off-shore wind technology within the geographic boundary of China is considered for the analysis.

#### 6.1. Step 1: Checking if the technology is in positive list or first-of-its-kind in the country

- 76. As per the CDM methodology TOOL32, a grid-connected renewable energy technology is automatically additional only if:
  - (a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent; <u>OR</u>
  - (b) The total installed capacity of the technology in the host country is less than or equal to 50 MW.

<sup>&</sup>lt;sup>42</sup> Estimated using the data obtained from the IRENA database.

<sup>&</sup>lt;sup>43</sup> <https://www.currentscience.ac.in/Volumes/115/02/0222.pdf> - last accessed on 07/08/2019.

77. The condition (b) will not be applicable to China, since the offshore wind installed capacity is greater than 50 MW. The offshore wind power generation has been in operation since 2010<sup>44</sup> in China. Therefore, it does not come under the first-of-its-kind technology.

#### 6.2. Step 2. Check if there is growth in offshore wind technology in China

78. Figure 9 shows the growth in offshore wind technology in China from 2011 to 2018.



Figure 9. Growth of offshore wind technology in China<sup>45</sup>

79. As per above information, there is growth in adoption of offshore wind technology in China.

#### 6.3. Step 3. Check if the growth rate is accelerating

80. For this assessment, the latest four-year growth data from 2015 to 2018 is considered. Table 5 shows the assessment of growth in off-shore wind technology and its growth rate (%).

<sup>&</sup>lt;sup>44</sup><https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Wind\_power\_in\_C hina.html> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>45</sup><https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish =yes&:toolbar=no> - last accessed on 07/08/2019.

Year	Net capacity addition (MW)	Growth rate (%)	Acceleration in growth rate (%)
	А	$B = ((A_i - A_{i-1})x100) / A_{i-1}$	C = ((B <sub>i</sub> – B <sub>i-1</sub> )x100) /B <sub>i-1</sub>
2015	119	-	-
2016	921	674%	-
2017	1,308	42%	-94%
2018	1,800	38%	-10%

#### Table 5. Offshore wind technology growth rate in China<sup>46</sup>

*Note:* Where "*i*" represents the year

81. The analysis of data shows that growth rate of offshore wind technology in China is decelerating in the last 3 years period of 2016 to 2018. Therefore, the technology cannot be considered as automatically additional.

#### 6.4. Step 4. Use guidelines or tools for additionality check

- 82. The decelerating growth rate of a technology does not mean that the technology is not additional. The decelerating growth rate may be due to market conditions such as absence of policies or inadequate funds or absence of incentives to promote the technology or other prevailing barriers.
- 83. Major barriers limiting the rapid up-take of off-shore wind technology in China were found to be the lack of long-distance transmission infrastructure and difficulties in managing the grid availability for power export<sup>47</sup>.
- 84. The checking of condition is given in Figure 10.

<sup>&</sup>lt;sup>46</sup><https://public.tableau.com/views/IRENARETimeSeries/Charts?:embed=y&:showVizHome=no&publish =yes&:toolbar=no> - last accessed on 07/08/2019.

<sup>&</sup>lt;sup>47</sup> Fixing wind curtailment with electric power system reform in China.



Figure 10. Flow chart of assessing automatic additionality for grid connected off-shore wind (China)

85. Given the observations, the project activity using offshore wind technology in China must consider using the other additionality assessment conditions given in the guidelines/ methodologies as applicable

#### 6.5. Validation of result through existing CDM conditions

86. As per the TOOL32, the project activity is automatically additional if "*The percentage share* of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent".

87. The analysis for the market share of offshore wind technology in China was carried out. It is found that the share of offshore wind technology was 0.24% as of 2018<sup>48</sup>. Therefore, the technology can be considered as automatically additional in China.

#### 6.6. Observations:

- 88. As per the accelerating growth rate approach, the technology is not automatically additional.
- 89. As per the market penetration approach of current CDM conditions, the technology is automatically additional.
- 90. This can be an example condition for the "Early adoption" where the market diffusion is <2.5% and it is difficult to predict growth rate trend in that region of diffusion curve.
- 91. If a technology with <2.5% market diffusion is considered as first-of-its-kind in the country, then the off-shore technology will be automatically additional in China.

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#### **Document information**

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<sup>&</sup>lt;sup>48</sup> Estimated using the data obtained from the IRENA database.