Deliverable 3.7

Financial Tool for CETP Sustainability and a Guiding Document for CETP Contract

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in consortium with

Consulting Services on Rehabilitation Measures on behalf of the National Mission on Clean Ganga

"Support to Ganga Rejuvenation"
Phase II
Uttarakhand and Uttar Pradesh

India

Indo-German Development Cooperation
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Abbreviations and Acronyms

BOD	Biochemical Oxygen Demand
CETP	Common Effluent Treatment Plant
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DM	District Magistrate
DoUD	Department of Urban Development
DUP	Department of Urban Development
GIZ	Gesellschaft für Internationale Zusammenarbeit
HPDA	Hapur - Pilkhuwa Development Authority
JTETA	Jajmau Tannery Effluent Treatment Association, Kanpur
MoWR	Ministry of Water Resources
NMGC	National Mission for Clean Ganga
RD & GR	River Development and Ganga Rejuvenation
SGR	Support to Ganga Rejuvenation
SMCG	State Mission for Clean Ganga
SPCB	State Pollution Control Board
SPV	Special Purpose Vehicle
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
ZLD	Zero Liquid Discharge

1 Introduction

Under the Indo-German Cooperation, the Government of Germany has extended support to the Government of India through sharing of experiences on river rejuvenation. In this framework, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) implements the project "Support to Ganga Rejuvenation", which contributes to the initiative 'Namami Gange', the umbrella programme for all Ganga Rejuvenation activities of the Indian Government. The project is organised into four fields of activities:

1. Providing strategic support at national level;
2. Consolidating the water partnership between India and the European Union;
3. Sharing knowledge with the private sector and research institutes; and
4. Providing advice on implementation at state level in Uttarakhand and Uttar Pradesh.

The lead executing agency for the project is the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD&GR). At national level, GIZ implements the project in close coordination with the National Mission for Clean Ganga (NMGC) (New Delhi), the implementing organisation. The key partner at state level is the State Mission for Clean Ganga, which come under the Department of Urban Development (DoUD) and the Department of Drinking Water and Sanitation in the state of Uttar Pradesh and Uttarakhand respectively.

At state level, the German consulting company GOPA-Infra GmbH in consortium with Fichtner GmbH has been contracted by GIZ for implementing the programme Component 4 in the states of Uttarakhand and Uttar Pradesh, in close coordination with the SMCGs in the respective states. In these states, the project implements activities in the fields of Municipal Wastewater Management and Industrial Wastewater Management, support to Capacity Development and knowledge-exchange/experience-sharing with project partners.

2 Background, Objective and Method

2.1 Background

Under the Water (Prevention and Control of Pollution) Act, 1974, every industry is required to provide adequate treatment of the effluents generated by it before their disposal, irrespective of whether the disposal is in a stream, on land, into sewerage system or into sea. It is not economically viable for small-scale industries to invest in on-site primary and tertiary treatment facilities and a sharing or this responsibility with other users through Common Effluent Treatment Plants (CETPs) is considered to be a more viable treatment solution. CETPs could potentially help in achieving treatment of combined wastewater from various industries at lower unit costs and also help facilitate better compliance and monitoring with standards.

There are several challenges associated with CETPs:

- According to a recent report of the Central Pollution Control Board (CPCB) (2005), less than 7% of CETPs in India discharge effluent in compliance with statutory wastewater discharge standards.
- There is no standard institutional or administrative form for CETPs in India. They are organised according to a wide range of different business and management models, from Government schemes to PPP to fully private ownership.
- There is no tariff policy or harmonised charging mechanisms and in some cases CETP members do not pay for treatment of effluents.

As a result, the issue of sustainability is often not addressed, particularly in cases where support for infrastructure development operation and maintenance are subsidised by Government.

2.2 Objective and Expected Outcomes

The objective of this study is to develop a financial tool for CETP sustainability that takes into consideration the different possible sources of income (charges from CETP members, sale of treated wastewater to industry and other revenues) and associated costs, both capital and recurrent. The tool should be accompanied by a checklist/guiding document for preparation of CETP contract with members including institutional set up, powers and responsibilities, monitoring mechanism, penalties, etc. to ensure checks and balances for effective operation of the CETP. The tool should be applied to a concrete case study, resulting in proposed effluent charges and water charges for sale of treated wastewater, penalties for quality or quantity (high discharges) violations against contract terms, checks and balances to monitor / deter infringements.

2.3 Methodology, Activities and Timeline

The assignment was undertaken through a combination of desk-study work, field activities and meetings in India[1].

These visits were the primary sources of data for the consulting analysis, much of which was provided verbally and not supported by detailed documentation. The consultants were unable to verify the data provided and therefore cannot provide any assurances as to the reliability and accuracy of the information provided. We do not believe that this will have any adverse impacts on the project’s outcomes as they are expected to be generic in nature but, where possible, tested on a real situation.

In the course of the project the consultants received logistical and peer review support from the Support to Ganga Rejuvenation (SGR) team. The work was undertaken over the two week period 9 – 23 February 2020 in India.

[1] The consultant visited two examples of CETPs

1. The Jajmau Tannery Effluent Treatment Association (JTETA) in Kanpur, and
2. The Hapur Pilkhuwa Development Authority (HPDA) Textile Center in Pilkhuwa

The JTETA facility is about to be developed whereas the HPDA facility is operational.

2.4 Observed Practices and Issues

Based on brief in-country observations, discussions with various parties and available documentation, we observed the following practices, issues problems related to the development and subsequent use of CETPs in India.

- CETPs are not performing as planned due to inadequate capital maintenance and abuse by users:
  - Treatment plants not working to optimum efficiency with the result that the wastewater is not treated effectively and is harming the environment
  - Users abuse systems and seek to avoid charges through illegal means, e.g. often exceeding their contracted capacities, bypass into sewers/drains, meter tampering etc.
- Wastewater quality in the CETP areas are variable:
  - Wastewater quality in homogenous zones (similar type industries) is marginally more consistent than for heterogeneous zones (mix of industries) but even in homogenous zones the variance can be significant[2].
- CETP charging structures not raising sufficient funds for proper operations and capital maintenance:
  - Charges largely based on securing finance for operations only.
  - Charges normally based on volume and fixed charges (set to recover operating and limited capital maintenance costs) but no details available as to how fixed and variable charges are determined.
  - Limited consistency with charging arrangements across CETPs.
- Charging structures do not encourage good environmental and health practices
  - Charges generally not cost-reflective, i.e. based on volume but not quality (although an example of an on future CETP agreement that applies quality based charges was discovered).
  - Consumers subject to agreements on contracted capacity (but not contracted loading) but it is not clear what happens if contracted capacity is exceeded.
  - No effective price signals to encourage pre-treatment, e.g. why would a consumer invest in better pre-treatment if charges will be unchanged?
  - Very little take-up of re-used water despite significant government pressure to encourage zero liquid discharge (ZLD) operations. Water re-use charges effectively competing against nearly free water from boreholes.
- Potential consumer resistance to charges
  - Users claim to be sensitive to charges and that it would have a profound impact on their profitability (no evidence provided to support this claim)
- Institutional structures inconsistent:
  - Various ownership models including: public, private, public/private (concessions etc.), special purpose vehicle (SPV) (normally a company or trust owned by the

[2] The JTETA facility provided sample wastewater quality data for the businesses in its service area. COD ranged from just over about 2,200 mg/l to just under 10,000 mg/l (median approximately 2,600 mg/l). TSS ranged between less than 500mg/l to just over 2500 mg/l (median approximately 1,600 mg/l)

consumers). Most common is SPV which has been assumed as the basis for this analysis.
  - Schemes are relatively small, generally in the order of 2 – 3 Ml/day (equating to a population equivalent of approximately approx. 20,000 -30,000. The largest is 100 Ml/day.
- Regulatory compliance and enforcement in place but not robust enough
  - Wastewater discharge quality standards set by state and central pollution control boards but enforcement is less than ideal, i.e. many CETPs exceeding standard limit values but allowed to continue to operate.
  - Not clear why enforcement is lacking, several reasons could be: lack of adequate resources in the regulatory bodies, economic interests superior to environmental interests, powerful interest/lobby groups able to sway decision making, political interests and more.
  - Limited levels of self-regulation for CETPs.
  - Enforcement of standards weak (but systems exist).
  - No independent economic regulation of charges, largely self-regulated by the SPVs (in agreement with users) or regulated through a contract.
  - When enforcement measures are imposed any penalties paid by the SPV are effectively passed on to users.

This study cannot be expected to resolve all of these issues. It is focussed on the charging aspects and proposes solutions that can address, as far as possible, many, but not all, of the problems identified above. In particular, many of the problems relate to enforcement rather than charging and are outside the scope of this study, although preliminary recommendations are made insofar as they directly relate to charging.

3 Principles of Wastewater Charging

For wastewater charging to be effective and sustainable it should adhere to a set of principles that are designed to balance the needs of stakeholders and deliver the best wider economic outcomes. The areas covered by these principles include:

- Cost recovery and financial integrity
- Cost reflectivity and behaviour incentives
- Transparency and accountability
- Predictability and stability
  - Balancing consumer and service provider needs
- Resources for implementation and practicalities

We discuss these principles in more detail below:

3.1 Cost recovery and financial integrity

Cost recovery can have a wide range of interpretations, e.g. cost recovery to satisfy a historic cost accounting convention, the current cost accounting convention (inflation adjusted), simple cash flow and other methods besides. Each of these definitions can result in widely varying charging outcomes.

Furthermore, charging for wastewater services cannot be determined in isolation of the levels of service provided; a low level of service requires low tariffs and vice versa. The required levels of service with respect to wastewater discharge standards from the CETP are set in legislation and are therefore considered to be non-negotiable obligations of the CETP. Charges should be sufficient to meet these obligations now and in the future. **Cost recovery is therefore defined as a revenue stream sufficient for the service provider to finance its activities that are in compliance its statutory obligations both now and in the future.** This means that the service provider should be able to secure sufficient income to meet its operating costs, capital maintenance[3] commitments and generate a return on capital[4] sufficient to attract the necessary loan or investment finance, all to ensure that the level of service satisfies agreed standards and expectations now and in the future.

Based upon a few limited observations the current charging arrangements do not appear to satisfy this principle. Charges in the observed cases appear to be set to recover a minimal level of operating costs with little or no provision for necessary capital maintenance. This has resulted in infrastructure that is performing well below its original levels of serviceability and in need of long overdue investment in refurbishment and service expansion. The resulting low levels of infrastructure performance constrain capacities which in turn restrict opportunities for industrial expansion with consequential adverse effects on employment and the wider economy.

For the CETPs in India cost recovery is distorted through the widespread use of grant financing from taxpayers or other agencies, largely for capital investment. In these cases the true cost of service provision is spread between the taxpayers (or other agencies) and the consumers whose contributions are generally limited to operating costs and some capital costs. This can lead to inefficient decision making, e.g. selecting a high capital cost / low operating cost option over a low capital cost / high operating cost option, even if the latter is the most economically viable solution. It is outside the scope of this study to examine and make recommendations on the merits or otherwise of grant financing instruments except where it has a material impact on the project outcomes.

[3] Capital maintenance expenditure is the expenditure necessary to finance the major repair or renewal of assets at or near the end of their useful lives. In many cases this is met through the application of depreciation (determined on a current cost accounting convention) or through infrastructure renewals accounting as applied by many utility regulators elsewhere in the world.

[4] In the case of the SPVs proposed for the operation of the CETPs where the consumers are also the shareholders the necessity of a return on capital is questionable. This is discussed in more detail in Section 4.1.1.3.

3.2 Cost Reflectivity and Behaviour Incentives

Cost-reflective charging requires that each consumer is charged an amount that reflects the costs that they impose on the system. To achieve cost reflectivity in practical terms consumers are generally grouped into similar types and their charges are set to reflect the costs that they as a group impose. Larger consumers who may be able to respond to economically efficient price signals would be subject to site-specific charges to reflect individual consumer parameters, particularly wastewater quality. As far as is reasonably practicable cost-reflective charges mean that no single consumer, or group of consumers, is subsidising another consumer or group of consumers.

Cost-reflective charges provide economic efficiency. Without cost-reflective charges those consumers paying charges lower than the costs they impose (a loss making position) will consume (or discharge) more than they would do than if the prices were higher and cost-reflective. The loss making service to these consumers is therefore exacerbated and takes away capacity that could be better used by other consumers. For those consumers that are being charged for more than the costs that they impose their overall production costs are higher than they would otherwise be which, in turn, leads to reduced economic output. This phenomenon is known in economic circles as the *dead-weight-loss*, where both service providers and consumers lose as a result of charges that do not reflect costs[5].

Unlike water supply, the quality of wastewater can vary considerably from one consumer to the next, especially for non-domestic industrial consumers as served by the CETPs. Cost reflectivity in this instance could include for charging not just on the basis of volume but also the quality of the wastewater discharged. The higher polluting industries would be expected to make a higher contribution towards the costs of wastewater treatment and disposal. This is a common practice worldwide through the use of the Mogden formula or similar that sets charges according to volume and specific wastewater characteristics, notably chemical oxygen demand (COD) and total suspended solids (TSS). This is not new to India and our investigations suggest it may have already been attempted[6].

Cost-reflective charges could also be negative. This may occur if a particular user provided a service to the system that was to the system's benefit rather than imposing a cost. Such opportunities in wastewater are rare but for those CETPs where discharge capacity is fixed the option to take effluent for re-use can actually provide a benefit; rather than being charged for the re-use it may be economically justifiable to offer the consumer a credit for this activity.
Cost-reflective price signals should create optimum behaviour responses from consumers and service providers alike, e.g. enhanced pre-treatment of effluent by larger industrial consumers, optimisation of water consumption levels etc.

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[5] For an academic explanation of dead-weight-loss see https://corporatefinanceinstitute.com/resources/knowledge/economics/deadweight-loss/

[6] The draft *Haridwar Industrial Estate Waste Water Collection and Treatment Service Agreement* sets out a charging framework that sets charges according to a volumetric base charge and surcharges depending on the levels of COD, pH, and total dissolved solids (TDS).

For the CETPs these behaviour responses can have marked wider economic benefits. If consumers respond rationally to efficient price signals their decision making will also be efficient, e.g. they will only invest in enhanced pre-treatment if the cost is less than the real cost of treatment by the CETP that is reflected in the charges. Similarly, the volume cost of treatment, if cost-reflective, could also lead to efficient decision making to improve operational practices to reduce water consumption.

Where the industries are operating in a constrained environment economically efficient behaviour responses will result in the optimum use of resources that can maximise industrial output within the constraints of the CETP's operating parameters. Similarly, it will lead to economically efficient decision making in the design and operation of the CETP (and associated network infrastructure) itself, e.g. reduced recurrent costs and reduced and/or deferred capital costs for treatment, if the behaviour response is a better quality influent to a future CETP.

Charges may also reflect the economic consequences to the environment from water supply and wastewater. For example, in a region where the water resources are stressed water abstraction taxes may influence the willingness of consumers to participate in water re-use activities. Similarly, site specific circumstances, e.g. environmentally sensitive areas, may demand a higher level of wastewater treatment from the CETP that in turn will increase costs which would pass through, in a cost-reflective manner, to consumers. In the extreme, some consumers may choose to relocate rather than face such charges (unlikely but not impossible). If the charges were cost-reflective (including the economic costs) such a decision would still be economically efficient.

3.3 Transparency and Accountability

For charges to secure the support of the consumers they must be clearly understood and that the calculation process is transparent. This includes proper consultation processes in the development of new wastewater charging arrangements and full accountability of the determined charges.

In the case of the CETPs where charges are site specific based on volume and water quality the underlying data from the industries raises commercial confidentiality issues. Individual consumers may be resistant to share information related to their wastewater generation and/or their wastewater quality with their competitors that are served by the same CETP. Although the service provider has to collect the data to determine charges such site specific data may need to be protected. This may not be so easy if the service provider is an SPV owned collectively by the industries served by the CETP.

3.4 Stability and Predictability

Cost-reflective wastewater charges are not necessarily stable but they are generally predictable. Changes in consumer patterns in response to price signals and other effects can result in charges changing year on year. For example consumers may adjust their capacity agreements in response to charges. The greater the changes to consumer patterns the greater the volatility of prices. Such changes are generally small and gradual and/or predictable although in the extreme a major unforeseen and sudden shock, e.g. a major consumer shutting down its business, could result in significant and immediate changes to charges for the remaining consumers.

Instability to charges can also come about from fluctuations in allowed revenues, especially if the allowed revenues are set to meet capital maintenance expenditure on an as and when needed basis. This is discussed in more detail in Section 4.1.1. Although fluctuations in capital expenditure needs may result in a degree of price instability such fluctuations are generally predictable, i.e. the service provider should have an outline rolling capital maintenance plan that sets out expenditure requirements several years in advance. Consequently, it should be possible to provide advance notice to consumers about expectations of future charges.

3.5 Balancing Consumer and Service Provider Needs

Consumers need to be satisfied that they are not being overcharged and at the same time service providers need to generate the revenues they need to meet their obligations. This can be delivered through a well-functioning governance framework, sometimes including an economic regulatory agency, a firm contract, independent board oversight of self-regulation or some other appropriate mechanism. This ensures that charges are determined on a fair basis and that the needs of both parties are balanced.

The proposal to create SPVs that are owned by the consumers to determine the charges they effectively impose on themselves presents an agency theory challenge. Although in theory the SPV should determine charges to ensure current and future compliance with statutory standards the consumers who own the SPV may demand charges that are lower to enhance their shorter term business profitability. This is all the more tempting if the effects of neglect through lack of financing do not manifest in failing levels of service until several years later. In these cases, prolonged neglect may result in a situation where the cost of rectification may be significantly greater than if proper capital maintenance was conducted when it was most opportune to do so. The governance framework within the SPVs needs to be resilient to such pressures. The proposals to have a board of directors, chaired by the District Magistrate (DM) and including representation from the State Pollution Control Boards are designed to overcome this risk.

3.6 Resources for Implementation and Practicalities

The business models for the CETPs are generally small scale operations, many of which are in the range of 1 – 2 Ml/day (population equivalent to communities of less than 20,000). Staffing would be in the order of up to about 12 persons (several shifts operating 24/7). The development of a pricing model needs to be proportionate to the level of sophistication of such a business model. Consequently, charges should be simple to determine, at its most complex being a basic MS Excel workbook.

Despite the need for simplicity the adoption of cost-reflective charges demands the collection and management of data that exceeds current capabilities and requirements, e.g. resources and powers for sampling and analysis of industrial effluents.

Other resource demands include the preparation of notices for enforcement measures, e.g. if a consumer exceeded its contracted capacities, and other administrative duties. It is questionable if such small scale operations can afford the resources required without having a disproportionate impact on consumer charges.

4 Charging based on Charging Principles

There are many charging options that can be applied. The choice of the most appropriate option will depend on a wide range of factors including but not limited to:

- **Business model:** e.g. concessions to private operators will demand quite different charging arrangements from SPVs, notably how charges accommodate capital maintenance demands and returns on investment.
- **Technical constraints:** e.g. limitations on wastewater outflows which could impose capacity constraints on individual consumers.
- **Future development and how financed:** e.g. if systems are expected to expand the charging framework needs to be developed to ensure a fair apportionment of capital investment contributions.

Based on the initial discussions during the mission the proposals in this report are largely based on the SPV model as the preferred approach. A principal feature of this model is that it is not designed to generate profit or loss and that the shareholders are effectively the consumers served by the respective CETPs.

Furthermore, from the observed case studies there are capacity constraints, i.e. there is no surplus capacity in the systems for expanding the consumer base.

These capacity constraints will not limit the option of further capital investment to increase capacity.

We set out below the proposed method of charging for wastewater services by applying the first two charging principles of: cost recovery and cost reflectivity.

4.1 Cost Recovery

Cost recovery is defined as a revenue stream sufficient for the service provider to finance its activities that are in compliance its statutory obligations both now and in the future.

In a conventional utility structure the costs that make up the revenue requirement include:

- Operational costs (including general maintenance activities)
- Capital maintenance (normally funded through current cost depreciation and/or cash flow driven infrastructure renewals charges, or some other mechanism)
- Return on capital (interest on debt and return on equity)

4.1.1 Revenue Requirement

4.1.1.1 Operational Costs

The expected operational costs would comprise energy, labour, consumables and general maintenance. These costs are generally predicable and estimating future costs should present no material challenges although a limited degree of uncertainty may exist, e.g. staff resignations and subsequent recruitment costs, or an unexpected hike in electricity prices.

These operational costs can be incurred directly by the SPV or indirectly through a service contract. Each has their respective advantages and disadvantages (

Table 4-1).

Table 4-1: Advantages and disadvantages of operational management options

Option	Advantages	Disadvantages
SPV undertaking direct operational responsibility	- Direct control of costs - Transparency and accountability - Flexible, can adapt to changing needs	- Limited access to proper skills - Managerial (human resources) responsibility in the SPV - Potential cost instability year on year - SPV absorbing risk
SPV delegating operational responsibility to a service contractor	- Skilled labour (and can draw on specialist skills where necessary) - Stability of costs year on year (risk transferred to contractor)	- Profit margins (higher costs) - Limited flexibility (needs to be built into contracts) - Efficiency gains retained by contractor (unless contract provisions and provide otherwise).

Neither option stands out as undoubtedly preferred. The choice of whichever option is most appropriate is a matter for the SPV to decide. Discussions with the future management of the SPVs suggest that a contract arrangement may be preferred, largely on the grounds that they may not have the technical skills for effective operation and maintenance of the CETPs. The tool prepared as part of this study can employ either option. For the contract option the true-up adjustments will be lesser as the operational costs will be more firmly fixed and stable.

In this model the operational costs should include provisions for other indirect costs including: anticipated tax liabilities (if any); loan interest charges[7] (if any); plus any other costs that do not fall into capital maintenance.

4.1.1.2 Capital Maintenance

Conventional accounting and charges determination approaches would determine the capital maintenance requirements through the application of depreciation (determined on a current cost accounting convention) or through infrastructure renewals accounting, or a combination of both as applied by many utility regulators elsewhere in the world.

[7] Interest charges would normally be included in the return on regulatory asset value. We recommend including any interest charges as an operational cost as the SPV model does not lend itself to the conventional return on regulatory asset value approach.

Depreciation effectively spreads the cost of the investment over the useful life of the asset, effectively a rental charge on the asset. Where there is complete separation of service provider and consumer, e.g. a conventional municipal water and wastewater utility, depreciation is a rational and widely adopted approach. For the SPVs where the consumers are the shareholders of the SPV it may be more appropriate to treat capital maintenance as a cash call on the shareholders as and when required. There are several reasons that support this approach:

- Depreciation is often referred to as a 'return of capital' whereby investors (banks and equity investors) recover their principal investment. For the SPV to charge their members depreciation on the one hand and returning it to them as a return on capital (as dividends or otherwise) on the other is a pointless activity.
- Depreciation charged to consumers on grant funded assets is, in effect, double charging; once by the grant provider and again by the consumer[8].
- Depreciation when the investments are largely financed by grants effectively means pre-financing investment many years ahead rather than financing the current investment, especially when the system is new. This will result in cash (that belongs to the shareholders) sitting idle in a bank account until needed for capital maintenance at some distant future. The shareholders may prefer to have that cash in their bank accounts where it can be used more profitably for their businesses and therefore deliver a better overall economic outcome. Furthermore, such an approach leads to this generation's users to be paying for assets to be used by future generations (the inter-generational equity dilemma). Consumers (and their shareholders) are primarily interested in investing in activities that offer returns to them in the short to medium term and not necessarily future generations.
- Although the cash call approach may result in variable year on year revenue requirements it is nonetheless predictable and provided the shareholders are given reasonable advance notice they can prepare for such charges.
- The shareholders' businesses are used to 'lumpy' expenditure in their own ventures, e.g. replacing a piece of factory equipment, and the cash call approach is no different.
- Over time the level of annual capital maintenance expenditure will settle down to a relatively steady state condition with small variations year on year.
- The cash call approach assures the SPV that it will have the necessary revenues to meet its requirements without having to seek loan finance. If loan finance is required then the shareholders themselves (with their access to their lines of credit) should be able to secure the finance to meet their CETP charges that include capital maintenance.

The cash call approach does have its disadvantages:

- Individual consumers may resist a spike in charges (even if temporary for one year) and the SPV may need to resort to enforcement measures to ensure payment, e.g. suspension of the SPV membership which in turn could lead to the temporary closure of the consumer's business.

[8] In accounting depreciation is reflected as deferred income where the value of the grant is amortised over the life of the asset. In the income statement this deferred income cancels out depreciation. If depreciation on grant funded assets is included in the revenue requirement then the deferred income also needs to be included. Consequently, it is much simpler to exclude depreciation on grant funded assets from the revenue requirement.

- Consumers as a group may try to unduly influence the SPV in their capacity as shareholders that some or all items of capital maintenance expenditure are not necessary so as to reduce their charges. This will undoubtedly lead to a fall in the level of service, not immediately but in the longer term. The governance arrangements in the SPV board will need to be structured to guard against this eventuality.

A third approach is a hybrid between the cash call approach and depreciation. The charges could include a rolling (say five year) average of intended capital maintenance charges which will smooth fluctuations to a degree but not necessarily tie up shareholders' funds for prolonged periods. The principal downside of this approach is that it complicates the reconciliation process between planned and actual capital maintenance expenditure. This is not insurmountable but the model produced in this study does not cater for this[9].

4.1.1.3 Return on Capital

The SPV model is based around the consumers being the owners of the system. In such a model there is no rational logic to the SPV earning a return on capital.

In the first instance the SPV is not expected to earn profits therefore return on equity should be zero. If a return was included in charges all that would happen is that consumers would be charged a return and then later get it back as dividends, a zero sum situation.

It can be argued that if the SPV itself borrowed money then the charges should include a return on capital to cover interest payments. This is correct in theory but to apply a return on regulatory assets approach is unnecessarily complicated and it would be easier to include interest charges as an operational cost and the repayment of principal as a capital maintenance expenditure charge (provided the full asset expenditure amount is not included in the charges as this would amount to double charging).

4.1.2 Structure of Charges

4.1.2.1 Charges based on Capacity

The SPV model is such that the shareholders have no commercial interest in transferring risk to the SPV and that the actual revenues should match, as close as possible, to the planned revenues. A principal risk associated with utility services is consumption risk, i.e. actual volumes of consumption (or discharge) differing from projected volumes resulting in a mismatch between actual and projected allowed revenues. This also applies to a mismatch between actual and projected values of water quality parameters (COD and TSS). Although private utilities may bear such a risk it is irrational for the SPV to do so, i.e. the consumers (also the SPV shareholders) are effectively transferring risk to themselves.

In the short run the SPV costs are fixed and are unlikely to vary much according to wastewater discharge volumes and quality. To remove volume (and quality) risk the

[9] The process for a rolling average capital maintenance charging arrangement may be best undertaken as a separate 'out of model' iteration from which its outputs are inputs into the charging model.

simplest approach is to apply charges that are also fixed in the short run, i.e. for the term of a year based upon agreed capacities. These capacities include agreed daily maximum values of: volume (kl); COD (kg COD); and TSS (kg TSS). These three parameters are chosen as the standard parameters used in the Mogden formula for conventional wastewater treatment for larger scale municipal systems. For CETPs serving specific industries that have characteristics that impose quite different costs, e.g. total dissolved solids (TDS) or pH the formula could be adjusted to suit. We caution against using too many parameters for charging purposes as this would dilute the price signals and add to complexity.

Each consumer should agree in advance the specific capacities based on their anticipated flows and wastewater quality. These capacities, in total, should not exceed the total capacities of the treatment facilities and any other constraints.
Charges are then applied on the basis of the consumers' agreed capacities for a limited period, say, one year.

4.1.2.2 Excess Capacity Charges

Excess capacity charges would apply to those consumers who exceed one or more of their contracted capacities. The design and application of excess capacity charges is discussed in more detail in Section 6.3.1.

4.1.2.3 Changing Contracted Capacity and a Micro Capacity Market

If during the year a consumer considers his capacity to be too high or too low that consumer could apply for a different set of capacities to take effect from the following charging year. Increasing capacity would be subject to its availability. If there is surplus capacity in the system one option could be for capacity to be made available on request at no purchase charge. Alternatively, the SPV could sell surplus capacity. As actual charges imposed on the users would be capacity based this should be sufficient to prevent users from securing capacity that is significantly in excess of their requirements[10].

There are several options for the allocation of available capacity:

- **A simple 'first come first served' process starting with the earliest applications.** This is probably impractical as it may be probable that applications will be received as soon as it becomes available and managing a fair system could prove challenging.
- **A sharing out of available capacity to all applicants.** This is a simple and easy to apply mechanism. The allocation should not be pro-rata to the application as this would promote unrealistic requests. The allocation could be made pro-rata to existing capacities or a fixed amount to all applicants.
- **A lottery.** The allocation could be subject to a simple random selection.

[10] In theory a consumer could purchase capacity well in excess of needs, not because the consumer may need that capacity in the future but rather to deny that capacity other competing businesses. This is irrational but not impossible, From an economic perspective it is arguable that as long as the consumer is prepared to pay for this capacity there is nothing wrong with this behaviour – debatable?

- **An auction.** Capacity is sold to the highest bidders (or at the price where the bid price matches available capacity).

For the first three options above it may be possible for the SPV to set a purchase price for the capacity but it is questionable as to how that price could be determined and if consumers would be willing to pay such a price. Any revenues received from the sale of capacity would carry forward to reduce the allowed revenue in a future charging year.

Where there are constraints on capacity, i.e. all available capacity for any or all of the capacity parameters are already allocated in full, a user can only increase its capacity if another user is willing to relinquish its capacity. This presents an opportunity to develop a **micro capacity market.** This is a more complex but economically efficient approach where sellers (those willing to relinquish capacity) are matched with buyers (those wishing to increase capacity.

The detailed mechanisms for a micro capacity market is outside the scope of this study suffice to say that the process should be simple and transparent. This may include a simple request for potential buyers and sellers to submit their offers to sell and bids to buy, by a set date, and for the capacities to be allocated by the start of the next charging year.

The principles of capacity market trading in the energy sector can be used as a basis for determining the price. The offers to sell are plotted from lowest to highest and the offers to buy are plotted from highest to lowest. The intersection determines the trading price for all trades (see Figure 4-1). If there is no intersection, i.e. the lowest bid price exceeds the highest offer price then the trade price would be at the lowest bid price and all offers will be accepted. If the lowest offer price exceeds the highest bid price then no trades will take place.

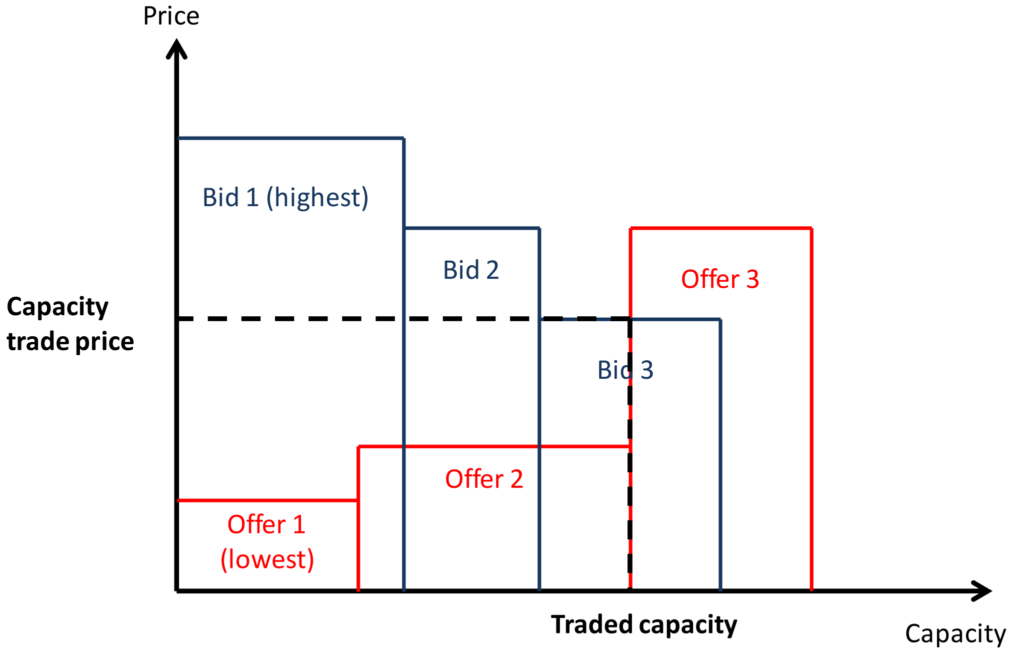

Figure 4-1 **Simplified capacity auction process to determine a uniform trade price**

A consumer should also be free to relinquish capacity without selling it, for example if there were no buyers, but he would still like to reduce his contract capacity to reduce his charges. The SVP could retain this surplus capacity until a buyer was interested in purchasing it. The revenue from its eventual sale could be passed over to the consumer that relinquished it or used to reduce charges for all consumers in a future charging year.

Peer to peer trading should be avoided as this provides opportunities for price fixing and unfair competition. All trades should be managed through a structured auction process administered by the SPV.

From the preliminary observations of the few examples within this study it is probable that the principal capacity constraint is likely to be volume whereas constraints on COD and TSS are less likely, but not impossible.

4.1.3 Annual Iteration Process

To maintain cost recovery any resulting difference between estimated revenues and costs and actual revenues and costs should be rolled over to a future charging year as an increase or decrease to the allowed revenue as appropriate. These differences can arise through various reasons including but not limited to:

- **Revenue increases:**
  - Proceeds from excess capacity charges
  - Proceeds from capacity sales
  - Mid-year increase in capacity from some consumers (only if spare capacity is available)

- **Revenue decreases:**
  - Consumer default (non-payment) and suspension from SPV. This should only be a temporary decrease in revenue and should be recoverable if applicable enforcement measures were taken, e.g. suspension from the SPV membership that effectively suspended the consumer’s business activities. For the consumer to resume membership then all outstanding bills shall be settled.
  - Consumer default (non-payment) and revocation of membership. This may result in a permanent loss of revenue until such time that the capacity made available by the revocation is taken up by new or existing consumers.
- **Expenditure increase**
  - Operating costs higher than planned, e.g. unexpected electricity price increase.
  - Emergency unplanned repair works.
  - Planned capital maintenance expenditure exceeding estimated costs.
  - Planned capital maintenance expenditure brought forward.
  - Penalties (fines) from the state pollution control board and other agencies.
  - Taxes and other costs higher than planned.

- **Expenditure decrease**
  - Operating costs lower than planned, e.g. improved operational efficiency, and/or electricity price adjustments less than expected.
  - Allowance for emergency unplanned repair works less than necessary.
  - Planned capital maintenance expenditure less than estimated costs.
  - Planned capital maintenance expenditure postponed.
  - Taxes and other costs lower than planned

All these effects need to be collated and the net adjustment is then rolled over to a future charging year's revenue requirement (adjusted for inflation).

Although any carry forward should ideally be from one year to the next this may prove impractical and the carry forward process may need to lag a year, i.e. the true-up results from year 1 will be reflected in year 3 charges and the true-up results from year 2 will be reflected in year 4 prices. This is because the true-up process can only happen at the end of the charging year and the results will only be known after the next year's charges are set and are being applied. The example model provides for this lag.

4.2 Cost Reflectivity and Behaviour Incentives

The approach to cost reflectivity is to charge consumers according to both the volume of wastewater and the quality or wastewater, i.e. the Mogden formula.

The Mogden approach is to determine the long run marginal costs of each component of wastewater conveyance and treatment. This includes both capital and recurrent costs.

These charges are adjusted to match the allowed revenues and then form the base unit charges to be applied to the capacity charges.
This will give consumers the financial incentives to make economically efficient operating and capital investment decisions to maximise their profits. This in turn optimises the use of the CETP.

4.2.1 Determination of Cost-Reflective Charges

4.2.1.1 Unit Capital Costs

The unit capital costs are determined through an annuity process:

1. Determine the overall capital costs of the system
2. Allocate the capital costs according to the principal components:
   a. Conveyance: sewer networks etc.
   b. Treatment
      i. Volume related components (inlet works, screening and primary treatment
      ii. COD related components: biological treatment facilities
      iii. TSS related components: sludge treatment and disposal

3. Convert each component to their annual costs using an annuity calculation[11]
4. Determine maximum design capacities (volume, COD mg/l, TSS mg/l)
5. Determine maximum annual values (m^3 per year, COD kg per year, TSS kg per year)
6. Determine unit costs by dividing annual costs by annual values to derive rates (conveyance INR/m^3, treatment volume INR/m^3, biological treatment INR/kg COD, sludge handling INR/kg TSS)

This process derives the long run unit capital costs of conveyance and treatment by the four principal parameters.

Note: the long run marginal costs are based on design capacity not actual capacity. This is because it is a reflection of the longer run investment. If the design capacity exceeds the actual capacity the spare capacity represents the under-utilisation of the asset and is not a marginal cost. In a conventional utility framework and without grant financing this under-utilisation will significantly add to the revenue requirements through depreciation and return on regulatory asset value. Consequently, charges could be significantly higher than the marginal costs illustrating capital inefficiency. This approach, therefore, not only provides incentives and price signals to consumers but also to utilities to encourage more efficient asset management planning.

4.2.1.2 Unit Operating Costs

This is a similar but simpler process to the allocation of capital costs.

1. Allocate operating costs (excluding capital maintenance) according to the same categories as for capital costs[12].
2. Divide operating costs by total actual contracted (not plant design) capacities of volume, COD and TSS to derive unit operating costs.

The sum of the unit operating and capital costs represent the unit long run marginal (cost-reflective) costs of the system[13].

4.2.2 Scaling

In setting cost-reflective charges the process includes an adjustment that reconciles the cost-reflective charges and the total revenues necessary to maintain cost recovery. The cost-reflective charges determined above are on the basis of full cost recovery (no grant contributions) and no excess capacity in either the networks or the treatment facilities.

[11] The annuity calculation depends on two principal parameters, the discount rate and the average useful life of the assets. In the examples used in this study a 5% discount rate and an average life of 40 years was applied to conveyance and 20 years for treatment.
[12] Capital maintenance is excluded as, by definition, this is already included in the capital cost annuity values.
[13] It is questionable as to whether all operational costs should be allocated in this manner as some operational costs are fixed regardless of wastewater flows and quality. There is room, therefore, to improve the approach by removing such fixed charges from the operational cost allocation. The amount removed will still need to be recovered through the subsequent scaling process and will feed back into charges, either as a fixed charge per consumer regardless of size, allocated to one or more parameters such as the volume capacity agreement, or spread across all parameters. The choice of approach should be the one that is considered to be the most cost-reflective. For the purposes of simplicity all operational costs are considered to be marginal. Enhancing the model to allow for re-allocating the non-marginal operating costs charges based on whatever is the chosen approach is a simple adjustment.

Full cost recovery revenue is normally higher than the pre-scaled revenue as it includes the unavoidable cost of excess capacity from stranded or under-utilised assets and operational inefficiencies. The difference is normally made up through a scaling mechanism that maintains cost-reflective differentials between consumers, i.e. the same absolute charge is passed on to all[14]. This is distorted through the effect of grant financing for capital investment which often results in cost-reflective pre-scaled charges that are greater than those necessary to meet cost recovery. Consequently, the adjustment is negative, i.e. charges need to be set below cost-reflective levels.

For wastewater charging this scaling process presents a dilemma; where should the reduction be applied, to the volume parameters or the quality parameters (or both) and how is relative cost reflectivity maintained? There is no strict right or wrong answer to this and each scheme may lean towards a different preference depending on its particular characteristics[15].

In the proposed model scaling has been allocated on a pro-rata basis to the un-scaled charges. This is not perfectly cost-reflective but for the needs of the CETPs it is considered a reasonable first estimate. If the preferred option was to introduce a fixed charge per consumer (regardless of volume or quality) allocating some or all of the scaling to the fixed charges could be considered as a minor improvement of cost-reflectivity. **Note:** if the scaling amount is negative (as it is in the case study model) and allocated to fixed charges this may result in negative fixed charges, which although could still be cost-reflective it is counter-intuitive and may prove unacceptable.

4.2.3 Behaviour Incentives

The charges determined on a cost-reflective manner provide economically efficient price signals to the consumers. This should encourage them to manage their discharge (volume and quality) to maximise their profits. If a user considers the charges to be too high he could undertake measures to reduce them, e.g. invest to improve the consumer's pre-treatment process, improve operational practices to reduce discharge and/or improve wastewater quality and other measures. Alternatively, the consumer may decide that the CETP and its charges are more efficient than investing or changing working practices. Whatever the decision, and provided the charges are cost reflective, it will be economically efficient.

[14] This concept is known as a 'fixed adder' and is applied by regulators many sectors, particularly energy and water. It is preferred to adjusting by a common percentage which can unduly distort cost reflectivity and thereby distort the economically efficient price signals.
[15] The UK electricity industry is facing a similar challenge. The UK electricity charging models allocate much of the scaling to electricity consumption for low voltage consumers but recent research suggests that this is not cost-reflective. Ofgem, the electricity regulator, is considering a variety of options based on: the status quo, capacity charges or fixed charges but no firm decision has been reached in this regard.

5 Proposed Charging Model and Procedures

5.1 Model Options

The request for consulting services seeks a generic charging model that can be used across many CETP schemes with varying: ownership structures; financing arrangements; technical parameters; and other details. It is not possible to produce a detailed model on a 'one-size-fits-all' basis and each scheme may require its own unique charging model characteristics.

We have prepared a model on the basis of achieving best the charging principles as set out in Section 3 which should apply to almost any charging model. The detailed charging methodology developed has been based on the observed case studies which include:

- The institutional framework comprises the favoured SPV business model.
- The facilities are operating at (in some cases beyond) full capacity.
- The consumers are homogenous (similar industries) in each case.
- Charges are to include for direct operating costs and necessary capital maintenance (charges do not include for future investment in service expansion)

5.2 Model Description and se

5.2.1 Outline Description

A generic model is provided as a separate file in Annex 1. The model is based on an MS Excel Workbook comprising several worksheets as scheduled in

Table 5-1:

Table 5-1: Charging model workbook

Worksheet	Description
Base_capital_charges	This determines the relative capital cost of conveyance and treatment for use in the Modgen formula. It determines the full capital cost (at base year price levels) of: conveyance (INR/m3), Volume component of treatment (INR/m3), COD treatment (INR/kgCOD), and TSS treatment ((INR/kgTSS). These costs are inputs for the determination of charges on an annual basis in subsequent year's charges worksheets.
Inflation_indices	This is a record of inflation indices and needs to be updated as over time as the data becomes available.
True_up_Year 00	This determines the under-spend / over-spend etc for the year. For this particular sheet all the values are zero prior to commencement of operations but the sheet is needed for the consistency of the following sheets.
Charges_year_01	This calculates the charges to be applied. It starts off with the first year's set of capacity agreements. Then it allows for inflation to adjust the base unit capital charges. After this the expected operating costs are included and apportioned to the various conveyance and treatment components. Added to the capital charges the un-scaled total charges are determined. It provides for several options as to how to treat water re-use. The unit charges are then

Worksheet	Description
	scaled to match the allowed revenue.
True_up_Year 01	This determines the under-spend / over-spend etc for the year 01. This determines what values need to be carried over to the allowed revenue for year 03, e.g. if costs were higher than planned then these will result in an upwards adjustment in year 3 revenues (and vice versa). The true-up values are then carried forward to worksheet 'Charges_year_03'. For practical reasons the carry forward cannot be taken to year 02 as the actual data for year 01 will not be reconciled until after the year and after charges are set for year 02. Consequently the carry forward skips a year. This continues throughout the model.
Charges_year_02	This calculates the charges for year 02. During year 01 consumers may apply to change their agreed capacities (subject to availability) for the following year, i.e. year 02 in this instance, and such changes (once agreed) to the capacity agreements are reflected in the worksheet. The worksheet highlights the changes through conditional formatting. Again the base unit capital charges are inflation adjusted. This then follows the same process as for year 1 charges.
True_up_Year 02	As for True_up_Year 01 and the resulting values are carried forward to worksheet 'Charges_year_04'
Charges_year_03	The allowed revenue is adjusted by the true-up values from two years previous (year 01). It then follows the process as for years 01 and 02.
And so on	

The model is based largely on the outline data relating to the The Jajmn Tannery Effluent Treatment Association (JTETA) in Kanpur. Of the schemes examined during this study this particular one had nearly sufficient data to produce a realistic model rather than invented dummy data that may bear little relationship to reality.

The model can be used for other schemes subject to any necessary adjustments as considered necessary.

5.2.2 Detailed Model Characteristics

All input cells are coloured blue.

5.2.2.1 Base_capital_charges

Plant and wastewater characteristics are based on the **maximum** capacities and loadings of the plant (not average or actual loadings). This is because the marginal cost is defined as the cost to introduce a unit of additional capacity when all existing capacity is used. Any surplus capacity will be reflected in scaling adjustments rather than marginal costs.

The plant loadings at maximum capacity (COD and TSS) are converted to kg/year.

The annual maximum volumes and kg of loadings are the denominators that determine the unit charges.

Similarly, the ZLD capacity is taken as the maximum design capacity.

The capital costs of the conveyance system and the treatment plant are apportioned between the various components of conveyance, inlet/pre-treatment, biological/tertiary treatment and sludge treatment/disposal. In the model example these costs were allocated based on an analysis of the construction contract data.

These costs are converted to annual capital costs based on an annuity calculation. For the purposes of this example the weighted average life of the assets is assumed to be 40 years for the conveyance system and 20 years for all other items. This is a matter for detailed investigations and the values can be refined if necessary. Similarly, the discount rate for the annuity calculation has been assumed to be 5% (real, i.e. adjusted for inflation) but again this could be refined subject to further investigations. The higher the discount rate the higher the unit capital costs but these effects are diluted due to the scaling process to balance charges with allowed revenues.

The final unit pre-scaled capital charges (per m^3 flow, per kg COD, and per kg TSS) are determined by dividing the annual annuity costs by the respective denominators.

5.2.2.2 Inflation_indices

This is a simple data entry sheet to record inflation. This is necessary to ensure that the capital charges, when transferred to determining charges, are adjusted with inflation. Without an inflation adjustment the effect of the cost reflective capital charges will be diluted over time.

Inflation is also used to adjust the true-up transfers to ensure that the recovery or reimbursement is real and not nominal. This assumes that any true-up adjustments incur interest charges or earn interest equal to inflation which may not be true. This concept is subject to further investigation to determine if and by how much true-up adjustments are corrected to cater for inflation and even returns on capital. Despite this debate, the true-up values are likely to be small relative to overall charges and any inflation and return on capital adjustments will not have a material effect on charges.

5.2.2.3 Charges_year_0[X]

Each charging year has its own worksheet.

The charging calculation goes through a series of progressive steps as below.

Step 1 – Capacity Agreements
This schedules every consumer according to their daily agreed capacity agreements for m^3 wastewater discharge, kg COD, kg TSS and m^3 re-used wastewater taken. Prior to the end of each year consumers can elect to change their capacity agreements (subject to available capacity) to take effect from the start of the following year. The model highlights those capacities that have been changed from the previous year). The actual capacities are input data but as a cross-check the capacities of COD and TSS are reconciled against the flow rates to determine COD and TSS in terms mg/l. For TSS the mg/l column

is colour coded (red/amber/green) to reflect compliance with statutory requirements[16]. Where the value exceeds the standards (cell colour red) the capacities must be adjusted to fall within allowable limit values.

The prototype model only provides for 10 consumers. In reality there may be many more consumers, possibly hundreds, in which case the model will need to be expanded to suit. In such circumstances the model may need additional worksheets dedicated to the customer details aspects. This is a matter for the model designer to determine.

Step 2 – Inflation

This step involves the calculation of inflation adjustment factors for the conversion of unit capital charges and true-up transfers to the current year price levels.

The number of days in the year is included in the input data to allow for leap years.

Step 3 – Capital Charges Inflation Adjusted

Unit capital charges are drawn from the Base_capital_charges and adjusted for inflation

Step 4 – Projected Operating Costs

The sum of the projected operating costs and the proportionate allocation between the charging parameters are the principal inputs. The allocated costs are divided by the respective capacity parameters to determine unit operating costs.

Step 5 – Total pre-scaled Charges

Unit operating and capital charges are combined to determine total pre-scaled unit charges.

Step 6 - Pre-scaled Charges (INR/day) on contracted Capacity Agreements

The total daily pre-scaled charges for each consumer are determined for each consumer based on their respective capacity agreements.

Step 7 - Determination of Wastewater Re-use Charges / Credits

The model provides for four options of charging (or giving credits) to those consumers taking re-used wastewater. The options include

- Charge users based on cost of re-use
- Charge user based on auction price
- Water re-use at no charge
- Water re-use credits based on value of volume component of treatment charges

This provides flexibility as to what approach to take.

Step 8 – Determination of the allowed Revenue

The allowed revenue for each year is determined as the operational costs plus any planned capital maintenance for that year. This is adjusted by any true-ups brought forward from two years previous and revenues / credits related to water re-use.

[16] *The Environment (Protection) Rules, 1986* state that the limit value for TSS for effluent from tanneries to a CETP comprising secondary treatment is 600 mg/l. Compliance with this requirement is assumed in the model.

The total allowed revenue is compared to the total pre-scaled revenue to determine an adjustment factor to match pre-scaled charges to the allowed revenue.

Step 9 - Scaled Charges
Scaled unit charges are determined by multiplying pre-scaled charges by the adjustment factor.
The daily charges for each consumer based on their agreed capacities are determined.

5.2.2.4 True_up_Year 0[X]

Each charging year has its own true-up sheet.

The sheet determines, ex-post, the difference allowed revenues and costs and actual revenues and costs. The differences are then carried forward as adjustments to the allowed revenue two years ahead.

The data for the true-up is determined outside the model, e.g. from the SPV's financial records, and included in the worksheets as inputs.

5.3 Suggested Process

For a charging system to work properly it needs a well-disciplined governance framework that sets out a timetable for the process. A suggested timetable of activities is set out in Table 5-2.

Table 5-2: Suggested annual calendar for the determination of charges

By Month	Activity	Responsibility
Start of month 1	New charges applied	All
By end of month 3	Complete true-up process and carry forward	SPV
By end of month 4	Invite consumers to submit applications for changes to their agreed capacities. If capacity is to be purchased the purchase price needs to be determined. Alternatively, if conducting a bid process then the invitation should set out how to submit bids and offers and by when. If possible inform consumers as to their actual usage relative to agreed capacity to allow informed judgement for their applications to revise capacity.	SPV
By end of month 6	Applications received (or bids/offers received). Applications received after a specified date should be rejected.	Consumers
By end of month 7	Applications evaluated and allocated subject to payments.	SPV
By end of month 8	Payments for capacities (or trades) received. If subject to bids and offers then the SPV to settle all trades. Final allocations agreed.	Consumers, SPV to settle trades
By end of month 9	Determine charges for following year based on projected financial needs, brought forward true-up details and revised capacities.	SPV
By end of month 10	SPV board approval of new charges and notifications to consumers.	SPV Board
End of month 12	New charges to take effect for the following year	All

The above is a rolling programme to be adhered to every year. Although it is a 12 month process there is limited slack time and the importance of keeping to the timetable cannot be over-emphasised.

5.4 Application of Charges

The model determines the charges on a basis of capacity per day. If capacities were agreed on the basis of annual capacity there is the risk that capacity could be significantly exceeded during the year but not on average overall. This would impair the performance of the CETP but would not provide any enforcement as annual capacity would not be exceeded.

Each consumer should be sent, prior to the start of the charging year, a schedule setting out their daily capacity agreements upon which a schedule of what their monthly charges would be. This could be based on a simple summation of the daily charges over the year and divided by 12 or 4 to give equal monthly or quarterly charges, or they could be based on the actual days in the month, i.e. February would incur the lowest charges. From an SPV cash flow perspective quarterly bills (in advance) may be preferable, but this is a matter of detail to be agreed with the SPV and its members.

This schedule should also set out other charges that may apply, in particular excess capacity charges, how they are determined and for the duration of the charges, e.g. month, quarter or year.

6 Conditions Precedent

The application of the Mogden formula or similar for trade effluent charges requires an appropriate legal, institutional and regulatory basis supported by the necessary physical infrastructure and human resources. We set out below areas that need to be considered. The recommendations below are outline issues for consideration in the preparation of legal instruments, consumer contracts and SPV articles of association in particular. Detailed legal drafting to accommodate these issues is the responsibility of the SPVs' legal counsel.

6.1 Physical Infrastructure

6.1.1 Flow Measurement

Wastewater flows need to be properly determined. In normal municipal wastewater systems this can generally be derived from water supply input with an assumed wastewater return factor. This does not apply to the CETPs where, in most cases, water is abstracted by the consumers from ground water on their premises and unless the water abstraction itself is measured the actual wastewater flows need to be measured or assessed in some other manner. This generally requires the installation of wastewater metering equipment (normally at the cost of the consumer). If wastewater metering equipment is installed it should be a condition of the agreement with the SPV that the SPV will have unrestricted access to the meter and any records related to it. This access should also extend to inspection of the complete wastewater system within a consumer's premises to investigate possible transgressions, e.g. meter bypass, discharge of waste into the environment etc.

If the consumer is responsible for calibration and maintenance of the meter the agreement should ensure that it is done at regular intervals according to manufacturers' recommendations and by accredited firms that can provide the necessary testing and calibration certification.

This meter will be used as a basis for wastewater charging. As the recommended approach is to determine charges based on agreed capacity the meter's primary functions are to identify flows in excess of agreed capacities and to inform the consumers' decision making with respect to changing their respective capacities.

Until such a meter is installed flows will need to be assessed (methods to be determined).

If there is a real risk of consumers tampering / bypassing the meter then the contract should provide for appropriate security measures where necessary, e.g. tamper-proof secure meter boxes and seals etc. Where such measures are installed the agreements should provide for deterrent charges, e.g. excess capacity charges based on a multiplier of agreed capacity and for a period long enough to have a real impact on consumer behaviour.

6.1.2 Quality Measurement

The quality of the wastewater has to be measured. This can be done through automatic continuous sensors (expensive) or from sampling at random (but short) intervals (less expensive). The SPV will need to have powers set out in the contract similar to the powers enjoyed by the CPCB and the SPCBs for taking samples and testing. Furthermore, the SPV should have access to the results of tests undertaken by the CPCB and the SPCBs including an agreement for the consumer to grant the SPV permission to access data directly from the CPCB and the SPCBs. Similarly, the SPV should provide the CPCB and the SPCBs unrestricted access to the data collected by the SPV, with the possible exception of commercially confidential data.

If the SPV is expected to undertake the tests directly then the SPV shall need a fully equipped laboratory for this purpose, as well as suitably qualified staff to undertake the tests.

6.1.3 Office Infrastructure

The SPVs management will require a minimal level of office support, e.g. billing of charges, revenue collection, accounts, recording of data, analysis of data, asset management planning, cost management, enforcement and more besides. The scale of these functions will depend on the scale of the SPV's operation. These functions will need the support of necessary office infrastructure, e.g. computer(s), telephones, internet access etc., with a realistic budget for office consumables together with suitably qualified staffing

6.2 Financing

6.2.1 Working Capital

The SPV will need opening working capital to cover effective operating expenditure until such time the revenues are received on a regular basis. This will depend on the charging arrangements. The working capital requirements will be less if charges were paid in advance (say quarterly) than if they were paid in arrears. A more detailed analysis of working capital requirements may be necessary before reaching a firm conclusion but general experience would suggest a minimum of three months of operating costs would be adequate. This could be allocated to each consumer based on three months charges according to their capacity agreements.

Each consumer should be obliged to submit their working capital contributions as part of their entering into an agreement with the SPV, i.e. until the contribution is received they are not permitted to use the system.

Even with an adequate working capital provision circumstances may arise where additional (unexpected) capital requirements arise, e.g. emergency repair works. If necessary the contracts should provide for the SPV to call on its members to contribute (pro-rata to their capacity agreements).

6.2.2 Operating and Capital Maintenance

The charges system proposed through this study is the basis of financing operating and capital maintenance of the system. To meet the operating costs without imposing severe financial stress on the SPV it is preferred that the charges are payable in advance and, if possible, quarterly rather than monthly.

6.2.3 Expansion

Although examining methods for financing system expansion is outside the scope of this study the contracts should provide a mechanism for this purpose, e.g. how the money is raised, who to meet the costs and their respective contributions (existing and new consumers), etc. The visit to the CETP HPDA Textile Center, Hapur – Pilkhuwa, revealed that significant equity issues with respect to the contributions that have been made through the plot sales to prospective future consumers but they are denied access to the CETP (see Section 8.2 for further details). This is a major challenge and if it cannot be resolved immediately the contract and/or articles of association for the SPV should provide for this to be developed at a later date and incorporated into future contract amendments.

6.3 Enforcement of Compliance with Contract Terms and Legal Obligations

6.3.1 Exceeding agreed Capacity

The proposed charging system is based on capacity agreements with the consumers. Each consumer is expected to enter into an agreement with the SPV to maintain their discharge within the limits set out in the agreement. Should a consumer exceed one of more of their agreed capacities then excess capacity charges should apply.

There are several options for determining the scale of excess capacity charges and how they are applied, the choice of which may depend upon local circumstances and the importance of managing capacity. Several principles should apply including but not limited to:

- Excess capacity charges should be higher than the agreed capacity charge to prevent consumers treating the capacity charge as an extension to their normal charges which will not encourage consumers to keep within their contracted capacities.
- Excess capacity charges should be high enough to deter consumers from exceeding their capacity. Options could be:
    - Excess capacity charges based on a simple multiplication factor, say 2x, the standard capacity charge for each element (simple but difficult to justify on economic grounds)
    - Excess capacity charges set on the basis of the pre-scaled value (provided the scaling is negative).This value is economically justifiable but if the difference between scaled and un-scaled charges is small the deterrent value is weak.
    - Excess capacity charges based on some other arbitrary value determined by the SPV.
- Excess capacity charges should also apply for a period long enough to deter consumers exceeding their capacity, either for a short period of about a month, or for a longer period:
    - Excess capacity charges could be set for the whole month that the capacity is exceeded. Assuming meter reads and samples taken are more than likely taken monthly this may be the minimum period for excess capacity charges. The problem with such short period is that is has limited deterrent value.
    - Excess capacity charges could apply for a longer period, say three months or even a year. Although a longer period has greater deterrent value there is the risk that a consumer who has breached the capacity threshold may choose to continue to breach on the basis that the excess charges are going to apply anyway. This behaviour can be discouraged if the period of excess charges kept being extended as the contracted capacities were breached.

The below example illustrates how excess capacity charges could be applied:

Example: Excess capacity charges

Basis of excess capacity charges: to be applied as a multiplier of 2 x base charge and applied for three months:

A consumer (customer CCC in the prototype model, year 01) has a capacity agreement of:

Parameter	Agreed capacity	Unit charge INR	Daily charge INR
Flow (conveyance and treatment)	1,100 m^3 day	31.3252	34,458
COD	3,500 kg per day	7.5788	26,526
TSS	450 kg per day	21.475	9,664
Total charge			**70,647**

In month 3 measurements show that the consumer exceeded capacities in flow and TSS by 150 m^3/day and 200 kg/day respectively.
The excess capacity charges are calculated as:

Excess over agrees capacity	Agreed capacity	Unit charge INR	Daily charge INR
Flow (conveyance and treatment)	150 m^3 day	31.3252	4,699
TSS	200 kg per day	21.475	4,295
Total charge			**8,994**
Excess capacity multiplier			2
Excess capacity charge			**17,988**

This consumer would face an excess capacity charge of INR 17,988 per day in addition to normal charges for a period of three months. The additional revenues collected would carry forward to year 03 to reduce the allowed revenue used to set charges for all consumers in that year.

The imposition of excess capacity charges should be accompanied by a request to correct their discharge to fall with their agreed capacity limits. This is to ensure that overall flows and concentrations are maintained within the system capacity constraints.

Subject to available capacity in the system the consumer should be permitted to ask for its agreed capacity to be increased. Even if such a request is granted the charging arrangements could still provide for the excess capacity charge still to apply for the prescribed period to maintain the deterrence effect. Furthermore, a mid-year increase in capacity should apply for the remainder of the year and, possibly, be the minimum value for the following year.

In the above example the consumer could request to increase the flow and the TSS capacities. The request to increase flow may not be granted due to system capacity limitations but the TSS capacity could be increased to 650 kg per day (provided this resulted in a TSS concentration of less than 600 mg/l, the statutory limit). The new TSS capacity will apply until the end of year 01 and possibly as a minimum level for year 02. This should not prevent the consumer seeking a further increase for year 02 if desired.

A mid-year request to increase capacity would result in additional revenues. In theory, a re-calculation of charges should result in a corresponding decrease in charges for all other consumers and changes to the capacity agreements. This is impractical. As the knock-on effect to other consumers of a capacity increase to just a few consumers is expected to be relatively small (almost negligible) a simpler and more practical approach is to rollover the additional revenue as part of the true-up process that will reduce charges two years hence.

Alternatively changing agreed capacities mid-year could be prohibited altogether. This has the advantage of simplicity and more stable revenues but it may constrain economic output.

6.3.2 Persistent Excess Capacity

If a consumer did not respond to the excess capacity charges and continued to breach the agreed limits then additional enforcement measures may be necessary, especially if the breach results in placing undue stresses on the overall system. The enforcement process may include instructions to reduce output to within the agreed capacities in the first instance but if there is still no response the consumer's membership could be suspended, i.e. the consumer is no longer entitled to discharge into the system which could result in the business temporarily closing. During a period of suspension the consumer should still be liable for capacity charges as the capacity is still being reserved for that consumer and denied to others. If all outstanding dues are settled and the SPV is satisfied that the consumer will adhere to agreed capacities then the suspension could be removed.

In the extreme, i.e. refusal to settle outstanding dues and/or the SPV is unconvinced that agreed capacities will be adhered to, membership of the SPV could be permanently revoked and the capacities allocated to other consumers. This is an extreme measure and is unlikely to be imposed but the threat of revocation of membership is necessary to deter extreme transgressions.

6.3.3 Non-payment

The enforcement provisions for non-payment should be robust. The SPV should be able to respond quickly to non-payment by consumers. For example, if payment is not received by the due date, e.g. quarterly in advance, the SPV should send a warning notification demanding immediate full payment. If, payment is still not received then a further notification may be required together with late payment charges, e.g. 1% of bill value per month (or part month) overdue.

If payment is still not forthcoming then more robust measures such as SPV membership suspension and ultimately revocation may be necessary.

6.3.4 Exceeding Limit Values Outside of Capacity Agreements

The contract may include limit values on parameters that are outside of capacity agreements, e.g. limits on pH or heavy metals etc. Financial excess capacity charges would not apply in these circumstances. The SPV should have the power to demand compliance with these limit values, failing which enforcement action including: enforcement notices to comply, financial penalties (these would need to be set out in a schedule of penalty charges), SPV suspension and revocation. The contract agreement should specify any limit values where applicable and the actions / penalties to be applied if they are exceeded.

6.3.5 Denial of Right of Access

Enforcement measures against denial of the SPV's officer's contract rights of access may need to be included in the contract. This should follow a process of warnings and for persistent offenders the option of SPV suspension or revocation may need to be considered. Financial penalties could be considered but it is questionable as to how effective they may be, e.g. the consumer may be more willing to pay the penalties than the consequences of the results of an inspection.

6.3.6 System Abuse

The enforcement regime should provide sufficient powers to deter system abuse including: meter tampering, corruption of SPV officials (e.g. to falsify quality measurements), meter bypass, system bypass and discharge into municipal sewers or the environment and other transgressions. There are several enforcement options open to the SPV depending upon the nature of the offence:

- Offences that are specific to the contract agreement (and not and legal offence), e.g. meter bypass, should be covered by enforcement measures in the contract agreement. These could include:
    - Backlog financial remedies comprising assessed discharge (volume and quality) and the imposition of excess capacity charges for a period going back to when the offence was believed to have commenced.
    - Financial penalties comprising fines (on a scale set out in the contact).
    - Suspension and/or revocation of the membership of the SPV.
- Offences that are contrary to law, e.g. discharge into municipal sewers or the environment, and discharge quality in excess of statutory obligations.
    - It is unlikely that the role of the SPV is to enforce and rule on compliance with legal obligations, this is the role of appointed state institutions such the CPCB or the SPCBs, local government and the judicial process. The SPV's role should be to inform the appropriate authorities of any transgressions including the provision of any supporting evidence as soon as it is aware of a potential offence. Under no circumstances should the SPV withhold information related to such transgressions from these authorities. Such behaviour could result in the SPV officers themselves being subject to prosecution as accessories to the offence. The appointment of the DM as a member (chair) of the SPV board reinforces this obligation. The DM is, in effect, an officer of the courts and as such cannot, under any circumstances, avoid the responsibilities attached to it. More in-depth legal counsel may be required to clearly define the SPV's legal obligations in this regard and that the SPV management and staff need to be made fully aware of their legal position.
    - Although enforcement in these circumstances is the responsibility of the appropriate authorities the SPV could also respond, e.g. suspension of membership until a legal ruling is made. This is unclear legal territory that is outside the scope of this study and further legal counsel may be required to determine the legal position in such circumstances.

6.4 Enforcement of Compliance with Environmental Obligations

The SPV will be subject to the provisions of legislation and other legal instruments with respect to compliance with statutory discharge standards and other obligations, e.g. restrictions on outflow. The obligations for the CETPs are set out in various legal instruments notably:

- The Water (Prevention and Control of Pollution) Act, 1974.
- The Air (Prevention and Control of Pollution) Act, 1981.
- The Environment (Protection) Act, 1986 and the Environmental (Protection) Rules, 1986.
- The Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2008.

A detailed commentary on these legal instruments are provided in the report 'Indo-German Environment Partnership, (May 2015), *Common Effluent Treatment Plants: Overview, Technologies and Case Examples*'. In summary, these legal instruments set out the roles and responsibilities of the various parties including CETP users, owners and operators, CPCB and the SPCBs and others. The Water Prevention and Control of Pollution Act, 1974 in particular sets out the powers and the responsibilities of the CPCB who is responsible for setting discharge standards for primary treatment by users and the discharge standards for the CETPs. These standards are scheduled on the CPCB web site https://cpcb.nic.in/effluent-emission/.

The Water Act also sets out a robust enforcement regime comprising custodial sentences for breaking certain the provisions of the Act. It is not clear as to how the Act is enforced in practice as it is reported that many facilities throughout India are not complying with the prescribed standards but are continuing to operate.

As described in Section 6.3.6 above the SPV has an implicit legal duty to report non-compliance with the statutory standards to the appropriate authorities for enforcement including prosecution if appropriate.

The CETP itself may find itself in contravention of its legal obligations, in particular non-compliance with CETP discharge quality standards as set by the CPCB. In such circumstances the SPV officers could find themselves personally exposed to prosecution including fines and custodial sentences. As the consumers are ultimately the shareholders of the SPV they will ultimately bear the financial burden of any financial penalties. This presents a major challenge to the SPV, especially if non-compliance may be attributable to one or more consumers violating their obligations (contract and legal) or even a failing in the operator if this is a contracted outside party. Should the penalties be passed on to individual consumers (or operator) who created the circumstances behind the penalties or should the penalties be borne by all consumers?

In theory, it would appear equitable to pass on any penalties to the specific consumers responsible (or the operator if that party is responsible) but in practice this may prove problematic and subject to legal challenge. The SPV would need to prove fault on the part of the consumer whereas the consumer could respond by citing failings in the CETP operation. The agreements between the SPV and its members should provide for a dispute resolution process including adjudication by independent third parties if necessary.

6.5 Governance Arrangements

The relationship between the SPV and its members will need to be formalised in an agreed governance framework. Such a framework should include conventional corporate requirements, e.g.

- Financial reporting (including audit) and approval of the SPV accounts (this will most probably be set out in statutory financial reporting requirements).
- Shareholder meetings (annual and extra-ordinary), voting rights, and decision making including appointment of the board and senior officers.
- Remuneration for senior officers.
- Major expenditure decisions.
- Etc.

The governance framework particular to the SPVs should also include specific and detailed procedures for (but not limited to):

- Membership.
- Suspension and revocation of membership including an appeals process.
- Enforcement processes.
- Changes to agreed capacities (including details for a micro market for capacity trading if to be adopted).
- Changes to limit levels to meet statutory obligations.
- Approval of charges (annually and timetable).
- Amendments to the charging model[17]
- Protection of commercially confidential information.
- Amendments to the governance process itself.

Decisions made within the governance framework may not always be put to majority voting. Some aspects may need the protection of veto by certain parties, notably the SPV. For example, the consumers may choose to restrict the allowed revenue which would jeopardise the CETP's ability to meet its statutory obligations. This would be unacceptable and that the SPV should have the authority to over-rule such a proposal.
These governance requirements need not necessarily be set down in the contract but could be presented as an accompanying document to the contracts and that the contract stipulates compliance with that document.

[17] The governance process for model amendments needs careful design. It should include details such as: a) guidance as to charging objectives to be met with proposals, e.g. improved cost reflectivity, b) who is eligible to propose an amendment, c) how is the amendment proposed (including supporting evidence), d) evaluation of the amendment (by whom?) and recommendation to adopt or reject, e) voting on the amendment (if voting is the recommended approach), and f) timetable for adoption and implementation.

7 Risks and Risk Response Measures

The development and operation of CETPs and the institutional arrangements therein involve many risks. Table 7-1 sets out a preliminary assessment of the identified risks and possible response strategies. The analysis is unable to assess the impact of the risk and the probability of the risk occurrence as this will be specific to each scheme. Not all risks are identified here and there may be many more risks specific to each scheme. This risk analysis framework can adopted as a basis for future risk assessments and expanded to include any other identified risks.

Table 7-1 Risk analysis

Risk category	Description	Impact description / symptoms	Impact of risk (high, med, low)	Probability of risk (high, med, low)	Risk response	Response strategy
Consumer behaviour	Consumers exerting undue influence over the SPV decision making.	Depressing of allowed revenues from what is required leading to failure comply with standards. Reduced cost reflectivity leading to lesser economic outcomes Consumers permitted to exceed limit values without sanction.			Mitigation and avoid	Governance framework designed to protect against undue influence, e.g. SPV powers of veto over certain decisions. Contract structured to avoid collusion by consumers.
Consumer behaviour	Consumers exceeding agreed capacities	Imposition of additional stress (and costs) on CETP. CETP discharge at risk of failing to meet standards and SPV subject to CPCB/SPCB enforcement measures including fines.			Transfer and avoid	Transfer cost to consumers through excess capacity charges. Enforcement measures for persistent and/or extreme excess capacity.
Consumer behaviour	Consumers abusing system, e.g. meter bypass, discharge into sewers or the environment	Reduced revenues to SPV (higher charges to other consumers) Potential environmental damage or damage to municipal sewers.			Avoid	Stringent enforcement measures including referral to external authorities where necessary, e.g. if it results in environmental pollution.

Risk category	Description	Impact description / symptoms	Impact of risk (high, med, low)	Probability of risk (high, med, low)	Risk response	Response strategy
Consumer behaviour	Consumers exceeding quality limit values, e.g. TSS, pH etc.	Imposition of additional stress (and costs) on CETP. CETP discharge at risk of failing to meet standards and SPV subject to CPCB/SPCB enforcement measures including fines.			Transfer and avoid	Transfer costs (including penalties) to offending (or all) consumers. Stringent enforcement measures including referral to external authorities where necessary.
CETP management and control	CETP failing to meet required discharge standards and other conditions.	CETP discharge at risk of failing to meet standards and SPV subject to CPCB/SPCB enforcement measures including fines.			Transfer and/or accept	If operated under private contract transfer costs to operator (subject to challenge). Transfer costs to offending consumers if they are responsible. SPV to accept risk and transfer costs to all consumers if responsibility cannot be assigned.
Consumer behaviour	Usage lower than anticipated	Costs allocated to lower number of consumers or higher unit costs.			Accept	The revenue model allocates all costs to consumers. Under-utilisation costs will be shared among all consumers.
Consumer behaviour	Consumers resisting payment of charges	Reduced revenue and therefore higher charges for all other consumers.			Mitigate	String enforcement measures including suspension and revocation of SPV membership to deter such behaviour.
Financial	Failure to meet cash flow requirements	Deferred expenditure on capital maintenance resulting in failing levels of service.			Avoid	Ensure sufficient working capital from consumer contributions. Additional contributions to working capital if necessary.
Consumer behaviour	Consumers not responding to price signals				Accept	
SPV management	Breaches of commercial confidentiality, e.g. consumer data	Consumer mistrust in the SPV Potential damages claims against SPV if consumer business adversely affected.			Avoid	Proper governance framework setting out data protection measures.

8 Case Studies

In the course of this study we examined 2 case studies:

1. The Jajmau Tannery Effluent Treatment Association (JTETA) in Kanpur, and
2. The Hapur Pilkhuwa Development Authority (HPDA) Textile Center in Pilkhuwa

Our observations are summarised below:

8.1 Case Study 1: JTETA, Kanpur

8.1.1 Summary Description

Table 8-1: JTETA, Kanpur

Description	Observations
General description of CETP	A large treatment plant comprising pre-treatment, biological treatment, sludge treatment and disposal facilities. It will also include a small wastewater for re-use treatment facility. Construction has just commenced.
Capacities	The design is for an inflow of 20 Ml/day. This capacity is limited by limitations on the discharge into the municipal wastewater outflow system based upon safe dilution levels. If the wastewater outflow capacity increased this would probably result in an increase in the available capacity of the CETP (or give room for expansion). The capacity for each consumer is allocated on the basis of 700 l per hide and according to the consumers' expected production levels and an operational practice of 365 days per year. Other design capacities are: BOD: 2,300 - 3,000 mg/l COD: 4,000 - 7,000 mg/l TSS: 3,000 - 5,000 mg/l TDS: 13,000mg/l pH: 7.5 - 9.0 Cr: 50 - 100 mg/l TSS is the principal contributor to sludge generation
Capital costs	The project's capital cost is INR 420 cr (INR 4.2 billion) of which INR 23 cr is for conveyance (sewerage network) and INR 20 cr (INR 200 million) is for a pilot wastewater for re-use treatment facility. Detailed analysis of the priced summary bills of quantities suggest that the CETP's capital costs (excluding conveyance and re-use) are split: Primary treatment: 26% Biological / tertiary treatment: 61% Sludge treatment / disposal: 13% In addition to the conveyance and treatment costs INR 137 cr (INR 1.3 billion) is to be spent on developing the primary treatment within the premises of the 380 consumers.
Financing	75% from central government (NMCG) as grant financed support 25% consumer contributions
Operating costs	The consumer charge is reported to be INR 60/m^3 and will cover all operating costs (including routine maintenance). This suggests the annual operating costs of INR 48 cr (INR 480 million).
Institutional arrangements	SPV established as a limited company to manage the CETP Contract agreements for capital contributions (but no details regards charging arrangements). Charges are intended to be capacity based rather than on actual volumes. The construction company has a commitment to operate the plant for a period of 5 years after commissioning.

Description	Observations
Consumers	380 consumers, 30 or which do not operate a full tannery process and use less water. Sample wastewater quality data for the businesses in its service area suggested COD ranged from just over about 2,200 mg/l to just under 10,000 mg/l (median approximately 2,600 mg/l). TSS ranged between less than 500mg/l to just over 2500 mg/l (median approximately 1,600 mg/l). It is assumed that TSS will be much lower (below the limit of 600 mg/l) due to the new investment in pre-treatment. All consumers will be subject to electronic continuous monitoring of flow and quality.
Consumer issues	Consumers have no choice to face charges and they are not expected to resist payment. Many consumers are currently not operating and are dependent on the CETP to allow them to restart operations.
Constraints	The outflow capacity of the CETP is limited by limitations on the discharge into the municipal wastewater outflow system based upon safe dilution levels. If the wastewater outflow capacity increased this would probably result in an increase in the available capacity of the CETP (or give room for expansion).
Other observations	The plant provides for chrome treatment which will be collected separately from consumers and delivered by tanker to the CETP. The recovered chrome will returned to the consumers This service is regarded as a commercial activity and will be charged for separately from the base treatment services. Consequently, this activity is excluded from the analysis. Similarly sludge will be used to generate revenues from the tallow oil industry to make soap. This is negligible and is not considered in the analysis.

8.1.2 Test Run of Model using Kanpur as a basis

The prototype price model has been based on the above data. It was impracticable to develop a model with 380 consumers so the prototype has just 10 consumers, although the sum of the capacities equates to the capacity of the CETP. The model is provided as Annex 1 and a more detailed description is provided in Section 5 of this report.

For testing purposes a wide range of capacities for volume, COD and TSS were applied to illustrate the effects of cost reflective charges. Examples of these effects include:

- The un-scaled charges are generally greater than the scaled charges. This is largely due to the grant financing of the CETP. Consequently, charges have to be reduced to match the allowed revenues.
- Charges can vary quite significantly depending on the consumer’s wastewater quality, e.g. When all charges are converted to a rate per m^3 for comparison purposes the average charge for the most polluting consumer (BOD 4672 mg/l and TSS of 595 mg/l) equates to INR 80.20 /$m^{3,}$ whereas the least polluting consumer (BOD 2250 mg/l and TSS of 375 mg/l) equates to INR 56.43 /m^3.
- Reductions in capacity charges can realise significant annual savings (e.g. customer 3 between year 1 and 2). A reduction in COD from 3182 to 2727 mg/l results in a reduction of INR 13.39 / m^3. For average annual wastewater discharge 20 Ml divided by 380 consumers) this saving equates to some INR 25.5 lakh (INR 250,000).
- In a constrained system it is possible to justify wastewater re-use as offering a benefit to the system by freeing up capacity for others to use. Valuing such a benefit as the

value of the (un-scaled) charge for the volume component of treatment and returning this to the consumer who takes the re-used wastewater the cost to the remaining consumers increases marginally by about INR 0.30 /m^3. This is largely due to the fact that the volume of re-used water is so small relative to total wastewater flows. A much larger re-use volume will deliver a bigger impact on those consumers who do not take the re-used wastewater.

8.2 Case Study 2: CETP HPDA Textile Center, Hapur - Pilkhuwa

8.2.1 Summary Description

Table 8-2: CETP HPDA Textile Center, Hapur - Pilkhuwa

Description	Observations
General description of CETP	An existing small comprising pre-treatment, biological treatment, sludge treatment and disposal facilities. The plant was built some 12 years ago but has only been in use for the last 3 years. The plant is in a poor state of repair and in obvious need of refurbishment. There are plans to increase the capacity by 4 Ml/day.
Capacities	The design is for an inflow of 2.1 Ml/day but in practice it is real capacity is restricted to about 1.9 Ml/day. The plant is running at levels exceeding its real capacity and may be failing in its discharge quality obligations. No details as to the plant's design capacities (BOD, COD etc.) were provided. Details of recent water quality results provided. Between 1 and 16 Feb 2020 daily inflow ranged from 330 kl/day to 1,300 kl / day. Over another period (Nov 2019) inflow COD and TSS levels were relatively consistent in the 450 – 550 mg/l range and TSS 200- 250 mg/l range respectively. After treatment these levels fall to 70 – 90 mg/l and 20 – 25 mg/l respectively.
Capital costs	No details on capital costs were provided.
Financing	Exact details of financing not provided. Consumers feel that they have contributed to the capital costs via the plot purchase from HPDA. This arrangement appears to be inequitable in that 195 plots have been sold but only 25 industries are operational. No new wet industries can be developed due to CETP capacity constraints. It appears as if all plot owners have contributed to the CETP but almost 90% of them are denied access to the CETC. Although capital financing is outside the scope of this study this circumstance does raise issues with respect to financing a future expansion, i.e. who to pay for it, especially considering that the existing users are have already paid the same as those who have been denied access? This requires further investigation and a detailed policy position to be reached.
Operating costs	Annual operating costs are covered by a service contract are approximately INP 10 lakh (INR 1 million) for sewer maintenance, and INR 102 Lakh (INR 10.2 million) for the CETP. HPDA pays these amounts to the appointed contractor. These costs are roughly broken down as energy 33%, labour 15% and consumables/maintenance 52%. It is understood that in the future operating costs shall be met through consumer charges.

Description	Observations
Institutional arrangements	The HPDA currently pays for the operating costs of the CETP, i.e. the industries are not charged for the service. The plant is operated through a contract with an operating company. An SPV is to be established for the future management of the plant.
Consumers	There are only 25 active consumers served by the CETP. There are potentially another 170 consumers that could be connected to the system in future (195 plots have been sold by the HPDA). Consumers have pre-treatment facilities (required as part of their operating consents.
Consumer issues	Although during the meeting it was suggested that consumers would be sensitive to wastewater charges (estimated to be about INR 20-30 per m^3based operation and maintenance operating costs divided by the inflow) a tour of one of the factories suggested (purely instinctively) that such charges may be very small in the consumers' overall value chains. We were not provided with any consumer's financial records to check this. Very little by way of consumer flow and quality monitoring equipment is installed.
Constraints	The capacity of the development areas is constrained by the size of the CETP.
Other observations	Consumers may be concerned about confidentiality issues, e.g. sharing information with their competitors related to wastewater flows and wastewater quality.

There is insufficient data to enable this case study to be modelled in the prototype charging model.

Annex 1

Example Charging Model

This annex is provided as a separate MS Excel file.

Following is provided in the excel file in different sheets:

- Determination of Annual Charges - Typical Wastewater Treatment Plant (using JTETA plant as an example)
- Inflation Indices
- True up and Carry Forward, Year 0
- Determination of Annual Charges and Agreements, Year 1
- True up and Carry Forward, Year 1
- Determination of Annual Charges and Agreements, Year 2
- True up and Carry Forward, Year 2
- Determination of Annual Charges and Agreements, Year 3

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