REDUCING TARIFFS AND TAXES ON TOILETS

Decision Support Tool User Guide

TETRA TECH

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GLOSSARY

Control panel	A table in the user dashboard of the model that allows the user to vary the value of key variables that determine the outputs of the model. The values entered in the control panel lead to real-time changes in the output tables in the model
Corporate Income Taxes	Refers to the tax on an enterprises profit that it needs to pay, typically applied to profit before tax (operating profit subtracted by interest and depreciation)
Cost of Goods Sold (COGS)	These are the direct costs related to the production of goods sold for an enterprise. In this case, this is composed of total material costs, and total labor costs
Cost Price (USD)	Refers to the price that each value chain actor receives a raw material at. This does not include VAT
Dashboard	A dashboard is a user interface that consolidates, organizes, and presents information in a way that is easy to read. The dashboard has two parts: a control panel that allows the user to select/ input the parameters of the model; and a table that displays the resultant outputs on the same sheet
Improved Sanitation	According to the WHO/ UNICEF Joint Monitoring Program (JMP), an improved sanitation facility is defined as one that hygienically separates human excreta from human contact
Initial price	This is the cost price faced by the actor at the start of the value chain of a material/ commodity. This actor could be an importer, manufacturer, or retailer
Key variables	A key variable is one that has a direct and significant impact on the output of the model. These could include the choice of housing segment targeted by the policy lever; the key constraints faced by house owners; and factors influencing compliance with the policy
Operating Expenses	Refers to an enterprise's expenses that are not directly associated with production. In this case, this is composed of Total sales commissions and transport costs
Operating Profit	This equals total revenue subtracted by total costs (operating expenses and COGS)
Price elasticity of demand	Measures the responsiveness of consumer demand to changes in the price of a good or service
Profit Markup	Amount of profit (absolute or %) that is applied to a total cost amount, the generate a final price
Sales Price (excluding VAT)	Refers to the final price a customer has to pay for a toilet, without a VAT amount
Total Sales Price (including VAT)	Refers to the final price a customer has to pay for a toilet, including a VAT amount

Unimproved Sanitation	In this model, the term unimproved sanitation refers to access to toilets that do not meet the criteria set in the definition of improved facilities. In addition, open defecation has also been clubbed with unimproved facilities in one category
User	In this document, user refers to someone who wishes to apply the penalties model to a specific geography/ market and is therefore interested in adapting it
Willingness to Pay Studies	Refers to the customer/ consumer research studies that estimate the price at which households are willing to purchase a toilet. It is generally from Willingness to Pay (WTP) studies that price and demand information is gathered in order to calculate the price elasticity of demand

1.0 INTRODUCTION

Inadequate access to sanitation remains a significant problem globally. According to the Joint Monitoring Programme (2020), 1.7 billion people still do not have access to basic sanitation facilities, while 494 million people still practice open defecation. Inadequate sanitation is linked to the transmission of numerous communicable diseases—particularly cholera, dysentery, hepatitis A, typhoid, and polio—with a disproportionally large effect on children. The scale of investment required to deliver sanitation goods and services to the hundreds of millions of people around the world that currently lack access is staggering and beyond the capacity of public finance alone.

The private sector has already proven itself a key player in the financing, construction, and operation of municipal water supply and wastewater systems in both developed and developing world settings, and has a significant role to play in the provision of onsite sanitation. Experts increasingly view market-based sanitation (MBS) interventions—through which private sector actors supply toilets and related services to individual households—as a promising approach for scaling the delivery of onsite sanitation to households that are not connected to centralized wastewater collection and conveyance systems. Successful MBS interventions in Southeast Asia and Bangladesh demonstrate the promise of this approach, yet those successes have proven difficult to replicate in other regions, particularly sub-Saharan Africa and India, where the need is greatest.

Water, Sanitation, and Hygiene Partnerships and Learning for Sustainability (WASHPaLS) is a USAID centrally funded research and technical assistance mechanism that focuses on identifying and filling gaps in knowledge concerning behavior change and sanitation product and service delivery. One of WASHPaLS' first tasks was to produce and disseminate an in-depth desk review report on market-based approaches to sanitation. With an overarching aim to illustrate how and when an MBS approach may best work within a given context, the desk review describes the current state of knowledge in market-based sanitation (MBS) and establishes a framework to analyze, design, and improve MBS interventions. It is based on a survey of approximately 600 documents on MBS, in-depth research into 13 MBS intervention case studies across the global south, and interviews with sector experts and program personnel.

The survey of the MBS literature and analysis of case studies made clear that, while the focus of these interventions tended to be the sanitation *market*[1] (the interaction between buyers and sellers), successful interventions also sought to bring about change in the broader sanitation *market system*[2] (e.g., value chains and such supporting functions like banking and infrastructure). In an effort to apply this *systems* lens to MBS, a "framework" for MBS interventions was developed that specifies the various levels at which stakeholders should intervene to bring about systems change.

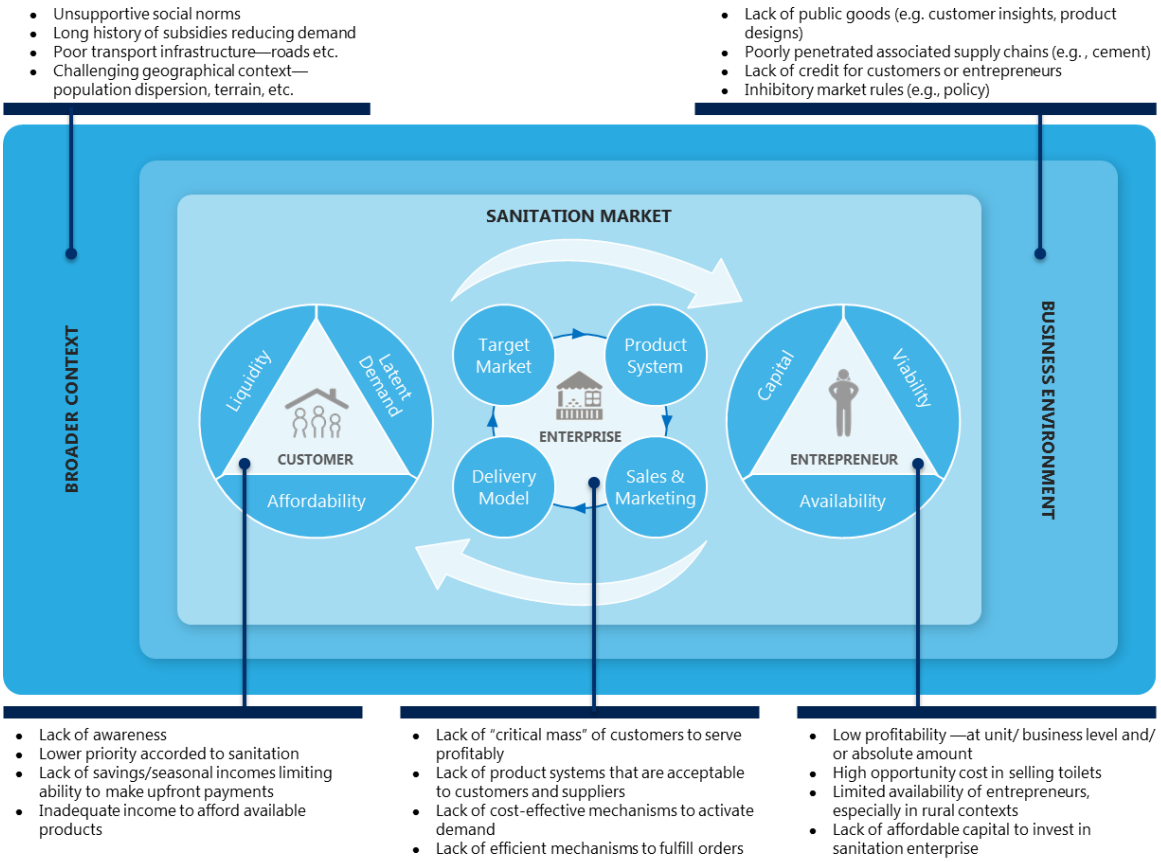
The framework specifies three distinct domains of the sanitation market system, based on degree of influence in each domain from an intervener's (funder and implementer) perspective: **context**, which

[1] According to the Making Markets Work for the Poor (M4P) approach, a **Market** is "*a set of arrangements by which buyers and sellers are in contact to exchange goods or services; the interaction of demand and supply.*" Alternatively, a market comprises buyers and sellers. In the above figure the market is represented by the customer, the sanitation enterprise, and the entrepreneur

[2] A **Market System**, meanwhile, is "*a multi-function, multi-player arrangement comprising the core function of exchange by which goods and services are delivered **and** the supporting functions and rules which are performed and shaped by a variety of market players.*" A market system therefore comprises value chains and supporting functions (e.g., banking system, infrastructure) that enable the market to function. The market system also includes formal rules (e.g., laws, standards) and informal rules or norms that influence interactions and outcomes.

interveners can understand but typically cannot influence; **business environment**, which interveners may potentially influence depending on the complexity and resources available; and the **sanitation market**, which large-scale interventions largely have the capacity to address. The existence and severity of barriers, or absence thereof, across the sanitation *market system* determines the depth of that market; see Figure 1 (USAID, 2018).

Figure 1: Barriers to scaling MBS across the sanitation market system



At the center of the framework is the **sanitation market**, with the business– the mechanism that facilitates the exchange of products and services between entrepreneur and customer, also known as the "**sanitation enterprise**," at its core. Sanitation enterprises must attract enough customers (a "critical mass") to operate profitably. At the same time, entrepreneurs with the attributes (e.g., skills, assets) and capital necessary to build or sell toilets are needed.

Both customers and entrepreneurs may be confronted with a distinct set of barriers, which, individually or in combination, hinder their participation in the market. Customers may lack income or savings to afford toilets that are available in the market (the "affordability" barrier); they may have unstable or seasonal income that prevents them from making the full payment upfront ("liquidity" barrier); or they may not be willing to pay for toilets that are affordable for a range of reasons ("willingness" barrier). On the supply side, the availability of entrepreneurs with attributes (e.g., skills, assets) necessary to build or sell toilets may be limited (the "availability" barrier). Low profitability of selling toilets may discourage entrepreneurs from entering or continuing to operate in the market (the "viability" barrier), or entrepreneurs may lack the capital required to invest in the sanitation enterprise (the "capital" barrier).

The functioning of a sanitation market is governed by the broader **business environment**. The business environment is shaped by factors such as the availability of non-excludable public goods (e.g., market information on product designs in the public domain); the state of associated supply chains (e.g., availability and price of construction raw materials used to build toilets); the state of financial services, which affects the availability of credit for customers and entrepreneurs; and **market rules**, i.e., business-related laws, regulations, and policies (e.g., government programs to provide in-kind hardware subsidies).

Finally, social norms or informal rules can be as powerful as market rules, or even more. Context, beyond the commercial activity related to sanitation, in our framework encompasses social norms, infrastructure, and geographical characteristics, which represents enablers or barriers that tend to shift slowly and can lie outside the influence of funders or implementers.

In order to embed and scale an MBS intervention in a given context, barriers across the three domains of the market system would need to be addressed (Figure 1). **In this document, we focus on efforts to address the barriers in the business environment; specifically the role market rules can play in creating an enabling environment for MBS interventions.**

Market rules include tariffs and taxes, laws, regulations, and policies. Shaping these to enable the sanitation market, support increasing demand and/or improve enterprise viability, is the role of the government at all levels—national, regional, and local levels (Pedi & Jenkins, 2013).

Market rules can address various barriers to customer participation in the sanitation market, like market-compatible targeted subsidies to poor households that enhance affordability. Market rules that affect willingness to pay take numerous forms, including building codes or by-laws that authorize permits only for properties with toilets or that only release housing subsidies to those who construct toilets. Penalties through denial of service or surcharges on households without toilets also shape customers' willingness to pay. For example, water supply boards in Honduras provide new connections only to households with functioning toilets, while Uganda prohibits the sale or lease of property without toilets. Such policies, however, create challenges because they risk inequitable treatment if applied to households that cannot afford toilets. They also can be difficult to enforce, especially in the context of informal housing.

Market rule adjustments by governments to enhance the viability of the sanitation enterprise can include reducing tariffs and taxes on raw materials used for constructing toilets, providing direct support to entrepreneurs by facilitating priority access to critical raw materials, or providing entrepreneurs with assured product or service orders to institutions like schools or local government offices. For example, in Benin, the government provided incentives to local masons to set up sanitation enterprises in their villages by offering contracts to construct toilets in schools. Market rules (e.g., policy, regulation) have a significant influence on the business environment for MBS interventions since they can address physical, institutional, financial and social barriers that affect sanitation markets. While enterprises and customers must ultimately operate independently in the sanitation business environment, key actors such as the government and other stakeholders have a crucial role in shaping market rules to catalyze market activity and depth.

Governments around the world have used various financial and legislative instruments/ actions to influence market rules governing provision of social services. While there are examples of such instruments being used in the sanitation sector, there is limited evidence available regarding their efficacy. Further, even where policies are present, they are often not enforced.

The lack of evidence, or an estimate of the costs involved, makes it difficult to convince policy makers of the benefit of changing market rules. To help address this lacuna, FSG undertook targeted research on the role market rules can play in creating a positive environment for sanitation markets. **Our research attempted to answer three key questions:**

A. How do policies that support entrepreneurs in the market directly impact their viability by enhancing their ability to sell toilets, and/ or improving their profitability and market depth?

B. How do reduced tariffs/ taxes impact toilet prices and consequent change in toilet sales and entrepreneur viability?

C. What is the impact of penalties on non-adoption of toilets amongst higher-income house owners who can afford, but do not have adequate sanitation facilities in their houses (either self-occupied or rented)?

Note: Henceforth, adequate sanitation may also be referred to as "toilet."

The research was carried out using an economic modeling approach. For each of the three research questions, a base economic model was created to estimate the impact of **specific policy levers** on toilet sales, and/ or viability of entrepreneurs, as well as the costs incurred by the government in enforcing the policy (e.g., loss in revenue, monitoring costs). The intention was to provide stakeholders with a tool to support decision making. That is, the models are intended to be an additional resource that policy makers, funders, and implementers can draw upon when exploring whether to introduce a particular market rule in the sanitation sector.

It should be noted, that these are economic models; not econometric models. **Economic models** are simplified descriptions of complex systems designed to simulate potential outcomes on the basis of a theory of economic behavior, existing data, and assumptions. **Econometric models** generally begin with economic models (Hymans, 2008) which are then formulated in a way that is testable (Shalab) through statistical trials. The results of these trials are compared and contrasted with the results from real-life examples. Econometric modeling requires the development of mathematical equations that can estimate the values of all variables in the economic model, as well as assumptions related to how variables outside the model may affect outcomes. In order to do this, econometric models rely on large, reliable data sets.

Given the limited instances of market rules being used in the sanitation sector (and the lack of data available on the outcome of these instances) creating robust econometric models would not be possible for us. Therefore, we decided upon economic modeling as the appropriate approach for our research. The model in this research generates potential outcomes using user input data, variables, and assumptions. Real-world results may vary due to variables and relationships that are unknown or not modeled in this research.

The base economic models were built using actual data from sample geographies where either similar policy levers existed, where analogous policy levers were available from other sectors, or where there was sufficient data to create hypothetical cases. Using actual data from these sample countries ensured that the models were grounded in real-world conditions, and allowed for the outputs of the model to be validated by experts from those countries. In addition, user guides were created to help stakeholders adapt these base models to other geographies/ markets.

This document is the user guide for the model created to answer Question B, i.e., how do reduced tariffs/ taxes impact toilet prices and consequent change in toilet sales and entrepreneur viability? This question seeks to study two distinct but related impacts of reduced tariffs/ taxes:

a) **Change in the volume of toilet sales** due to reduced toilet prices resulting from cheaper input costs and lower indirect taxes (e.g., value added tax or sales tax)

b) **Change in the viability of sanitation entrepreneurs** due to increased revenues resulting from increased toilet sales, and/ or increased unit profitability due to reduction in direct taxes

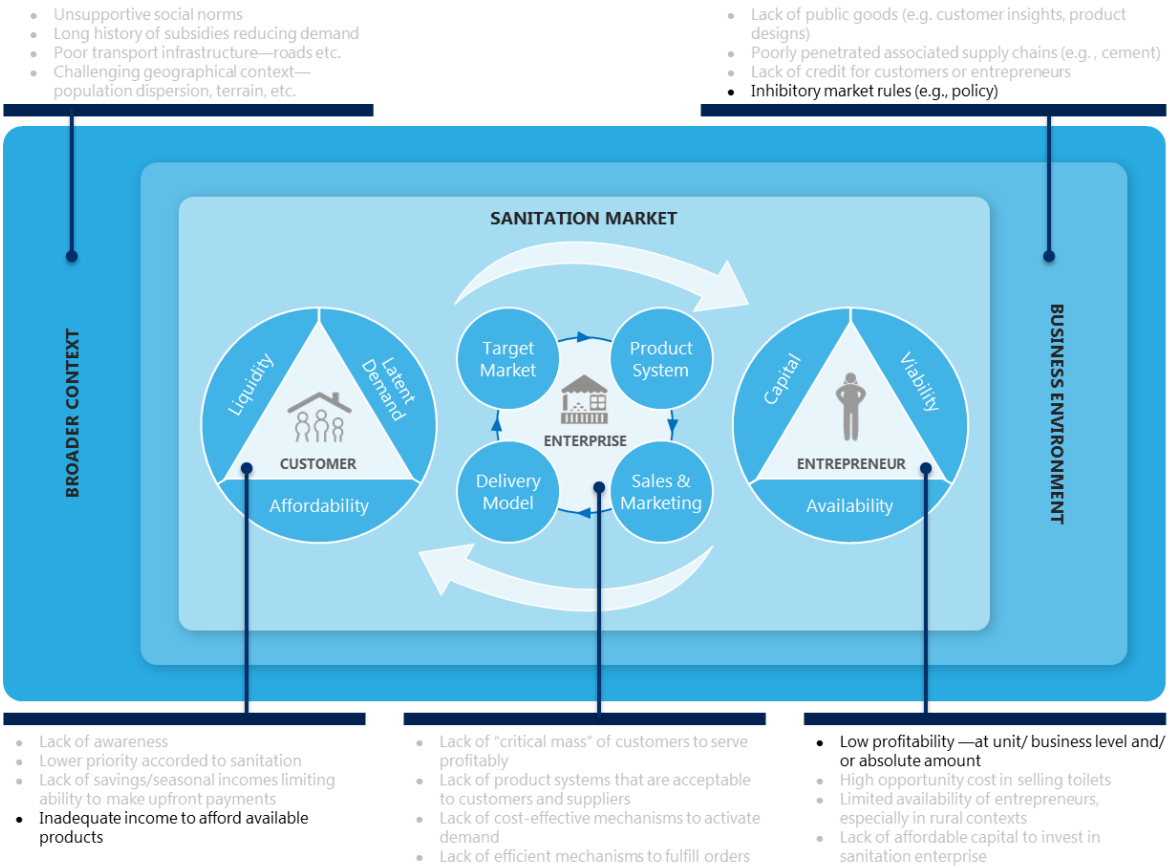
In line with this, two policy levers were evaluated in the base model (hereafter referred to as the 'tariffs and taxes model'): the first **policy lever is a rebate given to the entrepreneur on the import**

tariffs, and/ or indirect taxes imposed on raw materials (cement, iron bars), and components (toilet pans, PVC pipes) used to manufacture a toilet; and the second policy lever is a reduction in the corporate income tax rate imposed on sanitation enterprises.

Reduction in import tariffs should lead to lower cost of goods for sanitation entrepreneurs allowing them to lower their sales price without affecting profit margins. A reduction in indirect taxes, doesn't affect the costs or revenue of the entrepreneur, but does result in lower prices for the end customer. The reduced sales price of toilets should in theory result in higher sales (depending on the elasticity of demand for toilets in the selected market). A reduction in direct taxes (e.g., corporate income tax), on the other hand, does not lower the price faced by the end customer, but increases the profit after tax for the sanitation entrepreneur, thereby increasing the attractiveness of sanitation as a business. The base model constructed allows for both these impacts to be studied, either in isolation, or together.

Figure 2 highlights where this policy lever fits on our MBS framework. As the proposed policy lever is a market rule aimed at creating a supportive environment for MBS it addresses the "inhibitory market rules" barrier in the business environment. Further, the intended impact of the policy lever is to increase market depth by bringing more customers into the market by acting upon the "affordability barrier." In addition, the proposed policy levers can also address the "viability barrier" faced by entrepreneurs by increasing their revenues and/ or improving their profitability.

Figure 2: MBS framework barriers addressed by tariffs and taxes model



2.0 HOW TO USE THIS DOCUMENT

2.1 PURPOSE OF THIS DOCUMENT

This document serves as a guide to help interested stakeholders understand, adapt, and apply the tariffs and taxes base model to geographies/ markets they are working in. Specifically, the document aims to provide:

- An overview of the tariffs and taxes model including the overall objectives, the decisions it can support, and its limitations
- A detailed understanding of the workings of the tariffs and taxes model including the underlying logic, expected outputs (both the benefits and costs), and key variables/ inputs
- A step-by-step guide to adapting the model for application to other markets including the contexts in which the model can be applied, and the minimum data requirements

Funders and implementers can use this document to create context-specific models and use the resultant outputs as a starting point for discussions with government officials regarding potential policy changes. Governments in turn, can use these context-specific models to support decision-making.

2.2 RELATED DOCUMENTS

This user guide frequently refers to sheets in the **tariffs and taxes base model (WASHPaLS_Taxes-and-Tariffs-Base-Model_Cambodia_vf.xlsx) and should therefore be read in conjunction with it**. Throughout the user guide, screenshots of the base model have been inserted to aid in the explanation of the model. In certain instances the same sheet has been inserted multiple times in the document in order to illustrate different points. A list of figures has been provided at the start of this document to help readers navigate through the different sections. Further, under each figure, the actual name of the sheet depicted is provided. Using this, the reader can review the relevant sheet in the accompanying base model.

2.3 INTENDED AUDIENCE

The tariffs and taxes model and this user guide are intended for use primarily by practitioners who are interested in assessing the possible impact that a similar policy lever can have on sanitation markets in a particular geography or market. Three main stakeholders are identified who may find this document useful, i.e., funders, implementers, and governments. These three groups are defined below:

1. **Governments** are the actors who have the power and the resources to change and enforce market rules. Governments operate at the national, regional and local levels, and each can have a role in ensuring the successful implementation of market rules. For example, governments set rules that determine how markets function, including regulating products and services, establishing tariff and tax rates, and incentivizing preferred activities through subsidies and other measures
2. **Funders** are understood in this document as bilateral or multilateral aid agencies or large foundations that fund sanitation development with a willingness to intervene in markets in order to drive greater inclusion. Their strength lies in the financial and political capital that they hold. This enables them to push for changes in the larger market system to improve the business environment for market-based sanitation (MBS)

3. **Implementers** are actors who oversee the design and implementation of sanitation interventions on the ground, and have a strong local presence in the markets where they operate. They are typically supported by funders, and thus often depend on grant conditions to determine where they can intervene and in what way. For the most part, implementers of MBS are local or international NGOs, yet sub-divisions of multilateral organizations (e.g., WSP). In contrast to funders, implementers have limited scope to change market rules and prevailing norms. However, given their hands-on experience, they are often invited by governments to participate in policy forums, and can provide useful inputs into the design of market rules. Further, implementers often aid in rolling out such rules

In addition to these groups, there may be other stakeholders, such as academics, who find this document (and the associated model) useful. Researchers could find the model useful for estimating where the key sources of variability and potential for change in the market system may lie.

2.4 ORGANIZATION OF THE USER GUIDE

The user guide is organized into the following parts:

I. The first part consists of a single chapter **(Chapter 3) that provides an overview of the base model**, explaining its construct, the expected outputs, key variables/ inputs, and main assumptions

II. The second part of the user guide **(Chapters 4 and 5)** deals with how to adapt the base model for use in other markets

- **Chapter 4 takes the user step-by-step through the process** of identifying and collecting relevant input data and customizing the input sheets for a new market; explains the process of modifying the calculation sheets that covert the inputs to desired outputs; and identifies changes that may be needed in the output sheets and user dashboard
- **Chapter 5 guides the user on how to check for errors** in the updated model

III. The final section of the user guide **(Chapters 6 and 7)** deals with how the adapted model can be used, and the limitations to its use

- **Chapter 6 discusses the kind of decision making** that the adapted model can support and illustrates this by providing sample outputs generated from the base model
- **Chapter 7 highlights the limitations of the model**

For definition of terms or concepts, refer to the Glossary and [Scaling Market Based Sanitation: Desk Review on Market-Based Rural Sanitation Development Programs]

3.0 OVERVIEW OF THE BASE MODEL

3.1 GEOGRAPHY SELECTED FOR THE BASE MODEL

To ensure that the base model was grounded in reality, and that no critical logical relationship was missed out in the process of abstraction, actual data from a sample country was used to construct it. Using a real-world example also had the added benefit of allowing us to test the base model with experts who have experience working in the sanitation sector in the sample country.

To select an appropriate sample country, we conducted desk research to identify countries with the following characteristics:

- A low coverage rate of improved sanitation (i.e., number of households with access to "at least basic" sanitation facilities as defined by the WHO/ UNICEF Joint Monitoring Program)
- A functioning sanitation market with a sufficiently large pool of customers to make private provision of sanitation viable; and the availability of private sanitation entrepreneurs to supply toilets to those who demand it
- The cost of improved toilets is high relative to mean household incomes (i.e., customers face an affordability barrier)
- The cost of materials (e.g., cement, iron rod) and components (e.g., pan) required to manufacture a toilet form a high proportion of the overall toilet cost
- The tariff/ indirect tax rates levied on materials/ components required for manufacturing a toilet are relatively high

Identifying appropriate countries with these characteristics required certain minimum data to be available, including:

- Detailed break-up of the cost of manufacturing the prevalent toilet type in the country
- Information related to the import tariff rates, indirect domestic tax rates, and corporate income tax rates
- Willingness to pay (WTP) studies that assess the ability and willingness of customers to purchase toilets at different price points (this is used to calculate the price elasticity of demand for toilets)
- Sanitation supply chain studies containing information related to the different stages in the supply chain of key toilet inputs, the value added at each stage, and the markup charged by each player in the supply chain

Given these characteristics and the data needs, we identified Cambodia as the sample country for the tariffs and taxes, as it met both the contextual and data availability requirements. In Cambodia, only 48.4% of the population has access to "at least basic" sanitation facilities (38.6% in rural areas). The prevalent toilet type is a pit latrine consisting of a pit lined with three cement rings, a cement slab covering the pit, and a ceramic pan as the interface. The cost of this toilet type is ~USD 50 (for substructure and interface only), at which price only 10% of the households without sanitation can afford to buy a toilet. The cost of materials and components used to build the toilet are 72% of the cost of toilet, and Cambodia has a simple customs duty on all imports with the rate being either 15% or 7% depending on the good being imported, and a value-added tax (VAT) rate of 10% on the sale of goods. Therefore, Cambodia serves as an appropriate sample country to study the effect of a reduction in tariffs and taxes on toilet sales and entrepreneur viability.

3.2 UNDERLYING LOGIC OF THE BASE MODEL

The tariffs and taxes base model evaluates the impact of two distinct but related policy levers:

A. A rebate to sanitation entrepreneurs on import tariffs levied on toilet components, and/ or a rebate on the indirect taxes levied on toilet materials and components

The intention of this first policy lever is two-fold: first to reduce the final price of toilets for the end customer, thereby making them more affordable; and second to increase the viability of sanitation entrepreneurs through increased revenues (albeit at the same profit margins).

The mechanisms through which the tariff rebate and tax rebate work differ. Import tariffs are considered to be a part of the cost of goods, and hence, a rebate given to the entrepreneur on to the tariff amount in the input cost would reduce the effective cost price of that input for the sanitation entrepreneur. This in turn would allow the entrepreneur to reduce the sales price of a toilet without compromising the margin per toilet. Alternately, the entrepreneur can choose not to pass on the entire rebate amount to the customer by reducing the sales price by less than the rebate amount. In this scenario, the entrepreneur can still offer a slightly lower sales price, while also increasing the profit margin they earn per toilet.

Note, here the tariff rebate has been considered only for toilet components, i.e., inputs such as toilet pans and PVC pipes that are used in their original form. However, commodities like cement, iron bar, wire mesh, etc., that are used in manufacturing a toilet have not been considered eligible for a tariff rebate. Commodities can be used for multiple purposes apart from the manufacture of a toilet (e.g., cement for building a house, a school, or a well), making it nearly impossible to limit the rebate on a commodity to the sanitation sector alone. Allowing a rebate on commodities could lead to a lot of leakages and make the policy unsustainable. On the other hand, a toilet pan can only be used in a toilet, or a PVC pipe is used in low quantities and has comparatively limited uses. Hence, in both cases, the chance of leakage is greatly reduced.

A rebate on the indirect tax on toilet inputs works differently. While it reduces the overall tax liability of the end customer, it does not affect the unit economics of the sanitation entrepreneur as the liability of an indirect tax is not borne by the entrepreneur but passed on to the end customer. However, if the VAT charge is removed at the end of the value chain (i.e., on the transaction between sanitation entrepreneur and the end customer), but not on upstream transactions (i.e., all the transactions up to the sanitation entrepreneur), the entrepreneur would pay tax on his/ her inputs and not be able to pass it on to the customer. This would shift the tax liability to the entrepreneur. To avoid this, the entrepreneur is given a rebate on the tax paid on upstream transactions. The net result is that the unit economics of the entrepreneur are unaffected while the customer can purchase the toilet at a lower cost. Further, the indirect tax rebate can be applied to both commodities (like cement) and components (like toilet pan).

In both cases, the rebate on tariffs and the rebate on indirect taxes, the reduced price of toilets should result in an increase in toilet sales (assuming the price elasticity of demand for toilets is elastic). Increase in toilet sales could in turn result in increased revenue for existing sanitation entrepreneurs; thereby improving their viability.

B. A reduction in the corporate income tax imposed on sanitation entrepreneurs

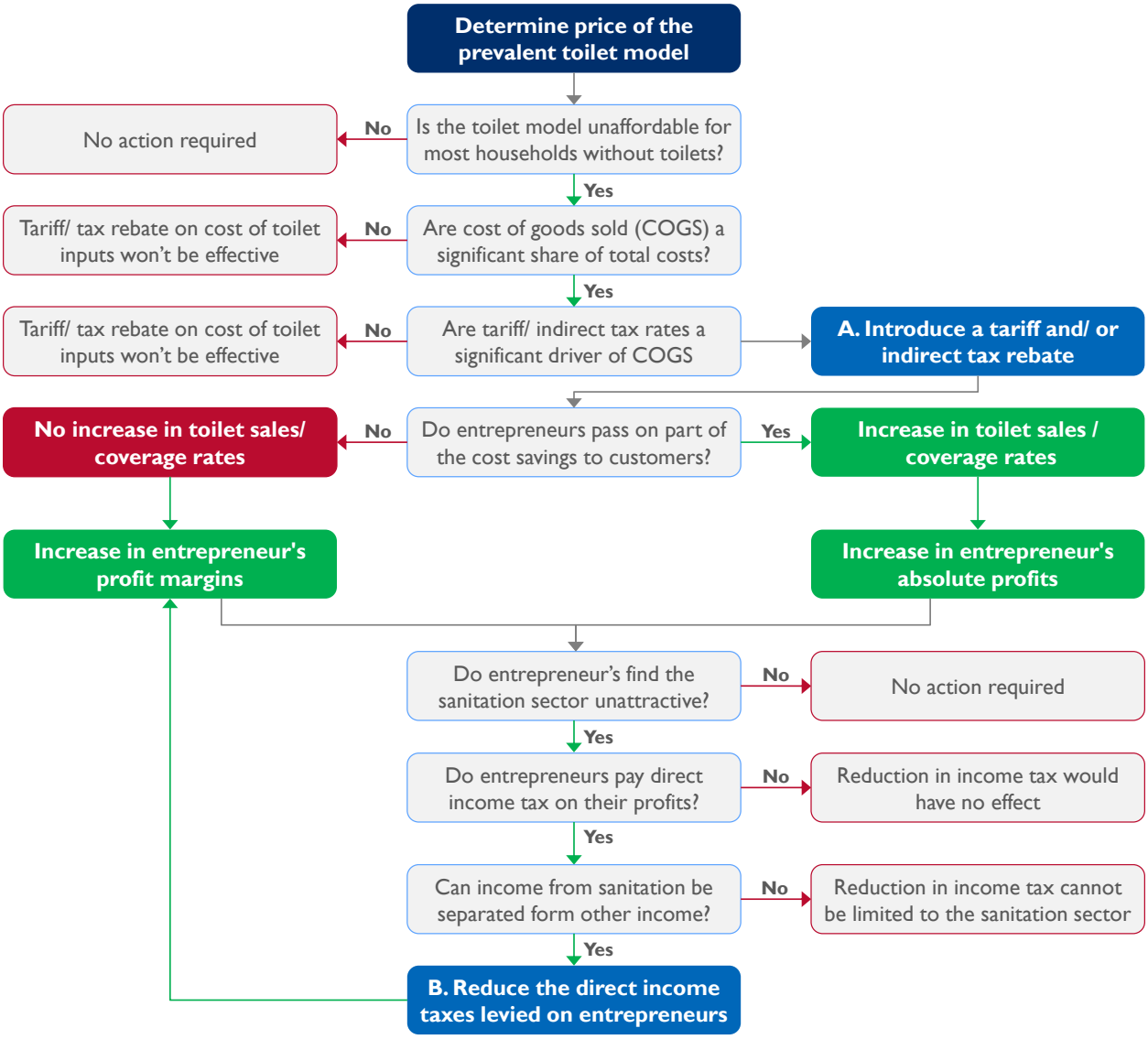
Unlike the first policy lever, the intention of this lever is not to increase toilet sales by bringing more customers into the market, but rather to increase the attractiveness of the sanitation sector in order to motivate entrepreneurs to stay engaged in selling toilets. This lever attempts to improve the viability of entrepreneurs by increasing their unit profitability by reducing the corporate income tax imposed on sanitation businesses

Reading Figure 3 top-to-bottom, we first describe the logical flow behind the policy lever that provides for a tariff and indirect tax rebate. It can be seen, that the policy lever is only relevant in markets where improved toilets exist, and people want these toilets, but cannot afford them. It is assumed that the affordability barrier is the key barrier preventing toilet sales; if there are other more pertinent barriers, tariff and indirect tax rebates will have limited to no effect. Further, for the policy lever to result in any meaningful increase in toilet sales (and thereby increase in absolute profits for sanitation entrepreneurs), the cost of the toilet should be driven to a large extent by the cost of goods sold (i.e., the cost of toilet inputs such as cement, or toilet pan, and labor) rather than other costs such as transport or sales commissions. This is because the rebates are offered only on goods used to produce a toilet, not on services; hence, if operating costs like transport are the major factor driving costs, providing rebates on tariffs and indirect taxes on goods will have limited effect. Similarly, the tariff and indirect taxes on goods should be a significant driver of the cost of toilet inputs; otherwise the policy lever will not be effective.

If the cost of goods sold (COGS) are a significant contributor to total toilet costs, and tariff and taxes contribute significantly to the COGS, then the government can introduce the first policy lever, viz., rebates on tariffs and indirect taxes. The tariff rebate would lower the effective COGS for the entrepreneur, while the indirect tax rebate would lower the end price for the customer by removing the need for the entrepreneur to pass on the tax burden as part of the price. However, the entrepreneur can choose to increase his/ her profit markup in anticipation of the price reduction. If the increase is equal to the entire potential price reduction, there will be no drop in price for the customer and toilet sales would not increase; however, the profit margin of entrepreneurs would go up. On the other hand, if the entrepreneur does decide to pass on the entire price reduction to the customer, the toilet price would reduce, leading to increased toilet sales, and therefore increase in the absolute profits for the entrepreneur (though the profit margin would not change). Finally, the entrepreneur can choose to retain some portion of the price reduction, while still passing on some of the savings to the customer; in this scenario, the entrepreneur may see some increase in absolute profits due to increased toilet sales, plus an increase in the profit margin per toilet sold.

Despite this increase in absolute profit, and/ or increase in profit margins, entrepreneurs may not find the sanitation sector to be attractive compared to other opportunities. The second policy lever discussed above, viz., a reduction in the direct income tax levied on sanitation entrepreneurs is aimed at increasing the attractiveness of the sector by increasing the profit margins that can be earned from selling toilets. From Figure 3, it is seen that the second policy lever would only work in markets where sanitation entrepreneurs are in the formal sector and pay corporate income tax on their profits. In markets where the majority of sanitation entrepreneurs are in the informal sector, reducing the corporate income tax rate would have no effect as the entrepreneurs are not paying taxes in the first place. Similarly, if the corporate income tax rate is very low, reducing it further would not have much of a difference. Finally, the application of this lever presupposes that there is a sanitation entrepreneur who acts as a focal point for the purchase of toilets, and that the entrepreneur's sanitation business can be separated from other businesses he/ she may be engaged in. If there is no focal point, and customers approach multiple goods and service providers to obtain a toilet, then this lever cannot be applied. Further, if the sanitation business line cannot be separated from the other business lines of the entrepreneur, it will not be possible to limit the policy lever to the sanitation sector.

Figure 3: Underlying logic of the tariffs and taxes base model



3.3 COMPONENTS OF THE BASE MODEL

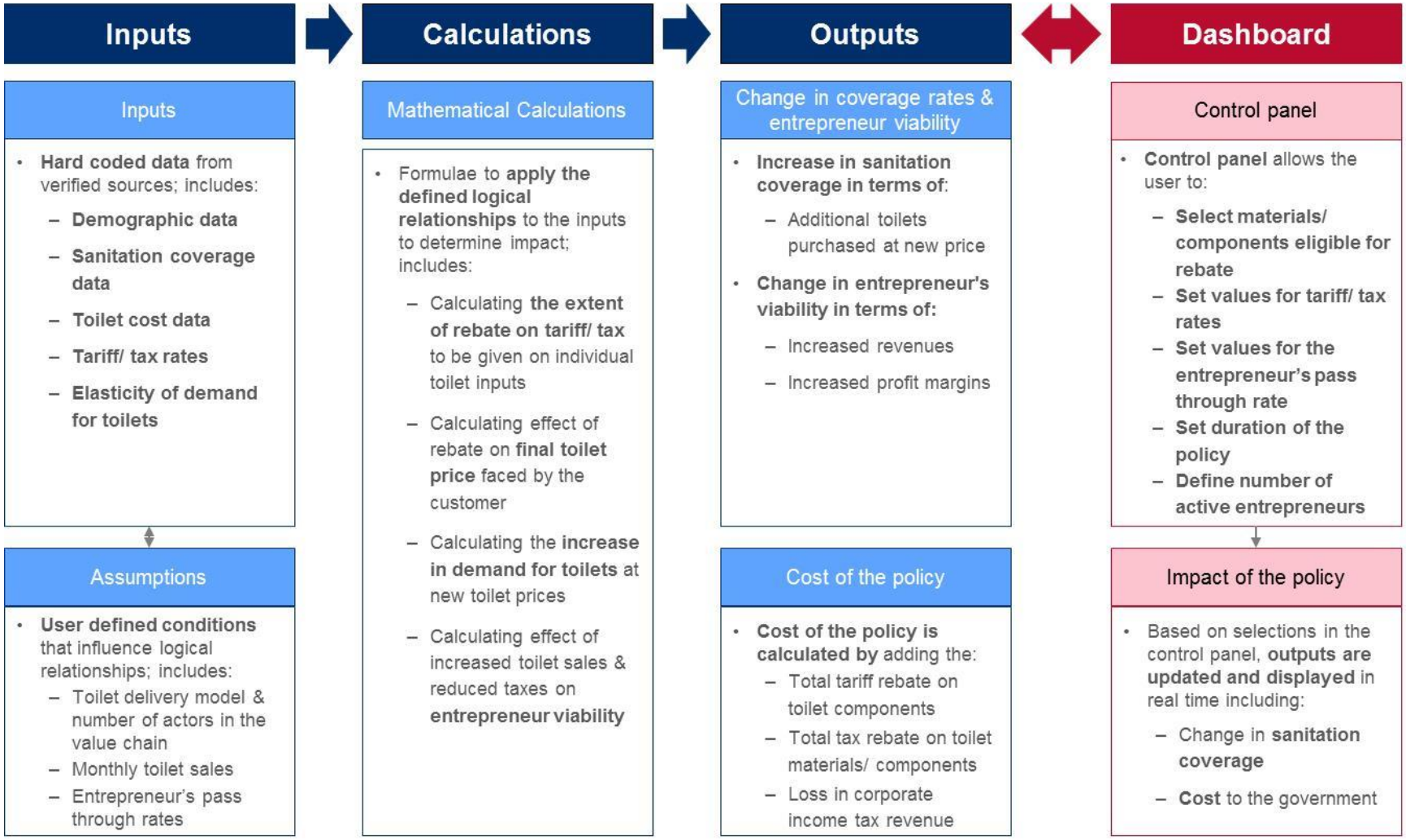
In order to covert this underlying logic into a model we would need the following components:

1. **Inputs** specific to the selected geography/ market such as data on: demographics, sanitation coverage rates, major drivers of toilet costs, current tax/ tariff rates, the price elasticity of demand for toilets, details regarding the number of actors in the value-chain of toilet commodities/ components, and the margins charged by each of these actors
2. **Mathematical calculations** that convert the inputs to outputs in line with the logical flow and assumptions defined above. This includes equations to calculate the effect of tax/ tariff rebates on toilet inputs, and the change in overall cost of toilets
3. **Outputs** that arise from these inputs and calculations, particularly in terms of the change in sanitation coverage, change in entrepreneur viability and the associated costs to the government

Figure 4 provides a visual representation of the components described above. As depicted, the inputs are the base of the model, upon which formulae are applied to arrive at the outputs. In addition, a dashboard is overlaid on the model. This is an interactive sheet that allows the user to vary the values of the key variables, and see the impact on outputs in real-time.

These components are described in more detail in the following paragraphs. To help the reader keep track of the different components, the explanation provided for each component is preceded by a simplified version of the schematic seen in Figure 5 with only the component being discussed highlighted.

Figure 4: Schematic of tariffs and taxes model



3.3.1 Inputs and assumptions used in the base model

When building the base model, we started with the inputs required to estimate the effect of the policy lever; from Figure 5 we can see that various types of inputs were required:

A. **Demographic data and sanitation coverage data:** This refers to data on the number of households and individuals within the target geography and the type of sanitation facilities they have access to

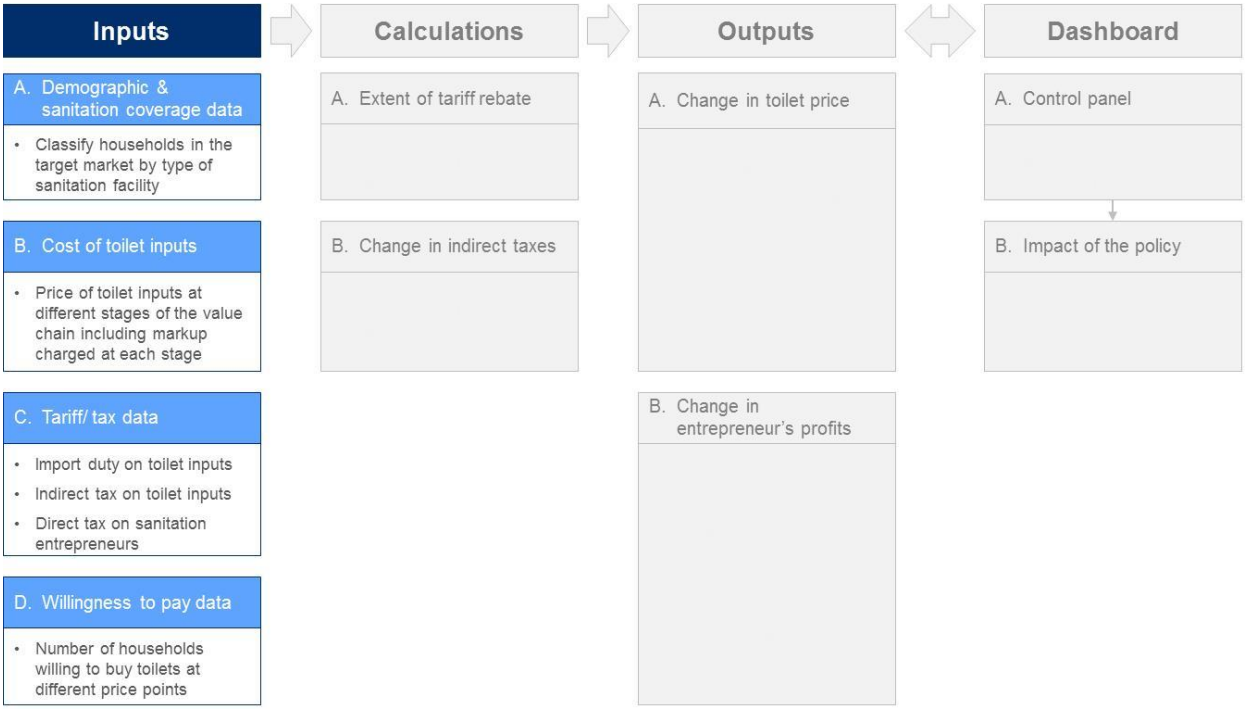
B. **Cost of toilet inputs:** The cost of raw materials/ components at each stage of the value chain, including the markups charged by actors at each stage. This is needed to calculate the effect of tax/ tariff changes on the prices of toilet inputs. Further, other toilet costs (e.g., labor and transport costs) also need to be captured

C. **Tariff/ tax data:** This includes the existing import duties and indirect taxes levied on toilet materials/ components at each stage of the value chain, as well as the direct corporate income tax rate imposed on sanitation entrepreneurs

D. **Willingness to pay data:** In order to calculate the change in demand for toilets when price changes, we need to compute the price elasticity of demand. For this, we need data about the willingness of customers to purchase toilets at different price points

These inputs are discussed below:

Figure 5: Components of the base model - inputs and assumptions



A. Demographic data and sanitation coverage data

To create the base model, we first needed to identify the population segment the policy levers would target. As the primary objective of the tariff/ tax rebate is to increase sanitation coverage, it should be targeted at households who either have no sanitation facilities or have unimproved facilities, and can't

afford to purchase an improved sanitation facility.[3] To identify the number of households in this segment, we needed data related to:

- The number of households in the target market (disaggregated by urban and rural areas)
- The percentage of households with different types of sanitation facilities

The target segment is expressed in terms of number of households, as the assumption is that toilet purchases happen at the household level. For the base model, Cambodia was selected as the sample geography. Data were available from the 2008 General Population Census of Cambodia for the total population (disaggregated by rural and urban areas) along with the mean household size in urban and rural areas. Using this, the number of households could be easily determined by dividing the total population by the mean household size.

The sanitation coverage rates for Cambodia were obtained from UNICEF/ WHO Joint Monitoring Program (JMP) data. Using the JMP definition of improved sanitation, which classifies households with "at least basic" sanitation as having access to improved sanitation, the number of households that do not have access to "at least basic" sanitation are classified as unimproved (including open defecation), and are identified as the target population segment (see Figure 6)

Figure 6: Demographic and sanitation coverage data

	B	C	D	E	F
2		Inputs	Data		
3	Demographic Data		National	Urban	Rural
4		Total Population	15,762,370.0	*3,300,640*	*12,461,730*
5		Mean Household Size	4.7	4.9	4.6
6		Number of Households	3,382,672	*673,600*	*2,709,072*
7					
8	Sanitation Coverage Data	**Sanitation coverage (%)**	**National**	**Urban**	**Rural**
9		At least basic	48.4%	88.0%	38.6%
10		Limited (shared)	7.6%	8.6%	7.4%
11		Unimproved	3.0%	0.9%	3.5%
12		Open defecation	40.6%	2.6%	50.5%
13		**Sanitation coverage (# individuals)**	**National**	**Urban**	**Rural**
14		At least basic	*7,711,638*	*2,903,903*	*4,807,735*
15		Limited (shared)	*1,203,201*	*283,525*	*919,676*
16		Unimproved	*467,699*	*29,046*	*438,653*
17		Open defecation	*6,379,832*	*84,166*	*6,295,666*
18		**Sanitation coverage (# HHs)**	**National**	**Urban**	**Rural**
19		At least basic	*1,637,793*	*592,633*	*1,045,160*
20		Limited (shared)	*257,792*	*57,862*	*199,930*
21		Unimproved	*101,287*	*5,928*	*95,359*
22		Open defecation	*1,385,800*	*17,177*	*1,368,623*
23		**Classifying HHs by level of service (#)**			
24		Improved sanitation	*1,637,793*	*592,633*	*1,045,160*
25		Unimproved sanitation (including open defecation)	*1,744,879*	*80,967*	*1,663,912*

Sheet name as per attached tariffs and taxes base model: "General Inputs"

B. Cost of toilet inputs

In order to understand the effect of tariff/ tax rebates on the cost of toilet inputs, and therefore the final price of the toilet, the following data is required

- Break-up of the quantities and costs of each raw material and component used to make a toilet

[3] According to the WHO/ UNICEF Joint Monitoring Program (JMP), an improved sanitation facility is defined as one that hygienically separates human excreta from human contact

- The number of actors in the value chain of toilet inputs, the amount of value added by each of these actors (transport, labor, etc.), and the amount of markup charged by them

Data regarding the number of value chain actors engaged in the value chain of each toilet raw material/ component is essential. Each actor incurs certain costs (related to manufacturing, refining, handling, and/ or transporting the material/ component) and adds a markup to the material/ component cost as they send it down the value chain. The indirect tax on the commodity is applied at each stage to the total cost plus markup of the actor at that stage of the value chain. Hence, to accurately estimate the amount of indirect tax that a toilet input bears, the costs at each stage of the value chain need to be understood. As tariffs are included as part of the cost of goods at the first stage of inputs that are imported, any change to the tariff amount has a multiplier effect down through the value chain. In order to understand this multiplier effect, again, it is crucial to understand the cost of goods at the first stage of the value chain.

Based on research on the sanitation value chain in Cambodia, we have assumed a three-stage value chain for most toilet inputs leading up to the entrepreneur:

- **Stage 1 – Importer/ manufacturer:** The first stage of the value chain is where the toilet input is brought into the system. It can either be through an importer who pays import duties to bring the toilet input into the country, or a manufacturer who produces it locally
- **Stage 2 – Retailer:** The retailer stores the toilet inputs and sells to both the sanitation entrepreneurs and the end customer to various retailers
- **Stage 3 – Sanitation entrepreneur:** The sanitation entrepreneur aggregates all the toilet inputs and offers the end customer a final toilet package including construction/ installation

In the base model, we have assumed that all components (toilet pan, PVC pipe) are imported and hence bear an import duty. For raw materials, with the exception of sand, we again assume the remaining materials are imported (cement and rebar) and bear an import duty. Sand is the only material that is not considered to be imported. In fact, the value chain is considered to be only a two-stage value chain as there is no manufacturer for sand; rather, it is assumed that sand is aggregated by retailers and sold to sanitation entrepreneurs.

Ideally, we would have liked to obtain actual cost data of toilet inputs at each stage of the value chain for that input. However, this was not available. We did have data on the cost of toilet inputs to sanitation entrepreneurs, as well as the markup charged by actors at each stage of the value chain. Using these inputs, we reverse calculated the cost at the start of the value chain (and at each subsequent stage). This was done by applying an equation that removes the value chain actor markups, tariff amounts, and value-added tax amounts from each final toilet raw material/ component price.

Figure 7 shows how the initial cost of the raw materials/ components was inputted. Along with the toilet input costs, other costs faced by the entrepreneur were also captured including labor, transport and sales commissions. The cost data was calculated for the most prevalent toilet type in Cambodia; viz., a pit latrine consisting of a pit lined with three cement rings, a cement slab covering the pit, and a ceramic pan as the interface.

Figure 7: Toilet cost inputs

	Inputs	Data				
	Material/ Component Type	Unit	Quantity	Price/ Unit (USD)	Original Price for Entrepreneur (USD)	Initial price (USD)
Raw material costs	Cement	kg	72.5	0.10	*7.40*	5.19
	Reinforcing Steel	kg	3.5	0.94	*3.27*	2.47
	Ceramic Pan	piece	1	8.30	*8.30*	6.26
	PVC Pipe	piece	1	4.70	*4.70*	3.55
	Sand	m^3	0.20	12.20	*2.47*	2.12
	Total cost of materials/ components				26.14	
Other costs	Sales Commissions	toilet	1.00	2.80	*2.80*	
	Transport	toilet	1.00	2.50	*2.50*	
	Labor	toilet	1.00	4.80	*4.80*	
	Total other costs				10.10	

Sheet name as per attached tariffs and taxes base model: "Toilet Inputs"

In addition to the cost at each stage of the value chain, some other inputs and assumptions were captured regarding the value chain actors including: the number of active sanitation entrepreneurs in Cambodia; the number of toilets sold per entrepreneur per month; and the markups of each actor in the value chain (Figure 8)

Figure 8: Data on value chain actors

Value Chain Actor Markups	Importer/ Manufacturer	6.4%
	Retailers	5.8%
	Entrepreneurs (Concrete Producers)	43.1%
Entrepreneur Data	Number of active entrepreneurs	876
	Average units sold / month	23
	Expected Profit Margin	29.0%

Sheet name as per attached tariffs and taxes base model: "General Inputs"

The number of active entrepreneurs was needed to calculate how long it would take for entrepreneurs to fulfill the demand for toilets in Cambodia, given the average amount of units an entrepreneur can sell every month. While reliable data on the number of sanitation entrepreneurs was not available, we made estimated the number based on reports from Cambodia iDE and WaterSHED intervention.

C. Tax/ tariff data

The policy levers modeled are a rebate on tariff/ indirect taxes on toilet components, and a reduction in the direct tax faced by sanitation entrepreneurs. Therefore, accurate information on tariff and tax rates

in the selected geography is essential for the model to work. Specifically the following information was required:

- The type of import duty applicable on toilet inputs and the rate of the import duty levied on each toilet input
- The type of indirect tax applicable on toilet inputs and the rate of the tax
- The rate of direct corporate income tax, if any, levied on sanitation entrepreneurs

The import duty information for Cambodia obtained was readily available through the World Trade Organization Download Facility, indirect domestic indirect taxes rates were identified from a KPMG Cambodia tax profile report, and the direct corporate tax rates were obtained from a report by BNG Legal.

In Cambodia, there is a simple customs duty on all imports (either at 15% or 7%); the indirect taxes are in the form of a Value Added Tax (VAT) which is set at a uniform 10% on all inputs required for toilets; and the direct corporate tax rate depends on the level of profit earned, with a minimum tax rate of 1% of turnover on all companies whether they earn a profit or not. These rates were entered into the "General Inputs" sheet as can be seen in Figure 9

Figure 9: Tariff and tax rates in Cambodia

	B	C	D	E
27	Raw Materials Tariff Rates	**Raw Materials**	**Original Import Tariff**	
28		Cement	15.0%	
29		Reinforcing Steel	7.0%	
30		Ceramic Pan	7.0%	
31		PVC Pipe	7.0%	
32				
33	Tax Rates	**Type of Tax**	**Original Tax Rate**	
34		Value-added Tax (VAT)	10.00%	
35		Tax on profit		
36		< 1,500 USD	0.00%	of profit
37		1,500 - 3,750 USD	5.00%	of profit
38		3,750 - 25,500 USD	10.00%	of profit
39		25,500 - 37,500	15.00%	of profit
40		> 37,500	20.00%	of profit
41		Minimum tax rate	1.00%	of turnover

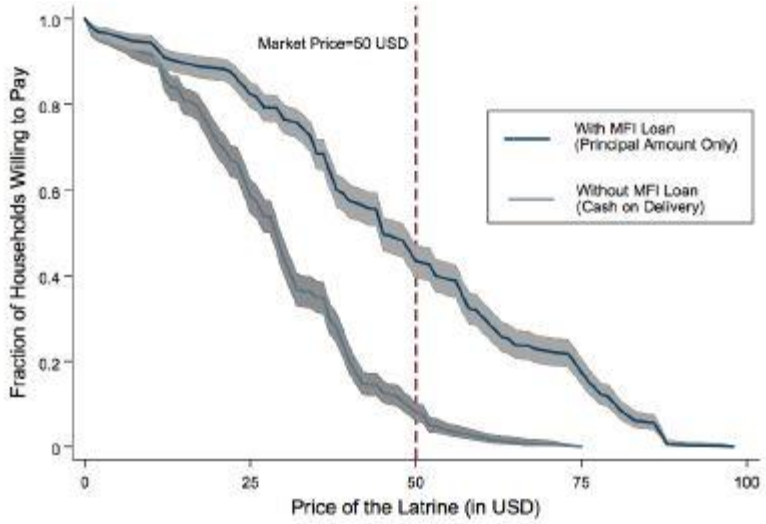
Sheet name as per attached tariffs and taxes base model: "General Inputs"

D. Willingness to pay data

In order for the base model to calculate changes in sanitation coverage, data relating to the willingness of customers to pay for toilets was required. Specifically, we needed to know how many households without toilets would be willing to buy toilets at different price levels. This information is required to calculate the price elasticity of demand for toilets, which in turn is used to determine the number of additional households who are likely to purchase a toilet if the tariff/ tax on toilet inputs is reduced.

We were able to obtain the required information from a report by IDinsight (IDinsight, 2013). The report provided information regarding the percentage of households without toilets that would buy a toilet at different price points, and presented the data in the form of a demand curve (Figure 10).

Figure 10: Willingness to pay for toilets in Cambodia



Source: IDinsight Policy Brief: June 2013

Using this demand curve, we calculated the price elasticity of demand for toilets in Cambodia (Figure 11). Given that the demand curve does not have a uniform slope, the elasticity of demand actually varies along the length of the curve. To ensure the right elasticity was used, we selected that portion of the demand curve that covered the actual price of the prevalent toilet model (USD 53). The following equation for price elasticity was used:

$$\frac{Q1 - Q2}{Q1 + Q2} / \frac{P1 - P2}{P1 + P2}$$

In the above equation:

P1 = the current market price for toilets (USD 53)
P2 = a lower price based on expected cost reductions (USD 45)
Q1= the number of households willing to purchase toilets at P1
Q2 = the number of households willing to purchase toilets at P2

Figure 11: Price elasticity of demand for toilets in Cambodia

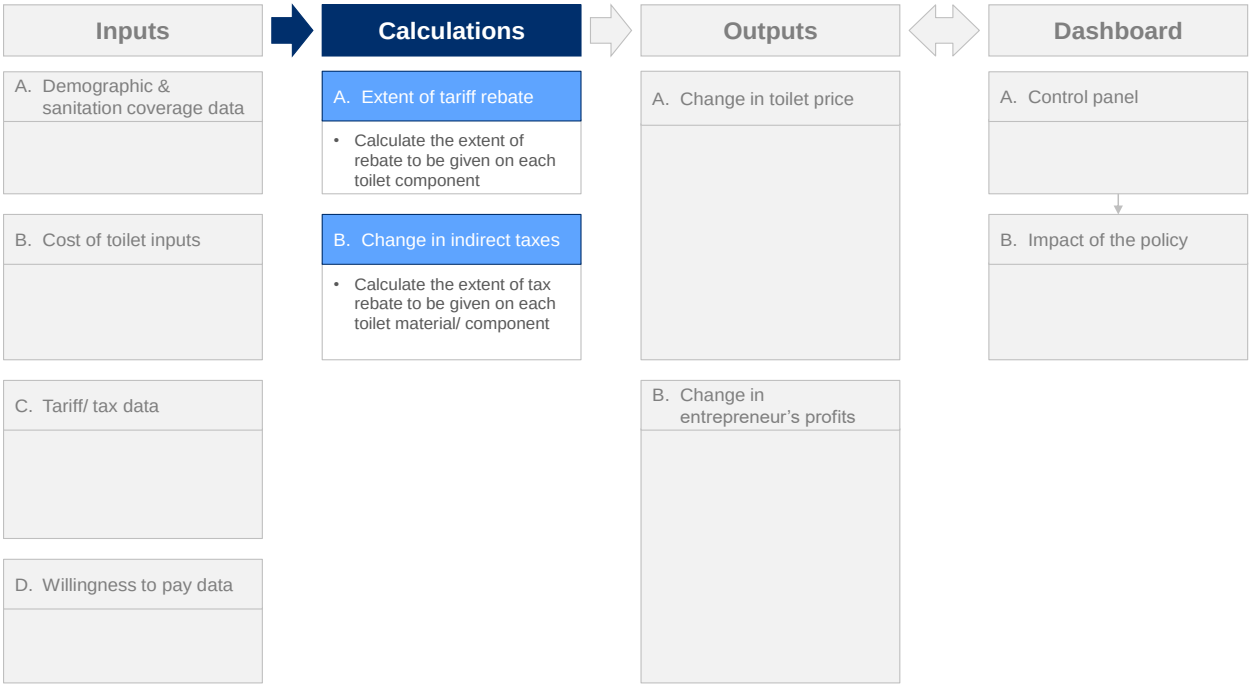
	B	C	D
51	Price elasticity of demand	P1 (USD)	53.3
52		P2 (USD)	45.0
53		Demand at P1 (%)	10%
54		Demand at P1 (# of toilets)	*166,391*
55		Demand at P2 (%)	17%
56		Demand at P2 (# of toilets)	*282,865*
57		Price elasticity of demand	*(3.06)*

Sheet name as per attached tariffs and taxes base model: "General Inputs"

3.3.2 Mathematical calculations developed for the base model

Once the inputs were defined, mathematical calculations were developed to calculate the extent of the tariff and indirect tax rebates (Figure 12).

Figure 12: Components of the base model - mathematical calculations



The objective of both the tariff and indirect tax rebates is to reduce the final price of the toilet for the end customer, thereby increasing sanitation coverage and entrepreneur viability. However, as mentioned in section 3.2-A, the mechanisms through which the tariff rebate and tax rebate work differ. The manner of calculating the two rebates is discussed below:

A. Calculating the extent of the tariff rebate

Import tariffs are considered to be a part of the cost of goods and are therefore reflected in the importer's profit and loss account. When the importer (and subsequent players in the value chain) adds a markup to his/ her costs, the cost includes the tariff amount; hence, if the tariff is removed, there will be a multiplier effect leading to a reduction in price that is greater than the tariff amount. This is illustrated in the example in Table 1.

Table 1: Effect of tariff reduction

Head	Scenario 1 (USD)	Scenario 2 (USD)	Difference (USD)
Base cost of toilet input	100.00	100.00	
Import duty @ 20%	20.00	0.00	
Total cost to importer	**120.00**	**100.00**	**20.00**
Importer's markup @ 10%	12.00	10.00	
Total cost to distributor	**132.00**	**110.00**	**22.00**
Distributor's markup @ 10%	13.20	11.00	
Total cost to retailer	**145.20**	**121.00**	**24.20**
Retailer's markup @ 10%	14.52	12.10	

Total cost to sanitation entrepreneur	**159.72**	**133.10**	**26.62**

The example in Table 1 presents two scenarios. In both scenarios a toilet input costs USD 100 before entering the country; however, in Scenario 1 a USD 20 import duty is imposed on the toilet input, while in Scenario 2, no input duty is imposed. Further, it is assumed the input passes through three actors before it reaches the sanitation entrepreneur, viz., importer, distributor, and retailer. Each of these actors adds a 10% markup to the cost of the input, and for simplicity it is assumed that they incur no additional costs. From the table, it is seen that a difference of USD 20 in the cost of the importer (due to reduction in the tariff amount) results in a USD 22 difference in the cost to the distributor, a USD 24.20 difference for the retailer, and USD 26.62 difference for the sanitation entrepreneur. Therefore a tariff on toilet inputs results in an increase in the cost price of that input for the sanitation entrepreneur by more than the actual tariff amount.

The proposed mechanism through which the tariff reduction is implemented in the model is a rebate given to the sanitation entrepreneur; therefore the actual tariff amount paid by the importer does not change. Similarly, the actual amount paid by each subsequent actor in the value chain (and by the sanitation entrepreneur) remains akin to what is shown in the hypothetical Scenario 1 in Table 1, rather than Scenario 2. In order to shift the cost faced by the sanitation entrepreneur to that shown in Scenario 2, it is proposed that the government provide a refund to the entrepreneur equal to the tariff amount in the toilet input cost. However, if the government provides a refund of only the actual tariff amount (USD 20 in Table 1), the entrepreneur will still bear an additional USD 6.62 which is the result of the markups at each stage being applied on the original tariff amount. Therefore, to provide the full effect of the tariff reduction to the entrepreneur, the rebate should be calculated by assuming that the tariff had been reduced at the first stage of the value chain and by factoring in the subsequent reductions at each stage until the input lands at the sanitation entrepreneur; this would look like what is shown in Scenario 2 in Table 1. Therefore, in our example, the actual rebate given to the entrepreneur should be USD 26.62.

To reiterate, the tariff is not actually reduced at the first stage of the value chain. In order to calculate the actual rebate amount, we carry out a hypothetical exercise to determine what the cost of the input to the entrepreneur would have been if there was no tariff (or a reduced tariff).

As tariff reductions reduce the cost of goods themselves, this, in turn, would allow the entrepreneur to reduce the sales price of a toilet without compromising the margin per toilet. Alternately, the entrepreneur can choose not to pass on the entire rebate amount to the customer by retaining some of the rebate amount as additional markup. In this way, entrepreneurs can still offer a slightly lower sales price, while also increasing the profit margin they earn per toilet. This will be discussed further in later in this user guide.

B. Calculating the change in indirect taxes

Each actor in the value chain adds a certain amount of indirect tax over and above their own sales price when they sell a product to the next actor in the value chain. However, the amount collected is not considered to be a part of the revenue of the actor as it is collected by the actor on behalf of the government and ultimately is transferred to the government as tax revenue. As it is not revenue, the amount collected as indirect tax does not enter a value chain actor's profit and loss account. Similarly, any amount paid by a value chain actor as indirect tax when purchasing a product is not considered to be part of the cost of goods for the actor (it is considered a separate tax payment), and therefore does not enter the profit and loss account. If the tax paid while purchasing a product is included in the profit and loss account, but the tax collected while selling the product to the next actor in the value chain is not, then the profits (if any) of a particular value chain actor would be artificially deflated. Hence, when considering the cost of a toilet input, the value chain actor subtracts the amount of indirect tax paid on

purchasing the input. Instead, the indirect tax paid, and the indirect tax collected by a value chain actor, is accounted for in a separate indirect tax ledger.

While the actual accounting of indirect tax may vary from country to country depending upon the type of indirect tax levied, the rationale explained above should hold true in most cases. In Cambodia, the indirect tax applied is a Value Added Tax (VAT); i.e., at each stage of a product's value chain, only the incremental value added to the product by the actor at that stage is taxed, and not the entire cost of the product.

In a hypothetical example, let us assume that in the value chain for cement in a sample country:

- There are three actors in the value chain for cement before it reaches a sanitation entrepreneur – manufacturer, distributor, and retailer
- Each actor in the value chain adds a value of USD 10 (due to labor, storage, transport, etc.)
- Each actor adds a 10% markup to the total cost (including the value added by that actor)
- The VAT rate in a country is a uniform 10%
- The manufacturer's price for one bag of cement is USD 100 (inclusive of markup)

In this example, the price paid by each actor in the value chain and the VAT paid and collected by each actor, will play out as depicted in Table 2.

Table 2: Example of VAT application

Head	Manufacturer (USD)	Distributor (USD)	Retailer (USD)
Cost of good		110	133.1
Less input VAT @ 10%		10	12.1
Effective cost of good		**100**	**121**
Value-added		10	10
Total cost		**110**	**131**
Markup @10%		11	13.1
Total price	**100**	**121**	**144.1**
Output VAT @ 10%	10	12.1	14.41
Total Sales price	**110**	**133.1**	**158.51**
VAT transferred to the government	10	2.1	2.31
Cumulative VAT collected	**10**	**12.1**	**14.41**

The table is explained in detail in the following bullets:

- The manufacturer sells one bag of cement to the distributor at USD 110 (USD 100 cost + USD 10 VAT). Of this USD 100, the manufacturer retains USD 100 and transfers USD 10 to the government
- The distributor pays the manufacturer USD 110 including the USD 10, which is called the input VAT as it is paid on the distributor's input. When calculating his/ her own cost, the distributor removes the USD 10 from the cost as discussed earlier. Therefore the effective cost of cement for the distributor is USD 100. To this the distributor adds USD 10 value taking his/ her total

cost up to USD 110 on which the distributor adds a further 10% markup (USD 11) resulting in a total price of USD 121 inclusive of a total value add of USD 21 (additional costs plus markup)

- When selling the cement, the distributor charges a 10% output VAT on the entire USD 121, taking the total sales price to USD 133.10 (inclusive of USD 12.10 output VAT). Of this, the distributor retains USD 121 (the cost plus markup) as revenue and from the balance USD 12.10, he retains a further USD 10 to cover the input VAT he paid, and transfers the balance USD 2.10 to the government. The government at this stage has received a total of USD 12.10 in tax revenue: USD 10 from the manufacturer (10% of the USD 100 value added by the manufacturer); and USD 2.10 from the distributor (10% of the USD 21 value added by the distributor)
- The retailer buys the bag of cement at USD 133.10, inclusive of the USD 12.10 input VAT. When calculating his/ her own price, the retailer removes USD 12.10 VAT paid to arrive at a cost of USD 121. To this the entrepreneur adds USD 10 value, to arrive at a total cost of USD 131, on which he/ she charges a 10% markup resulting in a price of USD 144.10 (inclusive of USD 23.10 value add)
- When selling the bag of cement, the retailer adds the 10% output VAT to the price resulting in a total sales price of USD 158.51. Of this, the retailer keeps USD 144.10 as revenue, and from the balance USD 14.40, he/ she retains a further USD 12.10 to cover the input VAT paid, and transfers USD 2.31 to the government (10% of the value added by the retailer). This takes the total tax revenue of the government up to USD 14.41

From the example above certain points emerge that are important to keep in mind. First, each player in the value chain both collects and pays VAT; however the VAT collected is not considered to be revenue, nor is the VAT paid considered to be part of the cost of cement. Hence, the VAT paid is subtracted by value chain actors when calculating the price they need to charge. If they do not do this, the result will be that the output VAT will be charged not only on the value added by the actor, but on the VAT paid by them as well. However, the markup charged by the value chain actors is included in the total price on which output VAT is charged.

Second, when transferring VAT revenue to the government, value chain actors subtract the input VAT they have paid when purchasing cement from the output VAT they collect from the next actor in the value chain. This is done to avoid double taxation. The input VAT paid by a value chain actor has already been transferred to the government by the actor who collected the VAT; hence, if the input VAT is not subtracted when transferring VAT to the government, the tax will be paid twice.

Third, the end customer always bears the entire VAT burden. As seen in the above example, the cumulate VAT revenue transferred to the government at any stage is equal to the output VAT charged at that stage. This is because each actor recovers the input VAT they paid from the output VAT collected and passes on only the tax on the value added by them.

As with the tariff reduction, the intended impact of the indirect tax reduction is to reduce the final price faced by the end customer. To do this the output VAT amount charged on the final toilet sold by the sanitation entrepreneur needs to be removed (or reduced). However, if the output VAT is reduced, but the input VAT paid by the entrepreneur is not reduced, the entire burden of VAT falls on the entrepreneur. This is because the entrepreneur still has to pay VAT on inputs purchased by him/ her but cannot offset this by collecting VAT from customers. Therefore, in order to remove (or reduce) the indirect tax burden from customers, the government would need to provide sanitation entrepreneurs with a VAT rebate equal to the amount of input VAT paid by them.

In the case of both tariffs and indirect taxes, the actual amounts paid by actors in the value chain (including the sanitation entrepreneur) do not change. To calculate the amount of rebate to be given to

the entrepreneur, we need to simulate what the implications would be if such reductions actually happened at each stage of the value chain. In Cambodia, five key toilet inputs were identified for the most prevalent toilet types of which three are commodities (cement, rebar, and sand), and two are components (toilet pan, and PVC pipe). For each of these five inputs, the extent of tariff and tax rebates were calculated based on new tariff/ tax rates inputted by the user. The user can set the desired tariff rate for each toilet component, and also set the desired VAT rate for each toilet component and commodity in order to arrive at the rebate amounts that need to be given.

It should be noted that while the VAT rate can be varied for all toilet inputs (commodities and components); the tariff rate can only be varied for toilet components and not for commodities; even though these commodities may bear a tariff amount. This is due to the fact that when commodities are used they no longer retain their original form making it difficult to account for how much of the commodity was actually used. Additionally, commodities can be used for multiple purposes making it even harder to ensure a commodity like cement is used purely for building toilets. As the policy lever is targeted at only the sanitation sector, leakages for other uses are undesirable. The nature of commodities makes the chances of leakage very high as opposed to toilet components whose use can be easily verified. Therefore, although cement is imported in Cambodia after paying an import tariff, the model does not allow the user to manipulate the tariff rate on cement.

Figure 13 shows how the tariff and tax rebate amounts were calculated for toilet pans in the case of Cambodia. As mentioned earlier, we have assumed a simple three-stage value chain for Cambodia consisting of the importer/ manufacturer, retailers, and sanitation entrepreneurs. In this example, the existing import duty was set to zero, and the existing VAT rate was also set to zero. The first half of the figure, ("Row 5" to "Row 14") shows how the effect of the original tariff and VAT rates on the price of toilet pans at each stage of the value chain leading up to the sanitation entrepreneur; and the second half of the figure ("Row 16" to "Row 25") illustrates the effect of removing tariffs and taxes on the price of toilet pans.

In Figure 13 we can see, that before the introduction of the policy lever, the tariff on the toilet pan was USD 0.44 (cell "D7") and the effective cost price for the entrepreneur (less input VAT) was USD 7.55 (cell "F5"). Once the policy is introduced, the tariff becomes zero (cell "D18") and the effective cost to the entrepreneur reduces to USD 7.05 (cell "F16"). As discussed earlier in this subsection, the reduction in cost (USD 0.50) is greater than the actual reduction in tariff amount (USD 0.44) due to the multiplier effect through the value chain. Therefore, to ensure the full effect is passed on, the government would need to provide a USD 0.50 rebate on each toilet pan used by the sanitation entrepreneur, and not a USD 0.44 rebate on each pan.

Further, we can see that the input VAT faced by the sanitation entrepreneur before the policy lever was introduced was USD 0.75 (cell "E13"), whereas it is zero post introduction of the policy (cell "E24"). This implies that if the government wants to remove the entire VAT amount on toilet pans not to be paid by the end customer, the sanitation entrepreneur would need to be given a USD 0.75 rebate. We do not show how the VAT charged by the entrepreneur in Figure 13; this is because the entrepreneur does not sell just to toilet pan, but an entire toilet and therefore he/ she would not charge a VAT on just the pan. Rather, the entrepreneur charges output VAT on the entire toilet. The way VAT is accounted for by the sanitation entrepreneur is shown in Figure 13.

It should be noted that the policy lever modeled is actually a tariff and VAT rebate that is given to the entrepreneur at the final stage of the value chain. The rebate is given as a reimbursement after the entrepreneur has demonstrated the toilet input was used to build a toilet. As such, the reductions in tariffs and taxes at different stages of the value shown in Figure 13 chain don't actually occur; i.e., the price faced by retailers and entrepreneurs does not reduce. However, the entrepreneur is expected to reduce the cost of goods sold, and include a reduced VAT amount on the final bill to the customer in anticipation of receiving the rebate, thereby bringing down the sales price faced by customers.

Figure 13: Simulating effect of tariff and tax reductions on toilet input costs

	B	C	D	E	F
3		Head	Data		
4			Stage 1: Importer/ Manufacturer	Stage 2: Retailer	Stage 3: Entrepreneur
5	Prices at Original Tariff/ Tax Rates	**Cost Price (USD)**	***6.26***	***7.13***	***7.55***
6		Tariff Rate (%)	7.00%		
7		Tariff Amount (USD)	0.44		
8		**Cost Price (including Tariff) (USD)**	***6.70***	***7.13***	
9		Profit Markup (%)	6.38%	5.82%	
10		Profit (USD)	0.43	0.41	
11		**Sales Price (excluding VAT) (USD)**	***7.13***	***7.55***	
12		VAT Rate (%)	10.00%	10.00%	
13		VAT Amount (USD)	0.71	0.75	
14		**Total Sales Price (including VAT) (USD)**	***7.84***	***8.30***	
16	Prices at New Tariff/ Tax Rates	**Cost Price (USD)**	***6.26***	***6.66***	***7.05***
17		Tariff Rate (%)	0.00%		
18		Tariff Amount (USD)	-		
19		**Cost Price (including Tariff) (USD)**	***6.26***	***6.66***	
20		Reduction in Cost (USD)	0.44	0.47	
21		Profit (USD)	0.40	0.39	
22		**Sales Price (excluding VAT) (USD)**	***6.66***	***7.05***	
23		VAT Rate (%)	0.00%	0.00%	
24		VAT Amount (USD)	-	-	
25		**Total Sales Price (including VAT) (USD)**	***6.66***	***7.05***	

Sheet name as per attached tariffs and taxes base model: "Calculations_Ceramic_Pan"

The example in Figure 13 is for toilet pans, and there are similar sheets for each of the five toilet inputs mentioned above. The sheets function in exactly the same manner as this toilet sheet with a couple of minor differences: one, the tariff rebate is not applicable on the cement, rebar, and sand sheets; and two, the value chain for cement has only two stages as it is assumed that sand is collected by the retailer and not produced or imported.

Figure 14 shows how the VAT rebate would be treated in the books of accounts of a sanitation entrepreneur in Cambodia. "Column C" shows how the sanitation entrepreneur accounts for VAT before the introduction of the VAT rebate, while "Column D" shows the treatment once the VAT rebate is introduced. In Cambodia, there is a 10% VAT charged on all goods, in the example shown in Figure 14, it is assumed that the policy lever sets the VAT on all inputs to zero.

Figure 14: Sanitation entrepreneur's VAT account

	A	B	C	D	E
3		Input VAT paid by entrepreneur			
4		Input	Original (USD)	New (USD)	Difference (USD)
5		Sand	0.22	0.22	0.00
6		Cement	0.67	0.67	0.00
7		Rebar	0.30	0.30	0.00
8		Pan	0.75	0.75	0.00
9		PVC pipe	0.43	0.43	0.00
10		VAT paid on toilet inputs	2.38	2.38	0.00
11		Output VAT charged by the entrepreneur			
12		Sand	0.22	0.00	-0.22
13		Cement	0.67	0.00	-0.67
14		Rebar	0.30	0.00	-0.30
15		Pan	0.75	0.00	-0.75
16		PVC pipe	0.43	0.00	-0.43
17		Other inputs	1.01	0.00	-1.01
18		Markup	1.46	0.00	-1.46
19		**Total output VAT charged to the customer**	**4.85**	**0.00**	**4.85**
20		**Effective VAT on toilet**	**10%**	**0%**	**10%**
21		VAT transferred to the government			
22		Input VAT paid by the entrepreneur	2.38	2.38	0.00
23		Balance VAT due to the government	2.47	-2.38	
24		Total VAT due to the government	4.85	0.00	-4.85
25		Total VAT paid by the entrepreneur	4.85	2.38	-2.47
26		**Rebate to entrepreneur from the government**	**0.00**	**2.38**	
27		Actual VAT revenue of the government	4.85	0.00	-4.85

Sheet name as per attached tariffs and taxes base model: "VAT Account"

Note, in Figure 14, the input VAT paid by the entrepreneur does not change (see cells "C10" and "D10"); however once the policy lever is introduced, the entrepreneur gets a rebate equal to the input VAT paid by him/ her (see cell "D26"). This is because, the mechanism through which the tax burden is reduced is a rebate given to the sanitation entrepreneur. Therefore, the actual input tax paid by the entrepreneur (and the actors preceding him/ her in the value chain) does not change.

3.3.3 Outputs of the base model

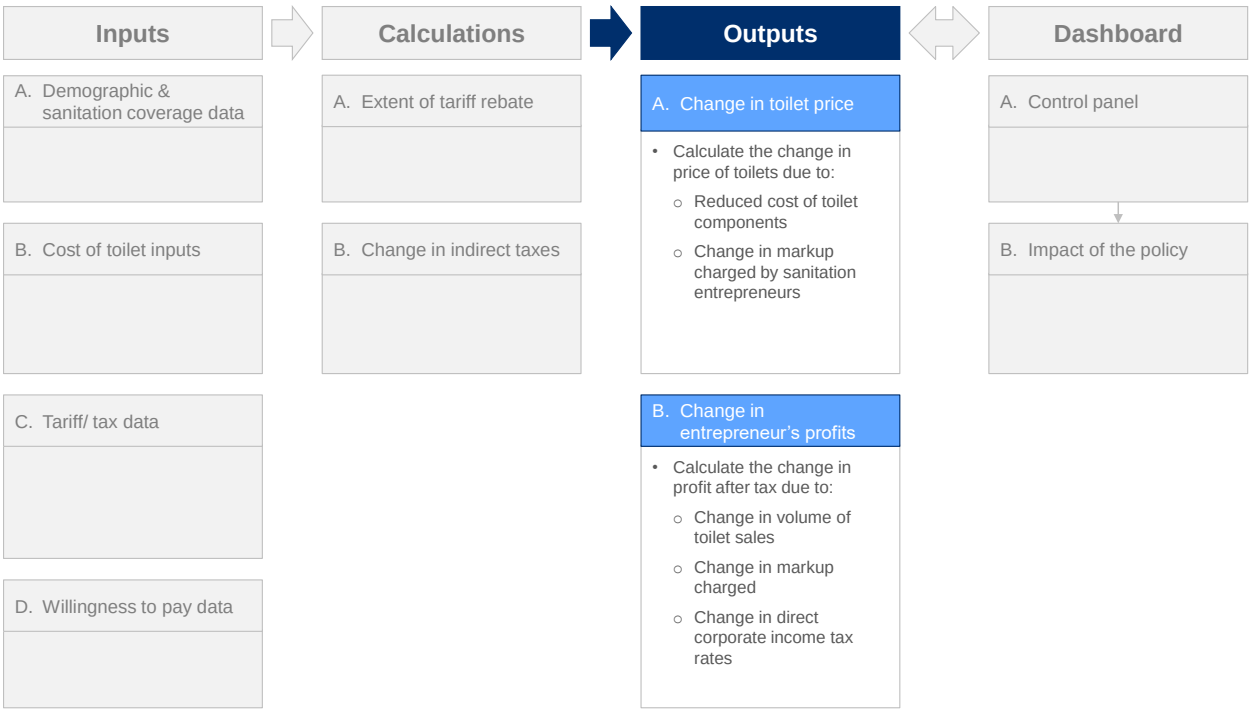
In order to serve as a tool to support decision making, the tariffs and taxes base estimates the potential impact of enforcing the policy levers on sanitation coverage rates and entrepreneur viability, while estimating the costs of doing this. The outputs of the base model have accordingly been split into the following (see Figure 15):

A. **Change in toilet price:** This refers to the overall reduction in toilet price faced by the end customer due to the rebates on tariffs and taxes. This is used to calculate the change in sanitation coverage and also the change in entrepreneur's revenues

B. **Change in entrepreneur's profits:** This refers to both increase in absolute profits due to increase in number of toilets sold, and the increase in profit margins due to increased markups and reduced direct taxes

The cost to the government is the sum of the rebate on tariffs, the rebate on VAT, and the loss in revenue due to reduced direct taxes.

Figure 15: Components of the base model - outputs



A. Change in toilet price

The calculation sheets described in the previous subsection were used to determine the extent of the tariff and indirect tax rebates on each individual toilet input. The "VAT Account" further illustrated the combined effect of the indirect tax rebates on all toilet inputs so as to show how the overall reduction in output VAT the sanitation entrepreneur will charge the customer and the rebate he/ she will get from the government.

To present a consolidated effect of the indirect tax rebate and the tariff rebate on toilet prices, a 'Change in toilet price' sheet was created. This sheet aggregates the change in price of each toilet input which is eligible for a tariff rebate, as well as the overall change in output VAT, and thus arrives at the change in price for the entire toilet sold by the sanitation entrepreneur (Figure 16).

The "Change in toilet price" sheet, as seen in Figure 16, has three tables. In all three tables, "Column D" displays values before the application of the tariff and tax rebates, whereas "Column E" displays the effect post introduction of the policy lever.

The first table ("change in Sales Price of Toilet") is a summary table that shows the overall change in the price of toilets as paid by the end customer. The change in price is determined by:

- The change in the effective cost of inputs for the sanitation entrepreneur due to tariff rebate on toilet components
- The change in the sanitation entrepreneur's markup, if any
- The change in output VAT charged to customers due to the VAT rebate on toilet inputs

The second table ("Change in cost of toilet inputs") aggregates the impact of change in prices of toilet inputs. The price of toilet inputs in this table excludes the input VAT paid by the entrepreneur while

purchasing them. The price of inputs before the policy lever ("Column D"), and the price post introduction of the policy lever ("Column E") are pulled into the sheet from the individual toilet input calculation sheets. As can be seen in "Column F" of Figure 16, the costs of sand, cement, and rebar ("Row 13" – "Row 15") do not change as commodities are not eligible for tariff reduction under the policy lever; however, the costs of the toilet pan and PVC pipe ("Row 16" and "Row 17") do change as the tariff on both these components has been removed. The user dashboard (discussed in Section 3.3.4) allows the user to remove (or reduce) the tariff on both components, any one of them, or on neither of them. The values set in the user dashboard are linked to the individual input calculation sheets which will automatically update the post-policy lever price of the inputs, which in turn will be imported into the "Change in toilet price."

Figure 16: Change in toilet prices in the base model

		Head	Data		
3					
4	Change in Sales Price of Toilet		Original (USD)	New (USD)	Change (USD)
5		Total Cost	33.86	33.09	(0.77)
6		Markup	14.61	17.25	2.64
7		Entrepreneur's unit price (excluding VAT)	48.47	50.34	1.87
8		Output VAT charged to customer	4.85	-	(4.85)
9		Total sales price (including VAT)	53.32	50.34	(2.98)
11		Input	Data		
12			Original (USD)	New (USD)	Change (USD)
13	Change in cost of toilet inputs	Sand	2.25	2.25	-
14		Cement	6.72	6.72	-
15		Rebar	2.98	2.98	-
16		Ceramic Pan	7.55	7.05	0.49
17		PVC Pipe	4.27	3.99	0.28
18		Total	23.76	22.99	0.77
20		Head	Data		
21	Change in markup charged by entrepreneur		Original (USD)	New (USD)	Change (USD)
22		Cost of toilet inputs (excluding VAT)	23.76	22.99	(0.77)
23		Other Costs (sales commissions, transport, labor)	10.10	10.10	-
24		Entrepreneur's total cost	33.86	33.09	(0.77)
25		Entrepreneur's markup @ 100% pass through	14.61	14.27	(0.33)
26		Expected output VAT @ 100% pass through	4.85	-	(4.85)
27		Price for customer at 100% pass through	53.32	47.36	(5.95)
28		Value retained by entrepreneur		2.98	
29		Actual markup charged by entrepreneur	14.61	17.25	2.64

Sheet name as per attached tariffs and taxes base model: "Change in toilet price"

"Row 18" in Figure 16 shows the total cost of toilet inputs faced by the entrepreneur before ("D18") and after ("E18") the policy lever is implemented. These values feed into the third table as the cost of toilet inputs ("Row 22"). This third table – "Change in markup charged by entrepreneur" – is where the markup the entrepreneur will charge post the introduction of the policy lever is determined.

The other costs borne by the sanitation entrepreneur, including sales commissions, transport, and labor, are pulled into this sheet (see "Row 23") from the "Toilet Inputs" sheet, and added to the cost of toilet inputs to arrive at the entrepreneur's total cost ("Row 24"). To this figure, the markup percentage defined in the "General Inputs" sheet is applied ("Row 25"). At this stage, it is assumed that the entrepreneur does not increase the markup percentage, but passes on the entire cost saving from the tariff rebate to the customer. Once the markup (at a 100% pass-through rate) is determined, the expected output VAT the entrepreneur needs to charge the customer is calculated ("Row 26"). From Figure 16, we can see that before the policy lever is introduced ("D26") an output VAT of USD 4.85 is charged to the customer; however if there is a full VAT rebate offered under the policy, the VAT amount becomes zero ("E26"). The cost reduction due to the tariff rebate and the VAT reduction together would result in a USD 5.95 reduction in the price of the toilet if the entrepreneur was to pass on all the savings to the customer ("F26").

At this stage, we assume that the entrepreneur, in anticipation of the rebates on tariff and VAT, may choose not to pass on the entirety of the potential price reduction to the end customer. Instead, the entrepreneur may choose to retain some portion as an increased markup in order to improve his/ her viability. The base model, therefore, introduces a pass-through rate which is the percentage of the total price reduction (at a given level of tariff and taxes) that the entrepreneur chooses to pass on to the customer. At a 100% pass-through rate, the entire price reduction possible at a given level of tariff and taxes is passed on to the customer; conversely, at a zero percent pass-through rate, the entrepreneur chooses to retain the entire price reduction possible as additional profit, and the customer does not receive any reduction in price.

The pass-through rate can be set by the user in the dashboard and based on the value inputted the share of the possible price reduction retained by the entrepreneur is calculated in the "Change in toilet price" sheet. In the example shown in Figure 16, the pass-through rate was set at 50%, i.e., the entrepreneur only passes on half of the total price reduction possible to the customer, while retaining the other half (see "Row 28"). As the output VAT charged to the customer is also charged on the entrepreneur's markup, at a zero pass-through rate, the amount retained by the entrepreneurs should be lower than the entire price reduction as the cost of the toilet plus the new markup plus the output VAT needs to equal the original price of the product. If the retained value is equal to the entire price reduction, once the output VAT is added, the final price to the customer will exceed the original price. To ensure this does not happen, the amount retained (see cell "E28") is calculated using the following formula:

Price reduction * (1- pass through rate) / (1+ output VAT rate on toilets)

As seen from the formula above, to determine the retained value, we multiply the expected price reduction by the percentage retained by the entrepreneur (1 – pass through), and then we divide this figure by 'one plus the output VAT rate. This ensures that even if the entrepreneur retains the entire price reduction, the final price to the customer will never exceed the original price of the toilet.

The actual markup charged by the sanitation entrepreneur once the policy lever is introduced ("E29") is arrived at by adding the markup charged at the original markup percentage ("E25") and the retained value ("E28"). This figure, along with the entrepreneur's total cost ("E24") and the new output VAT on toilets (taken from the "VAT Account" sheet) are added together in the first table ("Row 5" to "Row 9") to arrive at the revised total sales price of toilet that customers will pay due to the policy lever ("E9"). In the example shown in Figure 16, we see that the new toilet price is USD 2.98 lower than it was before the policy was introduced ("F9"), while the entrepreneur's markup is USD 2.64 higher ("F6"). In this way, the policy has resulted in both lower toiler prices for customers and higher profits for entrepreneurs. Further, due to the reduced prices, the entrepreneur should also see higher volumes of toilet sales. The model allows for the pass-through rate to be set at any level from zero to a hundred. This allows the user to see the impact of the policy purely on viability or purely on sanitation coverage.

B. Change in entrepreneur's profits

The effect of the policy lever on entrepreneur viability was briefly touched upon when we discussed the change in markups charged by the entrepreneur in subsection 3.2. In order to fully understand the impact of the policy lever on entrepreneur viability, a "Profit and Loss Statement" sheet was built to showcase the effect of the policy levers on the profitability of a representative sanitation entrepreneur. The profit and loss account not only shows the effects of the tariff and indirect tax rebates on the entrepreneur's profitability, but also models for the impact of the second policy lever discussed, i.e., a reduction in direct corporate income tax rates.

Figure 17 provides a snapshot of the profit and loss statement (P&L) created for the base model. The core components of the P&L are explained in the following:

- **Total revenues from toilet sales** – The total revenue ("C6" and "D6" in 17) is calculated by multiplying the number of units sold per year by the sales price per unit:
    - **The sales price per unit** is the price that covers the entire costs of the entrepreneur plus the markup, but excludes the output VAT to be charged. The sales prices before and after the introduction of the policy levers are imported from the "Change in toilet price" sheet (see cells "D7" and "E7" in Figure 16). In the example shown in Figure 17 the sales price after the introduction of the policy ("D5") is actually higher than the price before the introduction of the policy ("C5"), this is because we have assumed that the entrepreneur retains half of the overall price reduction (including the output VAT reduction) as additional markup. Therefore, the unit price charged by the entrepreneur goes up; however, the overall price faced by the end customer is still lower because of reduction in output VAT (see "D9" and "E9" in Figure 16)
    - **The number of units sold per year** at the original sales price ("C4") is taken from the 'General Inputs" sheet while the sales price post introduction of the policy lever ("D4") is calculated based on the price elasticity of demand in Cambodia
- **Total costs –** The total costs faced by the entrepreneur are calculated by adding total cost of goods sold (COGS) and the operating expenses:
    - **The cost of goods sold (COGS)** refers to those costs that are directly associated with the production of each unit (toilet) sold by the sanitation entrepreneur. This includes the cost of toilet inputs (e.g., cement, toilet pan) and labor

      The total COGS is calculated by adding the cost of materials and labor, which are expressed at a per-unit level and multiplying it by the number of units sold per year by the entrepreneur. The cost of goods per unit imported from the "Change in toilet price" sheet. From Figure 17 it can be seen that the cost of goods per unit (before the policy lever is introduced ("C8") and after ("D8") are shown to be the same. This is due to the rebate mechanism wherein the entrepreneur pays the full cost of a toilet input but then receives a rebate on the tariff amount (see "D9"). The effective cost per unit is therefore shown in "C10" and "D10" as the difference between the actual cost per unit and the rebate provided. Though the effective COGS per unit is lower after the policy lever is introduced, the absolute COGS is higher due to an increase in the number of units sold at the lower price
    - **Operating expenses** are those expenses that are not directly attributed to the production of each unit (toilet) sold by the producer, but are incurred in running the overall business; this includes sales commissions ("Row 15") and transport costs ("Row 16"). These costs are not affected by the rebates on tariffs and taxes; and therefore these costs do not change post introduction of the policy lever

Figure 17: Entrepreneur's profit and loss account in the base model

	A	B	C	D
2		Head	Original amount (USD)	New amount (USD)
3		Revenue		
4		Number of units sold / year	276	333
5		Sales price/ unit (excluding VAT)	48.47	50.34
6		**Total revenue from toilet sales**	**13,377.61**	**16,763.15**
7		Cost of goods sold		
8		Cost per unit	23.76	23.76
9		Less rebate on input costs		0.77
10		Effective cost per unit	23.76	22.99
11		Total cost of materials	6,558.88	7,655.97
12		Cost of labor	1,324.80	1,598.40
13		**Total COGS**	**7,883.68**	**9,254.37**
14		Operating expenses		
15		Sales commission	772.80	932.40
16		Transport	690.00	832.50
17		**Total operating expenses**	**1,462.80**	**1,764.90**
18		Total costs	9,346.48	11,019.27
19		Operating profit	4,031.14	5,743.88
20		Depreciation		
21		Interest		
22		Profit before tax	4,031.14	5,743.88
23		Corporate income tax rate	10%	5%
24		**Corporate income taxes**	**403.11**	**287.19**
25		Profit after tax	3,628.02	5,456.69
26		**Profit margin**	**27.12%**	**32.55%**

Sheet name as per attached tariffs and taxes base model: "Profit & Loss Statement"

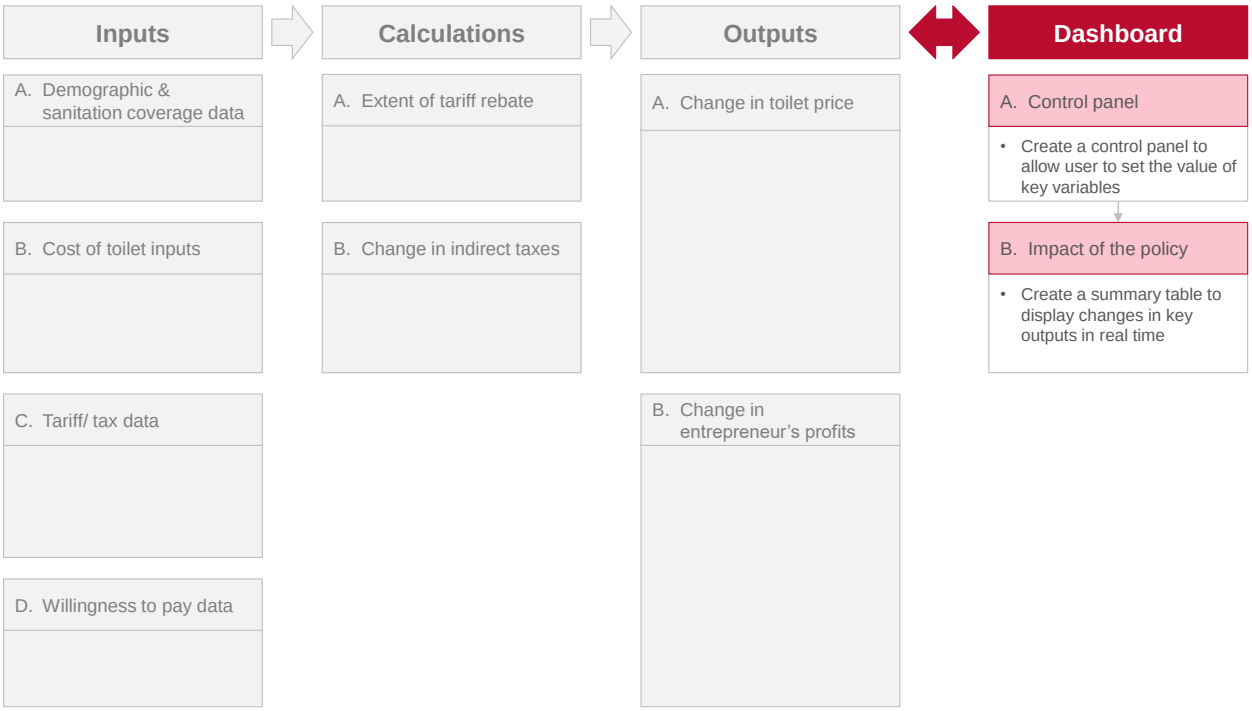
- **Operating profit –** The operating profit ("Row 19") is the difference between the total revenue ("Row 6") and the total costs ("Row 18"). From Figure 17 it can be seen that the operating profit of the entrepreneur is higher post the introduction of the policy lever ("D19") than it was before the policy ("C19"). This is due to the increased unit sales price (which in turn is due to a higher markup percentage), and the increased number of units sold (due to the lower output VAT faced by the customer)

- **Profit before tax –** This is the profit left with the entrepreneur after deducting depreciation of fixed assets and payment of interest on loans from the operating profits. In the example shown in Figure 17, for the sake of simplicity, we have assumed that both depreciation and interest payments are zero. Therefore, in this example the profit before tax ("Row 22") is the same as the operating profit ("Row 19")
- **Profit after tax –** This is the actual profit left with the entrepreneur once the direct corporate income tax ("Row 24") due to the government has been paid. The user can lower the rate of corporate income tax levied on entrepreneurs by inputting a new value in the user dashboard (see subsection 3.3.4). In Figure 17, before the policy is applied, the corporate income tax rate levied ("C23") is based on the tax rates inputted in the "General Inputs" sheet. If the user chooses to enter a lower value in the dashboard, the corporate income tax rate post introduction of the policy will ("D23") will update as seen in Figure 17. In this example, we have assumed that the corporate income tax rate is reduced from 10% to 5%; therefore, despite a higher profit before tax after the policy lever is introduced, the corporate income tax amount ("D24") is lower than it was before the policy was introduced ("C24"). As a result, the profit after tax is higher post the policy lever being introduced ("D25") than it was before ("C25"). Furthermore, if we see the profit margin in "Row 26" (profit after tax as a proportion of the total revenue), it is significantly higher post the introduction of the policy lever ("D26") than it was before ("C26"). Therefore, the policy levers have resulted not just in higher absolute profits for entrepreneurs, but also higher profit margins

3.3.4 User dashboard

The two output sheets present different outcomes of the policy levers, but neither provides the whole picture of the impact. Also, while the costs of the policy are implied in these sheets, they are not shown directly. The tariffs and taxes model intends to support decision making by presenting interested stakeholders with a view of all the benefits and costs of the proposed policy levers. To showcase these benefits and costs in an easy-to-understand manner, a user dashboard was created which summarizes the key outputs of the policy in one table, and allows the user to see how these outputs would vary depending on the value of certain key variables (Figure 18).

Figure 18: Components of the base model - user dashboard



A snapshot of the user dashboard was created for the base model and it consists of two parts:

A. Control panel:

The dashboard was constructed to allow the user to easily apply the policy to specific toilet inputs (or the entire toilet) and to update the value of key variables such as the tariff rate and the VAT rate. **The green table** depicted in Figure 19 is the control panel where users can select the toilet inputs to apply the tax/ tariff rebates to. Each toilet input is listed from "Row 5" to "Row 9" and, in addition, the value added by the entrepreneur (other costs plus markup) is listed in "Row 10." The user can choose to apply the policy tariff and indirect taxes policy lever to any, or all, of these inputs by selecting '1' from the drop-down menus in "Column D"; on the other hand, to exclude an item from the policy, the user can select "0" from the drop-down instead. For example, if the user wishes to apply the tariff and tax rebates to only the ceramic pan and not any other item, the value in cell "D8" should be set to "1," while setting "D5," "D6," D"8," "D9" and "D10" to "0." For each input that is selected the user can enter new tariff (not for commodities) and indirect tax rates. In addition, the user can enter new corporate income tax rates in cell "H13" and set values for the entrepreneur's expected pass-through rate (cell "H15").

The dashboard also allows a user to alter the desired duration of the policy and the number of entrepreneurs available in the market. The desired duration of the policy has an impact on the cost to government discussed further in 3.3.4-B. The number of entrepreneurs determines the time period in which the demand for toilets is met with more entrepreneurs resulting in fewer months required to meet the demand for toilets. The total number of entrepreneurs also impacts the total cost to government, discussed further in 3.3.4-B.

Changing any key variable listed in the dashboard will update the outputs of the model in real-time. In addition, there is a dialogue box in the dashboard (see red cell in Figure 19) which tells the user whether the demand for additional toilets will be met in the defined duration of months of the policy at the new sales price. In case the demand at the new sales price is met, it tells the user the period for which the

cost to the government will be calculated. In case the demand at the new sales price is not met, it tells the user the number of additional entrepreneurs needed to fulfill the demand within the user-defined duration. The calculation for additional entrepreneurs needed works for up to 1000 entrepreneurs inputted (since demand typically fulfills through that many entrepreneurs for most input values in the model). The dialogue text is dynamic and updates as the inputs are changed.

Figure 19: Control panel in the user dashboard of the base model

Dashboard

Control Panel

	Toilet inputs	Applicability	Existing Tariff Rate	New Tariff Rate	Existing VAT Rate	New VAT Rate
Tariffs and indirect taxes	Sand	1			10.0%	0.0%
	Cement	1	15.0%		10.0%	0.0%
	Rebar	1	7.0%		10.0%	0.0%
	Ceramic pan	1	7.0%	0.0%	10.0%	0.0%
	PVC pipe	1	7.0%	0.0%	10.0%	0.0%
	Value added by entrepreneur	1			10.0%	0.0%

	Head	Original Value	New Value
Corporate tax rates	Corporate income tax rate paid by Entrepreneur	10%	5%
Pass-through rate	Entrepreneur's pass through rate		50%
Duration	Desired duration of the policy (months)		24 months
Entrepreneurs	Number of active entrepreneurs		876 entrepreneurs
Notes		*The demand for toilets will be met before the user-defined duration of the policy. The cost to government will be calculated for the duration it will take to meet demand i.e. ~9 months.*	

Sheet name as per attached tariffs and taxes base model: "Dashboard"

B. Impact of the policy:

The blue "impact of the policy" table shown in Figure 20 below is where the outputs are updated depending on the values set in the control panel. In order to effectively support analysis and decision making, the dashboard provides only the most relevant information in a way that is easy to read and understand. Key outputs are displayed include:

- **Change in sanitation coverage –** This is presented in terms of the number of households gaining access to toilets as a result of the policy lever. It is assumed that one toilet will be demanded per household
- **Change in entrepreneur viability –** Entrepreneur viability is expressed in terms of change in number of toilets sold, change in total revenue, change in profit after tax in absolute terms, and change in the profit margin
- **Cost to the government –** This is the summation of the loss in tariff revenue to the government, loss in VAT revenue to the government, and the loss in corporate income tax revenue to the government. Each of these is calculated by determining the revenue the government would have collected from toilet inputs and sanitation entrepreneurs based on the number of toilets sold before the policy levers were introduced and subtracting from this the revenue earned at the new number of toilets sold after the introduction of the policy lever
- The cost to government has been calculated for the lower of either the actual duration to meet the demand for toilets at the new sales price ("Row 30") or the user-defined duration of the policy (Cell "H17" in Figure 19). For example, if the demand for toilets at new sales price is met in 8 months but the user-defined duration of the policy is 24 months, the government will be able to collect tax and tariff revenue for only 8 months and the cost to government is calculated for that period. However, if the demand for toilets at new sales price gets satisfied in 8 months, but the user-defined duration of the policy is 6 months, the cost to government will be calculated for only 6 months as it has been assumed that the user wants to know the impact of the policy for 6 months only.

  In addition to the overall cost to the government, we also compute the cost per toilet sold after the introduction of the policy lever. However, there is some degree of unfulfilled demand even at the original price of the toilet; hence, to get an accurate picture of the cost per toilet, the overall cost to the government should be divided by the number of additional toilets demanded over and above those demanded at the original cost.

Figure 20: Impact of the policy table in the user dashboard of the base model

Impact of the Policy

	Head	Data			
		Current values	At original sales price of USD 53.32	At new sales price of USD 50.34	Difference
Change in Sanitation Coverage	Total rural population	27,09,072			
	# Households demanding toilets		1,66,391	1,98,573	32,182
	# Households with access to improved sanitation facilities	10,45,160	12,11,551	12,43,733	32,182
	Rural sanitation coverage (%)	**38.58%**	**44.72%**	**45.91%**	**1.19%**
	Number of months taken to meet demand for toilets		8.3	8.3	

	Head	Data		
		Original (USD)	New (USD)	Change (USD)
Change in Entrepreneur Viability	Total sales price (including VAT)/ toilet (annual)	53.32	50.34	(2.98)
	Value-added Tax/ toilet (annual)	4.85	-	(4.85)
	Sales price (excluding VAT)/ toilet	**48.47**	**50.34**	**1.87**
	Number of toilets sold per entrepreneur/ year	**276**	**329**	**53**
	Total revenue per entrepreneur (annual)	13,377.61	16,561.79	3,184.18
	Profit before tax per entrepreneur (annual)	4,031.14	5,674.88	1,643.75
	Corporate income tax paid per entrepreneur (annual)	403.11	283.74	(119.37)
	Profit after tax per entrepreneur (annual)	**3,628.02**	**5,391.14**	**1,763**
	Profit margin per entrepreneur	**27.12%**	**32.55%**	**5.43%**

	Head	Data		
		Original (USD)	New (USD)	Change (USD)
Cost to the Government (over 8 months)	VAT revenue to government	8,06,490.66	-	(8,06,490.66)
	Corporate income tax revenue to government	2,43,023.42	1,71,258.18	(71,765.24)
	Tariff revenue to the government	1,66,054.39	-	(1,66,054.39)
	Total cost to the government			**10,44,310**
	Cost per toilet			**0.84**
	Cost per additional toilet			**32.45**

Sheet name as per attached tariffs and taxes base model: "Dashboard"

4.0 ADAPTING THE BASE MODEL

In this chapter, we discuss the different contexts in which the tariffs and taxes model can be applied, as well as the minimum data required to apply it to another geography/ market. We then describe how each component of the model (inputs, mathematical equations, outputs) can be modified for other markets.

4.1 APPLICABILITY AND DATA REQUIRED

MBS is based on the premise that customers' demand for toilets exists and suppliers from the private sector are willing to fulfill that demand. The tariffs and taxes model aims to estimate how sanitation coverage changes, as tax/ tariff rebates reduce the effective price of a toilet. The assumption is reduced effective toilet price would enhance affordability, enabling more households to purchase toilets. However, **the implicit assumption in the model is that the provision of the toilets to meet this increased demand will be through existing private sanitation enterprises**. Therefore, there are minimum contextual conditions that need to be met for the model to be applied:

- **Demand for toilets exists:** The model is based on the assumption that demand exists, but needs to be unlocked. Further, the assumption is that one of the key barriers to unlocking demand is that customers cannot afford existing toilet models. If households do not feel there is any need for sanitation in the first place, demand generation activities rather than MBS approaches may be required
- **A functioning sanitation market exists:** This means that a sufficiently large pool of customers exists to make private provision of toilets viable; that private sanitation entrepreneurs are present in the market; and that there are no major obstacles (physical or policy-related) that prevent these entrepreneurs from supplying toilets in the target market
- **Stable economic and political environment:** A certain amount of economic and political stability is required for any policy to be implemented effectively. This model does not take into account the effect of political or economic instability, and or any kind of conflicts as it is difficult to predict how these could affect implementation

Further, in order for the policy modeled to estimate changes in toilet prices, changes in sanitation coverage rates, and the effect on entrepreneur viability certain calculations need to be performed. These can only occur where there is access to certain types of input data. As a result, ***there is a minimum amount of data required*** to adapt this model to other markets, specifically the following data is required:

- Current prices and costs of producing toilets
- Indirect domestic tax rates, import tariff rates on toilet components/ raw materials, and corporate income tax rates
- Willingness to pay studies (in order to calculate the change in demand for toilets)
- Information on the structure of value chains of key toilet inputs and data on the markups charged by different actors in these value chains

In the absence of these contextual factors, and/or the minimum data required, it would not be possible to adapt the taxes/ tariffs model to another geography/ market. If the model was to be applied to a geography/ market where these conditions are not met, the predictions arising from the

model would be purely speculative and not grounded in reality. Therefore, before attempting to apply this model to other markets, we strongly recommend that the user check for the existence of these conditions and the availability of the required data.

4.2 VARIATIONS SUPPORTED

The description of the underlying logic of the tariffs and taxes base model and the process of creating it provided in the previous chapter should help readers understand how to similar models for other market rules that they wish to study. However, users may be interested in applying a variation of the policy lever as described to another geography/ market. In this case, the user can choose to adapt the base model itself rather than create a completely new model. The subsequent subsections in this chapter provide a step-by-step guide to doing this.

There are certain limitations to the extent the base model can be adapted without revamping the basic structure, and re-writing the major formulae. The structure of the base model is to a large extent influenced by the following factors:

- The prevalent toilet model present in the country as this determines the number and type of toilet inputs
- The nature of the toilet delivery model; i.e., whether it is delivered through a focal point like a sanitation entrepreneur, or whether it is a do-it-yourself model in which the customer needs to aggregate all the inputs and services needed to build a toilet
- The number of stages (and hence actors) present in the value chain of key toilet inputs
- The type of tariffs and indirect taxes levied in the target market and how these are accounted for in the books of accounts

When adapting the base model, differences in these key factors should be kept in mind. Depending on the change in these factors, the following variations may be found:

i. The prevalent toilet type in the country has more/ fewer inputs than those supported by the base model

ii. There is no focal point for sale of toilets, and hence no sanitation entrepreneur can be identified

iii. The number of stages in the value chain of key toilet inputs is greater/ less than the number in the base model

iv. Customs duties are not the prevalent tariff type in the selected market, and/ or VAT is not the form of indirect taxation

The first three variations can be accommodated by the existing base model with some minor structural changes and without the need for any major edits to existing formulae. The remaining variant may require significant changes to the formulae used in the base model and hence it is not covered in this user guide.

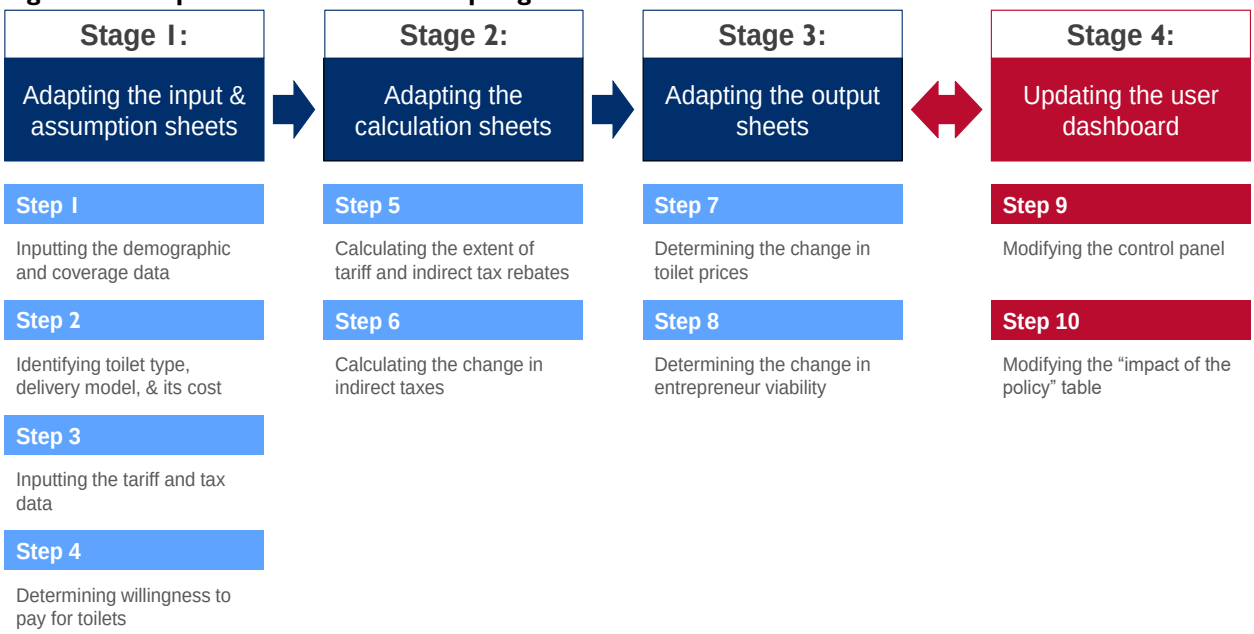
It should be noted that while there are limited variations supported within the existing structure of the base model, interested stakeholders can apply the basic principles highlighted in this document to create completely new models with more complex variations.

4.3 PROCESS OF ADAPTING THE BASE MODEL

The process of adapting the base model into a different geography/ market has been broken down into ten steps spread across four stages. These stages are aligned with the schematic of the base model introduced in Figure 4. The four stages have been summarized below:

- **Stage 1: Adapting the input and assumptions sheets –** The first stage in the process is to collect and input all relevant sanitation coverage data, demographic data, toilet-related data, value chain actor information, tax/ tariff data, and willingness to pay data. This refers to **Steps 1 – 4** in Figure 21
- **Stage 2: Adapting the calculation sheets –** The second stage takes the user through the steps involved in adapting the calculation sheets of the base model (**Steps 5 and 6)** wherein the extent of tariff and tax rebates, and the change in indirect tax charged by the entrepreneur are calculated
- **Stage 3: Adapting the output sheets –** The third stage, consisting of **Steps 7 and 8,** takes the user through the process of adapting output sheets, viz., the change in toilet price sheet and the entrepreneur's profit and loss statement
- **Stage 4: Updating the user dashboard –** The final stage is updating the user dashboard. **Step 9** elaborates on how to update the control panel and link it to the other sheets in the model, and **Step 10** describes the changes that may need to be made to the impact of the policy table

Figure 21: Steps to be followed in adapting the base model



STAGE 1: ADAPTING THE INPUT AND ASSUMPTION SHEETS

Step 1: Inputting the demographic and sanitation coverage data

Once the user has ascertained that prerequisite contextual conditions exist, and that the data needed is available, the first step to adapting the model is determining who is to be targeted by the policy lever. In order to do this, the user needs to be able to identify the proportion of the population in the selected geography that does not have access to improved sanitation facilities. Therefore, the user needs to do enter the following data in the "General Inputs" sheet of the base model (see Figure 22):

- **Determine the total number of households in the selected geography:** The user needs to collect population data which ultimately needs to be expressed at the household level, given that it is assumed that toilet purchase decisions occur at the household level. Population data should be readily available from secondary sources such as government census studies, government national sample surveys, or databases of international organizations, e.g., World Bank. It is recommended that multiple sources are evaluated in order to find the data that is most up to date. Where population data in terms of number of households is not available, household sizes can be identified, and the number of households can be calculated (as seen in the base model). If the user wishes to apply the policy to specific geographic divisions (e.g., to rural vs. urban areas), the population data should also be disaggregated by these geographic units. In the base model, it was decided to segment by rural vs. urban areas, and ultimately the policy was applied only to rural areas as: first, the majority of the population in Cambodia lives in rural areas; and secondly, the willingness to pay studies which were available focused on rural areas; hence, reliable willingness to pay data for urban areas was not available. The manner in which the household data was determined and inputted in the base model can be seen in Figure 22. The total population in terms of number of individuals was entered into the model in "Row 4." This national-level data ("D4") was split into urban population ("E4") and rural population ("F4"). The mean household size was also entered at each of the three levels; i.e., at the national level ("D5"), urban level ("E5"), and rural level ("F5"). Dividing the population data in "Row 4" by the mean household sizes in "Row 5," we arrived at the number of houses at the national level ("D6"), urban level ("E6"), and rural level ("F6")
- **Classify the households according to the type of sanitation facility they have access to:** The policy levers are aimed at increasing coverage amongst households that either do not have access to sanitation facilities, or have unimproved sanitation facilities as per the UNICEF/ WHO Joint Monitoring Program (JMP) definition. The base model relied on JMP data to determine the number of houses with different types of sanitation facilities; however, other sources can also be used, e.g., government census studies, or government national sample surveys which capture health-related data. JMP classifies access to sanitation facilities into the following categories: at least basic access (improved facilities); limited access (improved facilities that are shared); access to unimproved facilities; and open defecation (no access). The JMP data provided details of the percentage of individuals with access to these different facilities (see the green box in Figure 22). These coverage rates were applied to the Cambodian population to calculate the number of individuals that fell into each category ("Row 14" to "Row 7"). These values were divided by the average household sizes, to arrive at the total number of households in each coverage category ("Row 19" to "Row 22"). As the JMP defines only those with "at least basic" sanitation as having improved facilities, households with unimproved, limited and no sanitation facilities were clubbed into one category and labeled as unimproved sanitation (see "Row 25" in the yellow box in Figure 22). The sanitation coverage data was also split by urban ("Column E") and rural ("Column F")

Figure 22: Step 1: Inputting demographic and coverage data

	B	C	D	E	F
2		Inputs	Data		
3	Demographic Data		National	Urban	Rural
4		Total Population	15,762,370.0	*3,300,640*	*12,461,730*
5		Mean Household Size	4.7	4.9	4.6
6		Number of Households	3,382,672	*673,600*	*2,709,072*
7					
8	Sanitation Coverage Data	**Sanitation coverage (%)**	**National**	**Urban**	**Rural**
9		At least basic	48.4%	88.0%	38.6%
10		Limited (shared)	7.6%	8.6%	7.4%
11		Unimproved	3.0%	0.9%	3.5%
12		Open defecation	40.6%	2.6%	50.5%
13		**Sanitation coverage (# individuals)**	**National**	**Urban**	**Rural**
14		At least basic	*7,711,638*	*2,903,903*	*4,807,735*
15		Limited (shared)	*1,203,201*	*283,525*	*919,676*
16		Unimproved	*467,699*	*29,046*	*438,653*
17		Open defecation	*6,379,832*	*84,166*	*6,295,666*
18		**Sanitation coverage (# HHs)**	**National**	**Urban**	**Rural**
19		At least basic	*1,637,793*	*592,633*	*1,045,160*
20		Limited (shared)	*257,792*	*57,862*	*199,930*
21		Unimproved	*101,287*	*5,928*	*95,359*
22		Open defecation	*1,385,800*	*17,177*	*1,368,623*
23		**Classifying HHs by level of service (#)**			
24		Improved sanitation	*1,637,793*	*592,633*	*1,045,160*
25		Unimproved sanitation (including open defecation)	*1,744,879*	*80,967*	*1,663,912*

Sheet name as per attached tariffs and taxes base model: "General Inputs"

When adapting the model to another geography/ market, the user needs to arrive at the number of households with improved versus unimproved sanitation. If the data is already available at the household level, it can be directly entered without first determining the population in terms of number of individuals. The user can delete the redundant rows from the Ge Similarly, if the user does not wish to differentiate between geographic areas data only needs to be entered in "Column D" while "Column E" and "Column F" can be deleted.

Step 2: Identifying the prevalent toilet types, delivery models, and toilet costs

After the target population has been identified, the next step is to identify the prevalent toilet type in the selected geography. The model estimates the change in sanitation coverage, and entrepreneur viability, if tariff and tax rebates are sued to lower the price of an ***existing toilet model***. While there may be multiple toilet models available in the selected geography, we recommend selecting only the most prevalent type of improved toilet that exists in the market. This is because the intention of the model is to only demonstrate whether the concept of tariff and tax rebates can help increase sanitation coverage in general, and not if it can increase sales of specific toilet models. If there is no single toilet model that is prevalent in the country, we suggest the user take the price and cost of inputs as an average of the top three models in the country.

In Cambodia, the prevalent toilet type is a pit latrine consisting of a pit lined with three concrete rings, a cement slab covering the pit, and a ceramic pan as the interface. It should be noted, that this model is sold as just a substructure and interface package, and does not include the superstructure. Further, we determined that toilets are bought from sanitation entrepreneurs who are small business owners typically engaged in the production of concrete products. These entrepreneurs act as a focal point for customers who place an order for a toilet with them. The entrepreneur then aggregates all the inputs required for producing a toilet and engages masons/ artisans to install the toilet for the customer.

Once we identified the toilet type and the delivery model, we collected information on the key inputs used to produce the toilet and the quantities of each input that were required to produce one toilet. These details were captured in the "Toilet Inputs" sheet as seen in the green box in Figure 23. Further, we carried out research to determine the unit price faced by the entrepreneur for each of these inputs, and the total cost of inputs for the sanitation entrepreneur for one toilet and entered it in the model (see the yellow box in Figure 23).

For all the toilet inputs identified, there are at most two stages in their value chain before the input reaches the sanitation entrepreneur, viz., an importer or manufacturer, and a retailer. Ideally, at each stage, we would like to collect the cost of the inputs broken down by the purchase price at that stage, the value-added at that stage, and the markup charged at that stage. However, this data was not readily available in Cambodia. Hence, we reverse calculated the original import/ manufacturing price of each input based on the markups added at each stage (it was assumed there was no other value-added), and the tariff rate on each input and the indirect tax applied at each stage. A formula was used to remove the value chain actor markups and tariff/ tax amounts from the cost of the toilet input at the sanitation entrepreneur; and the resultant initial price was entered in the input sheet (see the purple box in Figure 23).

Figure 23: Step 2: Identifying toilet types, delivery models, and costs

	Inputs	Data				
	Material/ Component Type	Unit	Quantity	Price/ Unit (USD)	Original Price for Entrepreneur (USD)	Initial price (USD)
Raw material costs	Cement	kg	72.5	0.10	*7.40*	5.19
	Reinforcing Steel	kg	3.5	0.94	*3.27*	2.47
	Ceramic Pan	piece	1	8.30	*8.30*	6.26
	PVC Pipe	piece	1	4.70	*4.70*	3.55
	Sand	m^3	0.20	12.20	*2.47*	2.12
	Total cost of materials/ components				26.14	
Other costs	Sales Commissions	toilet	1.00	2.80	*2.80*	
	Transport	toilet	1.00	2.50	*2.50*	
	Labor	toilet	1.00	4.80	*4.80*	
	Total other costs				10.10	

Sheet name as per attached tariffs and taxes base model: "Toilet Inputs"

The formula to calculate the initial price of toilet inputs depends on the number of stages in the value chain of each toilet input. In Cambodia, it was evident that the value chain for raw materials was largely made up of an importer, retailer, and entrepreneur. However, in another geography, raw materials may be manufactured locally instead of being imported (e.g., Uganda), which implies that tariffs are not paid, and therefore do not need to be removed from the cost paid by the sanitation entrepreneur. Once the key value chain actors have been identified, it is also important to capture data relating to value chain actor profit markups. As a raw material passes up the value chain from one actor to another, individual profit markups are applied, therefore playing a key role in determining the final price of the input. These

profit markups are not standardized, and can vary across geographies, in addition to value chain actors. Where value chain profit markup data is not available, calculations can be completed using value chain profit margin data (assuming that this is available). This was done for the base model as data on markups was not available. The equation used to calculate markups from the profit margin is given below:

$$\frac{profit\ margin}{1 - profit\ margin} = profit\ markup$$

The markup figures ascertained through this process were entered in the "General Inputs" sheet (see the green box in Figure 24). Apart from the markups, the tariff and tax rates applied in the value chain were needed to arrive at the initial costs; these are discussed in Step 3.

Additionally, the user will also need to enter the number of active entrepreneurs in the program. The number of active entrepreneurs is needed to calculate how long it would take for entrepreneurs to fulfill the demand for toilets, given the average amount of units an entrepreneur can sell every month. This data is to be entered in cell "H19" in the sheet "Dashboard" (see Figure 33 in subsection 4.3-Stage 4), which is linked to cell "D47" in the "General Inputs" sheet (Figure 24).

Figure 24: Markups charged by different value chain actors in Cambodia

	B	C	D
43	Value Chain Actor Markups	Importer/ Manufacturer	6.4%
44		Retailers	5.8%
45		Entrepreneurs (Concrete Producers)	43.1%
46			
47	Entrepreneur Data	Number of active entrepreneurs	876
48		Average units sold / month	23
49		Expected Profit Margin	29.0%

Sheet name as per attached tariffs and taxes base model: "General Inputs"

In addition to the cost of all inputs required to produce one toilet, we also entered other costs borne by the sanitation entrepreneur in producing a toilet, viz., sales commissions, transport costs, and labor costs (see the blue box in Figure 23).

When adapting the model to a different geography, the main point to remember is that the key data required is the cost of toilet inputs for a specific toilet type. The cost of these inputs is required at each stage of the value chain for these inputs as this will help determine the multiplier effect a tariff/ tax rebate could have on the final cost faced by the sanitation entrepreneur. If this detailed information is available in the selected geography, the user can directly input these values in the input sheets of the base model without needing to use the formulae to reverse calculate the initial price of inputs.

Step 3: Inputting the tariff and tax data

The tariff type and rate need to be identified and entered into the "General Inputs" sheet as do the indirect tax and direct tax rates. Figure 25 shows how this was done for the base model.

- **Determining the tariff type and rate:** The green box in the figure, covering "Row 28" to "Row 31" shows the import tariff in Cambodia for each of the toilet inputs identified in Step 2. In Cambodia there is a simple customs duty on all goods entering the country, though the rate varies depending on the type of good. With respect to the toilet inputs needed for the prevalent toilet type, most of these inputs, except for sand, need to be imported and hence customs duty

would be charged on them. For cement, the customs duty is 15% in Cambodia, while for the other identified inputs it is 7%

When adapting the model to a different geography, the user would need to first identify whether the toilet inputs need to be imported, or if sufficient quantities are available within the country. If they do not need to be imported, nothing needs to be entered in the "General Inputs" sheet and these rows can be deleted (with related changes being needed throughout the document). For each input that does need to be imported, the user needs to identify the type of tariff applicable and the rate of that. The tariff for each input should be entered in a separate row. The type of tariff is an important consideration. For instance, some countries have a countervailing duty wherein goods from certain countries are taxed higher than others to prevent goods being dumped in their home country. If this is the case, the user may need to make additional assumptions regarding the quantities of an input being sourced from different countries and the differing tariff rates that need to be applied in each case

Figure 25: Step 3: Inputting tariff and tax data

	B	C	D	E
27	Raw Materials Tariff Rates	**Raw Materials**	**Original Import Tariff**	
28		Cement	15.0%	
29		Reinforcing Steel	7.0%	
30		Ceramic Pan	7.0%	
31		PVC Pipe	7.0%	
32				
33	Tax Rates	**Type of Tax**	**Original Tax Rate**	
34		Value-added Tax (VAT)	10.00%	
35		Tax on profit		
36		< 1,500 USD	0.00%	of profit
37		1,500 - 3,750 USD	5.00%	of profit
38		3,750 - 25,500 USD	10.00%	of profit
39		25,500 - 37,500	15.00%	of profit
40		> 37,500	20.00%	of profit
41		Minimum tax rate	1.00%	of turnover

Sheet name as per attached tariffs and taxes base model: "General Inputs"

- **Determining the indirect tax type and rate:** The indirect tax is treated in a similar manner to the tariff. First, the user needs to determine if all the toilet inputs bear an indirect tax burden; second, for those that do bear such a burden, separate rows should be inserted in the "General Inputs" sheet with the tax rate on each input specified. The yellow box in Figure 25 shows how the indirect tax rate was inputted in the base model. In Cambodia, there is a value-added tax (VAT) applicable on all goods, and the VAT rate is a flat 10% for all goods; barring certain exceptions. As none of the toilet inputs identified in Cambodia fall into the exemption category, all of them need to be taxed at 10% and only one row was required to enter the VAT rate

  However, when adapting the model for a different geography, the user will need to identify the type of indirect tax that is levied and the rates for each input. If the type of indirect tax in the selected is applied in a different manner from how VAT is applied, then the user may not be able to use the base model without significant changes to the formulae in the model

- **Determining the direct tax type and rate:** Finally the user needs to identify if there are any direct taxes on the profit and/ or revenues of sanitation entrepreneurs in the selected geography they wish to adapt the model for. If there is, the direct tax type and rates need to be entered in the "General Inputs" sheet. In Cambodia, there is a corporate income tax levied on all businesses, depending on the amount of profit they earn. This includes small and medium

enterprises as well. The blue box in Figure 25, covering "Row 36" to "Row 41," shows how the direct tax rates were entered in the base model depending on the tax slabs. Note, in Cambodia there is also a minimum tax rate of 1% of turnover, even if an enterprise does not earn profits

Based on our understanding of sanitation entrepreneurs in Cambodia, we assumed that the majority of these entrepreneurs are producers of concrete products who are in the formal sector and are classified as small or medium enterprises. Hence, we decided that all sanitation enterprises should bear the corporate income tax rate. However, if the user determines that the majority of entrepreneurs in the selected geography do not fall into the formal sector and would not pay taxes, then the direct tax need not be applied. More importantly, if the delivery model in the selected geography does not have a focal point, then there is no entrepreneur to pay direct taxes, and this section is not required at all

Step 4: Determining the willingness to pay for toilets

The willingness to pay for toilets is a crucial input in the model without which the model cannot predict the change in sanitation coverage, or the increase in the units sold per sanitation entrepreneur. The willingness to pay for toilets needs to be expressed in terms of the price elasticity of demand[4] for sanitation. As discussed in subsection 3.3.1-D, the price elasticity was computed using the following equation:

$$\frac{Q1 - Q2}{Q1 + Q2} / \frac{P1 - P2}{P1 + P2}$$

In the above equation:

P1 = the current market price for toilets
P2 = a lower price based on expected cost reductions
Q1= the number of households willing to purchase toilets at P1
Q2 = the number of households willing to purchase toilets at P2

From the equation, we can see that to be able to calculate price elasticity of demand, the number of households demanding toilets is required at least two price points. Further, as the elasticity of demand can vary between different sets of price points, one of the two price points chosen should be close to the actual market price of toilets; and the second price point should be lower than this point. In Cambodia, this data was obtained through a willingness to pay study conducted by IDinsight. According to this study, at the market price of toilets (~USD 53), approximately10% of households without toilets demanded toilets, while at a price point of USD 45, approximately 17% of the population demanded toilets. Multiplying the target population determined in Step 1 with the percentage in this study, we arrived at the actual number of households demanding toilets at these two price points. These figures were then used to calculate the price elasticity of demand (3.07) for toilets. This information was captured in the "General Inputs" sheet as seen in Figure 26.

When adapting the base model to a different geography, the user would need to collect the willingness to pay study for that particular geography. Further, the willingness to study may differ by type of area within a particular geography. For example, in Cambodia we had data only for the willingness to pay in rural areas; as income levels and affordability constraints are likely to differ between rural and urban areas, we limited the application of the policy levers to the rural population in Cambodia. If the user

[4] Price elasticity of demand is a measure used in economics to show the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price when nothing but the price changes

wants to apply the policy to both rural and urban areas, they may need to calculate the price elasticity of demand for each area separately.

Figure 26: Price elasticity of demand as computed for Cambodia

	B	C	D
51	Price elasticity of demand	P1 (USD)	53.3
52		P2 (USD)	45.0
53		Demand at P1 (%)	10%
54		Demand at P1 (# of toilets)	*166,391*
55		Demand at P2 (%)	17%
56		Demand at P2 (# of toilets)	*282,865*
57		Price elasticity of demand	*(3.06)*

Sheet name as per attached tariffs and taxes base model: "General Inputs"

The discussion on adapting the input and assumptions sheet reinforces the point that a lot of secondary data is required to construct and/ or adapt the model. **Box 1** provides a list of potential data sources.

Box 1: Potential sources for input data

Type of data	Potential sources
Sanitation coverage data	• Government census studies • Government national sample surveys which capture health related data (e.g., health surveys) • Reports by government ministries/ departments and/ or reports prepared for parliamentary committees • Sanitation coverage data from UNICEF/ WHO Joint Monitoring Program • World Bank development indicators database • Program evaluation reports by funders (e.g., USAID, DFID, UNICEF, BMGF, etc.), and implementers (e.g., WSP, Water for People, WaterAid, WaterShed, PSI, etc.) working in the sanitation space
Demographic data	• Government census studies • Government national sample surveys • Databases of international organizations, e.g., World Bank indicator database, CIA Factbook, etc.
Toilet raw material prices	• Toilet supply chain studies • Program evaluation reports by funders and implementers
Tax/ tariff data	• World Trade Organization Download Facility • Country tax profile reports by the Big 4 accounting firms
Value chain actor information	• Toilet supply chain studies • Program evaluation reports by funders and implementers
Demand curve data	• Sanitation willingness to pay (WTP) studies

Note: *Ideally, sanitation coverage data, and demographic data should be sourced from the same report/ database. Similarly, value chain actor information and toilet raw material prices should also be from the*

STAGE 2: ADAPTING THE CALCULATION SHEETS

The calculation sheets are at the heart of the model, containing the formulae that pull together all the inputs and assumptions and convert them into outputs on the basis of the underlying logic. These sheets are linked to the input sheets, the output sheets and the user dashboard. They extract data from the input sheets, and have links out to the output sheets and dashboard. In addition, they pick up user entered values set in the dashboard in order to determine which toilet input(s) to apply the policy to, and which exclude. While this last relationship will be discussed in more detail in Stage 4: Updating the user dashboard, it is important to remember that values entered in the dashboard need to be imported into the calculation sheets in order for them to function. The user will need to work on adapting the calculation sheets and user dashboard simultaneously, and therefore, it is recommended that the user read through the steps focused on adapting the user dashboard in addition to the steps in this Stage before starting to adapt the calculation sheets.

In order to effectively adapt the calculation sheets, it is important to understand the toilet delivery model in the selected geography. The important distinction that needs to be made is regarding the presence of a sanitation entrepreneur, and whether he/ she plays the role of a focal point in the toilet delivery model. As the focal point, the sanitation entrepreneur is required to aggregate toilet inputs and sell the entire toilet to customers. This is the model that was found in Cambodia. Alternately, in some geographies, the customer needs to independently aggregate toilet inputs, by procuring toilet materials and components from various supply chain actors. This type of delivery model present is ultimately important when adapting calculation sheets, for a few reasons:

- **It impacts how VAT is charged to the customer**: In a context like Cambodia, where a sanitation entrepreneur is selling an entire toilet to the customer, VAT is applied on to the overall toilet sales price paid by the customer, rather than on the individual toilet inputs. On the other hand, where customers need to aggregate toilet inputs independently, VAT is charged on the sales price of each individual toilet input that the customer purchases. This particularly has implications on the 'change in toilet price' output sheet
- **It impacts the user's ability to assess entrepreneur viability:** in a context where there is no sanitation entrepreneur acting as the aggregator, profit and loss calculations cannot be performed and as a result policy levers cannot be utilized to attempt to improve overall entrepreneur viability. In particular, the corporate income tax lever no longer becomes relevant to the model

Step 5: Calculating the extent of the tariff and tax rebates

As discussed in subsection 3.2, the proposed mechanism through which the tariff and indirect tax reductions are implemented in the model is a rebate given to the sanitation entrepreneur; therefore the actual tariff paid by the importer, or the indirect tax amount paid by all value chain actors, does not actually change. In order to encourage the sanitation entrepreneur to reduce the cost of the toilet, and to avoid transferring the burden of the indirect tax from the customer to the sanitation entrepreneur, it is proposed that the government provide a refund to the entrepreneur equal to the tariff amount in the toilet input cost (including the multiplier effect the tariff has had down the value chain) and a rebate equal to the input tax paid by the entrepreneur on purchasing individual toilet inputs. Therefore, to provide the full effect of the tariff and indirect tax reduction to the entrepreneur, the rebate should be calculated assuming the tariff/ indirect tax had been removed at the first stage of the value chain and by factoring in the subsequent reductions at each stage until the input lands at the sanitation entrepreneur.

The base model has been constructed based on the tariff and indirect tax systems that exist in Cambodia where the tariff is a simple customs duty, and the indirect rate is in the form of a VAT. The

ways in which the tariff and VAT rebates have been calculated through the five individual input calculation sheets the base model has been explained in detail in subsection 3.3.2-B (see Figure 13 and the supporting explanation), and are thus not repeated here. Instead, we focus only on how these individual input sheets may need to be updated based on the variations that the base model can support; i.e., if the number of toilet inputs changes, the delivery model is a DIY model as opposed to the focal point model, and if the number of stages in the value chain differ. Note, as mentioned in subsection 4.2, if the type of tariff or indirect tax differs significantly from those used in the base model, then it may not be possible to adapt this model; instead the user may need to construct a new model from scratch.

To start, see Figure 27 which is a repeat of the illustration that was first presented in Figure 13 in subsection 3.3.2-B. The sheet shown in this figure is used to simulate the effect a reducing tariffs and taxes throughout the value chain would have on the final cost of a toilet pan for the sanitation entrepreneur; see cost before the policy lever is introduced ("F5") versus the cost after the policy lever is introduced ("F16"). There are five such sheets in the base model; one for every toilet input needed to produce the prevalent toilet model sold in Cambodia. The initial cost price faced by the importer/ manufacturer ("D5") is imported from the "Toilet Inputs" sheet, while the original tariff rate ("D6") and the original VAT rate ("Row 12") are imported from the "General Inputs sheet." Conversely, the new tariff rate ("D17") and new VAT rate ("D23") are linked to the "Dashboard" sheet and updated based on the values entered there.

Figure 27: Step 5: Calculating the extent of tariff and tax rebates

	B	C	D	E	F
3		Head	Data		
4			Stage 1: Importer/ Manufacturer	Stage 2: Retailer	Stage 3: Entrepreneur
5	Prices at Original Tariff/ Tax Rates	Cost Price (USD)	6.26	7.13	7.55
6		Tariff Rate (%)	7.00%		
7		Tariff Amount (USD)	0.44		
8		Cost Price (including Tariff) (USD)	6.70	7.13	
9		Profit Markup (%)	6.38%	5.82%	
10		Profit (USD)	0.43	0.41	
11		Sales Price (excluding VAT) (USD)	7.13	7.55	
12		VAT Rate (%)	10.00%	10.00%	
13		VAT Amount (USD)	0.71	0.75	
14		Total Sales Price (including VAT) (USD)	7.84	8.30	
16	Prices at New Tariff/ Tax Rates	Cost Price (USD)	6.26	6.66	7.05
17		Tariff Rate (%)	0.00%		
18		Tariff Amount (USD)	-		
19		Cost Price (including Tariff) (USD)	6.26	6.66	
20		Reduction in Cost (USD)	0.44	0.47	
21		Profit (USD)	0.40	0.39	
22		Sales Price (excluding VAT) (USD)	6.66	7.05	
23		VAT Rate (%)	0.00%	0.00%	
24		VAT Amount (USD)	-	-	
25		Total Sales Price (including VAT) (USD)	6.66	7.05	

Sheet name as per attached tariffs and taxes base model: "Calculations_Ceramic_Pan"

- **Adapting to change in number of toilet inputs:** The first variation discussed above, is that the prevalent toilet model in the geography for which the model is to be adapted has either more, or fewer toilet inputs than in the base model. If the number of inputs is less, the user simply needs to delete the excess sheets; however if the number of inputs is more, the user will need to create additional sheets. To do this, the user can simply duplicate any of the existing sheets and link the initial sales price ("D5") to the relevant cell in the "Toilet Inputs" sheet, the original tariff and VAT rates to the relevant cells in the "General Inputs" sheet, and the new tariff and VAT rates to the relevant cells in the "Dashboard" sheet.
- **Adapting to changes in the delivery model:** The second variation supported is where the delivery model used is a DIY model as opposed to the focal point model shown in the base model. Assuming that the number of stages in the value chain does not change, this means that the retailer sells to the customer rather than to a sanitation entrepreneur. In this scenario, the user needs to delete "Column F" in Figure 27, as the cost to the customer would be the entire cost including VAT as computed in cells "E14" and "E25"
- **Adapting to changes in number of stages in the value chain of toilet inputs:** The final variation supported is when the number of stages in the value chain of a toilet input is either more, or fewer than those assumed in the base model. If there are fewer stages, the user needs to either delete, or blank out the excess stage. This is illustrated by how the sand is treated in the base model. Sand is one of the five toilet inputs identified, however unlike the others it is neither imported nor manufactured. Rather, it is assumed that retailers aggregate sand, package it, and sell it to sanitation entrepreneurs. Therefore, the value chain for sand starts from the retailer; this is depicted in Figure 28. In the figure, we can see that "Column D" has been blanked out preventing any values from being inputted. Instead, the initial price of sand is linked to "C5" and there is no tariff rate applied to it

  It is also possible that the number of stages in the value chain is more than depicted in the base model; for example, there is a distributor between the importer/ manufacturer and the retailer. In this case, the user will have to add a column and replicate the steps followed in the existing columns with regard to how the markups and VAT are applied. Further, the user would need to define the markup for the additional value chain player in the "General Inputs" sheet and link the value to the relevant cell in the input calculation sheet

  Note: if the number of stages in the value chain is different from that in the base model, the user would have to update the formula used to calculate the initial prices of the toilet inputs. For instance, in the case of sand the tariff amount did not have to be removed from the cost faced by the entrepreneur when calculating the initial price. On the other hand, if a stage is added to the value chain, the markup of the additional actor would also need to be removed from the cost borne by the sanitation entrepreneur to arrive at the initial price of the input

Figure 28: Adjusting the number of stages in the value chain of a toilet input

	B	C	D	E	F
3		Head	Data		
4			Stage 1: Importer/ Manufacturer	Stage 2: Retailer	Stage 3: Entrepreneur
5	Prices at Original Tariff/ Tax Rates	Cost Price (USD)		2.12	2.25
6		Tariff Rate (%)			
7		Tariff Amount (USD)			
8		Cost Price (including Tariff) (USD)		2.12	
9		Profit Markup (%)		5.82%	
10		Profit (USD)		0.12	
11		Sales Price (excluding VAT) (USD)		2.25	
12		VAT Rate (%)		10.00%	
13		VAT Amount (USD)		0.22	
14		Total Sales Price (including VAT) (USD)		2.47	
16	Prices at New Tariff/ Tax Rates	Cost Price (USD)		2.12	2.25
17		Tariff Rate (%)			
18		Tariff Amount (USD)			
19		Cost Price (including Tariff) (USD)		2.12	
20		Reduction in Cost (USD)		-	
21		Profit (USD)		0.12	
22		Sales Price (excluding VAT) (USD)		2.25	
23		VAT Rate (%)		0.00%	
24		VAT Amount (USD)		-	
25		Total Sales Price (including VAT) (USD)		2.25	

Sheet name as per attached tariffs and taxes base model: "Calculations_Sand"

Step 6: Calculating the change in indirect taxes

The changes in indirect taxes charged to the customer are computed in the 'VAT account' which depicts how VAT is accounted for in a sanitation entrepreneur's book of accounts. The VAT account created for the base model is depicted in Figure 29 which is the same as that depicted in Figure 14 in subsection 3.3.2-B. There are three parts to the VAT account; the first is where the input VAT paid by the sanitation entrepreneur on each toilet input is aggregated – "Row 5" to "Row 10" (see green box in Figure 29), the second is where the output VAT charged to the customer is calculated – "Row 12" to "Row 20" (see the yellow box), and finally the amount of VAT transferred by the entrepreneur to the government, and the extent of the rebate received – "Row 22" to "Row 27" (see the blue box).

The input VAT amounts in the green box are imported into the sheet from the individual toilet input calculation sheets; for example the input VAT paid on toilet pan ("C8" and "D8") is imported from "E13" in Figure 27. The original input VAT paid ("Colum C") and the new input VAT paid ("Column D") are the same as the policy lever modeled is a rebate, and hence the actual amount of VAT paid by the entrepreneur on purchasing toilet inputs does not actually change.

The output VAT amounts in the yellow box are computed by multiplying the cost of the input faced by the sanitation entrepreneur (taken from the individual toilet input calculation sheets) with the VAT rates in the "Dashboard" sheet. The VAT rates used to compute the values in "D12" to "D18" depend on

whether the user chooses to apply the policy lever to a particular input in the "Dashboard" sheet, and the new VAT rate the user enters for the inputs that it is applied to.

The rows in the blue box in Figure 29 compute the total VAT due to the government by subtracting the input VAT paid by the entrepreneur from the output VAT that is to be charged to the customer. If the output VAT is greater than the input VAT, the entrepreneur needs to transfer the balance to the government and receives no rebate (though the amount to be transferred may reduce). On the other hand, if the output VAT is less than the input VAT paid by the entrepreneur, the government gives the entrepreneur a rebate equal to the difference.

Figure 29: Calculating the changes in indirect taxes

	B	C	D	E
3	**Input VAT paid by entrepreneur**			
4	**Input**	**Original (USD)**	**New (USD)**	**Difference (USD)**
5	Sand	0.22	0.22	0.00
6	Cement	0.67	0.67	0.00
7	Rebar	0.30	0.30	0.00
8	Pan	0.75	0.75	0.00
9	PVC pipe	0.43	0.43	0.00
10	VAT paid on toilet inputs	2.38	2.38	0.00
11	**Output VAT charged by the entrepreneur**			
12	Sand	0.22	0.00	-0.22
13	Cement	0.67	0.00	-0.67
14	Rebar	0.30	0.00	-0.30
15	Pan	0.75	0.00	-0.75
16	PVC pipe	0.43	0.00	-0.43
17	Other inputs	1.01	0.00	-1.01
18	Markup	1.46	0.00	-1.46
19	**Total output VAT charged to the customer**	**4.85**	**0.00**	**4.85**
20	**Effective VAT on toilet**	**10%**	**0%**	**10%**
21	**VAT transferred to the government**			
22	Input VAT paid by the entrepreneur	2.38	2.38	0.00
23	Balance VAT due to the government	2.47	-2.38	
24	Total VAT due to the government	4.85	0.00	-4.85
25	Total VAT paid by the entrepreneur	4.85	2.38	-2.47
26	**Rebate to entrepreneur from the government**	**0.00**	**2.38**	
27	Actual VAT revenue of the government	4.85	0.00	-4.85

Sheet name as per attached tariffs and taxes base model: "VAT Account"

The VAT account may need to be changed if any of the three supported variations exist:

- If the toilet model in the selected geography has a different number of toilet inputs than depicted in the base model, the user would need to either delete the surplus toilet input rows in this sheet, or add additional ones
- If the delivery model is a DIY model, as opposed to the focal point model, then there is no single actor whose VAT account can be depicted, ***and hence this sheet would not be required***
- Finally, if the number of actors in the value chain are different from those assumed in the base model, the VAT account should update automatically once the user adapts the "General Inputs"

sheet, the "Toilet Inputs" sheet, the individual toilet input calculation sheets, and the "Dashboard sheet"

STAGE 3: ADAPTING THE OUTPUT SHEETS

Step 7: Determining the change in toilet prices

The change in the price of the toilet paid by the end customer is displayed in the "Change in toilet price" sheet. As mentioned in subsection 3.3.3-A, the change in price is determined by three factors:

- The change in the effective cost of inputs for the sanitation entrepreneur due to tariff rebate on toilet components
- The change in the sanitation entrepreneur's markup, if any
- The change in output VAT charged to customers due to the VAT rebate on toilet inputs

The change in the effective cost of toilet inputs in the base model is computed in the table shown in Figure 30. The values of the original cost and new cost of inputs in this table are imported from the individual toilet input calculation sheets. The change in price of inputs (if any) is due to the rebate of the tariff amount on these inputs. As tariff rebate is not provided for commodities, the original cost of sand, cement, and rebar ("D13" to "D15") and the new cost of these commodities ("E13" to "E15") are the same. However, the new cost of toilet components, viz., toilet pan ("E16") and PVC pipe ("E17") differ from the original costs of these components ("D16" and "D17"). This is because, in the example shown here, the policy lever has been applied to both pan and pipe in the "Dashboard" sheet. However, the user can choose to apply it to either one, or neither, of these components.

Figure 30: Aggregating the change in cost of toilet inputs

	B	C	D	E	F
11		Input	Data		
12			Original (USD)	New (USD)	Change (USD)
13	Change in cost of toilet inputs	Sand	2.25	2.25	-
14		Cement	6.72	6.72	-
15		Rebar	2.98	2.98	-
16		Ceramic Pan	7.55	7.05	**0.49**
17		PVC Pipe	4.27	3.99	**0.28**
18		**Total**	**23.76**	**22.99**	**0.77**

Sheet name as per attached tariffs and taxes base model: "Change in toilet price"

If the prevalent toilet model in the selected geography has more, or less, toilet inputs than those in the base model, the user will have to either add additional rows to the table in Figure 30 (and link them to the relevant toilet input calculation sheets), or delete the surplus ones.

In the base model, the **change in the sanitation entrepreneur's markup** is computed in the table depicted in Figure 31. The cost of toilet inputs in "Row 22" of this figure are linked to "Row 18" of Figure 30, while the other costs shown in "Row 23" of Figure 31 are imported from the "Toilet Inputs" sheet. The entrepreneur's markup at the original markup percentage ("Row 15") is calculated by multiplying the entrepreneur's total cost ("Row 14") by the entrepreneur's markup entered in the "General Inputs" sheet. "Row 26" shows what the output VAT would be charged to customers if the entrepreneur actually did pass through the entire cost saving to the customer and charged only his/ her

original markup. The VAT rate used in "D26" is the original VAT rate entered in the "General Inputs" sheet, while the VAT rate used in "E26" is the VAT rate selected in the "Dashboard" sheet.

Based on the change in the entrepreneur's total cost ("F24") and the change in output VAT charged ("F26"), we can determine the total change in price of a toilet if the entrepreneur were to pass on the entire price reduction to the customer ("F27").

Figure 31: Computing the change in entrepreneur's markup

	B	C	D	E	F
20		Head	Data		
21	Change in markup charged by entrepreneur		Original (USD)	New (USD)	Change (USD)
22		Cost of toilet inputs (excluding VAT)	23.76	22.99	(0.77)
23		Other Costs (sales commissions, transport, labor)	10.10	10.10	-
24		**Entrepreneur's total cost**	**33.86**	**33.09**	**(0.77)**
25		Entrepreneur's markup @ 100% pass through	14.61	14.27	(0.33)
26		Expected output VAT @ 100% pass through	4.85	-	(4.85)
27		**Price for customer at 100% pass through**	**53.32**	**47.36**	**(5.95)**
28		Value retained by entrepreneur		2.98	
29		**Actual markup charged by entrepreneur**	**14.61**	**17.25**	**2.64**

Sheet name as per attached tariffs and taxes base model: "Change in toilet price"

However, as mentioned in subsection 3.3.3-A, the entrepreneur, in anticipation of the rebates on tariff and VAT, may choose not to pass on the entirety of the potential price reduction to the end customer. The base model, therefore, introduces a pass-through rate which is the percentage of the total price reduction (at a given level of tariff and taxes) that the entrepreneur chooses to pass on to the customer. At a 100% pass-through rate, the entire price reduction possible at a given level of tariff and taxes is passed on to the customer; conversely, at a zero percent pass-through rate, the entrepreneur chooses to retain the entire price reduction possible as additional profit, and the customer does not receive any reduction in price. The pass-through rate can be adjusted by the user in the "Dashboard" sheet and based on the value set there, the value in cell "E28" in Figure 31 will update automatically. The retained value in "E28" is added to the entrepreneur's markup at the original markup percentage ("E25") to arrive at the actual markup the entrepreneur would charge ("E29") once the policy lever is introduced.

The change in the entrepreneur's total cost, and the actual markup charged are linked to the table shown in Figure 32 ("Row 5" and "Row 6" respectively"). These figures are added to arrive at the entrepreneur's unit price per toilet ("Row 7"), and the actual output vat charged to the customer is calculated on this amount. The VAT rates used are taken from the original VAT rate and new VAT rate for the value added by the entrepreneur, as entered in the "Dashboard" sheet.

Figure 32: Determining the change in toilet price for the end customer

	B	C	D	E	F
3		Head	Data		
4	Change in Sales Price of Toilet		Original (USD)	New (USD)	Change (USD)
5		**Total Cost**	**33.86**	**33.09**	**(0.77)**
6		Markup	14.61	17.25	**2.64**
7		**Entrepreneur's unit price (excluding VAT)**	**48.47**	**50.34**	**1.87**
8		Output VAT charged to customer	4.85	-	**(4.85)**
9		**Total sales price (including VAT)**	**53.32**	**50.34**	**(2.98)**

Sheet name as per attached tariffs and taxes base model: "Change in toilet price"

Of the three variations supported by the base model, no changes need to be made to this sheet if the number of toilet inputs, or the number of stages in the value chain of toilet inputs changes as adjustments made in other sheets will automatically reflect here. However, if the delivery model changes, significant changes to this sheet would be required, as elaborated below:

- First, the table used to compute the change in entrepreneur's markup (Figure 31) is not needed and can be deleted
- Second, the effect of tariff reduction and change in output VAT does not need to be calculated separately. Instead, the total sales price of each toilet input charged by the last actor in the value chain can be directly imported from the relevant input calculation sheet. This is because the customer buys individual inputs and therefore there is no need to determine the output VAT charged by an entity that aggregates these inputs to produce a toilet
- Third, the change in toilet input prices does not need to be aggregated as was shown in Figure 30, as there is no entrepreneur who is reducing the cost of producing a toilet, hence this table can be deleted

Step 8: Determining the change in entrepreneur viability

In the base model, the effect of the policy levers on a representative sanitation entrepreneur was estimated in the "Profit and loss statement" account. The construction and workings of this output sheet have been explained in detail in subsection 3.3.3-B; and hence, this is not repeated here. Instead, here we focus on changes that may be needed to this sheet when adapting it to a different geography.

Of the three types of variations supported by the base model, neither a change in the number of toilet inputs, nor a change in the number of stages in the value chain of toilet inputs would result in a change in this sheet. This is because adjustments made in the other sheets should automatically feed into this output sheet.

However, in the third variation discussed, the nature of the delivery model has a significant impact on this output sheet. If the delivery model in the selected geography is a DIY model, in place of the focal point model assumed in the base model, then there is no sanitation entrepreneur whose viability can be modeled. Hence, in this scenario the user would not need the "Profit and loss statement" sheet and can delete it when adapting the model.

STAGE 4: UPDATING THE USER DASHBOARD

Step 9: Modifying the control panel

The green table depicted in Figure 33 is the control panel constructed for the base model. As described in subsection 3.3.4-A, the control panel allows the user to: a) make key decisions about the applicability of the policy lever; and b) change the value of key variables that determine the output of the model. The user can choose which toilet inputs the tariff and tax rebates are applied to by changing the selection in the drop-down menus found in cells "D5" to "D10"; selecting a value of "1" in any of these cells will automatically apply the policy to that cell, while selecting a value of "0" excludes the corresponding toilet input from the policy lever.

The key variables that can be modified include: the tariff rate on toilet components ("F8" and "F9"); the VAT rate on toilet inputs ("H5" to "H10"); the corporate income tax rate "H13"; and the pass-through

rate of the entrepreneur "H15." It should be noted that the tariff and VAT rates can only be modified for those toilet inputs that are selected for application of the policy lever. If the value in "Column D" is set to "0" for any toilet input, the corresponding cells in "Column E" to "Column H" are blanked out preventing the user from inputting any values.

The control panel is linked to nearly every sheet in the model. The tariff and VAT rates in "Column F" and "Column H" are linked to the individual toilet input calculation sheets, as well as the "VAT Account" sheet, and the "Change in toilet price" sheet. The corporate income tax rate "H13" is linked to the "Profit and loss statement" sheet, and the pass-through rate "H15" is linked to the "Change in toilet price" sheet. The duration of the policy "H17" is linked to cost to government in the Dashboard sheet. The number of entrepreneurs "H19" is linked to the "General Inputs" sheet.

Figure 33: Step 9 - modifying the control panel

	A	B	C	D	E	F	G	H
2								
3		Control Panel						
4			Toilet inputs	Applicability	Existing Tariff Rate	New Tariff Rate	Existing VAT Rate	New VAT Rate
5		Tariffs and indirect taxes	Sand	1			10.0%	0.0%
6			Cement	1	15.0%		10.0%	0.0%
7			Rebar	1	7.0%		10.0%	0.0%
8			Ceramic pan	1	7.0%	0.0%	10.0%	0.0%
9			PVC pipe	1	7.0%	0.0%	10.0%	0.0%
10			Value added by entrepreneur	1			10.0%	0.0%
11								
12			Head				Original Value	New Value
13		Corporate tax rates	Corporate income tax rate paid by Entrepreneur				10%	5%
14								
15		Pass-through rate	Entrepreneur's pass through rate					50%
16								
17		Duration	Desired duration of the policy (months)					24 months
18								
19		Entrepreneurs	Number of active entrepreneurs					876 entrepreneurs
20								
21		Notes		*The demand for toilets will be met before the user-defined duration of the policy. The cost to government will be calculated for the duration it will take to meet demand i.e. ~9 months.*				

Sheet name as per attached tariffs and taxes base model: "Dashboard"

The control panel would need to be modified when adapted to a different geography. For example, the existing tariff, VAT, and corporate income tax rates would need to be updated in line with the rates in the selected geography. Further, if the prevalent toilet model in the selected geography has a different number of toilet inputs than depicted in the base model, the user would need to either add additional rows to the control panel, or delete the surplus rows. If rows need to be added, the user needs to replicate the drop-down menus and conditional formatting used in the existing rows. More importantly, a number of "IF functions" have been used in the linked sheets to determine when the values entered in the control panel should be imported; for instance if the value in "Column D" is set to "0" for a particular toilet input, the tariff/ VAT rate for that input should not change in the relevant toilet input calculation sheet, or in the "VAT account" sheet, or in the "Change in toilet price sheet." When adding additional toilet inputs, the user would need to identify the places in linked sheets where these values need to be exported and ensure the "IF functions" are updated in these sheets.

Additionally, in adapting this model to a different geography, the number of active entrepreneurs will need to be updated. The number of active entrepreneurs is a key figure in the model as its impacts both the duration it takes to meet the demand for toilets and the cost to the government.

The dialogue in the control panel in cell "D30:H30" is calculated automatically based on the inputs previously entered by the user. The dialogue displays to the user whether the demand for additional toilets will be met in the defined duration of months of the policy at the new sales price. In case the

demand at the new sales price is met, it tells the user the period for which the cost to the government will be calculated. In case the demand at the new sales price is not met, it tells the user the number of additional entrepreneurs needed to fulfill the demand within the user-defined duration. The calculation for additional entrepreneurs needed works for up to a 1000 entrepreneurs inputted (since demand typically fulfills through that many entrepreneurs for most input values in the model). The dialogue text is dynamic and updates as the inputs are changed.

The inputs of the dialogue are sourced from a backup calculation performed in sheet "General Inputs" below "Row 63." To prevent any accidental changes to the backup calculation, the cells performing the calculation in sheet "General Inputs" are locked. To unlock these cells, a user has to 'Unprotect' the sheet by clicking on 'Review' in their Microsoft Excel Ribbon (see green box in Figure 34), and then "Unprotect sheet" (see red box in Figure 34). Performing such an action will reveal a data table that calculates the duration that will be required to meet the demand at the new sales price across 1-10,000 entrepreneurs. As this data table only performs a minor calculation in the dialogue box on the "Dashboard" sheet, it was made a part of the backup calculation and hidden from view. In case the user updates the model, the hidden data table will automatically update. To ensure that the data table automatically updates, the user should open Microsoft Excel options, go to 'Formulas' (see green box in Figure 35) and then enable 'Automatic' calculations (see red box in Figure 35).

Figure 34: Setting changes to unhide data table for dialogue box calculations

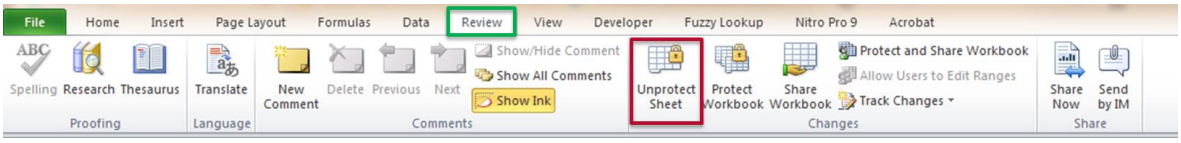
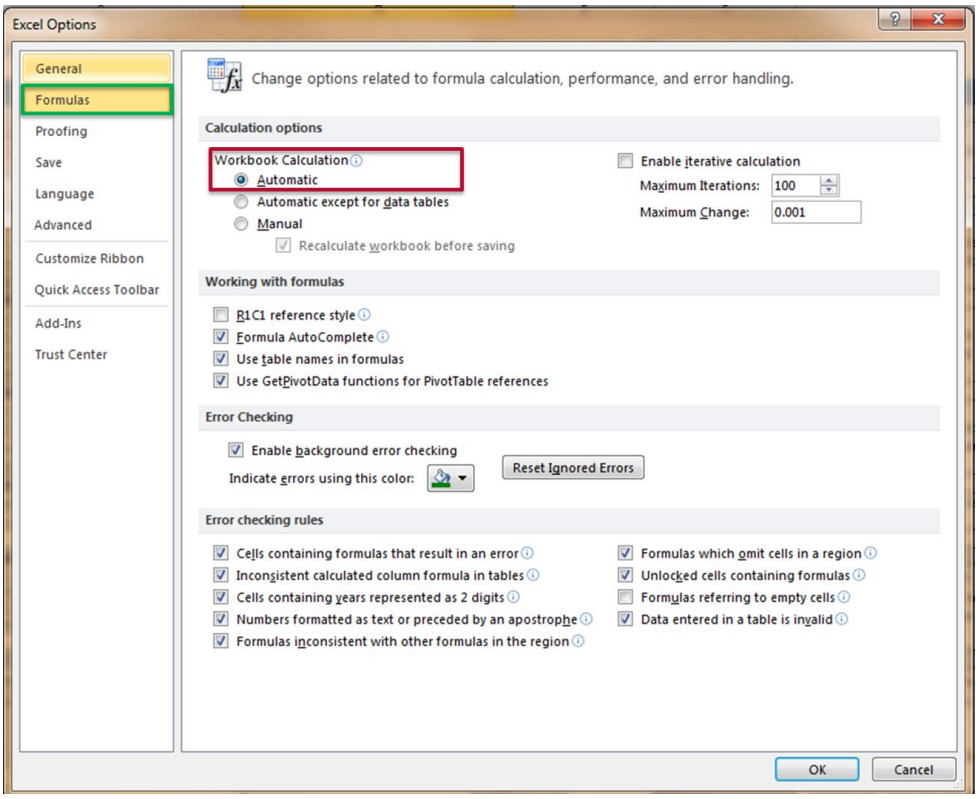


Figure 35: Setting changes to enable automatic calculation of data tables



Step 10: Modifying the 'impact of the policy' table

The user dashboard displays only the key impacts of the tariffs and taxes base model; both in terms of the potential benefits that may accrue from the proposed policy levers and the costs associated with administering these levers. These impacts are displayed in the "Impact of the policy table" in the "Dashboard" sheet (see Figure 36). There are three main impacts presented in the "Dashboard sheet":

- **Change in sanitation coverage** (see the green box in Figure 36): Change in sanitation coverage is measured in terms of the number of additional households that demand a toilet due to the reduction in toilet price. This is expressed both in absolute terms ("Row 28") and in percentage terms ("Row 29"). Additionally, the estimated time it will take for supply to meet the additional demand is computed ("Row 30") based on the number of sanitation entrepreneurs in the country, and the average number of toilets sold in a month per sanitation entrepreneur (these values are taken from the data entered in the "General Inputs" sheet; data on the number of active entrepreneurs is entered in cell "H19" of the "Dashboard" sheet). The increase in toilets demanded is calculated based on the price elasticity of demand defined in the "General Inputs" sheet

Figure 36: Modifying the impact of the policy table in the user dashboard

Impact of the Policy

	Head	Data			
		Current values	At original sales price of USD 53.32	At new sales price of USD 50.34	Difference
Change in Sanitation Coverage	Total rural population	27,09,072			
	# Households demanding toilets		1,66,391	1,98,573	32,182
	# Households with access to improved sanitation facilities	10,45,160	12,11,551	12,43,733	32,182
	Rural sanitation coverage (%)	**38.58%**	**44.72%**	**45.91%**	**1.19%**
	Number of months taken to meet demand for toilets		8.3	8.3	

	Head	Data		
		Original (USD)	New (USD)	Change (USD)
Change in Entrepreneur Viability	Total sales price (including VAT)/ toilet (annual)	53.32	50.34	(2.98)
	Value-added Tax/ toilet (annual)	4.85	-	(4.85)
	Sales price (excluding VAT)/ toilet	**48.47**	**50.34**	**1.87**
	Number of toilets sold per entrepreneur/ year	**276**	**329**	**53**
	Total revenue per entrepreneur (annual)	13,377.61	16,561.79	3,184.18
	Profit before tax per entrepreneur (annual)	4,031.14	5,674.88	1,643.75
	Corporate income tax paid per entrepreneur (annual)	403.11	283.74	(119.37)
	Profit after tax per entrepreneur (annual)	**3,628.02**	**5,391.14**	**1,763**
	Profit margin per entrepreneur	**27.12%**	**32.55%**	**5.43%**

	Head	Data		
		Original (USD)	New (USD)	Change (USD)
Cost to the Government (over 8 months)	VAT revenue to government	8,06,490.66	-	(8,06,490.66)
	Corporate income tax revenue to government	2,43,023.42	1,71,258.18	(71,765.24)
	Tariff revenue to the government	1,66,054.39	-	(1,66,054.39)
	Total cost to the government			**10,44,310**
	Cost per toilet			**0.84**
	Cost per additional toilet			**32.45**

Sheet name as per attached tariffs and taxes base model: "Dashboard"

- **Change in entrepreneur viability** (see the yellow box in Figure 36): Change in viability is presented for a representative entrepreneur, and is measured in terms of change in the number

of toilets sold at the reduced price ("Row 37"), the change in total annual revenue ("Row 38"), change in profit after tax (in absolute terms – "Row 41"), and change in profitability (in terms of change in profit margins – "Row 42"). These figures are imported from the "Change in toilet price" sheet and the "Profit and loss statement" sheet

- **Cost to the government** (see the blue box in Figure 36): The total cost to the government ("G49") is the sum of the losses in VAT revenue ("G46"), corporate income tax revenue ("G47"), and tariff revenue ("G48'). Each of these is calculated by determining the revenue the government would have collected from toilet inputs and sanitation entrepreneurs based on the number of toilets sold before the policy levers were introduced and subtracting from this the revenue earned at the new number of toilets sold after the introduction of the policy lever

  The cost to government has been calculated for the lower of either the actual duration to meet the demand for toilets at the new sales price ("Row 30") or the user-defined duration of the policy (Cell "H17" in Figure 19). For example, if the demand for toilets at new sales price is met in 8 months but the user-defined duration of the policy is 24 months, the government will be able to collect tax and tariff revenue for only 8 months and the cost to government is calculated for that period. However, if the demand for toilets at new sales price gets satisfied in 8 months, but the user-defined duration of the policy is 6 months, the cost to government will be calculated for only 6 months as it has been assumed that the user wants to know the impact of the policy for 6 months only.

  In addition to the overall cost to the government, we also computed the cost per toilet sold after the introduction of the policy lever. However, there is some degree of unfulfilled demand even at the original price of the toilet; hence, to get an accurate picture of the cost per toilet, the overall cost to the government should be divided by the number of additional toilets demanded over and above those demanded at the original cost

When adapting the model to a different geography, the user should not have to make any changes to this table as it will update automatically based on the changes made in other sheets in the model. However, if the delivery model in the selected geography is a DIY model, then there is no entrepreneur whose viability needs to be estimated; hence, the yellow table in Figure 36 can be deleted. Further, in the cost to government, there will be no cost due to reduction in corporate income tax revenue ("Row 40").

However, in case there is a DIY delivery model there may be additional administrative costs incurred by the government. If there is no entrepreneur, the only way the VAT rebate can work is if it is provided directly to the customer. To claim the VAT rebate, the customer would need to demonstrate that he/she has built a toilet and provide the government with a bill of quantities for all the inputs used in building that toilet. This is similar to how travelers may claim VAT rebate on goods purchased in foreign countries upon presenting a valid bill of purchase when leaving that country. While this may be possible, the human resource and infrastructure required to verify that a customer has built a toilet, and to issue the rebate directly to households, would likely result in significant administrative costs.

5.0 CHECKING FOR ERRORS

The previous chapter discussed how the base model could be modified for use in different geographies/ markets. While in some instances adapting the model may be fairly straightforward, in other cases it may require changes to the structure of the model and the formulae used. In the latter instance, there are chances that the changes made may not reflect throughout the model, or that the formulae in some sheets are not updated accurately. Even if the changes made don't actually require changes to the structure and formulae, it is possible for errors to be made in the way the data is entered in the input sheets and how these sheets are linked to each other. If either case occurs, the model would generate faulty outputs, and/or there may be errors that prevent it from generating any outputs at all. Some of the common pitfalls that occur when adapting an existing model are mentioned in Box 2.

There are a series of checks the user should run in order to ensure the model is error-free. The main checks that should be carried out are described below:

i. **Hygiene checks:** These are basic quality checks that should be done sheet-wise as the user finishes updating a sheet, and again at the end once all updates have been made. The hygiene checks include:

   a. Going through each sheet and making sure none of the cells contain error messages such as "#REF!"; if such an error does exist, it means that there is an incorrectly linked formula, and/ or one of the cells the formula refers to has been renamed or deleted

   b. Ensuring hardcoded data has been entered and cleaned correctly and there are no errors such as the wrong unit being used for a number (extra zeroes, or too few zeroes), misplaced decimal points, incorrect formatting of cells (e.g., format type set to number instead of percentage when entering percentages)

   c. Ensuring that links in and links out from a sheet connected to the correct cells. For example, ensuring that links out to the urban enforcement schedule are from the urban sanitation coverage inputs sheet and not the rural sanitation coverage sheet

   d. Ensuring that only the data that is to be displayed is being displayed in cases where conditional ("IF") functions have been used.

ii. **Stress tests:** Stress tests involve deliberately introducing extreme values into the model and doing a sense check to see if the resultant outputs are valid. This involves using values that are either known to be unrealistic, or are outside a defined range set by the model and seeing if the logical relationships still hold. For example, if tariff rates are set at 100% and there is still a net increase/ decrease in sanitation coverage, it indicates that one of the formulae governing the logical relationship has broken down. Similarly, if very high and very low values are set for the key variables but there is no discernable change in the net sanitation coverage, it implies that either a formula is not correctly implied, or the key variable selected is inappropriate. It is recommended that this test be done for all key variables, but one at a time; i.e., at any time one of the key variables should be varied while holding the values of the others constant

iii. **Testing for overweight variables:** This is a subset of the stress test. While testing the key variables individually, the user should also see whether any of the variables has a disproportionate effect on the outputs. If this is the case, it could be due to incorrect hardcoded data, or an assumption that gives undue/ insufficient importance to one of the key variables. In this case, the price elasticity of demand has a significant effect on the overall output of the model, i.e., the increase in sanitation coverage. However, it should be noted that sometimes extreme values may result due to the context in the chosen geography/ market

iv. **Scenario tests:** This test flips the model on its head. Starting with a desired output, the user tests to see the combination of key variables that are required to achieve this pre-defined output. For example, if a minimum 10% increase in sanitation coverage is desired within 24 months, what combination of values for the key variables would achieve this? The user then needs to do a sense check to ascertain whether this combination of variables is realistic or not. Note, for this test to work, the user should have a general idea of what is realistically achievable in a given context

v. **Field tests:** The final test is an external test, as opposed to the earlier four tests which are all internal to the model. Field testing means validating the model (and its predicted outputs) with experts who have in-depth experience in the sanitation sector in the selected geography/ market. Reactions from these experts can help refine assumptions and correct any logical flaws there may be in the model

Box 2: Common pitfalls in adapting an existing model

Common Pitfalls

Some of the common mistakes made while updating an existing model include:

- **Incomplete adaptation:** The different sheets in the base model contain multiple linkages to each other and changes to any one will require changes in all linked sheets. For example, if the user changes the number of housing segments in the input sheets, he/ she would need to make similar changes in the calculation, output, and dashboard sheets
- **Overwriting formulae:** To enable the interlinkage of sheets, a number of cells have formulae that import data from source cells. When updating these linked cells, changes need to be made in the source cells. If data is hardcoded into a linked cell, it may lead to erroneous outputs
- **Linking wrong cells:** When working with multiple housing segments, toilet types and geographic units, it is possible that errors can be made in linking data. For example, linking the cement import price to the sand calculations sheet
- **Deleting linked cells:** Another challenge of working with linked cells is that if the user deletes any such cell, all linked cells would be affected and it may be difficult to trace back the error
- **Working with named cells:** Some of the cells in the input and calculation sheets have been named and the formulae that link to these cells utilize the name of these cells. This may result in some challenges when updating the model. For example, if the name of any of these cells is changed, the formulae that link to these cells will break. Similarly, dragging formulae that contain names of cells would copy the exact value in the original cells rather than replicate the formulae

6.0 USING THE MODEL AS A DECISION MAKING TOOL

Once the user has finished adapting the model and checking for errors, the model can be used to generate outputs which can facilitate decision-making on sanitation policymaking. The model outputs can aid decision-making through 3 key benefits:

- Users can use the model to aid **prioritization** of different target markets and policies. They can compare the impact of applying the policy to different target markets under their purview. For example, users of the base model can compare the impact of applying the policy to urban vs. rural segments in Cambodia. They can also compare the impact of applying the policy in their target market, to the impact of applying other policies (for which similar models may exist).
- User can gather inputs to **plan implementation** from a financial and operational perspective, which can be used for advocacy and budgeting purposes. This model can generate estimates of the total foregone tax revenue required for achieving a desired change in sanitation coverage, as well the types of taxes which need to be reduced, such as corporate tax vs. value-added tax, and for which inputs.
- Finally, users can use the model to **strengthen the confidence of decision-makers** on the policy by identifying the critical factors that drive the outputs of this model, which may warrant further investigation. For example, the price elasticity is a critical factor that drives the outputs of the model. Users can choose to conduct further research on understanding this factor to get more robust estimates. This develops greater confidence on the potential efficacy of the policy and enables buy-in from different stakeholders.

7.0 LIMITATIONS OF THE MODEL

The model described in this guide can be a powerful tool for policymakers to support their decision-making on sanitation-related market rules. However, the model has limitations since it is based on an economic modeling approach; more specifically, this model is limited by its reliance on publically available data and select expert interviews.

Economic modeling has certain inherent limitations as an analytical tool and these are reflected in this model:

- **Economic models are an abstraction of reality, and cannot include all the logical relationships** that influence the model outputs since the precise mathematical equation for such relationships may not be known.

- **Economic models hold certain systemic or macroeconomic factors constant over time** as they are hard to predict or model. However, if contextual factors do change, the data in the model may need to be updated to reflect this. Below, we highlight the most pertinent contextual factors which are assumed to be constant in the base model:

    - **Variety of toilets available:** The base model assumes that the kinds of toilets available in Cambodia will not change for the duration of the policy. However, a change in the type of toilets available may impact the price of available toilets, leading to a change in rebate levels.
    - **Political and economic environment:** If there is an economic crisis in the country, the ability of households to afford toilets may be drastically affected (thus impacting the price elasticity), and/ or the ability of entrepreneurs to access capital to run their businesses may be severely limited (thus reducing the supply of toilets in the market).

In all of the above cases, stakeholders need to exercise their judgment when entering values for variables to ensure they are as close to a reflection of reality. At the same time, they need to complement the outputs produced by the model with their understanding of the ground-level realities of the markets they hope to influence. Doing this ensures that the model produces more robust outputs that are useful for guiding decision-making in most 'normal' conditions.

This model is further limited due to the fact that it was built using publically available data and select interviews with experts. Economic models require a minimum base level of data and the estimates generated are only as good as the quality of underlying data. As such, the data used to construct the model lacks granularity, which can manifest as an issue in multiple ways:

- **The quality of outputs can significantly reduce due to errors in estimating the most sensitive variables** as data for many such variables is not available publically at a sufficiently granular level. Any errors in such variables get amplified as the model outputs are highly sensitive to them. Below, we highlight the most pertinent of these variables for this model:

    - **Demand curve of toilets in target market:** The output in the model is highly sensitive to the nature of the demand curve for toilets. Even minute variations in the demand curve can lead to significantly different coverage outcomes. For the base model, we were able to obtain the required information from a report by IDinsight (IDinsight, 2013) as previously detailed in Section 3.3.1-D. The report provided information

regarding the percentage of households without toilets that would buy a toilet at different price points, and presented the data in the form of a demand curve (Figure 10).

- **Entrepreneur pass-through rate:** Entrepreneur pass-through rate affects the amount of rebate that is passed onto the customer. Therefore, entrepreneur pass-through rate has a significant influence on the price of the toilet for the customer and consequently, sanitation coverage.

Users of the model should sufficiently validate the accuracy of the above variables.

- **The model does not incorporate all the intricacies of a typical policy process** since it is based on sample market rules. The different processes of the market rule were modeled based on publically available data and select expert interviews. For example, the tax system in this model is based on a Value Added Taxation (VAT) system, which is not followed universally. Further, these processes encapsulate the major stages of the policy and do not detail the sub-stages or intermediate minor stages, which are unavailable in the public domain and not captured in the models.

ANNEX 1: ACKNOWLEDGMENTS

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ANNEX 2: REFERENCES

The tariffs and taxes base model was constructed using secondary data on Cambodia. The key references used in the base model are listed below:

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