STEP-BY-STEP MONITORING METHODOLOGY FOR INDICATOR 6.3.1 DRAFT

Please note that the following document is work in progress, to be revised in the third quarter of 2016, based on country feedback – version 20 May 2016

PROPORTION OF WASTEWATER SAFELY TREATED

1. MONITORING CONTEXT

1.1 INTRODUCTION OF THE INDICATOR

Target 6.3 **By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally**

Indicator 6.3.1 **Proportion of wastewater safely treated**

Target 6.3 sets out to improve ambient water quality, which is essential to protect ecosystem health (Target 6.6) and human health by protecting recreational waters and drinking water sources (Target 6.1), by eliminating, minimizing and significantly reducing different streams of pollution into water bodies. The main sources of pollution include wastewater from households and economic activities (point sources), as well as runoff from urban and agricultural land (diffuse sources).

The indicator addresses the proportion of all wastewater generated that is safely treated at source or through centralized wastewater treatment plants before it is discharged into the environment impacting ambient water quality)with implications on human and ecosystem health) as measured by indicator 6.3.2 “proportion of bodies of water with good ambient water quality ”. The target wording covers wastewater recycling and safe reuse (with implication on water use efficiency), although it is not fully addressed by the global indicator and methodology.

Indicator 6.3.1 measures the proportion of wastewater generated by households and by economic activities (based on ISIC categories) that is safely treated compared to total wastewater generated by households and economic activities.

This guide is in two parts: Part A covers the methodology for wastewater generated by households (in common with Indicator 6.2.1) and Part B covers the methodology for hazardous-economic activities (industrial wastewater) pre-treated at source before discharge to either the sewer for further treatment or directly to the environment.

Part A responds to the target wording "**halving the proportion of untreated wastewater"** by monitoring household and non-hazardous economic activities treated in municipal treatments plants. The methodology is dual-purpose with indicator 6.2.1 "the proportion of population using safely managed sanitation services…" This approach should lead to efficiencies in data collection, allowing the fate of household wastewater from all sanitation sources to be analyzed together and guide investment towards the parts of the service chain where there is greatest need.

The methodology for Part B is intended to address the target wording "**eliminating dumping and minimizing release of hazardous chemicals"** by monitoring generation and pre-treatment of hazardous wastewater at source. This approach should lead to greater knowledge of all discharges from economic activities and increase the proportion that are meeting discharges standards by reducing use of hazardous substances and/or improving pretreatment to protect downstream municipal wastewater treatment plants and the environment.

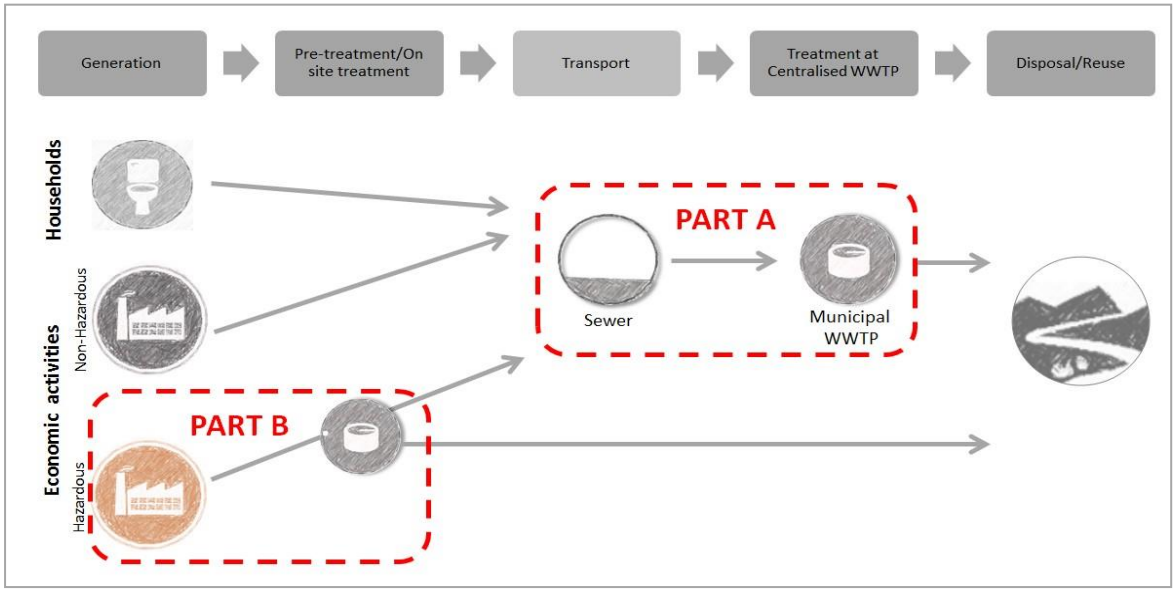

Figure 1: Part A "halving the proportion of untreated wastewater" versus Part B is intended to address the target wording "eliminating dumping and minimizing release of hazardous chemicals"

1.2 TARGET SETTING FOR THE INDICATOR

The 2030 Agenda for Sustainable Development specifies that all SDG targets "are defined as aspirational and global, with each Government setting its own national targets guided by the global level of ambition but taking into account national circumstances." The global ambition of the target 6.3 is to "halve the proportion of untreated wastewater" and "substantially increase recycling and safe reuse". It is up to each country to set their own target for the indicator and define acceptable levels of treatment for the receiving environment and downstream use. Draft treatment definitions building on the UN Statistical Division SEEA-Water (2012) definitions are included in this monitoring guide as a reference for national definitions and target setting.

PART A: WASTEWATER FROM HOUSEHOLDS

1. PROPOSED MONITORING METHODOLOGY

1.1 MONITORING CONCEPT AND DEFINITIONS

1.1.1 DEFINING WASTEWATER GENERATED BY HOUSEHOLDS

The proposed SDG sanitation service ladder (refer to the step-by-step methodology for indicator 6.2.1) will be used to track progress across countries at different stages of development; the key terms are further explained below:

- Improved sanitation facilities: These include flush or pour flush toilets connected to a piped sewer system, septic tank, or pit latrine; ventilated improved pit (VIP) latrines; pit latrines with slab; and composting toilets.

- Not shared with other households: The possible negative impacts of shared sanitation facilities have long been debated. The main concerns centre on human rights, safety and dignity, with health as an important but secondary issue. It is acknowledged that this is very much a contextual issue, and for the purposes of global monitoring WHO/UNICEF JMP will exclude shared facilities from basic and safely managed services.

- Safely disposed/treated in situ: When pit latrines and septic tanks are not emptied, the excreta may still remain isolated from human contact and can be considered safely managed. For example, with the new SDG indicator, households that use twin pit latrines or safely abandon full pit latrines and dig new facilities, a common practice in rural areas, would be counted as using safely managed sanitation services.

- Treated offsite: Not all excreta from toilet facilities conveyed in sewers (as wastewater) or emptied from pit latrines and septic tanks (as faecal sludge) reaches a treatment plant. For instance, a portion may leak from the sewer itself or, due to broken pumping installations, be discharged directly to the environment. Similarly, a portion of the faecal sludge emptied from containers may be discharged into open drains, to open ground or water bodies, rather than being transported to a treatment plant. And finally, even once the excreta reaches a treatment plant a portion may remain untreated, due to dysfunctional treatment equipment or inadequate treatment capacity, and be discharged to the environment. For the purposes of SDG monitoring, adequacy of treatment will be assessed through consideration of both the overall treatment effectiveness and end-use/disposal arrangements.

The percentage of population with safely treated wastewater is therefore defined as:

- The fraction of households using a basic sanitation service whose excreta:
  - Are carried through a sewer network to a designated location (e.g. treatment facility) and are treated at a treatment plant to an agreed level; or
  - Are emptied from septic tanks or latrine pits by an approved method that limits human contact and transported to a designated location (e.g. treatment facility) and treated to an agreed level; or
  - Are not emptied but stored on site (e.g. in a twin pit latrine) until they are safe to handle and re-use (e.g. as an agricultural input).

The 'safely treated wastewater generated by households' (i.e. wastewater and faecal sludge) will be dual-purpose, covering SDG Target 6.3 as well as SDG Target 6.2 'safely managed sanitation'.

1.1.2 PROPOSED MONITORING FRAMEWORK

Monitoring the safely treated wastewater generated by households will require tracking how household wastewater and excreta are managed along the sanitation chain. Monitoring at each step of the chain captures the fate of all wastewater generated by households, not only the percentage that is treated at treatment works, but also the fraction that is safety treated in-situ, or that leaks from sewers, or that is dumped untreated in the environment.

Practitioners represent this process as a mass-balance framework, as shown in Figure 1. Flows from each facility type are classified at each step along the sanitation chain as either 'safe' or 'unsafe'. The green arrows represent safely managed flows, while the red arrows indicate unsafe discharges to the environment. This approach is being proposed for use in selected Proof of Concept countries to evaluate its appropriateness for monitoring of the safe management of sanitation services including the final safe treatment step at national and global levels.

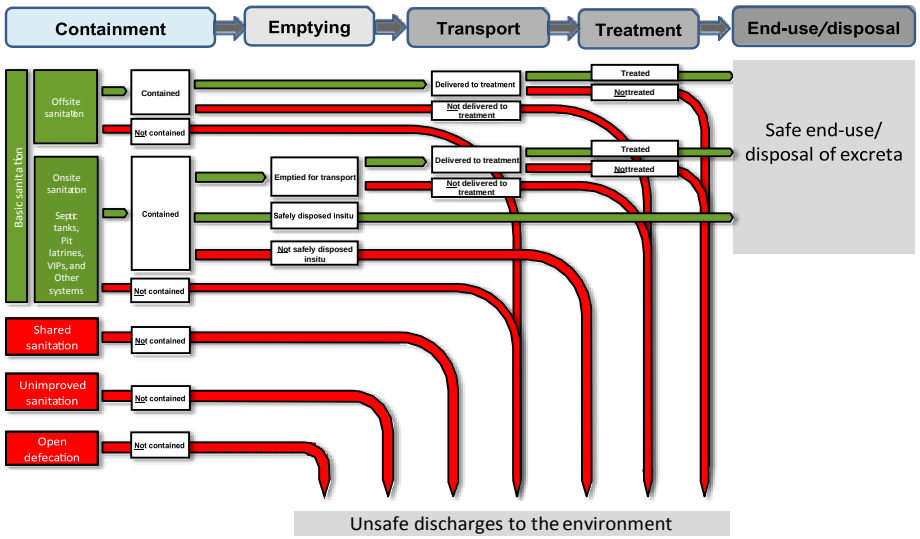

Figure 1 Mass-balance framework of excreta flows (Source: author, adapted from SuSana, 2015)

The value of the flows represented by each of the green and red arrows can be calculated using a simple framework for any location or situation, as shown in Figure 2.

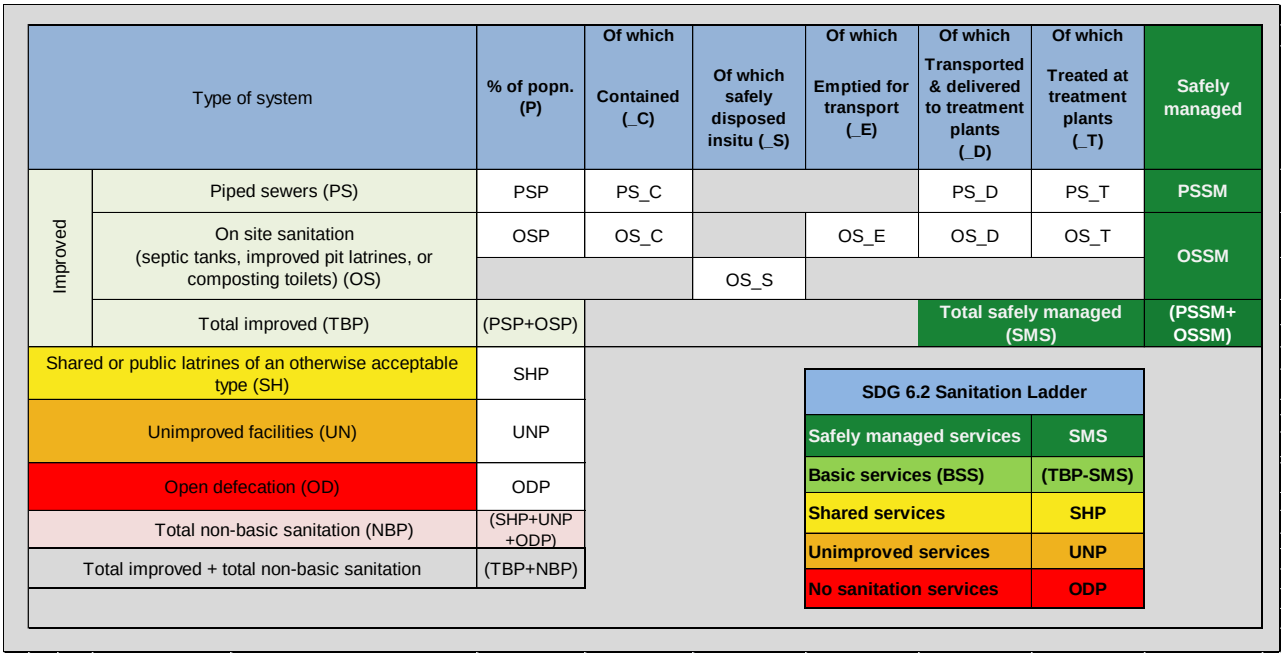

Figure 2 Framework for monitoring the safely treated wastewater generated by households (also indicator 6.2.1)

The key components of this framework are further explained below:

Type of system

The left hand column is organised in accordance with the proposed SDG sanitation ladder divided into the four basic service types:

- Piped sewers
- Septic tanks
- Improved pit latrines (simple pit latrines with slabs, or Ventilated Improved Latrines)
- Composting toilets

Below this are the sanitation systems that are considered not to meet the requirements of basic services split into:

- Pit latrines without a slab
- Hanging latrines, bucket latrines and other facilities that flush to locations other than improved pits, septic tanks or sewer lines
- Open defecation

Shared sanitation of an otherwise improved type may not be considered a basic service, and its estimations will be done in the same manner as was done for the MDGs. Therefore discounting of shared sanitation from the safely managed sanitation services will also be done accordingly.

Besides the Type of System column, across the top are seven main column headings. Each of the blue shaded headings refers to a stage of the sanitation chain and to a variable, the value of which could be different in every location. In-depth investigation of each of these stages in the sanitation chain is being put forward for testing in Proof of Concept countries but may not be appropriate for the purposes of global monitoring. The variables are further explained below.

% of population (P)

This variable is the proportion of the population using each system type. For any country included in MDG monitoring these data are available from the JMP country files, and are typically derived from national household surveys and censuses which allow respondents to report using a range of different sanitation technologies. These data can be aggregated into each of the eight main system types for the vast majority of countries.

Of which contained (_C)

This variable is for the proportion of the population using each system type that is 'contained'. Household survey and census data does not differentiate between septic tanks that are working properly and those that are not; for example, septic tanks that are damaged, cracked or flooded or where the effluent outlet is connected to an open drain. It is important to make this differentiation as where basic sanitation systems are not working properly it is necessary to identify that the excreta are not safely managed. The fraction of the population using 'basic' sanitation systems that are considered to be working properly is subsequently used in the next stages of the framework.

Of which Safely disposed in situ (_S)

This variable represents the proportion of the population using 'contained' toilet facilities in which excreta are safely stored in situ as per the 6.2.1 definition. This only applies to those using the three 'basic' onsite sanitation system types namely, septic tanks, improved pit latrines and composting toilets. For example, it includes the fraction of the population whose excreta is 'safely disposed in situ' using a twin pit latrine facility or through covering and sealing a full latrine pit.

Of which Emptied for transport (_E)

Similar to the above, this variable only applies to the proportion of the population using the three 'basic' onsite sanitation system types and represents the fraction using each of these that is 'contained', which is 'emptied for transport.' This includes those whose excreta are emptied from onsite containers using a system that prevents unsafe contact between the emptier and the excreta.

This fraction is used in the next stage of the framework.

Of which transported and delivered to treatment plants (_D)

For the proportion of the population using 'to piped sewers' this variable represents the proportion of the population whose excreta are 'contained', which is conveyed in closed sewer pipes that is delivered to a treatment plant. It does not include the fraction whose excreta leak from sewers or discharge directly to the environment before reaching the treatment plant. Similarly, for the three basic onsite sanitation system types, it represents the proportion of the population whose excreta (i.e. faecal sludge) are 'contained', 'emptied for transport', which are transported using a method that safely separates the transporter from the excreta and are delivered to a

treatment plant. It does not include the fraction whose excreta are discharged without treatment to the environment (to open drains, to open ground or to water bodies).

This fraction is used in the next stage of the framework.

Of which safely treated at treatment plants (_T)

This variable represents the proportion of the population whose excreta are treated at treatment plants. This includes both the excreta delivered via sewer pipes (i.e. wastewater) and that delivered by vehicles (i.e. faecal sludge). It does not include the fraction delivered to treatment plants but that remains untreated and is discharged direct to the environment. This could be where the plant is not working or working sub-optimally.

Treatment implies any process for rendering wastewater fit to meet applicable environmental standards or other quality norms; treatment can be categorized into primary, secondary, and tertiary treatment levels, with further categorization by mechanical, biological, and advanced technologies and treatment efficiency.

Importantly, the treatment level and performance of the treatment plant should be considered together with the end use of the treated fractions. The former will be measured in terms of the proportion of the treated fractions that complies with discharge limits. While an assessment of the likely environmental and public health exposure risk from the end use will help inform the latter (refer Figure 4).

These normative definitions proposed by GEMI align with the System of Environmental Economic Accounting (SEEA) definitions, statistical standards and treatment categories and would be used both with Target 6.2 and Target 6.3.

Focus on public health dimension

Focus on environmental dimension

Treatment Level	Exposure		
	High (reuse for food production)	Medium (disposal on land or water bodies – not for food production)	Low exposure (long ocean outfall or groundwater recharge)
Advanced treatment	Safely managed	Safely managed	Safely managed
Tertiary treatment	Safely managed[1]	Safely managed [1, 2]	Safely managed
Secondary treatment	Not safely managed	Safely managed[2]	Safely managed
Primary treatment	Not safely managed	Not safely managed	Safely managed
No treatment	Not safely managed	Not safely managed	Not safely managed

[1] where only advanced N,P removal then classed as 'not safely managed'
[2] where disposal is in proximity of bathing areas then classed as 'not safely managed'

Figure 4: Treatment level/exposure matrix for wastewater (and liquid fraction of faecal sludge)

1.2 Recommendations on spatial and temporal coverage

Spatial coverage

There are often distinct differences in the manner that sanitation and wastewater services are managed in rural and urban-areas. For example, in rural areas of Africa and South Asia the use of pit latrines and septic tanks – onsite sanitation not connected to sewers predominates; while households in towns and cities are often served by a mix of onsite sanitation and connections to sewerage. In each country, it is recommended that monitoring will need to collect data from different locations and potentially different data sources representative of both urban and rural settings in order to capture the full range of scenarios needed for a national estimate.

Temporal coverage

Temporal coverage will depend on the availability of data. The regression methods used to create estimates will allow estimates to be produced for any year desired, including years for which no data points are available. However, there will be a limitation in the duration of extrapolation after the most recent data point from household surveys and service providers.

1.3 Steps for progressive monitoring

The methodology for 6.3.1 – recognizing that countries have different starting points when it comes to wastewater monitoring – allows countries to begin monitoring efforts at a level in line with their national capacity and available resources, and from there advance progressively.

1. As a first step, the indicator can be populated based on estimation of total wastewater generation by households from household surveys and population records, and estimation of proportion wastewater received and treated from institutional/utility records.
2. Moving on to the next steps of progressive monitoring, and initial assessment be made using available secondary data from existing wastewater monitoring at household and service provider and where possible regulator using the suggested initial assessment tool as a guide.
3. For more advanced steps, a full assessment using household survey and service provider tools to fill gaps in secondary data or generate more reliable or more national representative data may be used as described in Section 3 below.

2. Data sources and collection

2.1 Data requirements to compute treatment of wastewater generated by households

Figure 2 shows the proposed monitoring framework with the data required to calculate treatment of wastewater generated by households - which is also the proportion of population using safely managed sanitation services (SMSS) under indicator 6.2.1. The unit of measurement for all the data points or variables (shown with abbreviations in the white cells) is the 'percentage of the population'. So for example PSP = percentage of population using "to piped sewers"; and PS_T = percentage of population using to piped sewers whose excreta reaches a treatment plant, which is "Treated at treatment plants".

A simple Excel-based spreadsheet is available that is based on the framework in Figure 2 and into which data for each variable can be entered as a percentage (in the white cells where the short variable abbreviations are given). For each of the system types the spreadsheet then calculates the percentage of wastewater generated by households that is safely treated. This is reported in the far right hand column and summed in the cell marked SMSS.

2.2 SOURCES OF DATA – SHORT AND LONG TERM

It is recommended that wherever possible assessment of SDG indicator 6.3.1 be made using available data, and new data collection is proposed only when existing data sources are unreliable or no other data sources are available including proxy data. The possible data sources are described below, in terms of the framework shown in in Figure 2.

2.2.1 DESCRIPTION OF POTENTIAL DATA SOURCES

Existing national household surveys and censuses, typically provide information about the use of a range of sanitation technologies. These data can be aggregated and extrapolated to inform the first column – '**percentage of population'** variable - this provides the foundation on which to monitor flows along the chain.

For the '**of which contained'** variable, aggregated results from ongoing studies and published literature can be used to establish a credible estimate for a typical percentage for each type of system in a given country. For example, the percentage of septic tanks that are functional.

Institutional records and reports from relevant service providers and regulators can be used to inform the '**of which transported and delivered to treatment plants'** variable and the '**of which treated at treatment plants'** variable, particularly for offsite sanitation. Useful additional data sources for these variables include the United Nations Statistical Division (UNSD); International Benchmarking Network for Water and Sanitation (IBNET) and AQUASTAT online databases.

2.2.2 TYPICALLY INVOLVED ORGANISATIONS AND INSTITUTIONS

It is recommended that the following organisations and institutions be consulted during the assessment:

- Organisations responsible for regulating and/or licensing emptying, transport and treatment services for wastewater and faecal sludge.
- Senior line ministry officials responsible for sanitation service provision and wastewater treatment.
- Senior level representatives in organisations responsible for emptying, transport and treatment services.
- External agencies engaged in supporting sanitation services within a given country. These could include UN Agencies, academic institutions, NGOs, donors, private investors or consultants; and
- Other persons with an interest in and/or knowledge of sanitation services in the location.

2.3 RECOMMENDATIONS ON DATA MANAGEMENT

Data will be compiled by the GEMI partners from national sources, and published in country files available online/offline. Raw data will be made available to the extent possible, given ownership of the data. Before publication of any country estimates, they will be shared with national authorities for review and comment. Estimates derived from models using non-country-specific data will not be published for individual countries, but could be published in aggregate form, such as regional or global estimates.

3. STEP-BY-STEP DATA COLLECTION AND COMPUTATION OF WASTEWATER GENERATED BY HOUSEHOLDS

An initial estimate of the proportion of the population with safely treated wastewater will be made through an initial assessment in Steps 1 to 2. The initial assessment will enable the key knowledge gaps to be identified, which can then become the focus of a follow-up 'full assessment' in Steps 3 and 4.

The key questions to be addressed during the initial assessment exercise are summarized in Table 1.

3.1.1 STEP 1

Data sources from household surveys, censuses, like those used by the JMP to identify the proportions of population using each of the four basic household sanitation types and those using unimproved sanitation– shared, unimproved and open defecation - should be compiled first to give the proportion of the population using each type of sanitation facility.

3.1.2 STEP 2

It is recommended that an initial assessment be made using available secondary data. This can be the departure point to have further engagement with the countries for 'full assessment' of safely managed sanitation services in Step 3. The initial assessment will draw on household surveys and censuses plus a review of available secondary data provided by utilities, regulators, line ministries, researchers or others with appropriate technical expertise, to enable estimates to be made of the proportion of households whose excreta is treated offsite or safely disposed in situ. The key questions to be addressed in the initial assessment are summarized in Table 1.

3.1.3 STEP 3

Where the 'initial' assessment identifies important knowledge gaps and elements of the sanitation that require verification, a 'full' assessment involves feedback from countries filling these gaps, use of specially designed monitoring tools, like ad-hoc data collection in strategically selected countries etc.

The 'full' assessment tools include both household questionnaires and service provider survey instruments.

Household questionnaires

Building on existing household surveys and national censuses, household surveys could be extended to include questions on:

- The immediate downstream fate of household generated wastewater (e.g. outlet is connected to a piped sewer or to an open drain or to a water body etc.);
- Emptying and transport from an onsite container, if any is used
- Disposal in situ

When used with a statistically robust sampling frame and sample size , the household questionnaires can be used to derive or verify the following framework variables: 'percentage of population using system connected to a particular containment type or not', 'of which contained', 'of which safely disposed in situ' and 'of which emptied for transport'.

Service provider surveys

Interviews and observation surveys can gather performance data from public and private faecal sludge emptying and transport service providers (both formal and informal service providers) as well as treatment plant service providers. Where necessary they can also be used with service providers who operate sewer networks and the associated treatment plants as well. However, it is anticipated that in the majority of locations the data gathered during the initial assessment will be sufficiently complete and robust for monitoring of SDG indicator 6.2.1.

The emptying and transport (E&T) service provider survey is therefore designed for use in the same location that the household questionnaire was implemented, and will be used to inform the 'of which emptied for transport' and 'of which transported to treatment' variables for onsite sanitation systems. The survey includes questions on:

- The number of septic tanks and pit latrines emptied over an agreed time period.
- The disposal sites used (e.g. to a treatment plant, to a sanitary landfill or to a water body).
- The proportion of all trips made to each disposal site.

A sampling frame and representative sample size may be used to select the number of service provider surveys required to generate statistically robust estimates for each variable.

The treatment service provider survey is designed for use in the same location that the emptying and service provider surveys and household questionnaires were implemented. The survey will be used to inform the 'of which safety treated at treatment plants' variable for the onsite sanitation systems. The survey includes questions on:

- Process used and level to which excreta is treated (e.g. planted drying beds)
- Installed treatment capacity (e.g. m^3/year)
- Plant performance data (e.g. volume of faecal sludge delivered to the treatment plant (m^3/year) and volume of treated faecal sludge complying with discharge limits (m^3/year)).

Similar to the E&T service provider survey, a carefully designed sampling frame may be used to select the number of treatment service provider surveys required in order to generate statistically robust estimates for the treatment variable.

In absence of treatment data, as well as to validate and verify the treatment data, data from geospatial information and earth observations could be used. For example, if a treatment plant is fully operational, and supposedly treating the receiving fecal and wastewater matters, then there should not be much evidence of surface water pollution, like eutrophication, formation of harmful algae-blooms, detection of chlorophyll-a in the receiving water bodies etc.

3.1.4 STEP 4

The data obtained from steps 1 to 3 can be entered into the framework to obtain the percentage of wastewater safely treated that originates from household sources.

4. EXAMPLE

Figure 6 shows an example of the results from monitoring of wastewater generated by households in a middle-income country in the Latin American and Caribbean region. The figure shows diagrammatically the percentage of wastewater from household sources (on-site and off-site) that is safely treated which is a total of 33% of total shown in dark green.

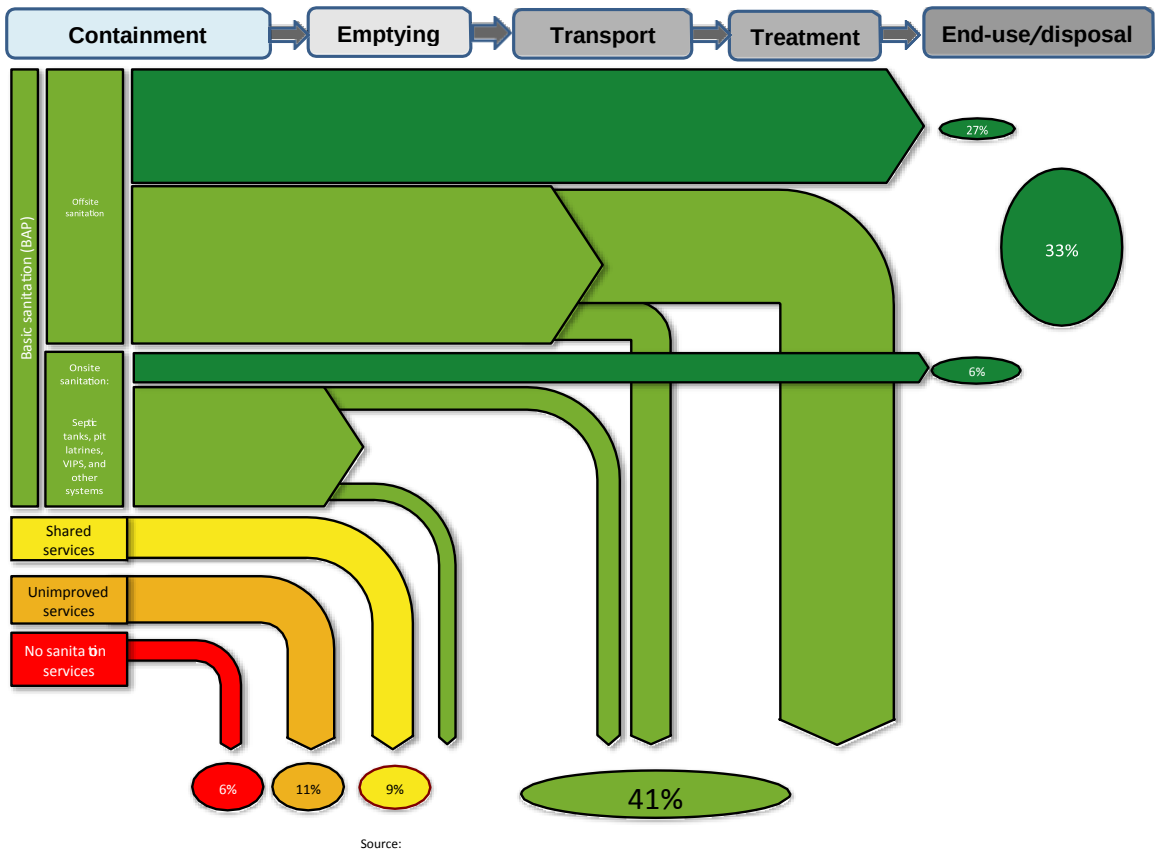

Figure 6 Example of output from monitoring of SDG indicator 6.3.1 in a middle-income country in the Latin American and Caribbean region.

Table 1 Key questions to be addressed in the initial assessment

	System type	Of which contained	Of which safely disposed insitu	Of which emptied for transport	Of which transported and delivered to treatment	Of which treated at treatment plants
Proportion of the population using each system type and method	**Piped sewers**	Do some sewer pipe connections leak or does the pipe discharge directly to an open drain, water bodies or open ground? Estimate % contained _____%	-	-	Do sewer pipes regularly leak (e.g. exfiltration and overflow) before reaching treatment? Estimate % transported and delivered to treatment? _____%	What is level of installed treatment capacity? Are treatment plants overloaded? What is level of treatment plant performance? Estimate % treated _____%
	Septic tanks	Are some septic tanks damaged or flooded so that they leak and/or are they connected to open drains, water bodies or open ground rather than to soak pits or sewers? Estimate % contained _____%	Are some septic tanks never emptied or emptied very rarely? Are some emptied and the excreta buried? If so, is the excreta safely emptied and safely buried? Estimate % safely disposed insitu _____%	Are some septic tanks emptied and the excreta transported away? If so, is the emptying done safely? Estimate % emptied for transport _____%	Does all of the proportion 'emptied for transport' reach treatment or is some discharged to open drains, water bodies or to open ground? Estimate % transported and delivered to treatment? _____%	What is level of installed treatment capacity? Are treatment plants overloaded? What do monitoring records indicate about treatment performance? Estimate % treated _____%
	Pit latrines with slabs and VIPs	Are some pit latrines with slabs and VIPs damaged or flooded so that they leak and/or are they connected to open drains, water bodies	Are some pit latrines with slabs and VIPs never emptied or emptied very rarely? Are some emptied and the excreta buried? If so, is the excreta safely	Are some pit latrines with slabs and VIPs and the excreta transported away? If so, is the emptying done safely? Estimate % emptied for transport	Does all the proportion 'emptied for transport' reach treatment or is some discharged to open drains, water bodies or to open ground?	What is level of installed treatment capacity? Are treatment plants overloaded? What do records indicate about treatment

	System type	Of which contained	Of which safely disposed insitu	Of which emptied for transport	Of which transported and delivered to treatment	Of which treated at treatment plants
		or open ground? Estimate % contained _____%	emptied and safely buried? Are some emptied only once the excreta is safe to handle? Estimate % safely disposed insitu _____%	_____%	Estimate % transported and delivered to treatment? _____%	performance? Estimate % treated _____%
	Other systems including composting toilets	Are some other systems including composting toilets damaged or flooded so that they leak and/or are they connected to open drains, water bodies or open ground rather than to soak pits or sewers? Estimate % contained _____%	Are some other systems including composting toilets never emptied or emptied very rarely? Are some emptied and the excreta buried? If so, is the excreta safely emptied and safely buried? Are some emptied only once the excreta is safe to handle? Estimate % safely disposed insitu _____%	Are some other systems including composting toilets emptied and the excreta transported away? If so, is the emptying done safely? Estimate % emptied for transport _____%	Does all the proportion 'emptied for transport' reach a treatment plant or is some discharged to open drains, water bodies or to open ground? Estimate % transported and delivered to treatment? _____%	What is level of installed treatment capacity? Are treatment plants overloaded? What do records indicate about treatment performance? Estimate % treated _____%

PART B: WASTEWATER FROM ECONOMIC ACTIVITIES

1. PROPOSED MONITORING METHODOLOGY

1.1 MONITORING CONCEPT AND DEFINITIONS

Wastewater considered under this part of the monitoring framework of GEMI addresses sources from industry and commercial activities. This includes not just productive industries and processes, but also commercial and institutional sources, of both public and private character. Wastewater composition and its definition needs careful consideration and is therefore quite complex in nature. Human activity is of course not solely undertaken at home and much waste from human activity is produce in the extra household settings. For example, many persons, particularly those in parts of the world which are poorer, will use facilities at their place of work. In high income economies the same applies but hotels, sports centers, restaurants, prisons etc. all contribute significantly. In addition to places of work there are certain institutions, where wastewater production is high in comparison to land area of facilities on account of frequent passage of people.

Airports, markets, railway and bus terminus and hospitals are good examples. High frequency of use of facilities will greatly contribute to municipal wastewater production.

Looking at global water use, after agriculture, industrial use of water is the next largest used, often accounting for between 20-40% of the overall use. Following the logic used in estimating wastewater production from household sources, and assuming the water used is not sold as a product, as much as 80% of potable water supplied to establishments, could be discharged.

The issue of hazardous waste is also captured in Goal 6 under 6.3. This in itself is a subset of industrial wastewater but also must be measured. In many countries, strict regulations are in force concerning the transport and handling of hazardous wastes, however there are still illegal discharges and sometimes accidents result in serious infringements.

Industries can be classified according to internationally recognized codes, so called ISIC codes. This system offers the opportunity to disaggregate industrially produced wastewater even further. This is discussed and used as an organizing principle below.

1.2 RECOMMENDATIONS ON SPATIAL AND TEMPORAL COVERAGE

Recommendations on spatial and temporal coverage

1.3 STEPS FOR PROGRESSIVE MONITORING

Description of proposed monitoring rungs and how to apply them

2. DATA SOURCES AND COLLECTION

2.1 SOURCES OF DATA – SHORT AND LONG TERM

Description of potential data sources, including the potential for novel sources; description of typically involved institutions including potential to involve other stakeholders; challenges and opportunities in the short and long term

Wastewater generated by households and non-hazardous economic activities (municipal wastewater) is covered under Part A of this guide. The sources of data are therefore related to:

1. Wastewater from commercial establishments
2. Wastewater from non-hazardous industries
3. Wastewater from hazardous industries

Data sources for commercial establishments fall into some clear categories. Much of the information will be available through local authority registers on businesses and industry and indeed Government establishments. Local authorities will also have records on institutions such as hospitals and schools. The commercial establishments will have to provide information on numbers of customers and or employees.

Databases on industries will be available within the Ministry of Industries national database or equivalent. A database of industry for many countries is available in the UNIDO Industrial Statistics database. By reviewing the ISIC codes for hazardous industries, data can be further disaggregated.

Engagements with relevant line ministries as follows are needed:

- Ministry of Water
- Ministry of Health
- Ministry of Environment
- Ministry of Education
- Local Authority Departments Education, Health, Business

2.2 DATA REQUIREMENTS TO COMPUTE THE INDICATOR

Table with required data and their units of measurement, for each of the proposed monitoring rungs; recommendations on data aggregation/disaggregation, and implications for monitoring

2.2.1 COMMERCIAL/INSTITUTIONAL WASTEWATER

An inventory of commercial establishments will be compiled, drawing on the various sources of information. The wastewater production capacity of the institution will be estimated/computed based on two figures. One based on

a knowledge of the industry and its production processes and the other as a function of the mains water supplied. It is assumed that ALL commercial wastewater (unless a country wishes to report to the contrary) will be disposed of to municipal sewer. Wastewater consumed will be retrieved from water utility records. Most water utilities bill residential and commercial users separately. Some industries do "sell" water in their product. This needs to be accounted for. In the absence of information in UNIDO registers, local authority records and planning applications will also be explored. A hierarchy for sources of data acquisition will apply the following principles:

1. Data from regulatory authorities
2. Data from water and sanitation utilities
3. Data computed from specific industries, based on billed water consumption
4. Data compiled from registries of industries and or local authority records

2.2.2 Non-Hazardous Industrial wastewater

UNIDO industrial registers (available for most countries) will be use to specify the specific ISIC coded industries. Billed water consumption data will be used to estimate where possible estimated flows. In some circumstances a simple questionnaire will be developed, designed to establish, the level of information available. An example of the various levels is given in Figure 3.

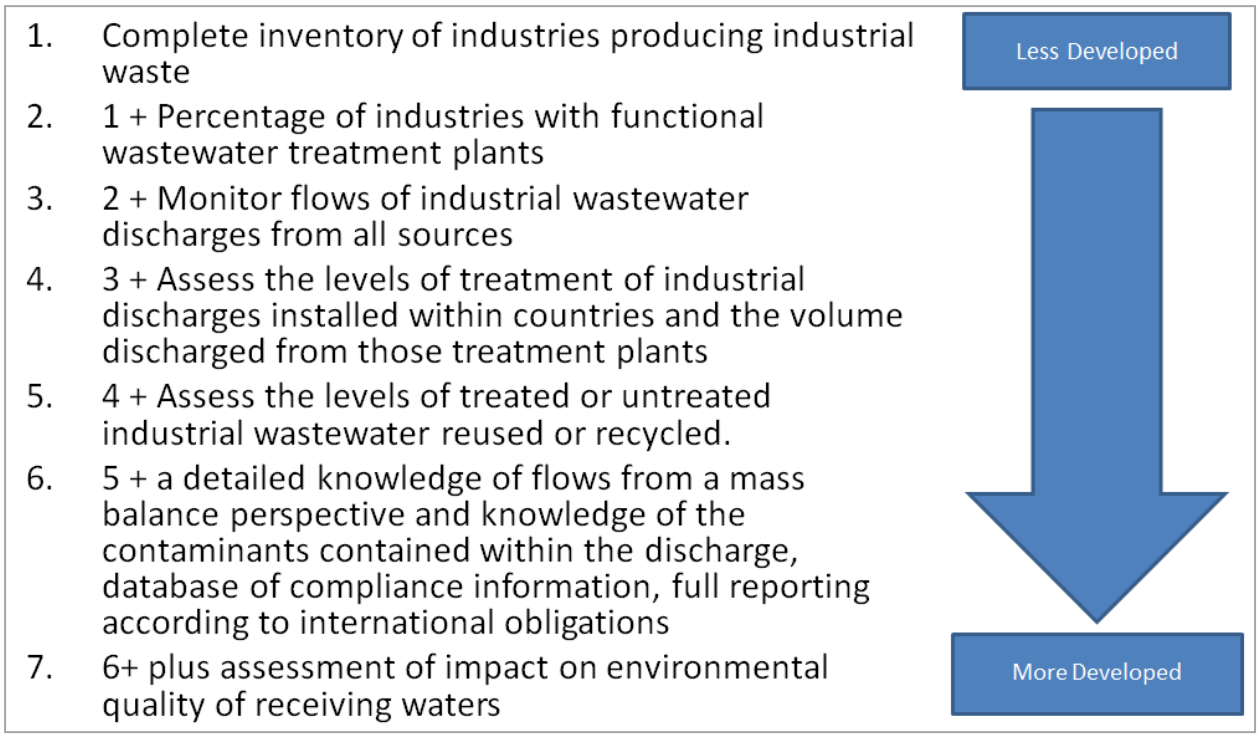

Figure 3: Stages in producing database for industrial wastewater

2.2.3 Industrial Wastewater

An inventory of industrial establishments will be compiled based on ISIC codes. The estimated production capacity will be collected from permit information an estimations of wastewater production computed. If regulatory data is available, this will also be used.

2.2.4 Hazardous Industrial wastewater

The sub-set of industries that produce hazardous wastewater, as defined by standard ISIC codes or those who use "red list" substances in their processes. In some cases industries are allowed to discharge limited amounts if they have a permit to do so. The discharges are closely monitored.

2.2.5 Detailed method for monitoring Wastewater from economic activities

The total volume of industrial wastewater (the denominator) can be reliably estimated from an inventory of industries, which will be available in the vast majority of member states. This can be populated from databases and records held by Ministries of Industry, Tax offices, local authority registries etc. For each industry, records will be available on the amount of water they abstract from municipal supplies or from boreholes or other sources. Given the knowledge of the type of industry (from International Standard Industrial Classification from all economic activities, revision 4, ISIC Rev4) and a mass balance of products in and out, the proportion of wastewater flow generated as waste water can be estimated.

The proportion of those industries which deal with hazardous substances, (defined according to pollutants documented in the various conventions (Stockholm, Basel and Rotterdam) and classified by ISIC codes can then be computed. The breakdown of treated wastewater can be calculated based on compliance records, related to national standards. Unless verified otherwise, through audited compliance records, the waste generated will be considered untreated.

The method described above might not cover small-scale or informal industries. As most of these activities occur in urban centres, or in their peripheries, available GIS tools, including high resolution remotely sensed images could be used to estimate such components.

Methodologies are being developed for point sources of pollution emanating from farms and agricultural establishments, where data from earth observations could be of use. Attention also needs to be given to landfills and disposal sites that produce significant quantities of leachate. It must also be borne in mind that some industrial processes have so-called "godfather installations", i.e. although having ceased production, they still are responsible for continued emission of pollutants.

Baseline indicators are therefore reliably measured using existing data, and various sources of information. In addition to such indicator for global monitoring, member states can be encouraged to progress "up the monitoring ladder" by increasingly refining monitoring systems and protocols as they see fit.

In terms of definitions, industrial wastewater is either directly discharged or in the case of a large proportion of non-hazardous industrial waste, is combined with household wastewater in a municipal sewer. Municipal wastewater would therefore be defined as a combined mix of household (black and grey water) together with waste water from commercial and non-hazardous industries. So called "trade wastes" are frequently non-hazardous wastes, with approved discharge permits. In addition to the records cited above, the possibilities for data from utilities can also be used to further refine estimates.

In all instances and if possible for the larger industries or those with significant hazardous flows, and In addition those industries with permitted discharges, process diagrams and flows should be available which are usually needed for the granting of a permit to discharge.

2.3 RECOMMENDATIONS ON DATA MANAGEMENT

Process for quality control and assurance

Data requirements for global reporting, including metadata and good practices – could this be done jointly? To be further discussed, pending discussion on global data repository and input from the IAEG process

3. STEP-BY-STEP DATA COLLECTION AND COMPUTATION OF INDICATOR

The following stages are to be undertaken in the Proof of Concept Phase of the GEMI initiative to monitoring industrial and commercial wastewater.

3.1.1 STEP 1

Prepare an inventory of ALL sources of economic activities (Industrial and commercial, disaggregating by:

- Commercial establishments;
- Non-hazardous industries
- Hazardous industries

This should include estimate of "informal" industries using walk through audits of informal areas (Note this will only give qualitative information)

Following the stage approach given in Figure 3. If wastewater production/treatment data is available obviously use this.

3.1.2 STEP 2

Gather data on the wastewater production from each establishment by flow, BoD, or population equivalent. Estimates of the size of wastewater production can be made using metered water supply volumes or number of employees at the establishment.

3.1.3 STEP 3

Establish those industries from Step 1 above which under ISIC classifications are defined as hazardous OR utilising red list substances and those industries governed by permitted discharges from Local EPA registers (if any).

3.1.4 STEP 4

Prepare a simple (excel-based) spreadsheet comprising overall waste water flows from commercial and industrial sources up-aggregate the information from each locality to obtain national estimates to record and calculate the total hazardous flows in compliance as a proportion of all hazardous flows.

Depending on the level of information available, it may be possible only to report on the proportion (or number) of industries who comply rather than computation of actual proportions based on volumetric flows.

4. EXAMPLE

Practical example where the methodology has been applied

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5. REFERENCES

5.1 PART A

Baum, R., Luh, J., Bartram, J., (2013). Sanitation: a global estimate of sewerage connections without treatment and the resulting impact on MDG progress. Environ. Sci. Technol. 47, 1994–2000, http://dx.doi.org/10.1021/es304284f

Corcoran, E., C. Nellemann, E. Baker, R. Bos, D. Osborn, H. Savelli (eds) (2010). Sick Water? The central role of wastewater management in sustainable development. A Rapid Response Assessment. United Nations Environment Programme, UN-HABITAT, GRID-Arendal. www.grida.no ISBN: 978-82-7701-075-5

Malik O., Hsu A., Johnson L., and de Sherbinin, A. (2015). A global indicator of wastewater treatment to inform the Sustainable Development Goals (SDGs). Journal of Environmental Science and Policy 48, 172 to 185.

Peal, A., Evans B., Blackett, I. Hawkins, P. and Heymans, C. (2014). Fecal Sludge Management: analytical tools for assessing FSM in cities. Journal of Water, Sanitation and Hygiene for Development 4 (3), 371–383.

Raschid-Sally, L. and P. Jayakody. 2008. Drivers and characteristics of wastewater agriculture in developing countries: Results from a global assessment, Colombo, Sri Lanka. IWMI Research Report 127, International Water Management Institute, Colombo. 35pp.

SuSanA (2015). Website of the The SFD Promotion Initiative. Managed by GIZ under the umbrella of the Sustainable Sanitation Alliance (SuSanA). Available at: http://sfd.susana.org

UNDESA (2012). International Recommendations for Water Statistics (IRWS). UN Water. Available at: http://unstats.un.org/unsd/envaccounting/irws/

UN-Water Meta data note for SDG 6.

WHO/JMP (2015). WHO JMP Green Paper: Global monitoring of water, sanitation and hygiene post-2015. Geneva, Switzerland

WHO/UNICEF/JMP (2015). WASH Post-2015: Proposed indicators for drinking water, sanitation and hygiene. Briefing note. Geneva, Switzerland.

Williams, A., and Overbo, A. (2015). Unsafe return of human excreta to the environment: A literature review. The Water Institute at UNC, Chapel Hill, NC, USA.

5.2 PART B

International Finance Corporation (IFC). (2007). Environmental, Health, and Safety General Guidelines. Washington: World Bank.

The World Bank Group. (1998). Pollution Prevention and Abatement Handbook 1998 - Towards Cleaner Production. The World Bank Group in collaboration with the United Nations Environment Programme and the United Nations Industrial Development Organizaton. Washington D.C.: The World Bank Group.

UN Water. (2013). Water Quality Fact Sheet for World Water Day 2013. Retrieved 2015, from UN Water.Org: http://www.unwater.org/downloads/water_quality.pdf

UNESCO. (2009). Water in a Changing World - The United Nations World Water Development Report 3. Paris & London: UNESCO & Earthscan.

United Nations Economic Commission for Europe (UNECE). (2007). Environmental monitoring and reporting by enterprises. Eastern Europe, Caucasus and central Asia. Geneva: UNECE.

United Nations Economic Commission for Europe (UNECE). (2012). Guidelines for developing national strategies to use air and water quality monitoring as environmental policy tools for the countries of eastern Europe, the Caucases, central Asia and south-eastern Europe. Geneva: UNECE.

United Nations Environment Programme (UNEP). (2008). Water Quality for Ecosystem and Human Health Second Edition. Ontario: UNEP Global Environment Monitoring System (GEMS).

United Nations Environment Programme (UNEP). (2010). Clearing the Waters - A focus on water quality solutions. Nairobi: Pacific Institute.

United Nations Industrial Development Organisation (UNIDO) and United Nations Environment Programme (UNEP). (1991). Audit and Reduction Manual for Industrial Emissions and Wastes. Vienna: UNIDO.

World Health Organisation (WHO). (2014, July). Media Centre, Water Fact Sheet. Retrieved January 16, 2015, from WHO: http://www.who.int/mediacentre/factsheets/fs391/en/#