Enhancing Water Use Efficiency

Case of Thermal Power Plant in India

Jal Manthan-2

Integrated Approach for Sustainable Water Management

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The Energy and Resources Institute (TERI)

Structure of Presentation

Creating Innovative Solutions for a Sustainable Future

1. *Major Challenges in Water Sector*

2. **Opportunities to Enhance Water Use Efficiency: Case Study of Thermal Power Plant**

Major Challenges in Water Sector

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- **Declining** per capita **water availability**
- Many **river basins** are **water stressed** and likely to be **water scarce.**
- **Increasing** & **competing water demand** *(demand-supply gap)*
- **Overexploitation/Depletion** of groundwater
- Water quality issues
- **Inefficient use** of water: Agri/ Irrigation; Domestic (Urban & Rural), **Industrial**
- Irrational Tariff, **inequitable access**
- **Climate change** impacts; Trans-boundary issues

Thermal Power Plants:

- Of **total 288005 MW** power generation capacity *(Jan'2016)*, ~**60.8%** is coal based.
- Of **total 83000 MLD** of **wastewater** discharged by **all** industries**, ~ 80% (**66700 MLD) was **discharged** by Thermal Power Plants ***(CPCB 2001)***
- Indian **TPP** consumed **~ 80 m^3** water **per MW** as compared to **<10 m^3/MW** in **developed** nations ***(CSE 2012)***

NWM: Focal Areas

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National Water Mission

(Identified Goals)

- Comprehensive **water data base in public domain** and **assessment of impact of climate change on water resource**;
- Promotion of **citizen and state action for water conservation, augmentation and preservation**;
- **Focused attention to over-exploited areas**
- **Increasing water use efficiency by 20%**
  - **Develop guidelines**; **Recycling/reuse of water/wastewater**, Water positive/neutral technologies, Urban water supply efficiency
  - **Develop guidelines** for **mandatory water audit**
  - **Pilot studies** in collaboration with states
- Promotion of **basin level integrated water resources management**

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Water Audit of Thermal Power Plant

2009-10 & 2014-15

"What gets measured, gets managed"

Water Audits *should become* ***routine exercises*** *and* ***must*** *be* ***institutionalised***

Water Audit

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Quantitative and qualitative analysis of water consumption/use to identify losses and options for water conservation by means of recycling and reuse of water.

Scope of Water Audit

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- **Establishment/investigation of water supply & distribution network**, pipes, pumps etc.
- **Establishment of complete water balance** overall and individual stages.

  (*Including the raw water, clarified water, DM water, drinking water system; circulating water, fire water, service water****, cooling towers, ash handling water,*** *drain/sewage, residential colony drinking water* ***etc.)***
- Assessment of **overall water consumption**
- Characterization of **water quality** in main streams and identification of options for recycle and reuse.
- Assessment of Cycle of Concentration (**COC**), **specific water consumption**.
- Identification of **leakages and losses** in the system.
- Identification of **scope for water conservation** with recommendation on **recycle and reuse**.

Water Use in Thermal Power Plants *(Coal Based)*

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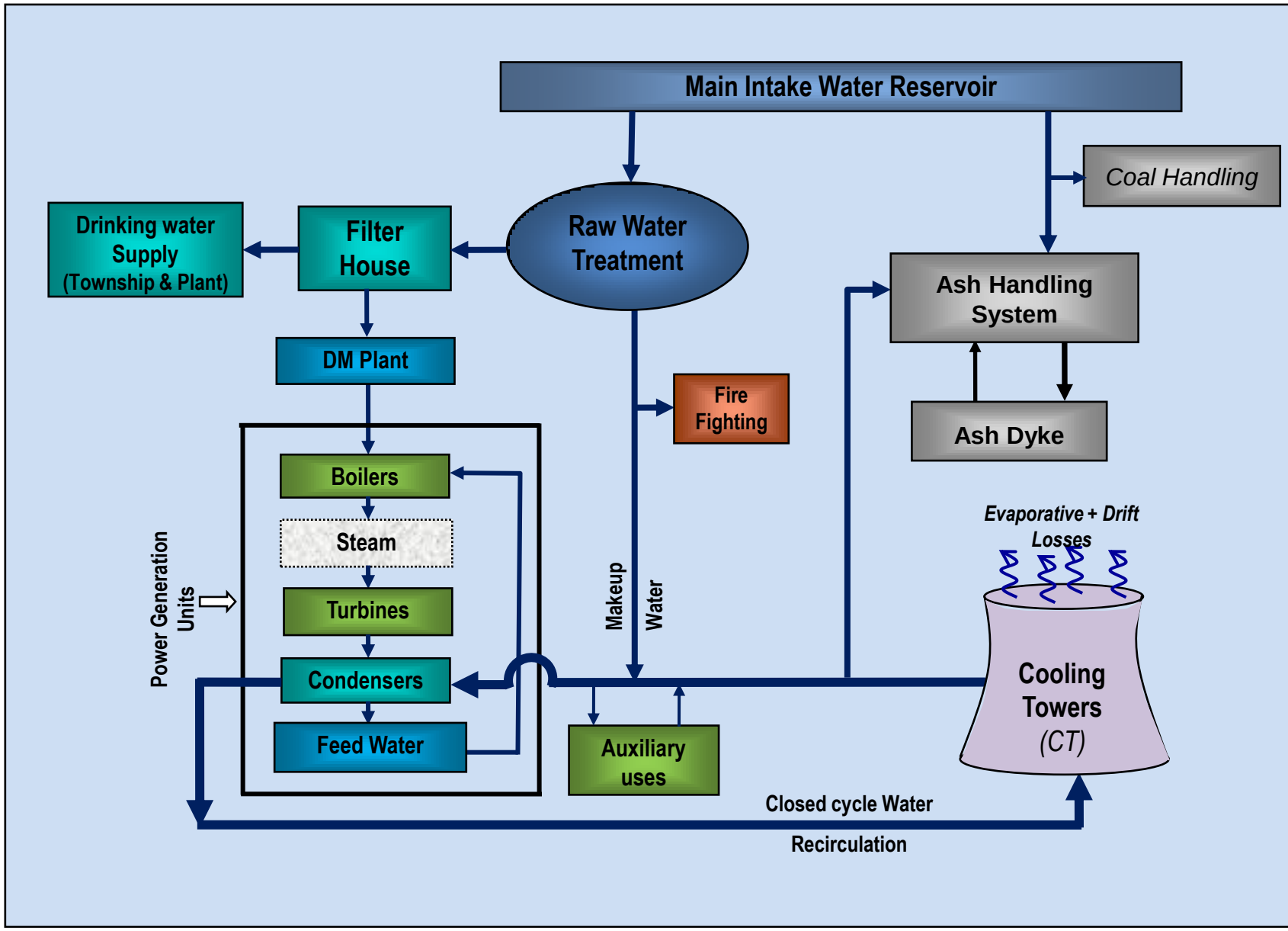

Establishment/Verification of water use & water supply network

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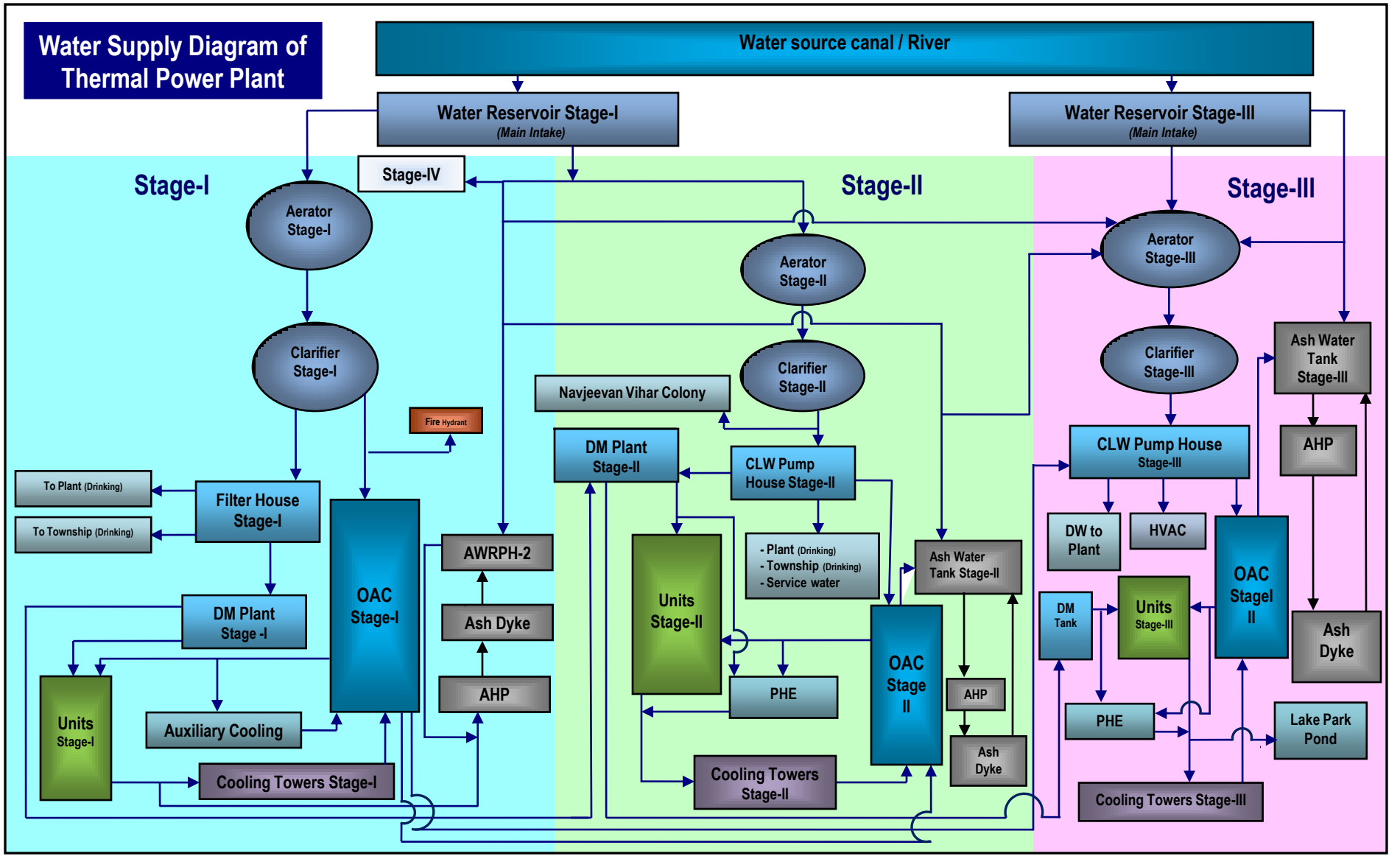
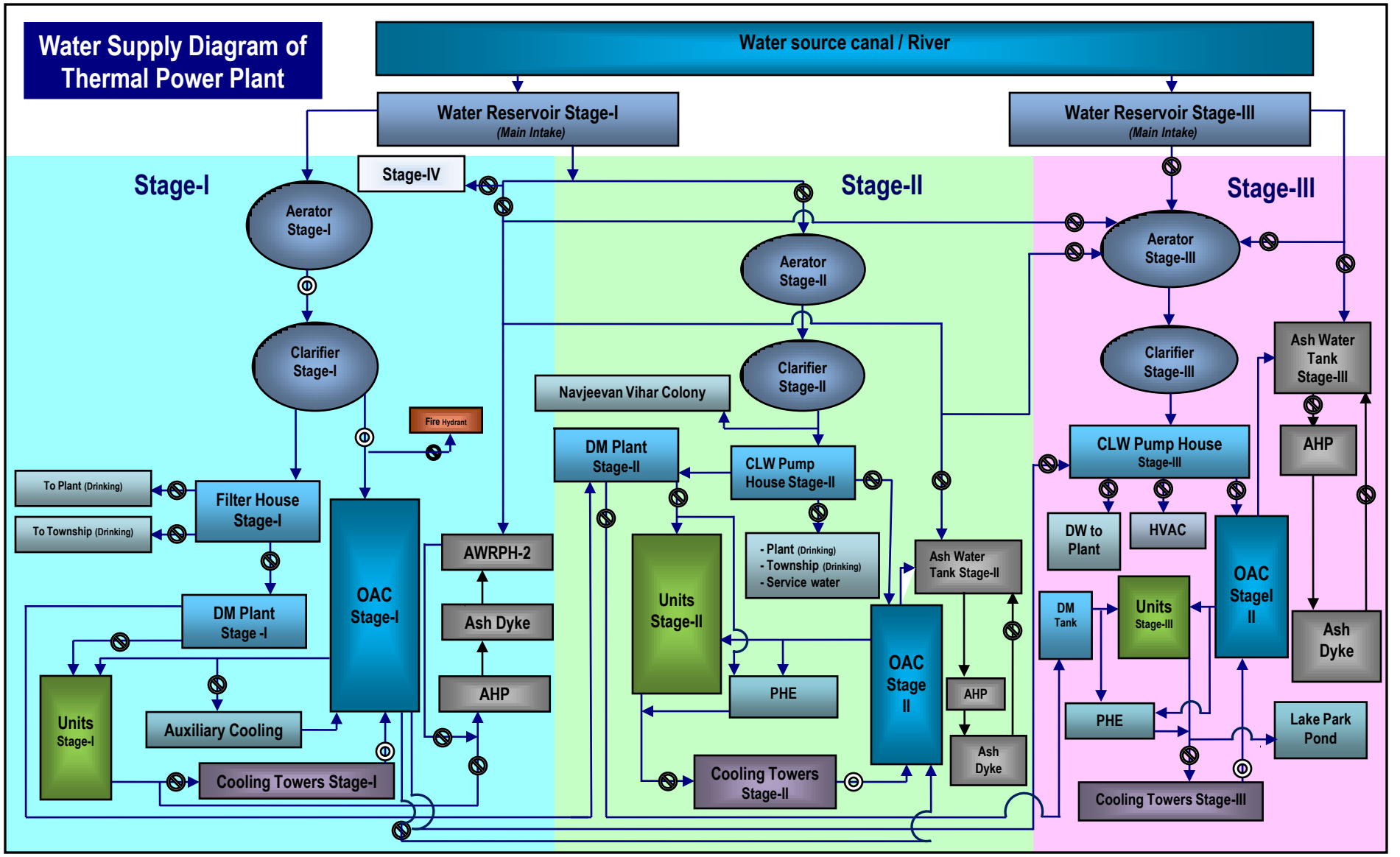
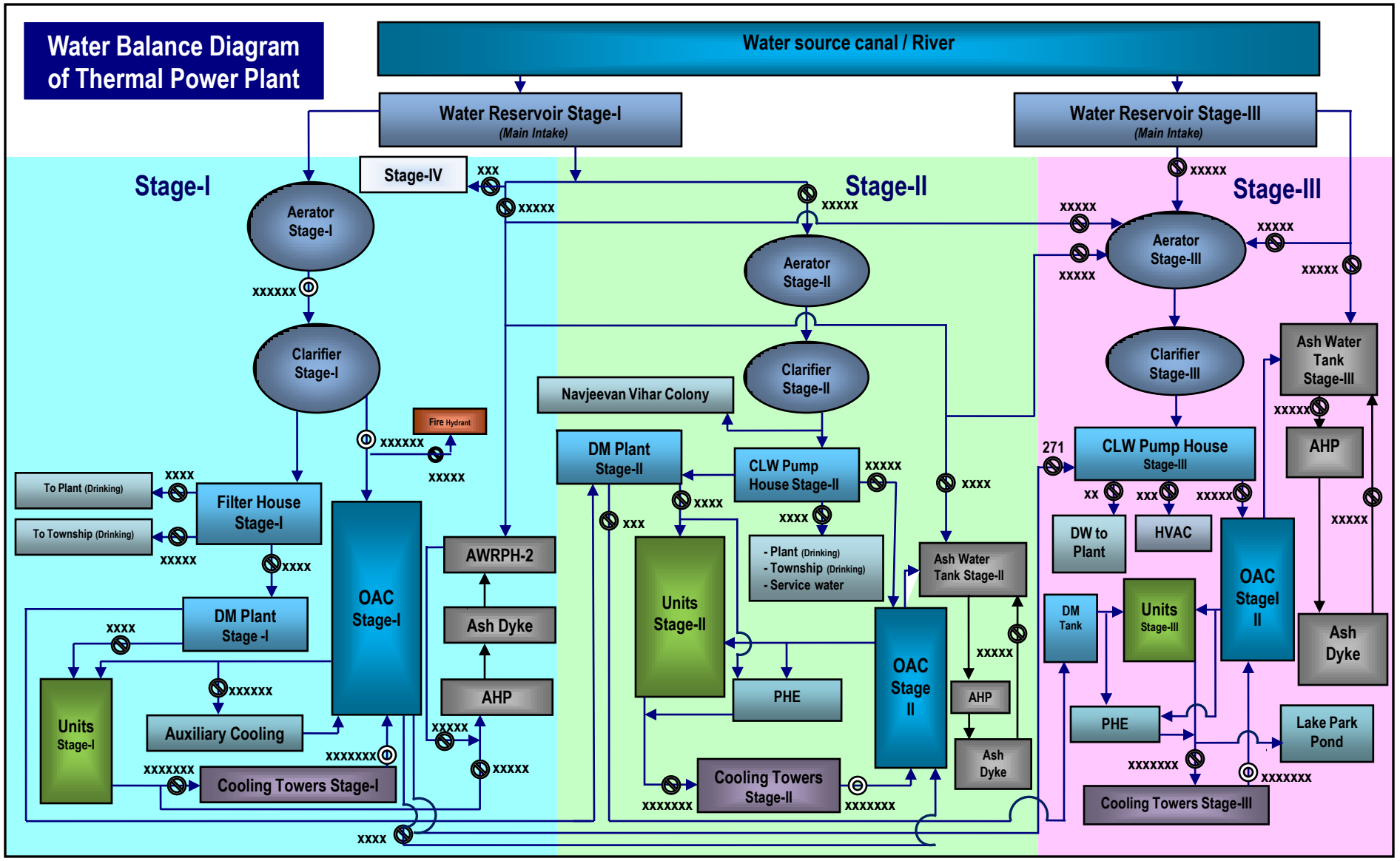


Flow & water quality monitoring



Establishment of Water Balance



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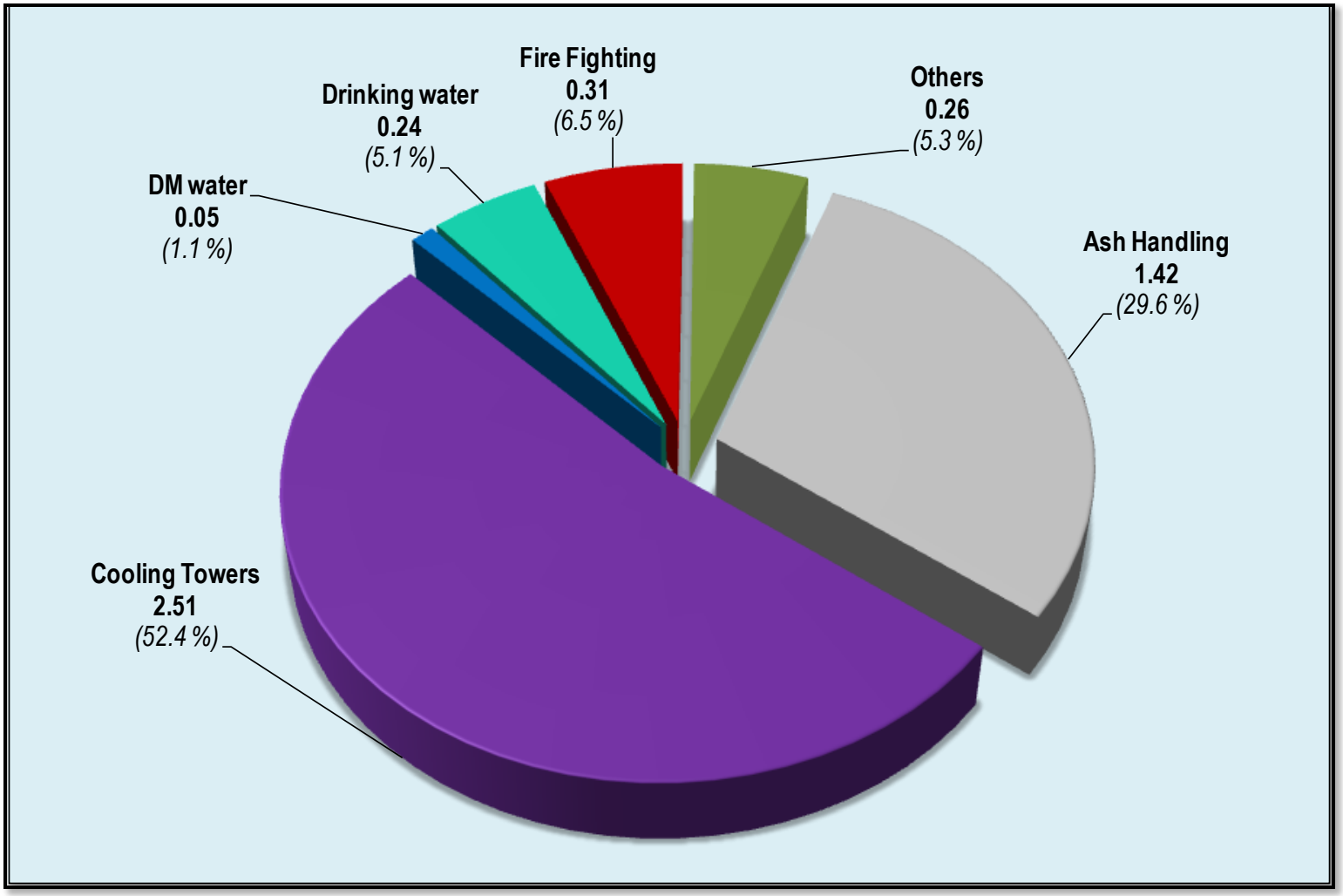
Ist Water Audit (2009-10)

(Major Findings)

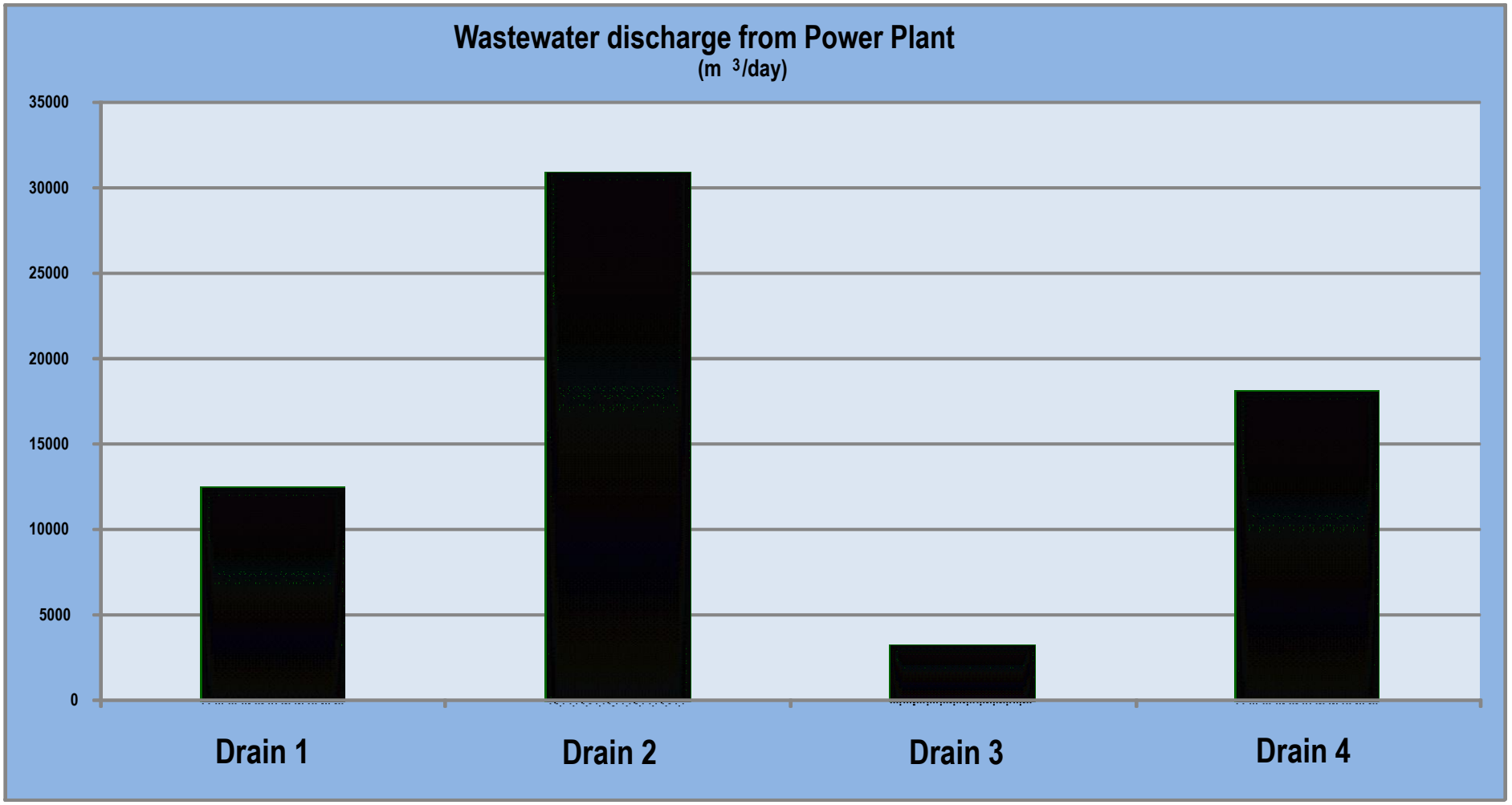
Specific Water Consumption (m^3/MW)



Actual Overall Specific Water Consumption – about 4.8 m^3/MW

Scope for optimizing (Achievable Target SWC) – 3 m^3/MW

Wastewater Discharge



- **Total Wastewater Discharged *(unused)* = 64000 m^3/day *(About 18% of Intake water)***
- **Wastewater quality** reasonably **good for recycling** (**Zero Discharge**)

Water use at Township

Township

- **Per Capita Water Consumption**, (lpcd) : **1500**
  *(About **11 times** the norms of 135 lpcd)*

- Even if about 350 lpcd water is provided to the Township there stands an **opportunity to save** about **13000 m^3/day of treated water**.

Leakages/Losses: Some Visuals

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Leakage at pipe to aerator

Overflow & leakage

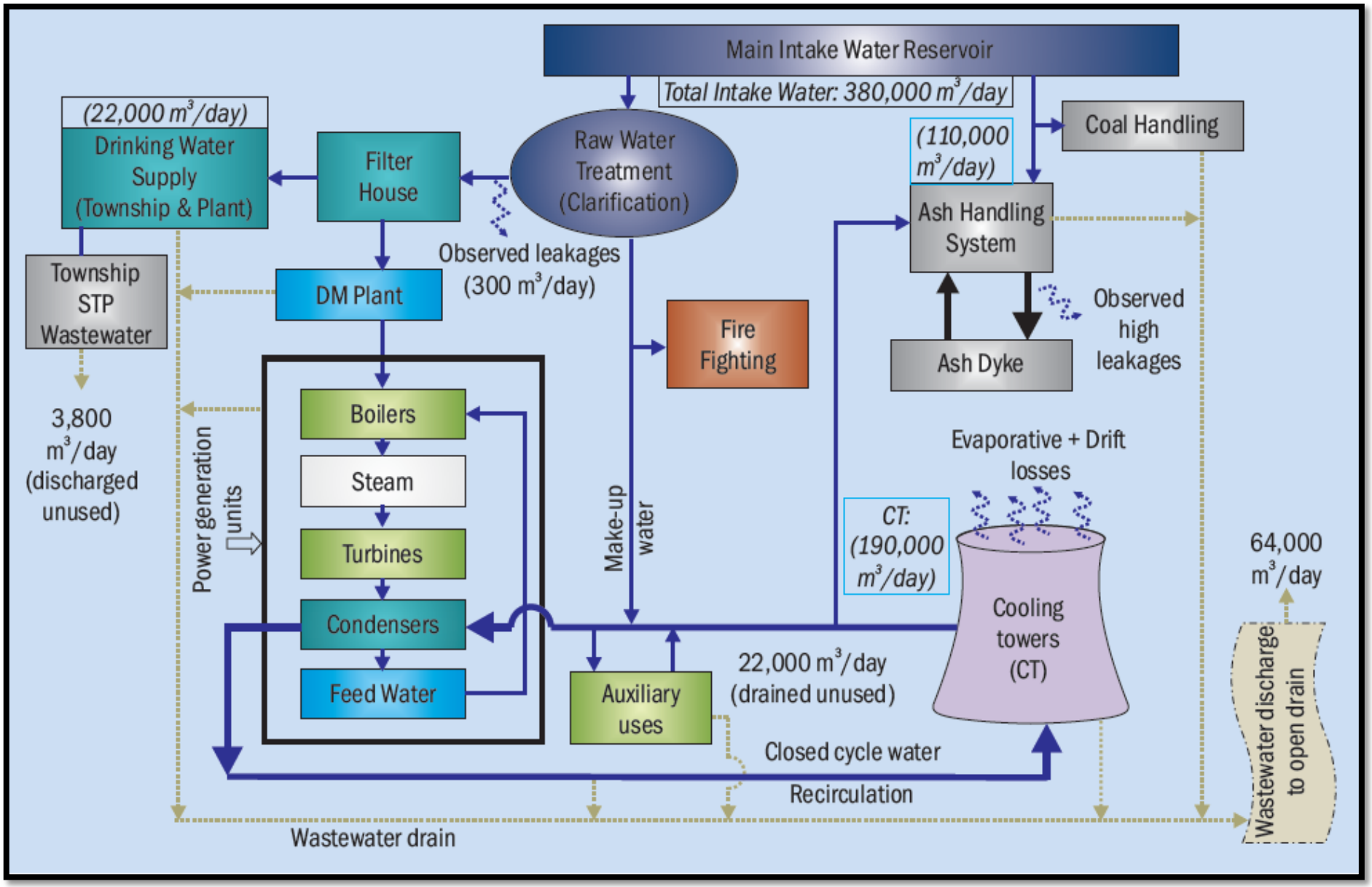
Overflows

Overflow

Burst pipe leakage jet

Leakage jet at pipe

State of water use before audit



Potential water saving areas identified
(after audit)

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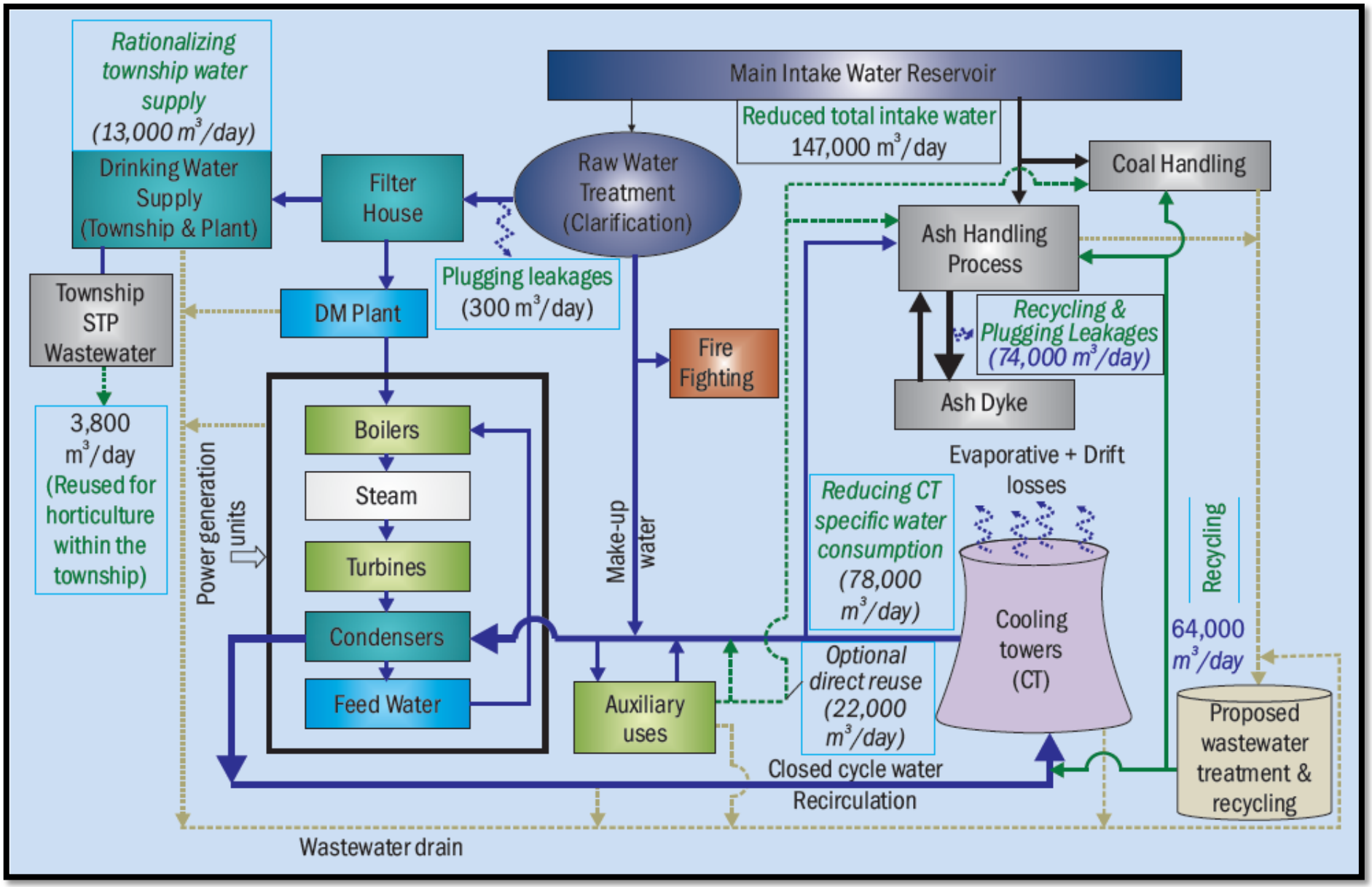

Recommendations for water conservation

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- High **water loss (80-50%)** in **Ash Handling** should **be brought down** (overflows & leakages curbed, **Wet to Dry ash handling**)
- **Cooling Towers**: **CoC (Cycle of Concentration)** must be **increased**, **Specific water consumption** should **be reduced** (to about 1.5 m^3/MW), **overflows** must be **checked**.
- **Recycling** of about **64000 m^3/day** of **wastewater** to **achieve Zero discharge** through a **WW recycling plant**.
- **Water** for **boiler auxiliary** (discharged as waste) should **be reused** .
- **Township**: **Reduction** in **per capita water consumption** (to 150 lpcd).
- **Township STP discharge water** (suitable for horticultural uses) should be **reused** entirely thus **ensuring zero discharge**

Potential reduction in water consumption

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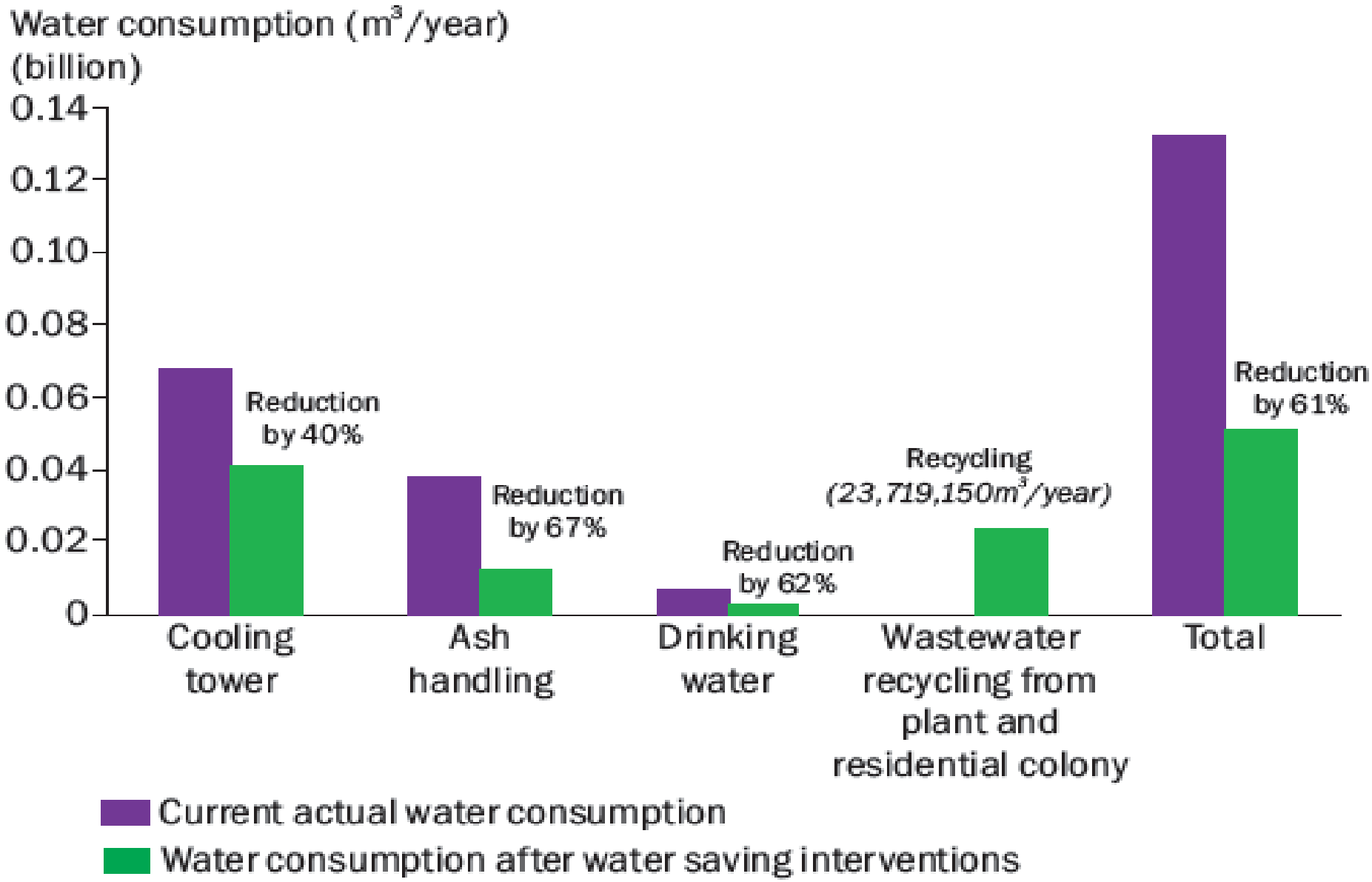

Potential for water saving

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- Immediate saving potential of **about** (81000 m^3/day) **23%** of total **intake water.**
- A total overall water saving potential was about **60% of** the **total intake water (freshwater)** of the entire plant.
- **Significant financial savings** from water saving interventions of about **INR 7-9 Crores**.
- **Cost benefit** of **wastewater recycling** system was positive with a **payback period** of just **2.3 years**.

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IInd Water Audit (2014-15)

(Major Findings)

Water Supply Network of TPP

(II[nd] water audit, 2014-15) Capacity: ~4200 MW

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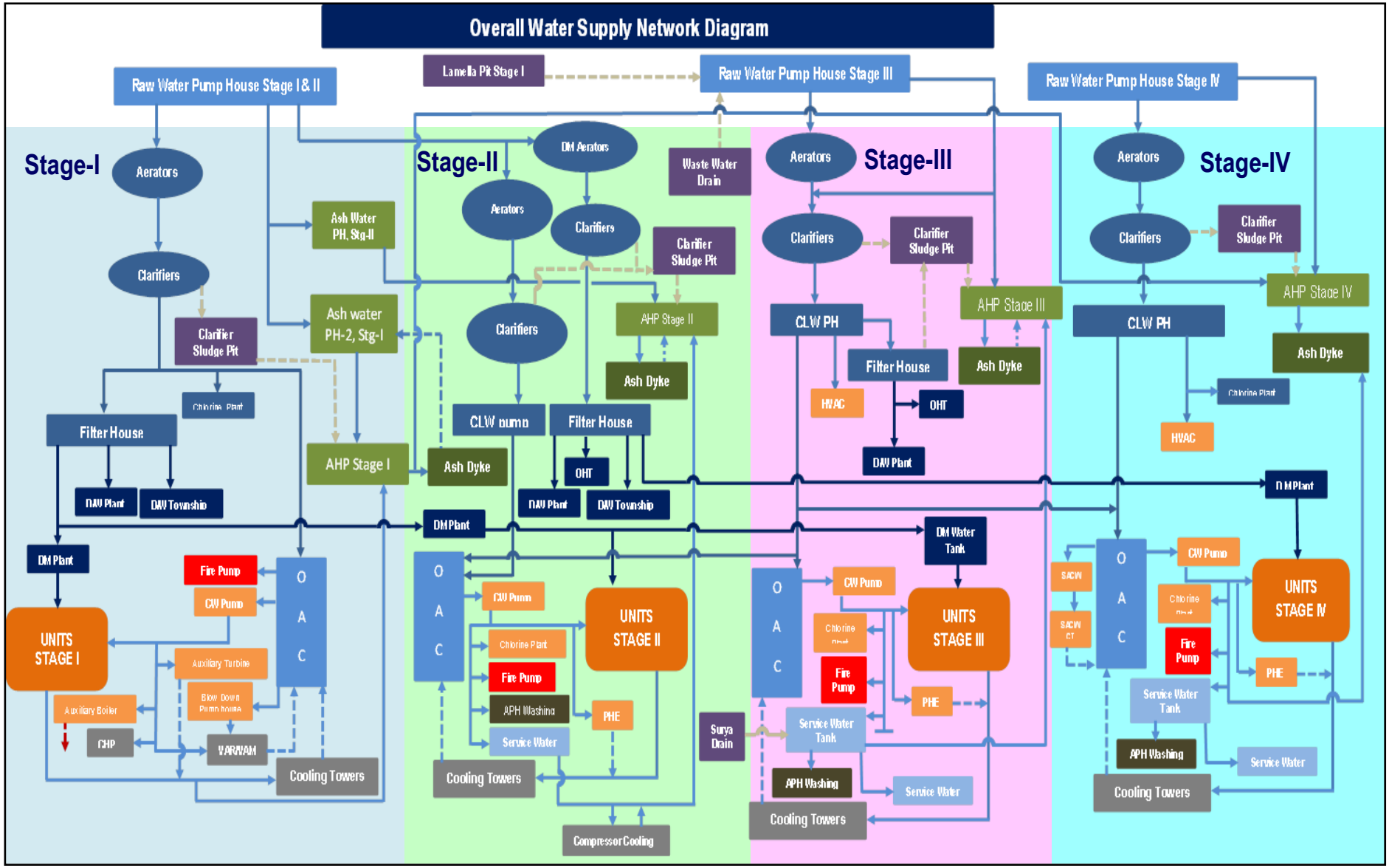

State of water use after IInd water audit

(2014-15)

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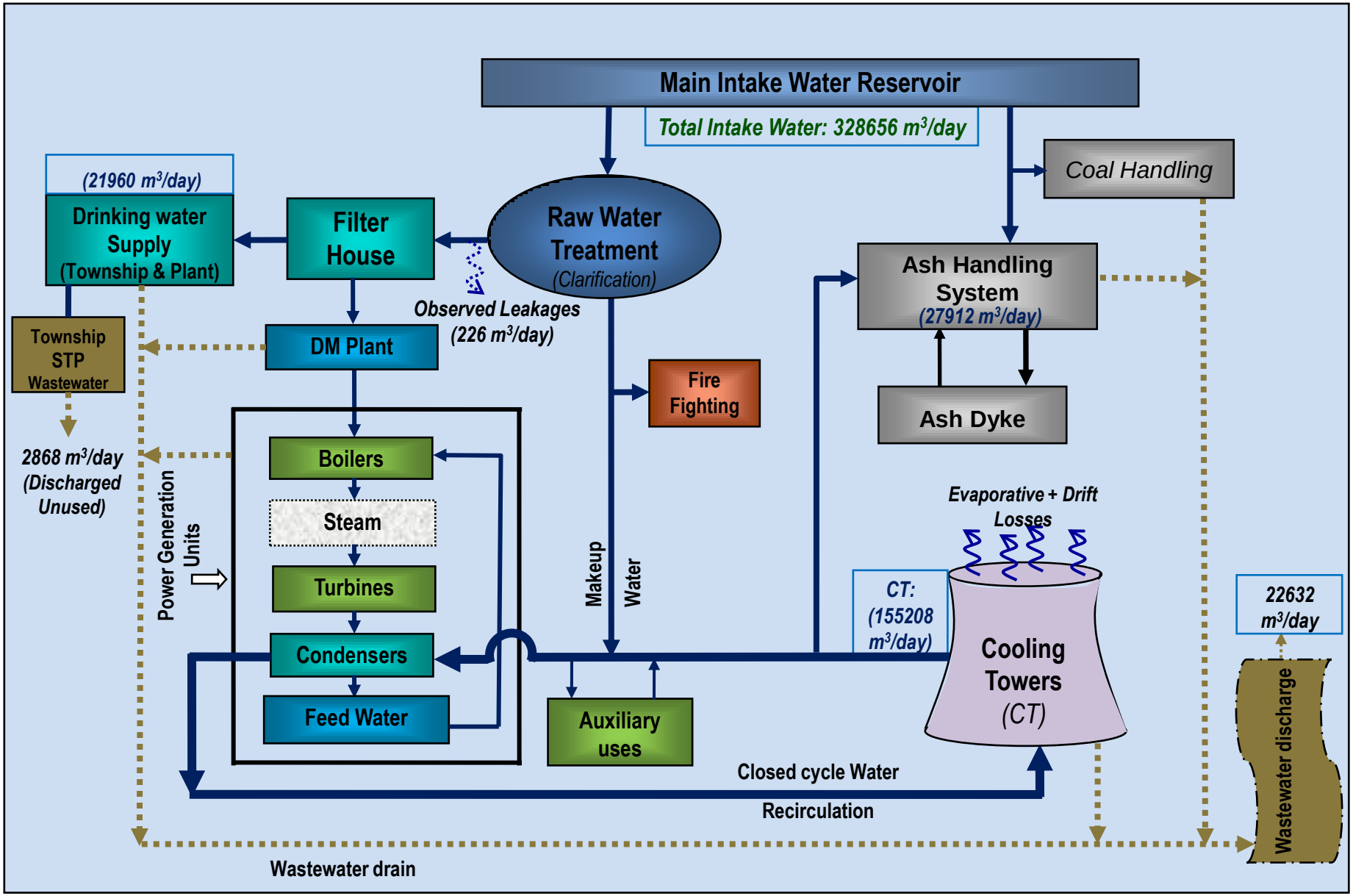
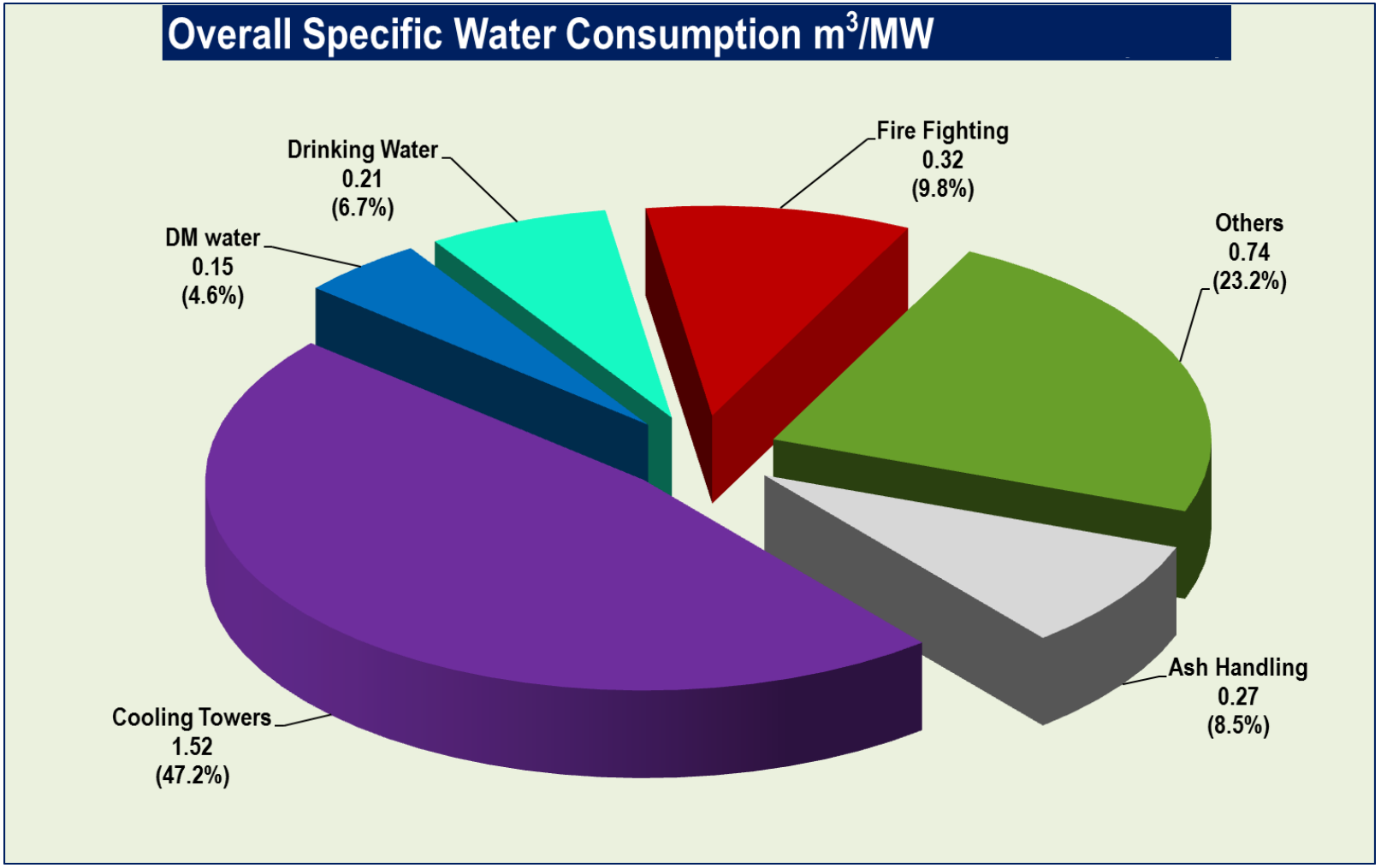


Specific Water Consumption (m^3/MW); (2015)



Actual Overall Specific Water Consumption – 3.2 m^3/MW

Scope for optimizing (Achievable Target SWC) – 2.3 m^3/MW

Comparative Water Use *(2010-2015)*

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Areas	Water Consumption (m^3/day)		Amount of Water Saved (m^3/day)
	2010	2015	
Cooling Towers	195120	155208	**39912**
Ash Handling System	109680	27912	**81768**
Demineralized Water **(DM) Plant**	4176	15146.4	*(-10970)*
Domestic Water (drinking, toilets etc.)	21648	21960	*(-312)*
Fire Fighting	25632	32280	*(-6648)*
Other (Service water, CHP, Auxiliary Cooling etc.)	23064	76152	*(-53088)*
Total Water Intake	***379320***	***328656***	***50664***
Water **leakages**/losses	336	226	**110**
Total **Wastewater discharge**	63936	22632	41304

Recommendations for Power Plants

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- **Recycle ash water**: *(e.g. for ash handling, gardening, dust suppression in coal stacking yard)*
- Shift from **Wet ash handling** to **dry ash handling** *(use of hydro bins).*
- Shift from **Once-through** cooling system to **closed-cycle system** with **high number** of re-circulations **(CoC).**
- **CoCs** in cooling towers should **be increased.** ***(e.g. chemical treatment*** *(anti-sludging, anti-sepsis, acidification, etc.),* ***periodic maintenance****, etc.*
- **Wet** cooling **to dry cooling systems** where it is **feasible**
- **Wastewater** must **recycled** to achieve **Zero discharge** *and* ***save freshwater*** *(including* ***Township STP*** *discharge).*
- **Fire hydrant** (fire fighting) water **must not** be used for **any other purposes**.
- **Regular water audits** must be **internalized** *(under* ***corporate policy)****.*
- **Automation** should be introduced with a **centralized control system** and established **management information system** (**MIS**).

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Impact of the Water Audit & Interventions

Water savings achieved / being pursued

(After IInd water audit; 2014-15)

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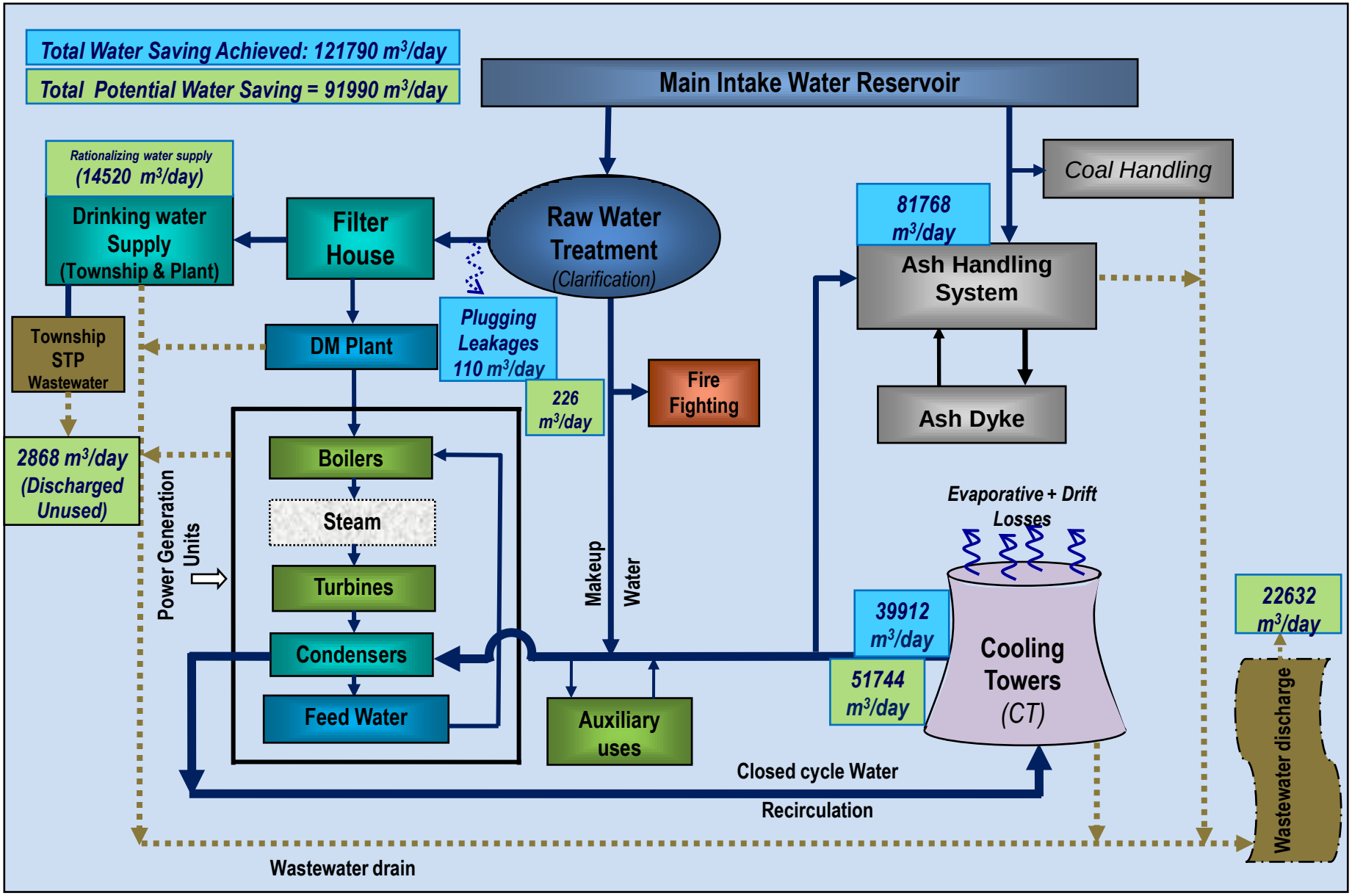

Impact of the study / interventions

(2011→ 2015)

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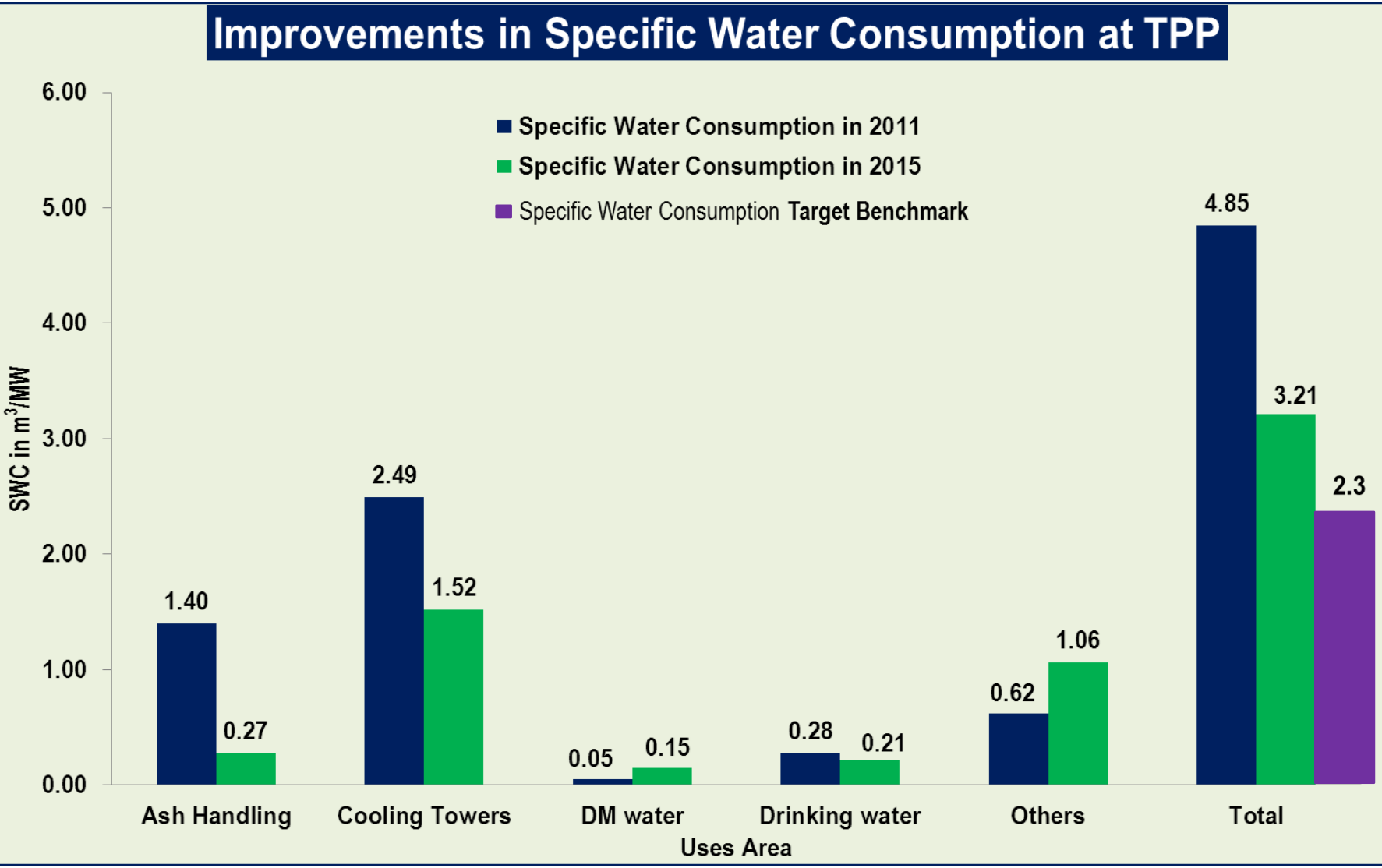

Actual reduction in **SWC** 2011*(3260MW)*-**2015***(4260MW)*= **33%**

Policy Interventions

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- **Policy intervention** in **setting targets/ develop SWC benchmarks** for **industrial Water Use** (Efficiency)**.** ***(supports SDGs)***
- **Regular water audits** should be **internalized** and **made mandatory policy** (third party audits encouraged)
- Establishing **Bureau of Water Use Efficiency**
- **Data sharing** in **public domain** should be **institutionalized**
- **Incentivizing efficient water use** (**dis-incentivizing** inefficient use)
- **Climate Change: India's Potential INDC (Intended Nationally Determined Contribution)**
  - **Measure & reducing the industrial water foot print**
  - **Enhancing water use efficiency**
  - **Recycle/reuse wastewater OR adopt zero discharge**

Publications

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POLICY BRIEF DECEMBER 2012

The Energy and Resources Institute

Enhancing water-use efficiency of thermal power plants in India: need for mandatory water audits

CONTENTS

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Introduction

With its continuously declining per capita water availability (from about 5,177 m^3 in 1951 to 1,654 m^3 in 2007),[1] India stands water stressed[2] and is close to being categorized 'water scarce'.[3] Water demand in India is expected to grow annually by 2.8 per cent to reach 1,500 bcm (by 2030) while the current supply is only about half (viz.,744 bcm).[4]

The Government of India, in its National Water Mission (NWM) under the National Action Plan on Climate Change (NAPCC), has emphasized the need to develop a framework for optimizing water-use efficiency by 20 per cent, through regulatory mechanisms with differential entitlements and pricing. It further emphasizes the need to focus on integrated water resource management through water conservation, wastewater minimization, etc. This would require various sectors, including industries, to optimize their practices ensuring conservation, recycling, and reuse.

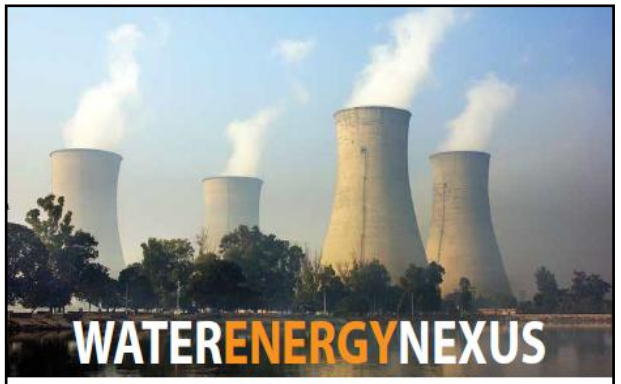
Challenges to industrial water use in India

Agriculture is the largest consumer of water in India, and in 2010, it accounted for about 85 per cent of the total demand, followed by industry at 9 per cent, and the domestic sector at 6 per cent.[5]

Water requirements of various sectors of Indian industries had almost doubled during the last decade and are expected to increase more than

[1] Central Water Commission, National Institute of Hydrology. 2008. "Preliminary consolidated report on effect of climate change on water resources". New Delhi: Ministry of Water Resources.
[2] A situation of per capita water availability falling below 1,700 m^3.
[3] A situation of per capita water availability falling below 1,000 m^3.
[4] 2030 Water Resources Group. 2009."Charting our water future: economic frameworks to inform decision-making". Executive Summary.
[5] Infrastructura Development Finance Company (IDFC). 2011. Water: policy and performance for sustainable development. India Infrastructura Report 2011. New Delhi: Oxford University Press.

EDITOR
R K Batra



Water Efficiency Interventions in Thermal Power Plants in India

Case study drafted from materials
Resources Division, The Energy and

Power generation capacity in
199,627 MW in 2012, and new
growth. However, with decli
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has the potential to constrain
technologies, and manageme
needed to meet the country's

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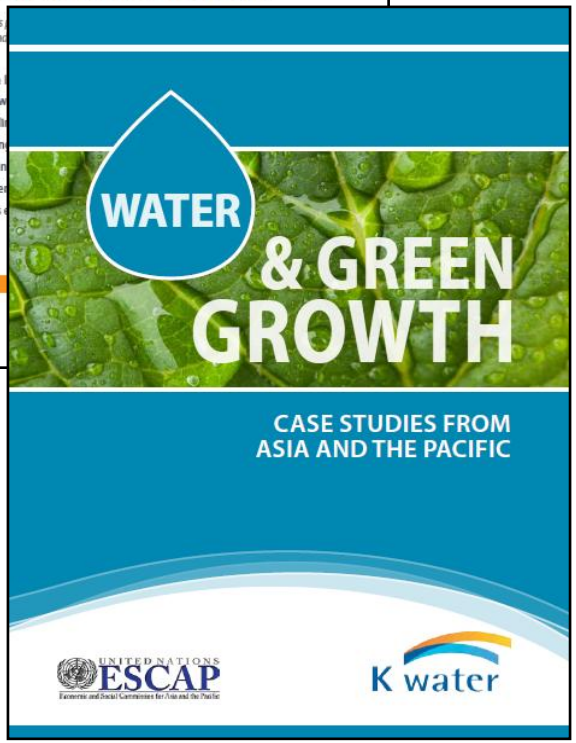

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Thank You

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