Water and Energy Sustainability

with a focus on

Membrane-Based Sustainability Solutions

Elena Bailey, M.S., P.E.
Eimco Water Technologies
Global Director, Technology and Sustainability

Definition of Sustainability

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs"

UN World Commission on Environment and Development,
***Our Common Future*, 1987**

Delivering Solutions Today … For Tomorrow's Water

Eimco Water Technology Slogan = Sustainability!!!

World Economic Forum Water Initiative

Managing Our Future Water Needs for Agriculture, Industry, Human Health and the Environment

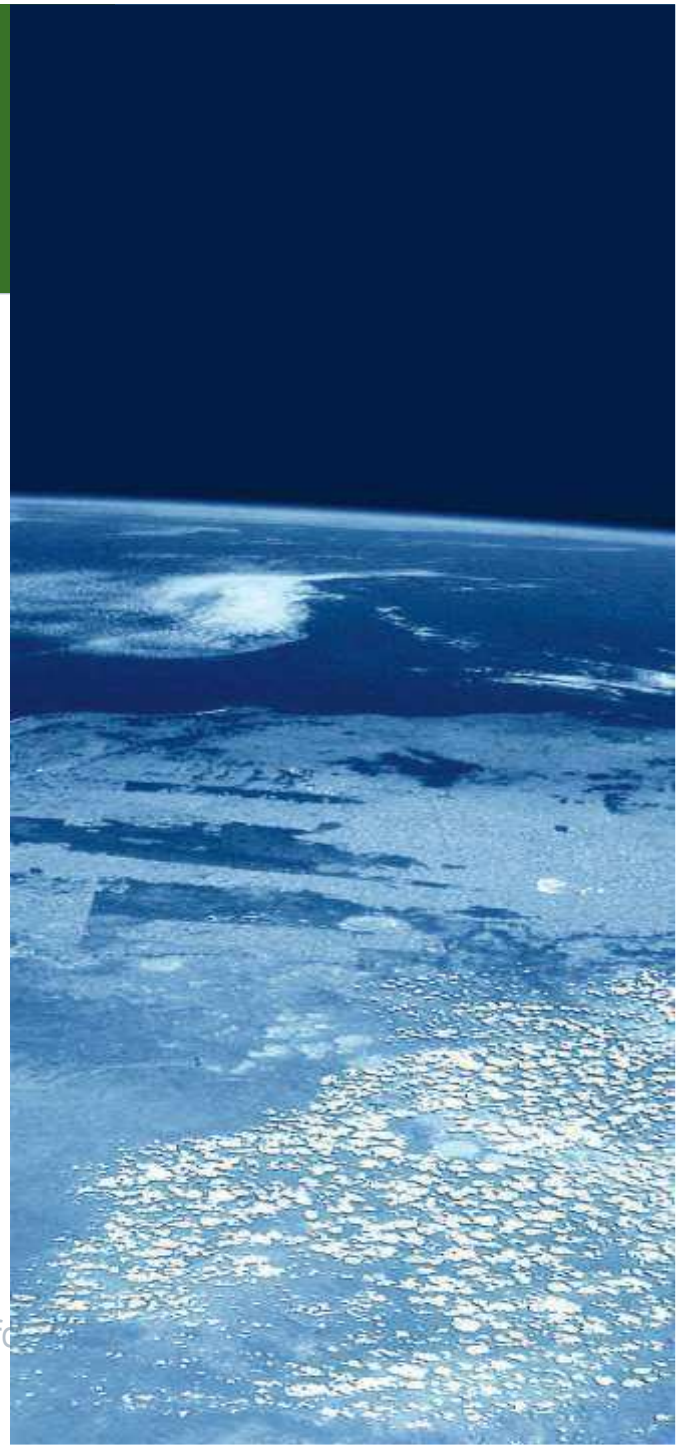
The Bubble Is Close to Bursting:
A Forecast of the Main Economic and Geopolitical Water Issues Likely to Arise in the World during the Next Two Decades

"For the first time, all the different perspectives and expertise required to define the full dimension of the problem and propose solutions are brought together", **Ban-Ki Moon, Secretary General, United Nations, New York**

January, 2009

Delivering solutions today…fo

www.weforum.org



16000 litres water

1 kg beef

Water

Footprint

3000 litres water

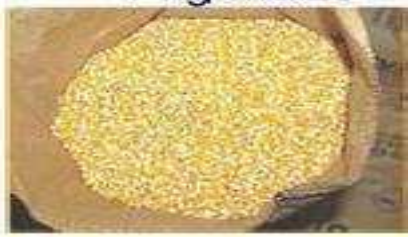
1 kg rice

1350 litres water

1 kg wheat

900 litres water

1 kg maize

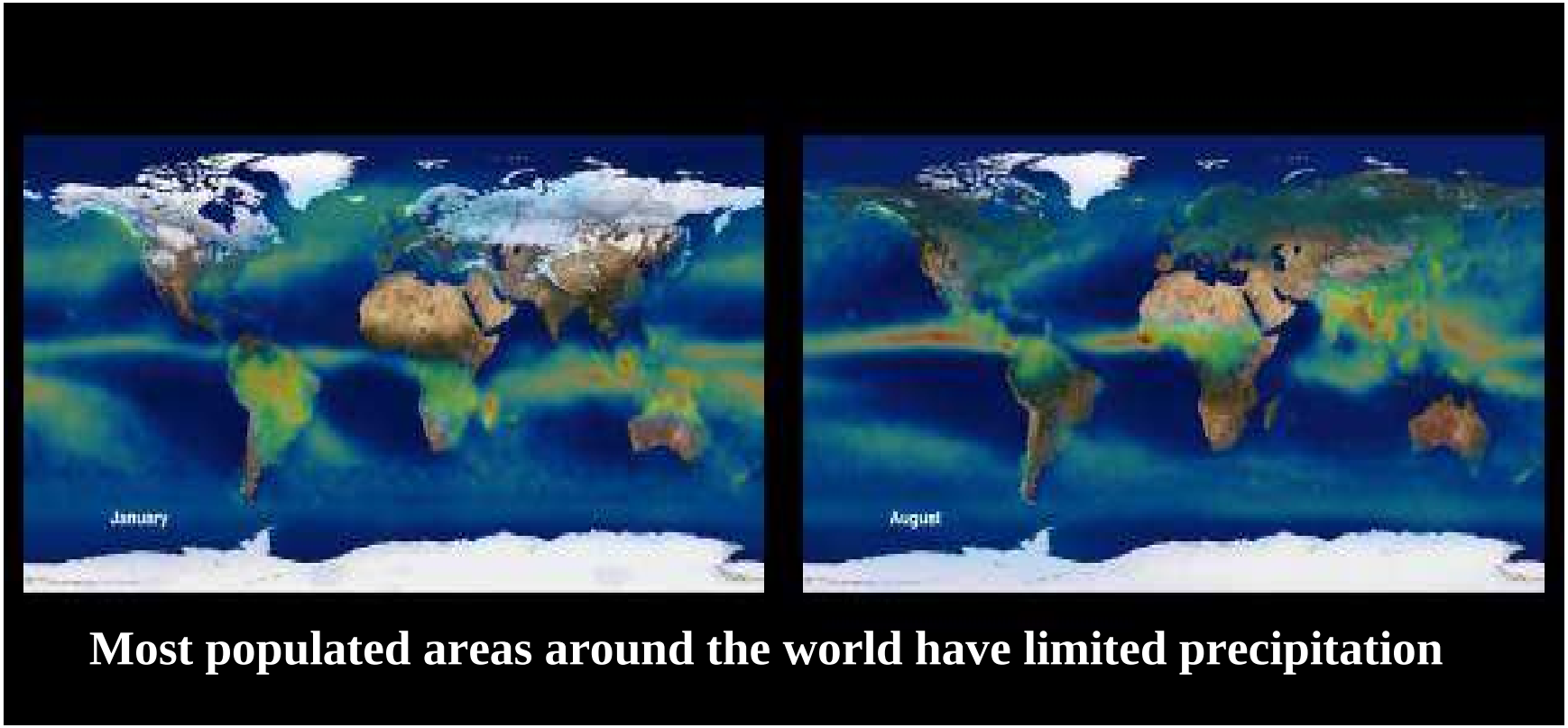


140 litres water

1 cup of coffee

Global Precipitation:

Averaged monthly rainfall for January and August from 1979 through 2006.



Top 5 of Economic and Geopolitical Water Issues for the Next Two Decades

1. Water scarcity will increase dramatically in many parts of the world. **Global grain harvests** will be threatened, more countries will rely on food imports and the livelihoods of many people will be threatened.

2. Meanwhile, global demand for food, **especially meat**, will rise sharply, placing more pressure on water for agriculture.

3. Fast-growing economies, especially in the **Middle East and Asia**, will likely allocate less water to agriculture over the next two decades and more to the growing demands of their **urban, energy and industrial sectors**.

4. **Business and capital** will be attracted to those economies in water scarce regions with sound water management. **New technologies, new markets and new financing ideas will be attracted to solving the water challenge!!!.**

5. **Water will become a mainstream theme for investors**. Governments in water-scarce regions that undertake water reforms will strengthen and position their economies well. Global financial regulators will have to develop clear rules to manage the inevitable appearance of **innovative water funds**.

Primary energy uses of a typical municipality's energy consumption is water distribution and wastewater operations which account for over 60% of the energy use in a City.

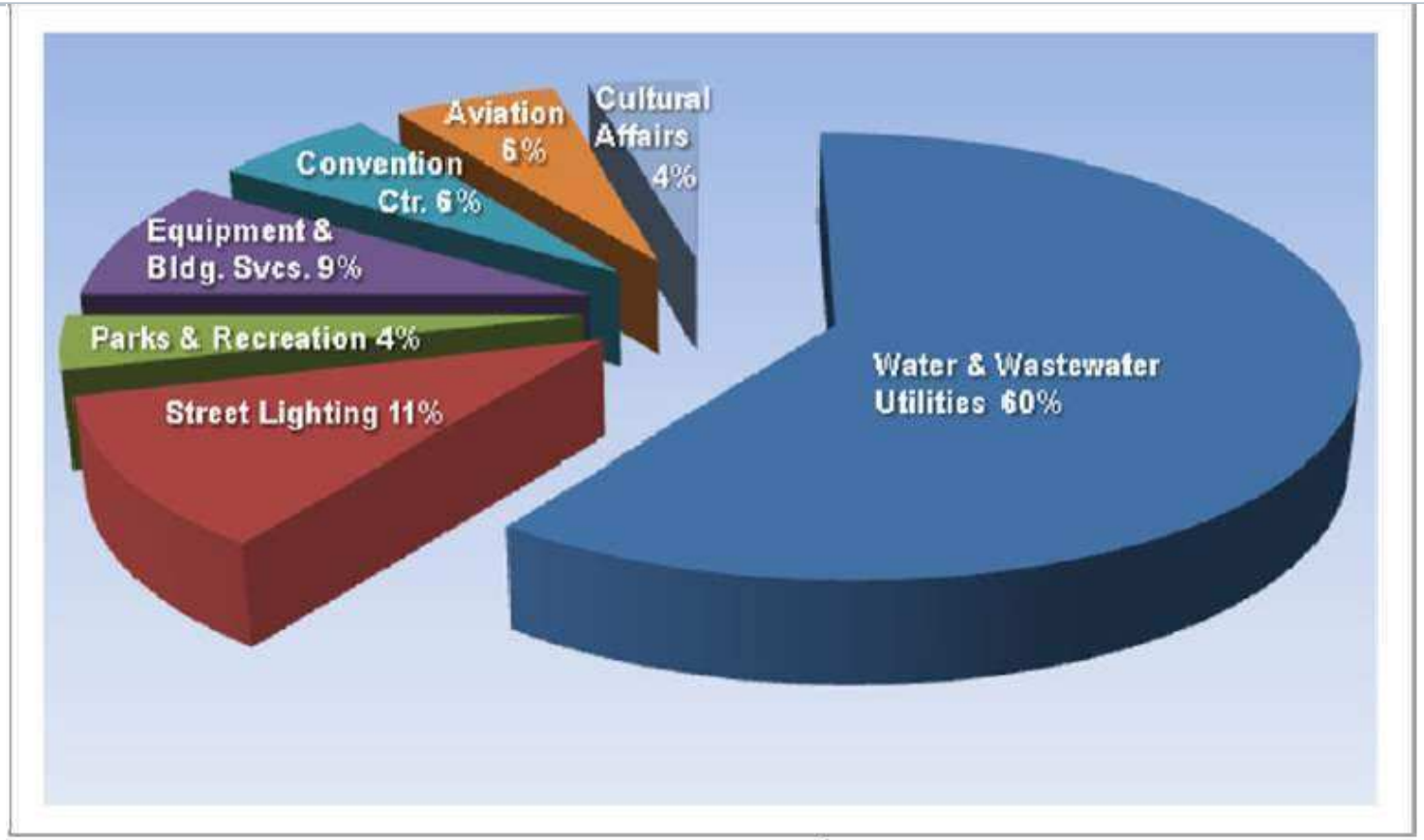


Figure 1 – Typical City Energy Usage[1]

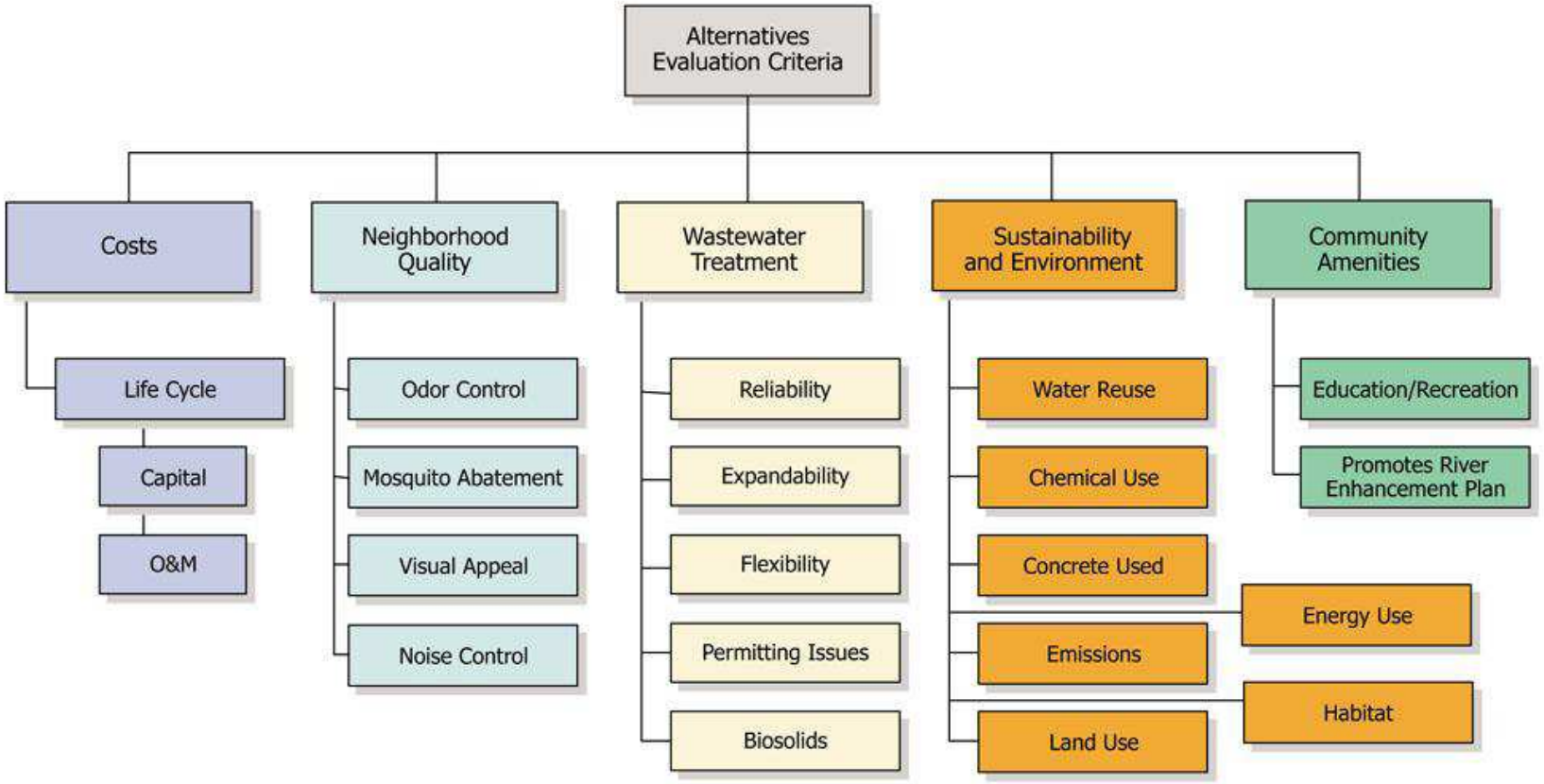
At CDM, We Don't Make the Energy Savings. We Make the Energy Savings Better.
J. Peters, P.E. 1, BCEE, Chris Varnon, P.E. 1, Dean Towery2, WEFTEC, 2008*

Eimco Water Technologies

- Experienced MBR solution provider
  - Over 300 MBR plants worldwide in operation or under construction in 5 continents
  - Municipal and Industrial
  - Exclusive licensee for Kubota
    - UK and Ireland – Over 100 MBR plants operational
    - US – Over 100 MBR plants operational
    - India

Alternative Evaluation Criteria:

Sustainability will now become part of the evaluation in future projects



Recycled Water Cycle

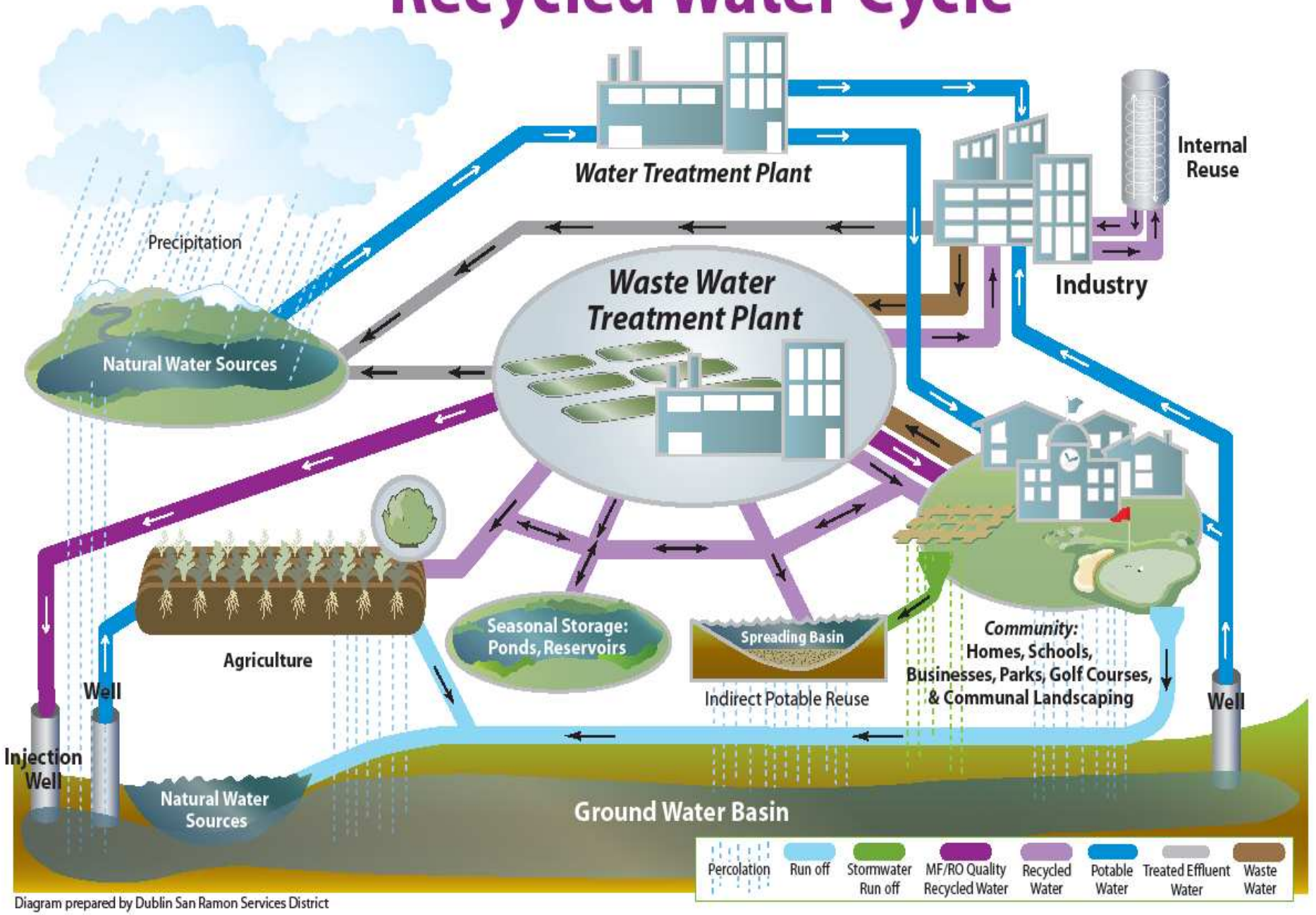


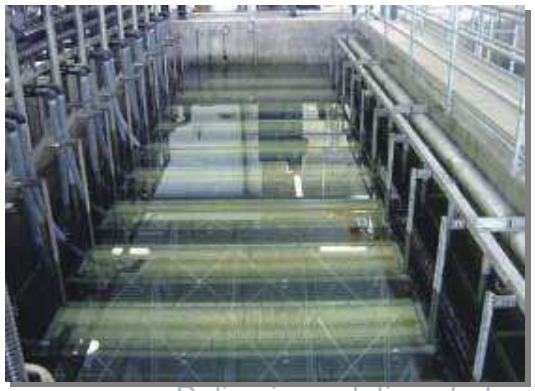
Diagram prepared by Dublin San Ramon Services District

Tailored Made Water
From Recycled to Ultra Pure Water

MBR is a Sustainable Process

- Reduced footprint
- Ease of operation
  - Remote monitoring
- Highest water quality
  - Reuse
- Decentralize
- Proven process

- LEED certified technology
- Proven Process
  - >3000 Plants Worldwide
  - >100 in North America

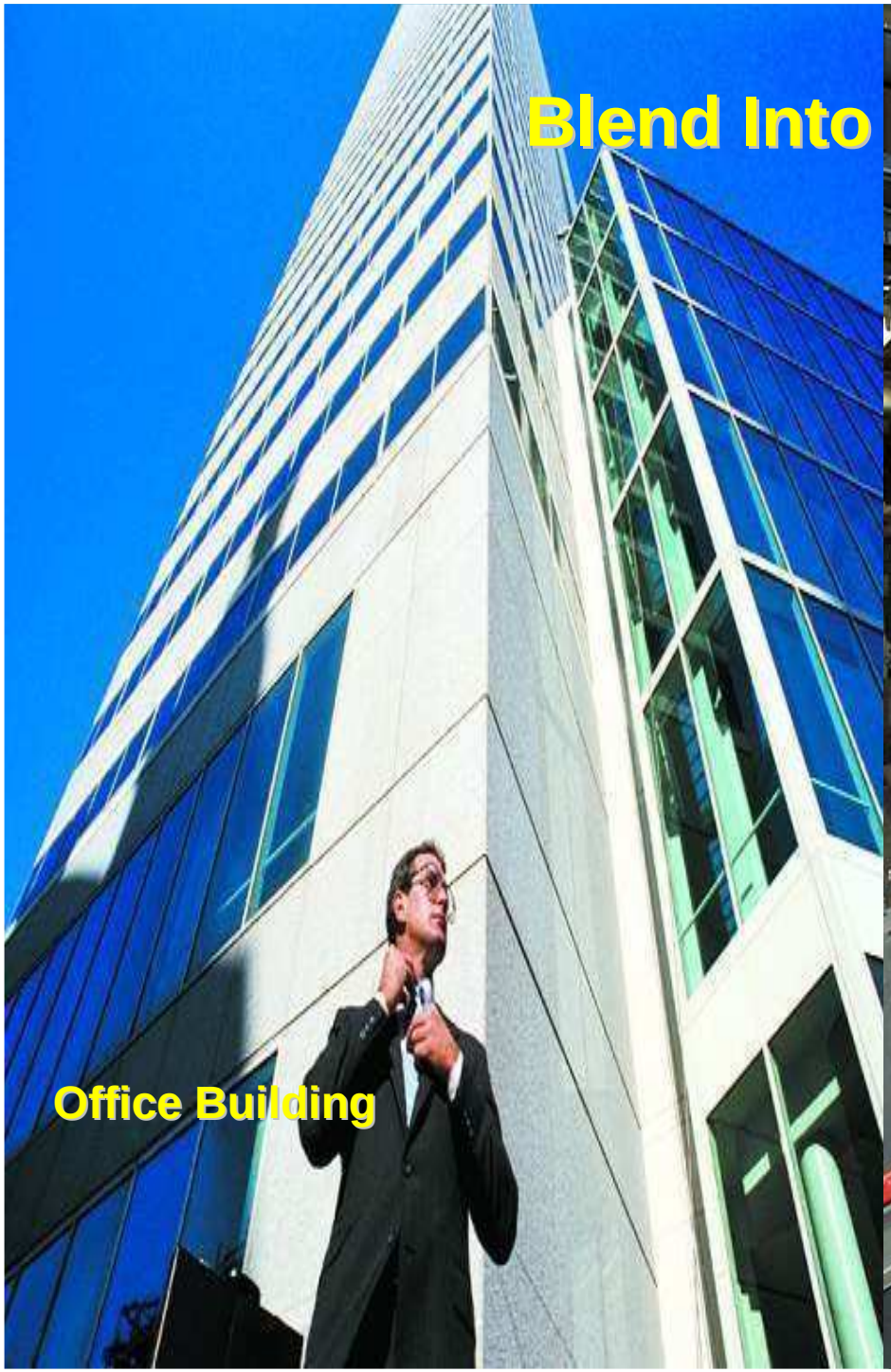


Why Decentralize?

"Adequately managed decentralized wastewater systems are a cost effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas." – US EPA report to Congress, 1997 (EPA 832-R-97-001b)

- Economics
  - Failed Septic Systems
  - Cost of Sewers
  - 20 Year Planning
    - Forestall Expansions
  - Centralize Operations
  - Distribution Piping
    - Smaller, shorter runs
    - Reduced pumping energy
- Politics
  - Autonomy
  - Keeping the Water

Blend Into Surroundings



Office Building

MBR in basement
of Office Building

Sea Water Desalination Plant - Al Zawrah, U.A.E.

Client:
Federal Electricity & Water Authority

Capacity:
27.300m^3/d

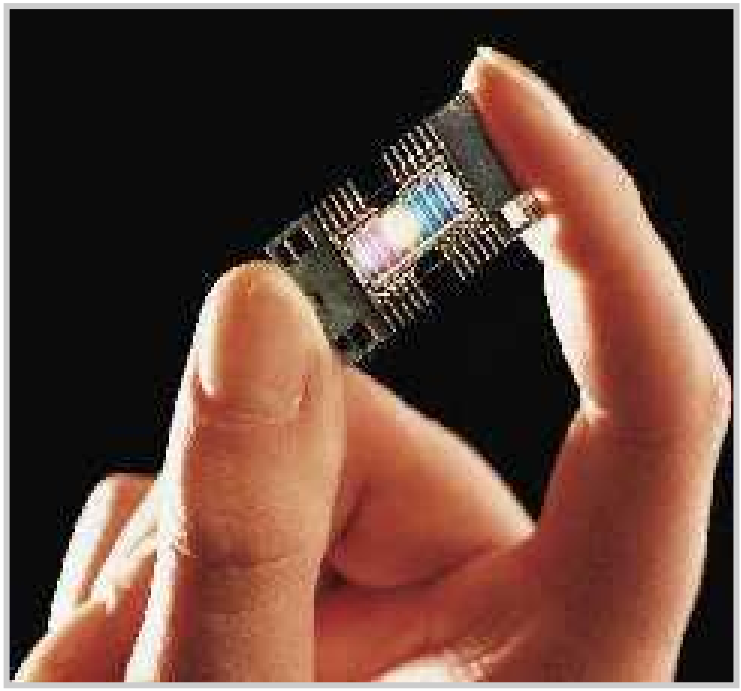
Sea Water Desalination Plant - Hamriyah, U.A.E.

Client:
Sharjah Electricity & Water Authority

Capacity:
91.000m^3/d

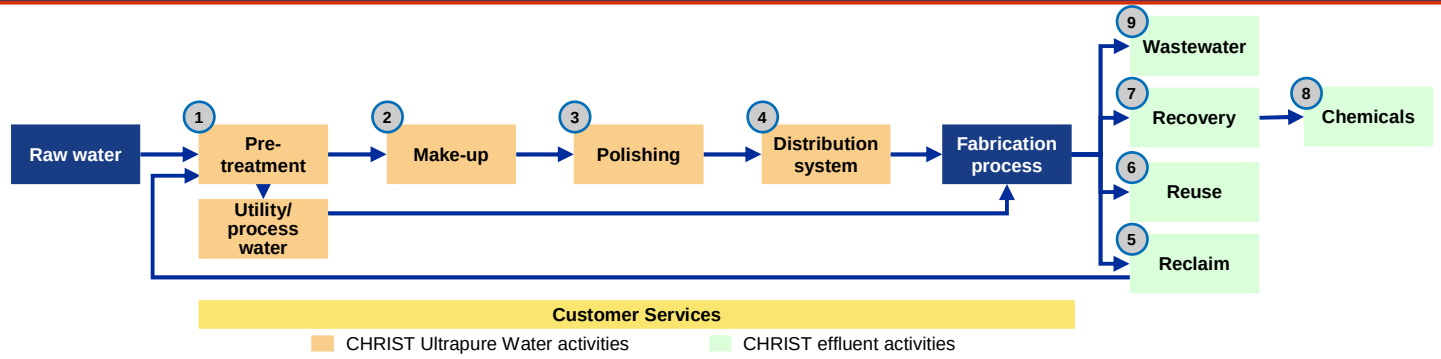
Provide Ultra Pure Water for Semiconductors

Semiconductor Element



Ultrapure Water Production

Semiconductor Solutions



1 **OSMOSTIL**

2 **REDEX**
Ion Exchange

2 3 **LUMOSTIL**

2 3 **MAXISTIL**
MOVEX

3 **ULTRASTIL**

4 **STERITRON**

5 6 **Tocsorb**

7 8 **Electrolysis**

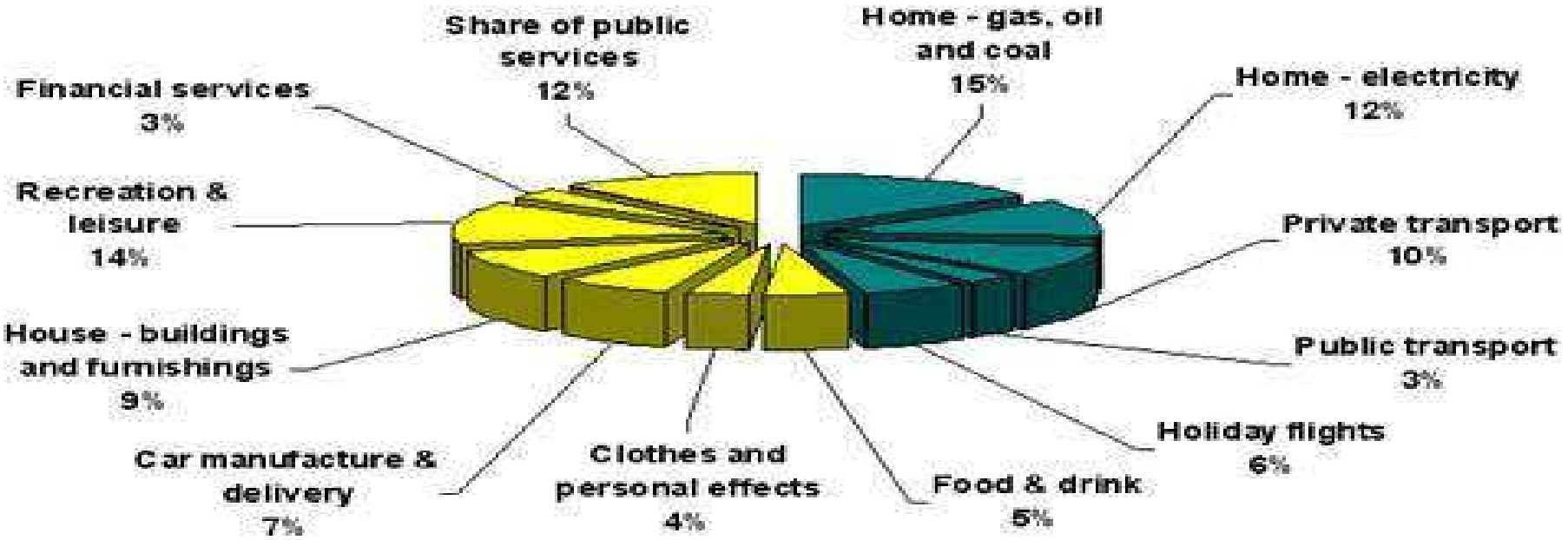
5 **Advanced oxidation**

What is a Carbon Footprint?

What is a Carbon Footprint?

1. The **primary footprint (shown as the green slices of the pie)** is a measure of our direct emissions of CO2 from the burning of fossil fuels including domestic energy consumption and transportation (e.g. car and plane). We have direct control of these.

2. The **secondary footprint (shown as the yellow slices of the pie)** is a measure of the indirect CO2 emissions from the whole lifecycle of products we use - those associated with their manufacture and eventual breakdown. To put it very simply – the more we buy the more emissions will be caused on our behalf.



Concrete:
Major contributor to CO2 emissions

- Roughly **7 percent of global CO2 emissions** are related to the manufacture and transportation of cement, a major ingredient of concrete.
- For each ton of cement manufactured, one ton of CO2 is put into the atmosphere.
- For each **cubic yard of concrete** poured, contributes to **630 lbs of CO2**.
- **Less cement means less greenhouse gas produced.**


FLEECE JACKET
66 Pounds
LAUNDRY DETERGENT
31 Pounds
BOOT
121 Pounds
MILK
ORGANIC
7.2 Pounds
CAR
97,000 Pounds
BEER
FAT TIRE
7 Pounds

LEED Global Certification for Sustainable Sites (Leadership in Energy and Environmental Design)

- **Credits for various levels of certification prior to 2009**
  - **Certified - 26-32 points**
  - **Silver - 33-38 points**
  - **Gold - 39-51 points**
  - **Platinum - 52-69 points**

- **Credits for various levels of certification in 2009** NEW
  - **Certified – 40-49 points**
  - **Silver – 50-59 points**
  - **Gold – 60-79 points**
  - **Platinum - 80 points and above**

EWT MPAC™ MBR meets LEED certification in “Green” Building

- Rainwater capture
  - 500,000 gal/yr
  - 10% of the building’s water requirements
- 100% wastewater recycling
  - Estimated 5,475,000 gal/yr of wastewater production
  - Recycled water to be used for:
    - Toilet flushing
    - Cooling tower
    - Landscape irrigation

WWTP earned the project 3 points towards LEED platinum status!

OHSU Building Goes Platinum! February 2007

- At the time they applied, there were only **13 LEED** platinum buildings in the world.
  - The bldg received 55 of a possible 69 points, which is 3 more points than required for a platinum rating.
- At that time this was the **largest LEED platinum building in the U.S.A**
- **First medical and research facility in the world** to achieve platinum status.
- At that time, this was the **greenest large-scale health and bioscience building in the world.**
- **Building Incorporated Solar Energy**

Jaspers won the Best Managed Large Business

The **Cornwall Sustainability Award 2008** and scooped the overall winner award!

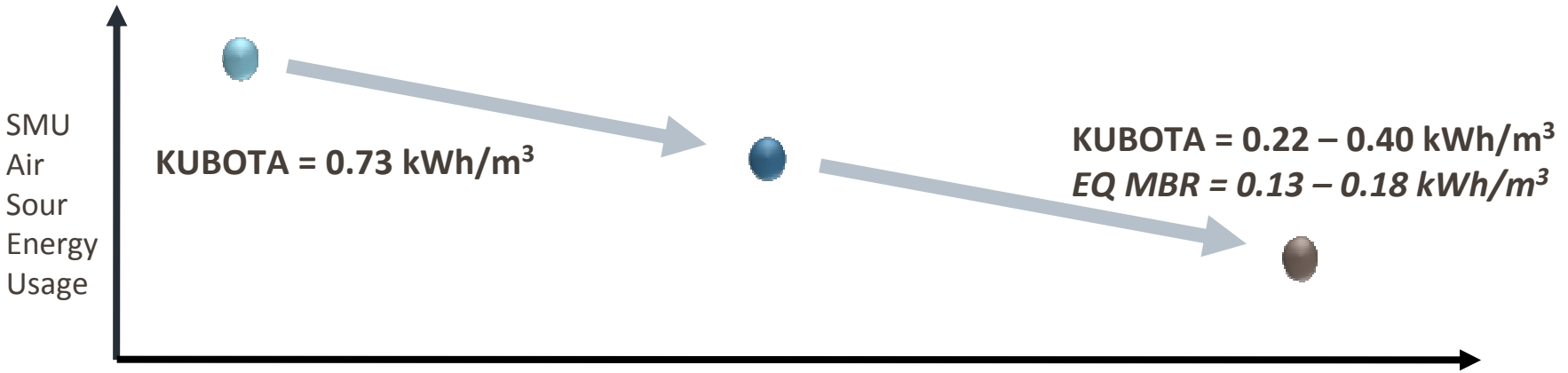
- Jaspers become the first abattoir in the United Kingdom to receive a Certificate of Environmental Benefit for its efficient membrane filtration system provided by **Eimco Water Technologies**, U.K.

- The family-owned business was recognized for the exceptional lengths it has gone to in **reducing water consumption and carbon emissions**.

- Under the scheme, capital expenditure on membrane filtration systems that produce a 'disinfected' final effluent (suitable for water reuse) **can qualify for 100% per cent first-year capital allowance,** providing they meet certain criteria.

EWT MBR Developments to Optimize Energy and Carbon Footprint

SMU Energy Trend Summary



1989

- ES SMU (Single Deck)

2001

- EK SMU (Double Deck)

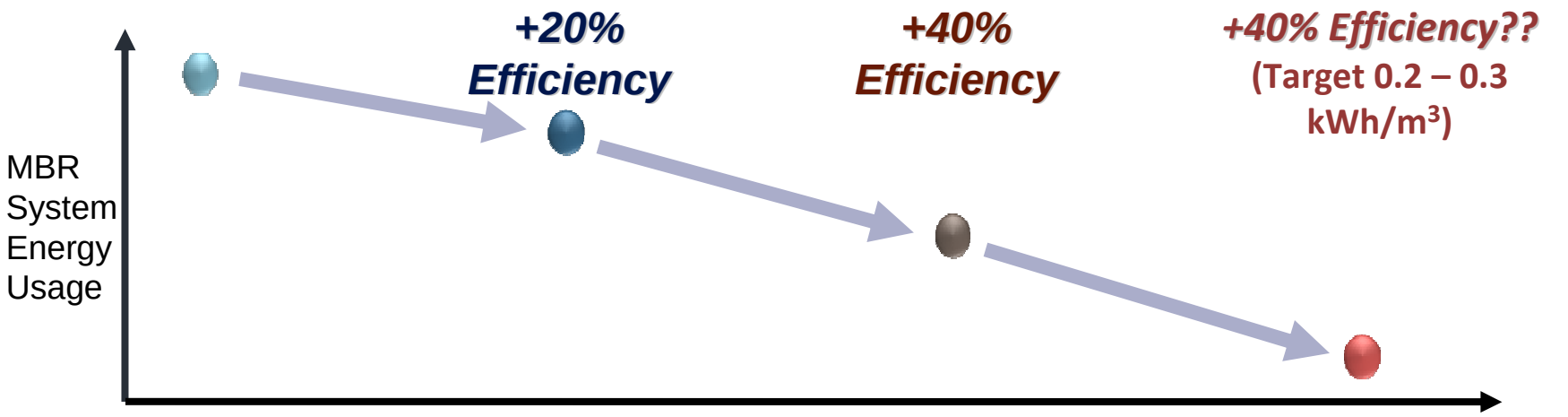
(Type 510 Cartridge)

2009

- RW SMU (Double Deck)

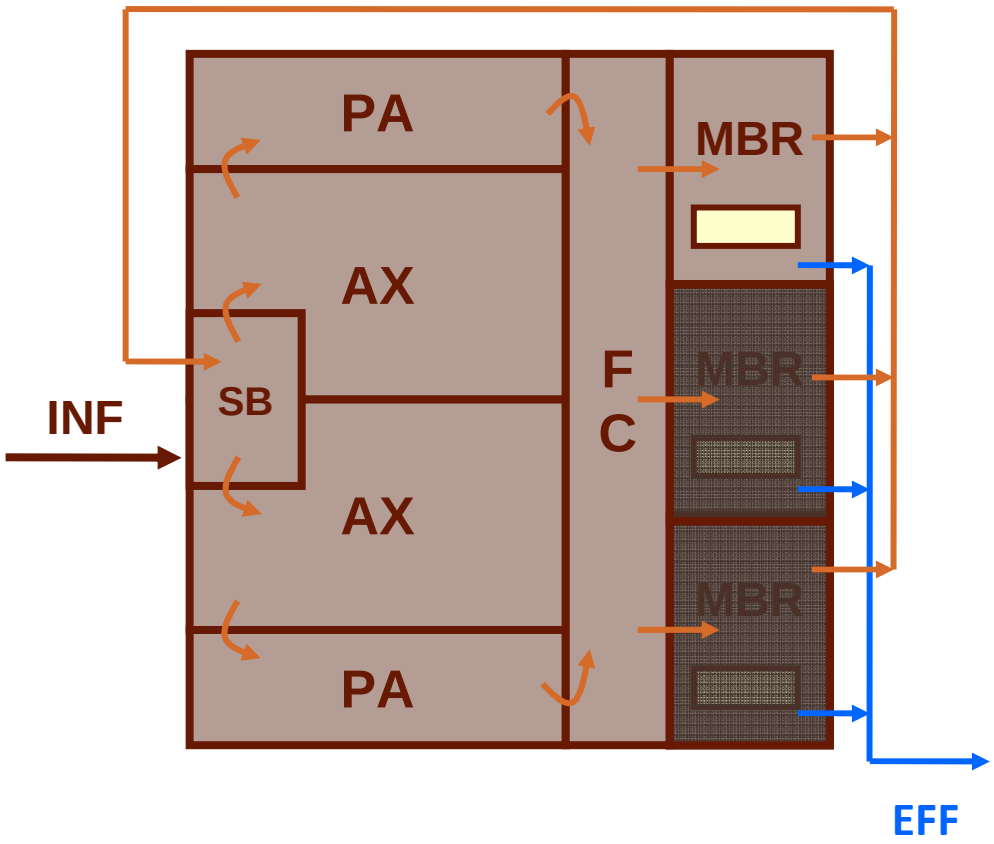
(Type B2-515 Cartridge)

Improving Plant Efficiency



2001	2004-2005	2006-2009	R&D
▪ *EK SMU (DD)*	□ *EW SMU*	□ *Proportional Aeration*	□ *Integrated Roll Pattern (IRP)*
▪ *Optimize SRT/MLSS*	□ *Energy Pro™*	□ *RW SMU*	□ *ECO BLOX*
▪ *Biomonitoring*	□ *Pump-Assisted Gravity*		□ *New SMU*

Energy Pro™

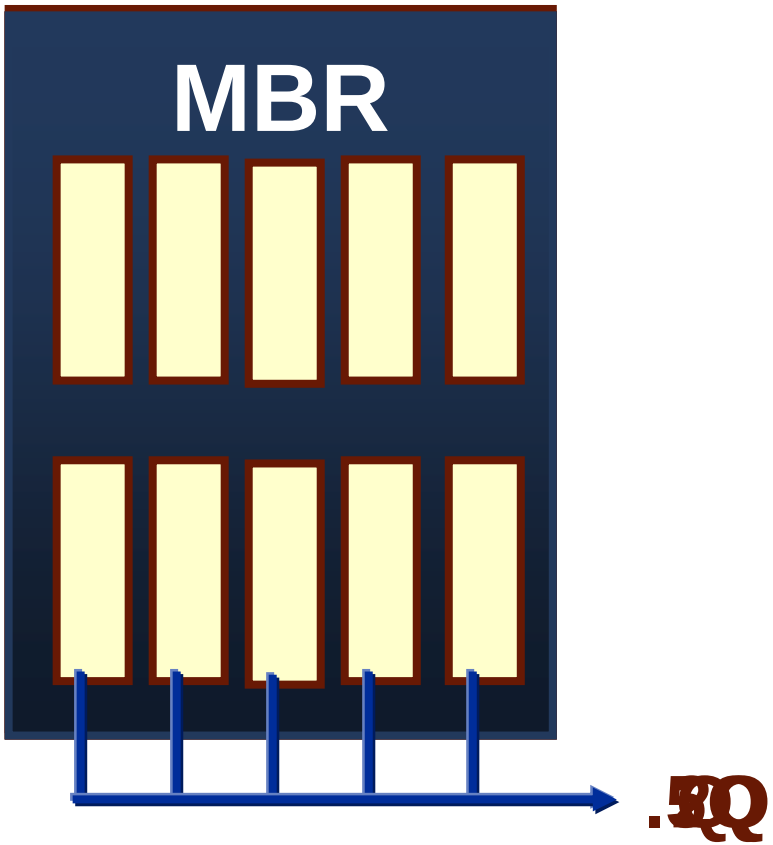


MBR Zones Automatically Brought Online to Incrementally Match Demand

2/3 of capacity at medium flow

Full capacity at high flow

Proportional Aeration

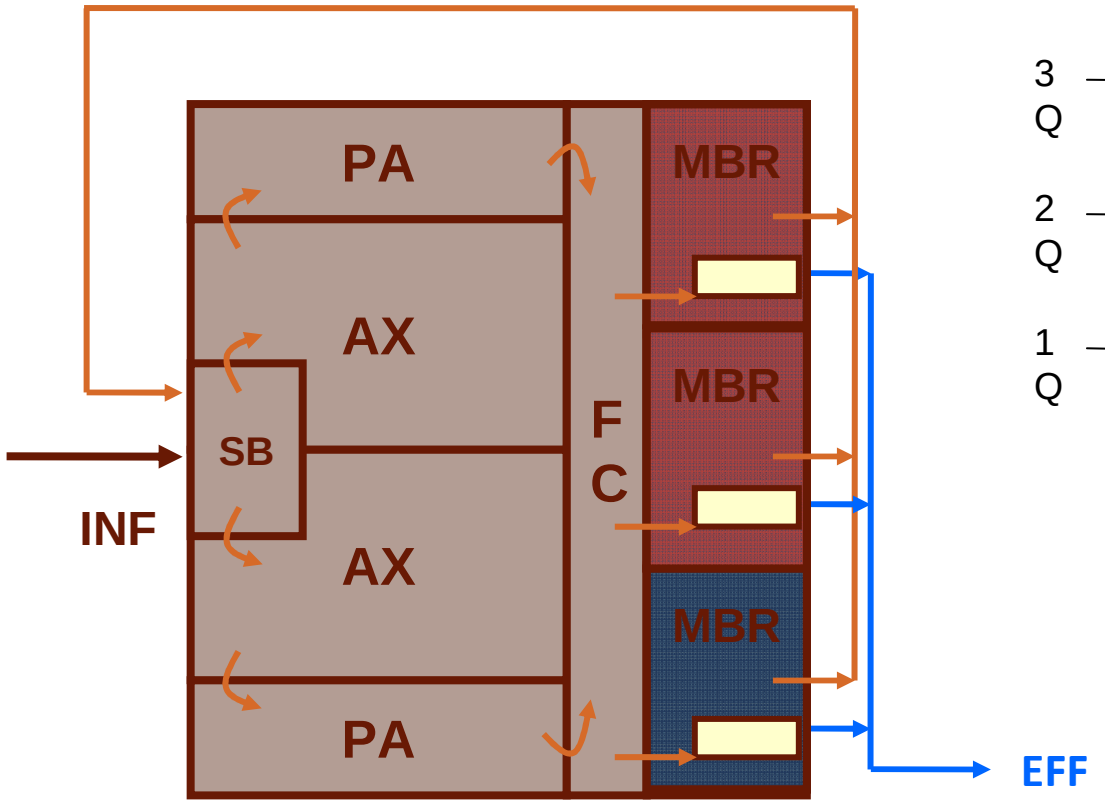


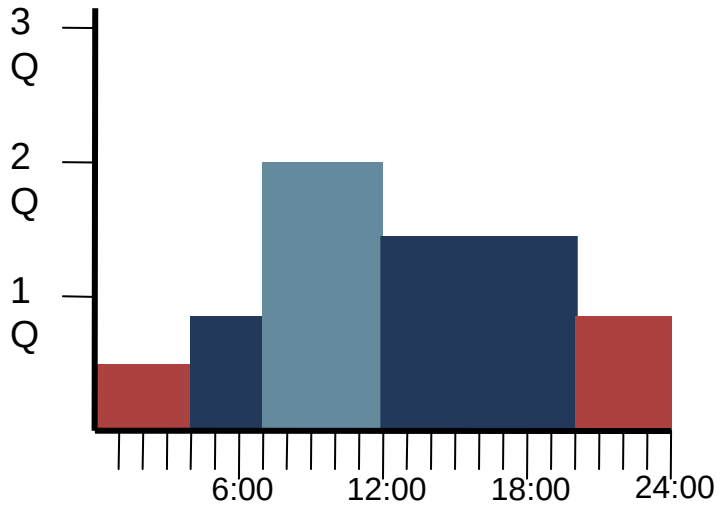
Low Intensity at Low Flux

Medium Intensity at Medium Flux

High Intensity at High Flux

Plant Turndown
Proportional Aeration + Energy Pro™





Low Intensity

Medium Intensity

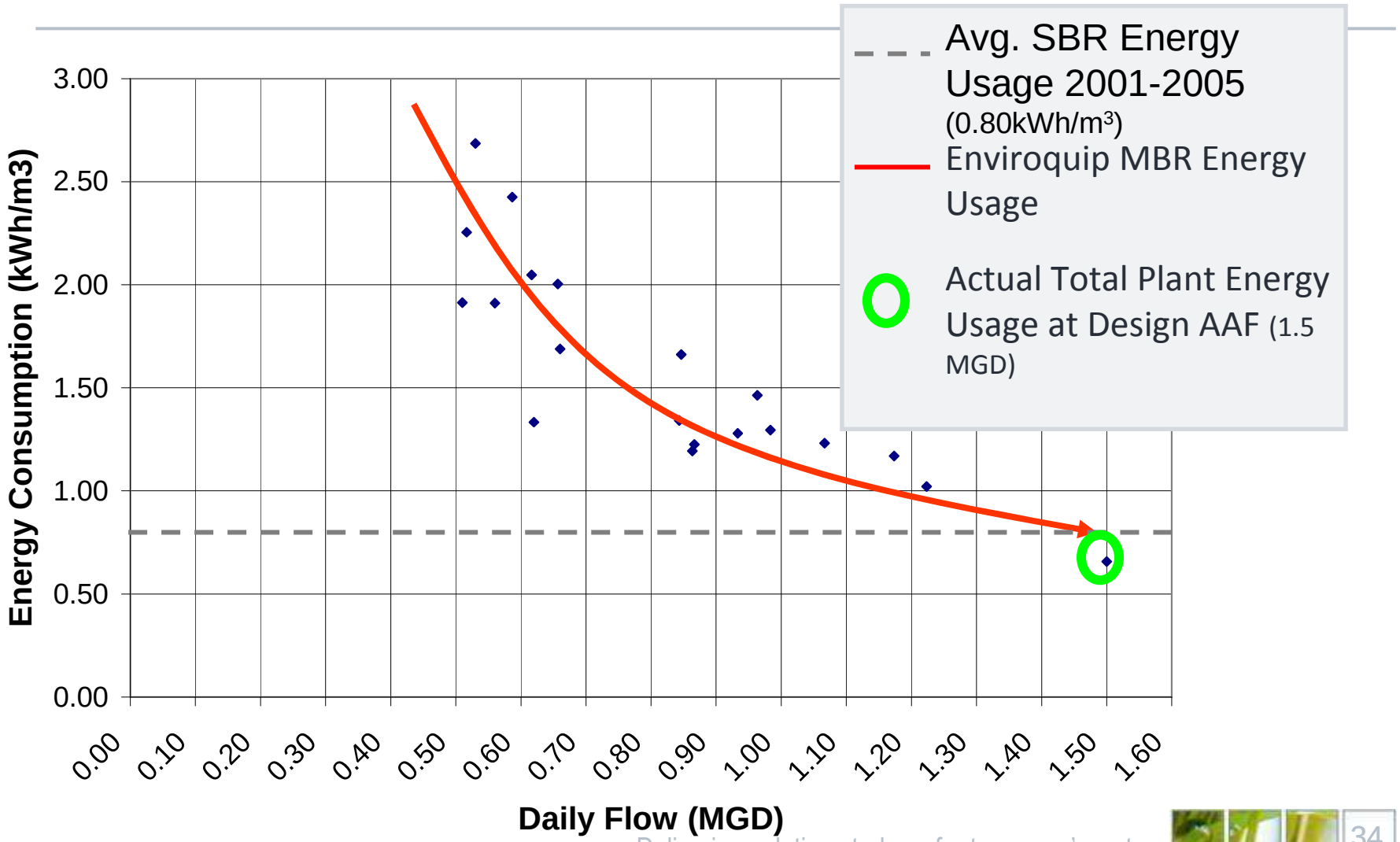
High Intensity

Impact of SMU Evolutions of Energy

Note: RW is completely compatible with on-site Membrane Treatment System (MTS) due to design features developed by EWT

	EK-400	EW-400	RW-400
gpd at 14.7 gfd	50700	79280	91960
kWh/m3 at 14.7 gfd (Kubota)	.364	.275	.230
kWh/m3 at 14.7 gfd (EWT Prop Air)	.214	.167	.144

Actual Energy Data – Dundee MI



Impact of Evolutions in Energy

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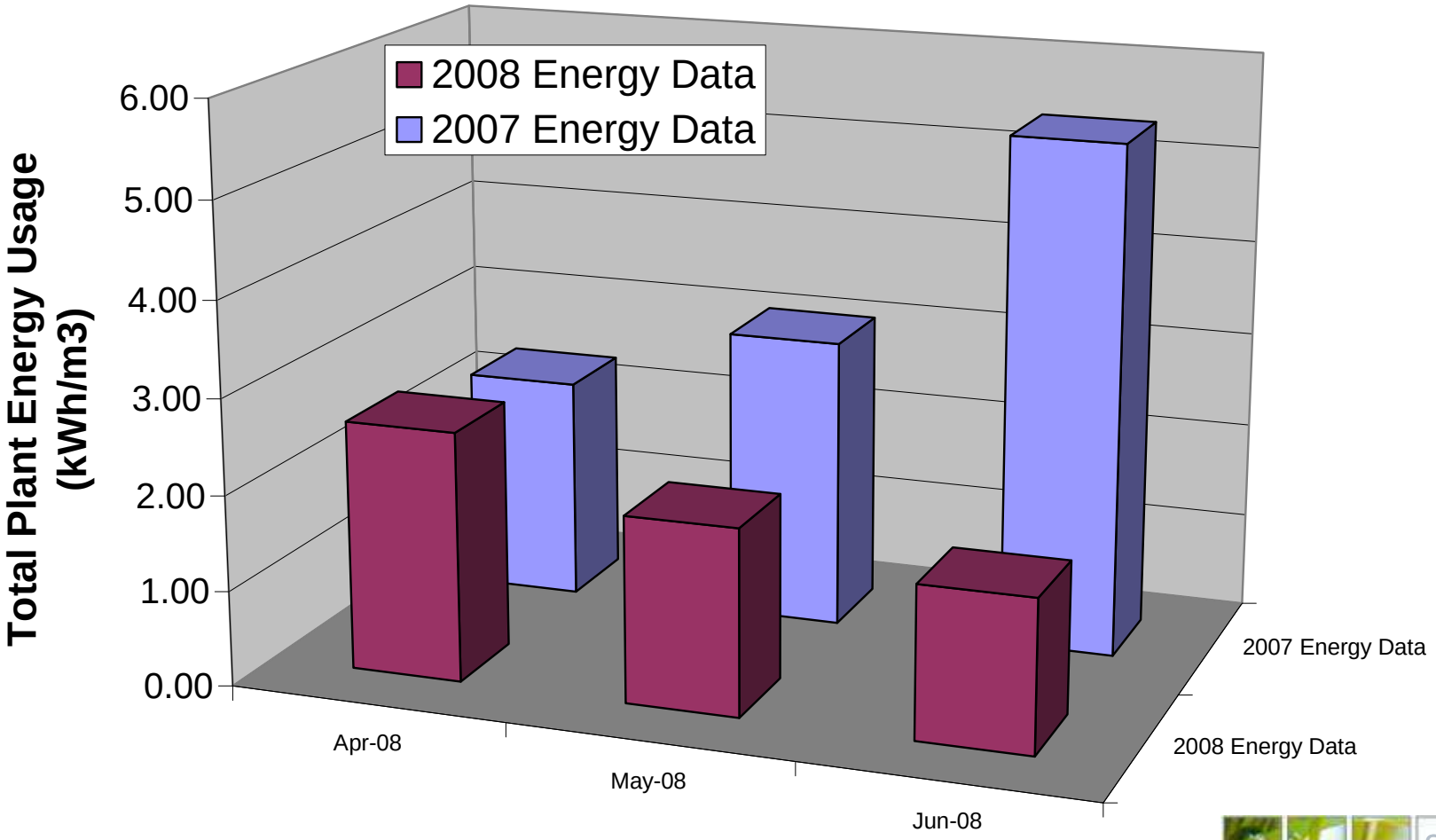
Delphos, OH WWTP, U.S.A.

The Delphos, OH WWTP

(Energy Audit Excerpt)



Eimco Water Technologies is…

Delivering solutions today…for tomorrow's water

ECOBLOX

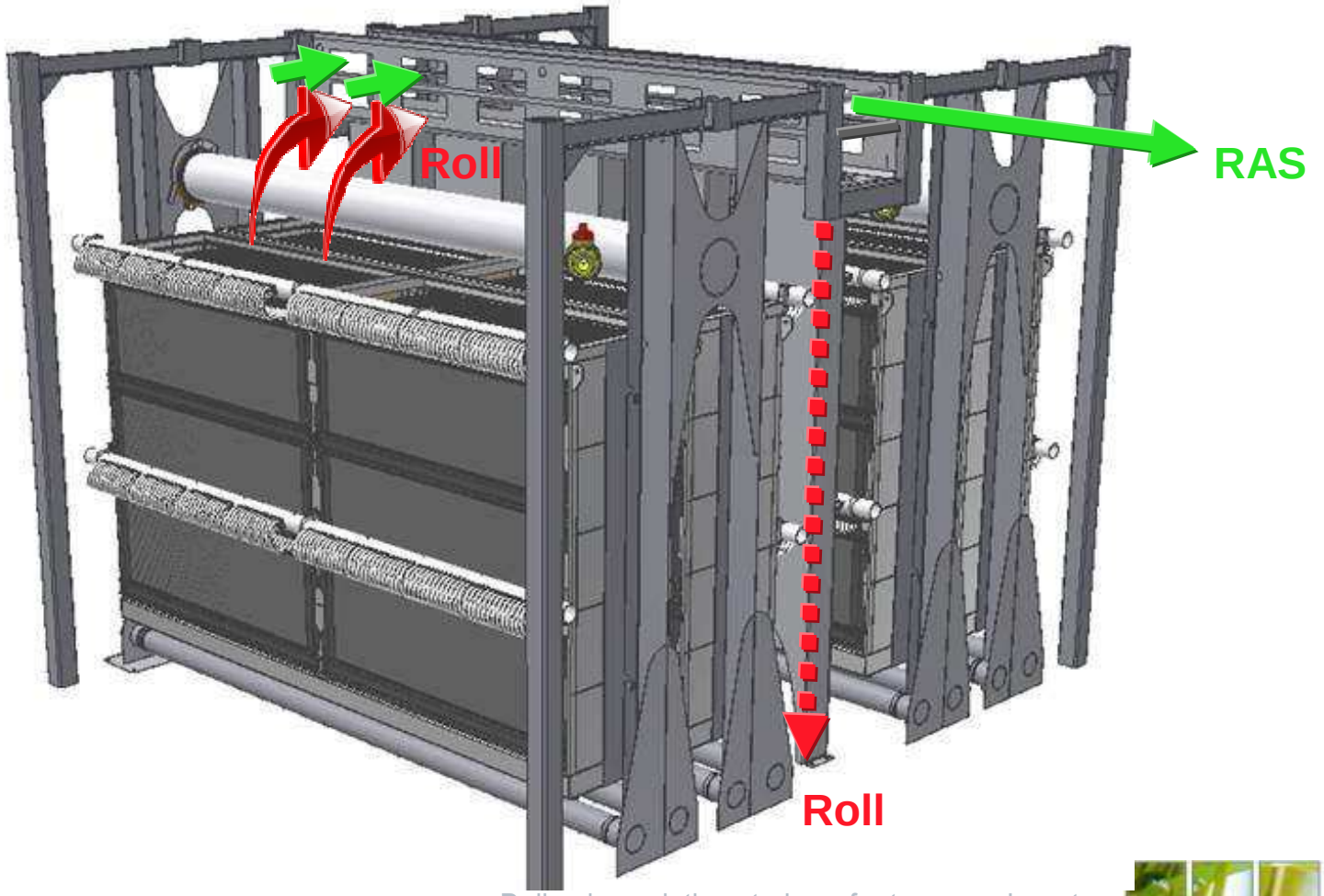
Advanced MBR Treatment for sustainable wastewater treatment and reuse.


ECOBLOX
EQLOGIX™
SP
MTS
Pure O_2
Ozone

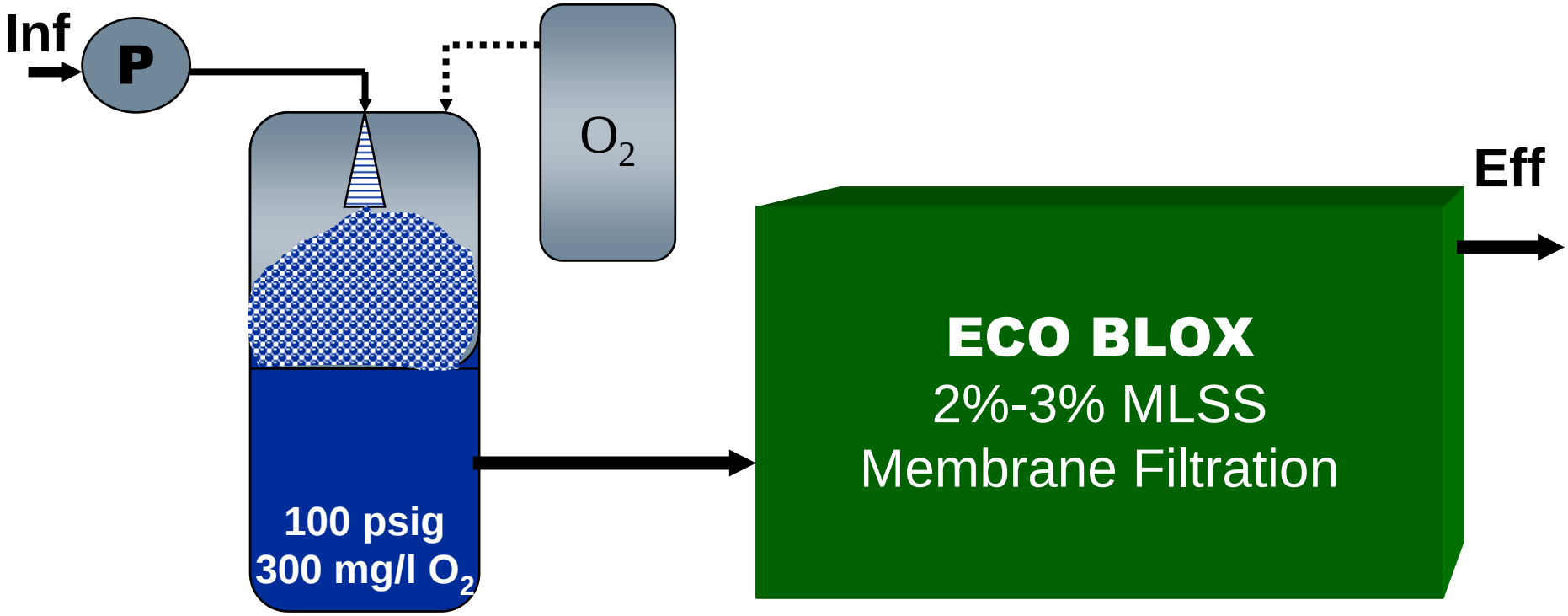

Eimco Water Technologies is...
Delivering solutions today...for tomorrow's water
ECOBLOX
Advanced MBR Treatment for sustainable wastewater treatment and reuse.


Eimco Water Technologies is...
ECOBLOX
BlueInGreen

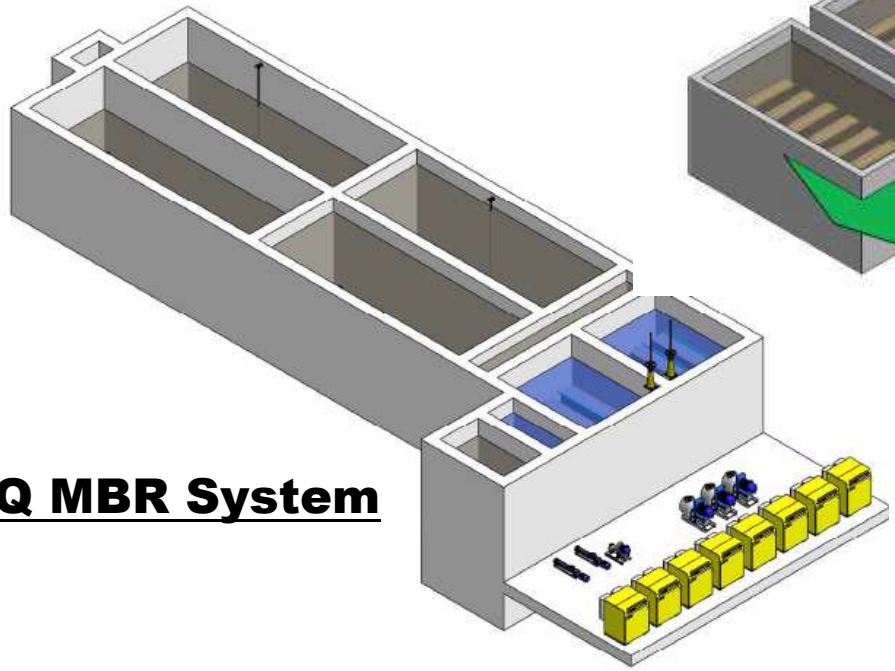
IRP Process Cell (Perspective View)



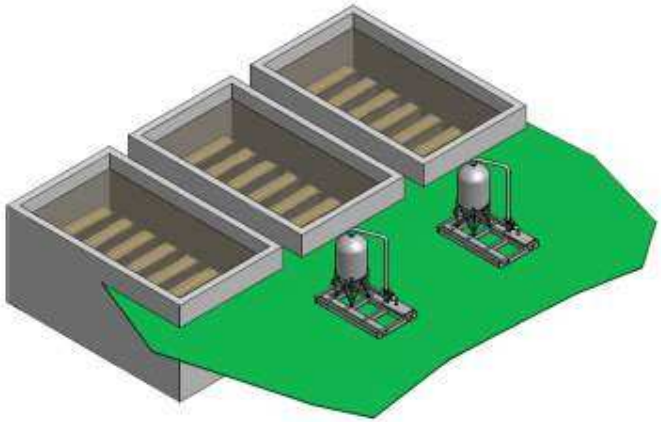
Part 2. Oxygen saturation



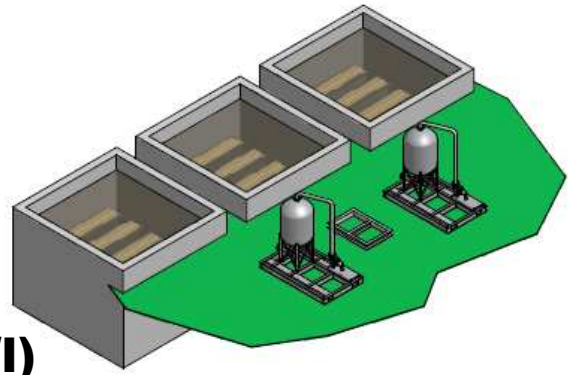
ECO BLOX Benefits **Upper Skagit, WA, USA**



EQ MBR System



ECO BLOX™ (20,000 mg/l)

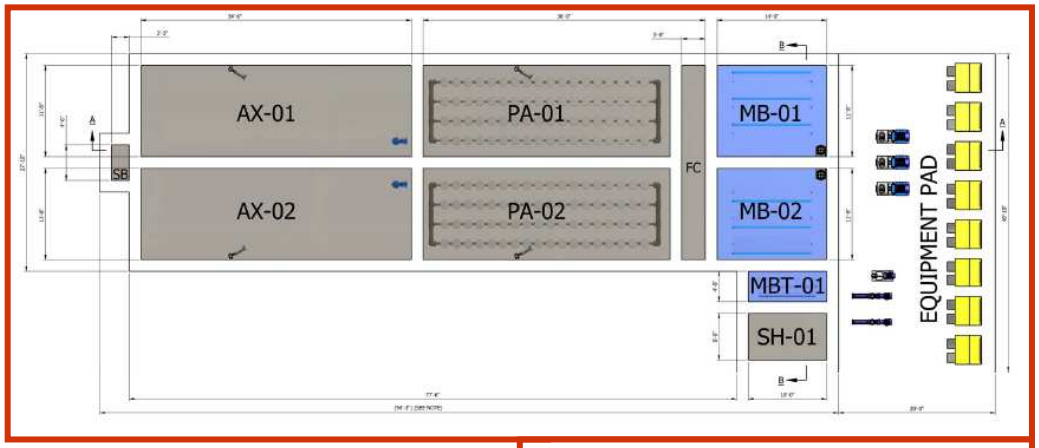


ECO BLOX™ (30,000 mg/l)

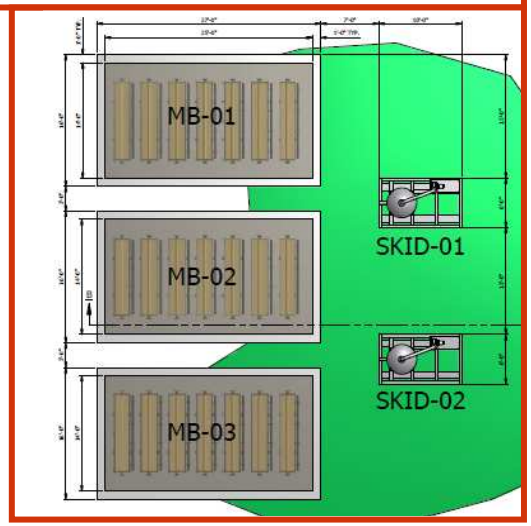
Upper Skagit **Plan Views**

~100ft

~50ft



EQ MBR System



ECO BLOX™

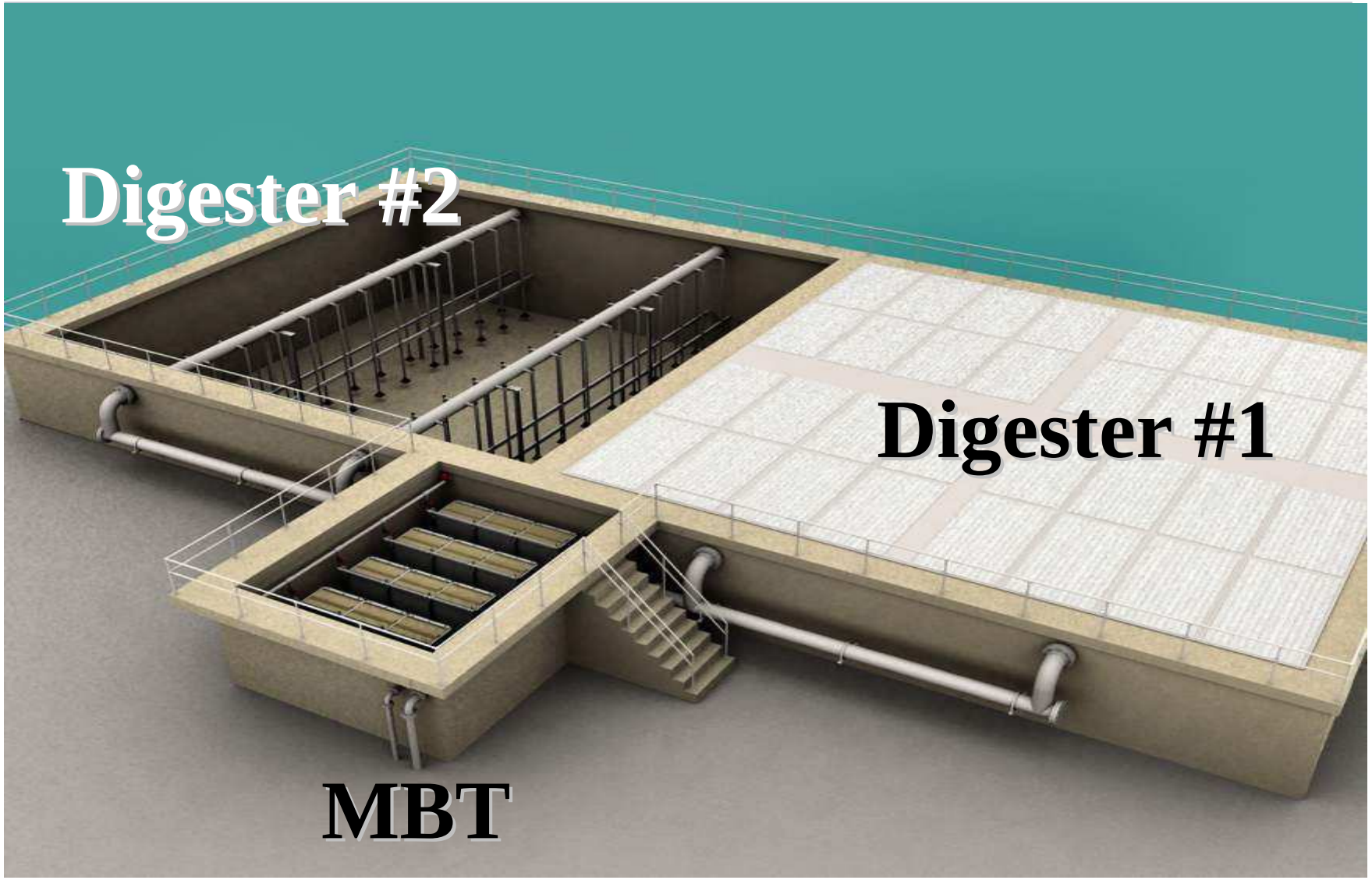
(20,000 mg/l)

Sustainable Biosolids Solutions

Membrane Thickening Aerobic Digestion

Dundee, MI, U.S.A.

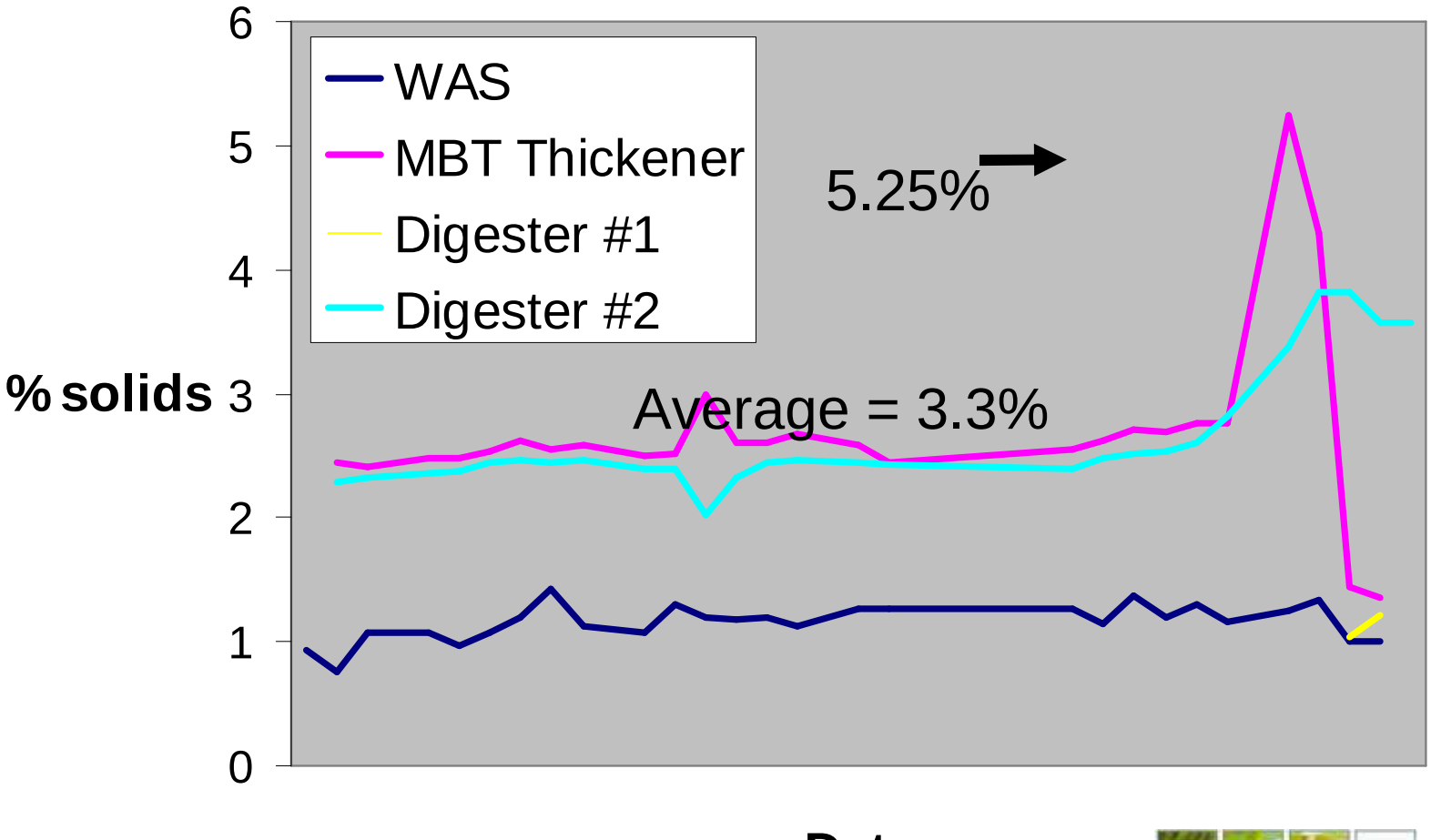
PAD-K Membrane Thickener / Digestion



Dundee, MI, U.S.A. CASE STUDY

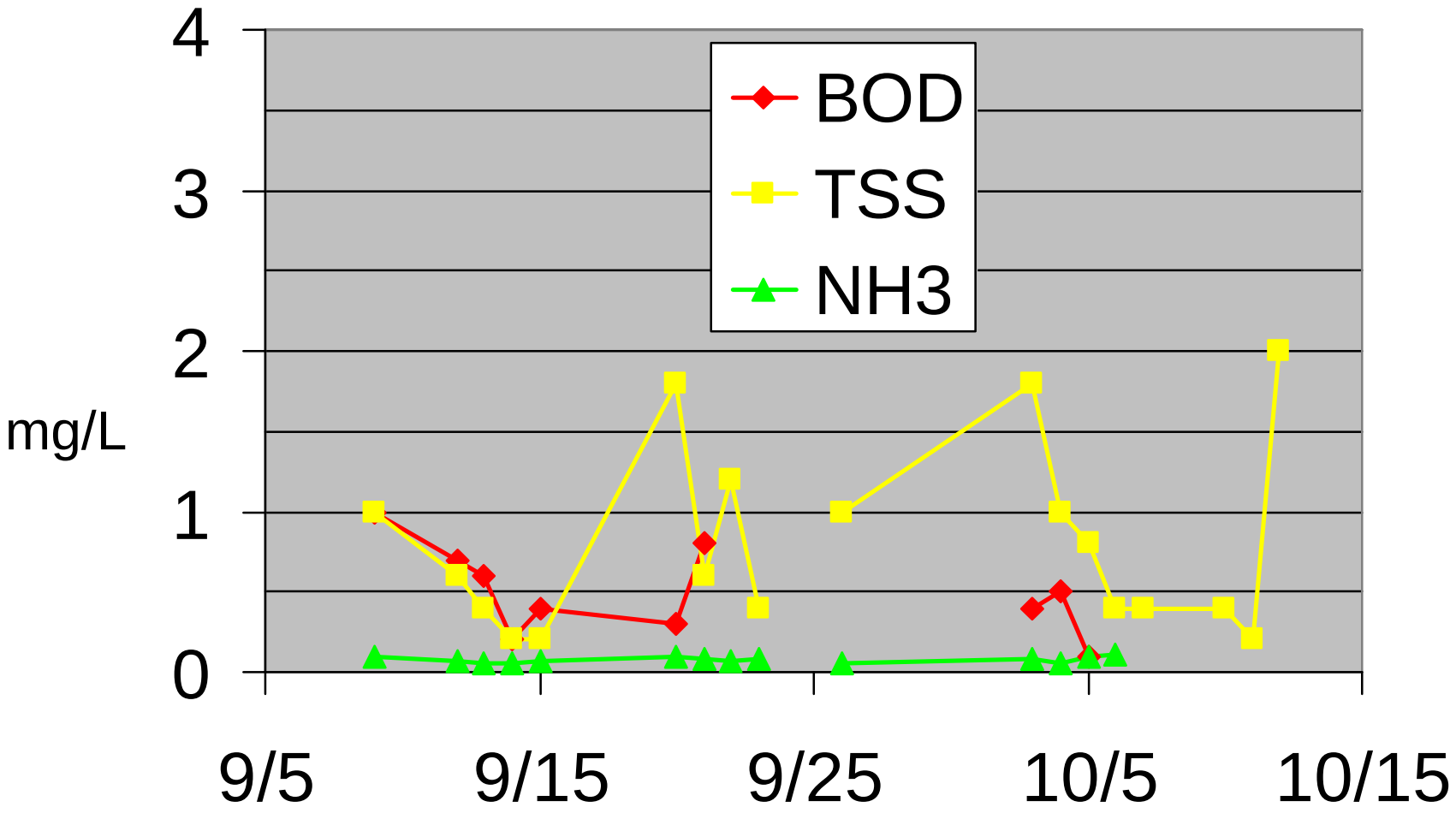
Dundee, MI

Sep & Oct 2005 Operation



MBT Permeate Quality

October 2005



Dundee WWTP, Michigan
January 2007 to June 2008

Sustainable Permeate Quality

before it's blended with MBR effluent

BOD:	**1.12 mg/l**
TSS:	**2.00 mg/l**
NH_3-N:	**0.22 mg/l**
NO_3-N:	**0.03 mg/l**
TP:	**1.09 mg/l**

Note: Combined effluent is not disinfected prior to discharge

*Highest solids concentration achieved in MBT to date 5.25%

Dundee, MI
Sludge Handling Cost Summary

Years	Gallons Hauled	Dry Tons	Yearly Cost
2001	1,483,200	125.53	$35,258 – No MBT
2002	1,425,600	114.55	$43,196 – No MBT
2003	313,000 – Belt 1,102,600 – Truck 1,415,600 - Total	24.80 – Belt 80.05 – Truck 104.85 - Total	$21,290 – Belt $35,590 – Truck $56,880 - Total
2004	248,885 – Belt 943,200 – Truck 1,192,100 - Total	22.67 – Belt 99.39 – Truck 122.06 - Total	$16,850 – Belt $30,088 – Truck $46,938 - Total
2005 MBT operational for 2nd half of year only	572,400 – Belt 432,000 – MBT 1,004,400 - Total	55.62 – Belt 47.55 – MBT 103.17 - Total	$39,135 – Belt $14,623 – MBT $53,758 – Total
2006	887,400 - MBT	130.48 - MBT	$32,739 - MBT

Belt press was needed for years 2003 -05 due to lack of storage space.

Sludge Hauling costs for first full year of operation of MBT in 2006 was $32,739 which is cheaper than the last 5 years

Constructed Costs For MBR Systems

Constructed Cost Data, U.S.A.

Items	Star Sewer & Water District	North Lake Recreational Sewer & Water District	City of Kuna, Idaho	City of Bellevue, Idaho
Average Day Flowrate, MGD	0.8	1.25	2.9	0.5
Effluent Water Quality	TSS <= 5; BOD <= 10; TN <= 10; TP <= 2	TSS <= 5; BOD <= 10; TN <= 10; TP <= 0.1	TSS <= 5; BOD <= 10; TN <= 5; TP <= 0.07	TSS <= 5; BOD <= 10; TN <= 5;
Current Status	Completed in January 2006	Startup anticipated in January 2008	Under Construction	Under Design
Membrane Manufacturer	Kubota	Zenon	Siemens	Zenon
Membrane Procurement Scope of Supply	• Membranes • Permeate Pumps • Air Scour Blowers • Chemical Cleaning	• Membranes • Permeate Pumps • Air Scour Blowers • Chemical Cleaning • Diffused Aeration System • RAS Pumps & Mixers	• Membranes • Permeate Pumps • Air Scour Blowers • Chemical Cleaning • Diffused Aeration System • RAS Pumps & Mixers	• Finescreen • Membranes • Permeate Pumps • Air Scour Blowers • Chemical Cleaning • Diffused Aeration System • RAS Pumps & Mixers
Membrane Procurement Award Price	$1,296,000	$2,858,887	$4,482,496	$1,097,662
Project Scope of Work	• Headworks Building • Process Basins • Process Building • Civil Sitework	• Headworks Building • Process Basins • Process Building • Civil Sitework	• Headworks Building • Process Basins • Process Building • Civil Sitework • Electrical Building • Solids Handling Building	• Process Basins • Process Building w/ Screen Room • Civil Sitework
Total Project Cost	$5,284,964	$11,500,000	$21,648,212	$6,500,000[a]
Capital Cost per Gallon	$6.6/gallon	$9.2/gallon	$7.5/gallon	$13/gallon

Notes: (a) Total project cost is based on engineer's estimate

Delphos, OH WWTP, U.S.A.

Basis of Design

- Greenfield Construction
- MMF = 6.0 MGD
- PDF = 12.0 MGD

Highlights

- Storm Master™ Design
- UNR1™ Process Design
- 28:1 Process Turndown
- Process & MBR Warranty by Enviroquip
- Includes ATAD and UV

Constructed in 20 Months

Constructed Cost: $31.8M

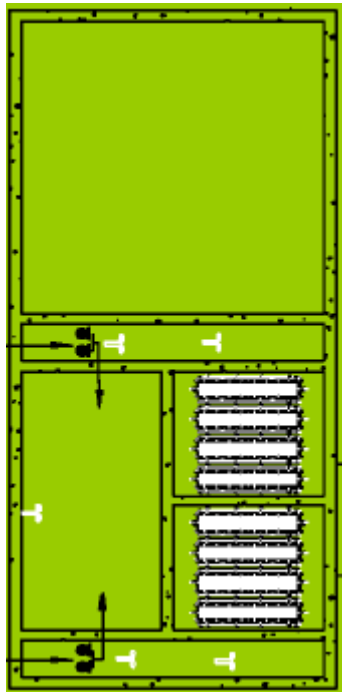
Project Costs – Delphos, OH

Flow	EWT Scope	Constructed Cost	Cost Multiplier
6 MGD 24,000 m^3/day	$7.95M	$31.8M	4x

Constructed Cost Retrofit Opportunities Utilizing 100% of the existing plant and tanks

Case Study – Rio Del Oro, NM, U.S.A.

- Before (Operational 1986)
  - 100,000 gpd Conventional Activated Sludge
  - 2005 flows exceeded 150,000 gpd
- After (Operational 2006)
  - **Phase 1 - 200,000 gpd**, converted existing clarifier to MBR basins single stack SMUs
  - **Phase 2 – (future) 400,000 gpd**, to convert premix channel and chlorine contact basin to an AX basin. Add upper decks to MBRs
  - **Phase 3 – (future) 800,000 gpd**, will convert existing Pre-Air basin to a second MBR facility



Case Study – Rio Del Oro, NM, U.S.A.

- Retrofitted Phase 1MBR while keeping the plant fully operational
- This plant was installed fully within the limits of the existing facility and provides a higher capacity and quality
- Built for a private utility Co.

- Estimated to be ½ the constructed cost over traditional technology

Case Study – Rio Del Oro, NM, U.S.A.

- Construction Challenges for Phase 1.
  - NMED would not approve a variance during construction
  - Facility had to remain in operation and still meet permits
  - Temporary MBR system was installed in the PA basin

Partitioning of old clarifier into two MBR(s) and Preaeration Basin

Case Study – Rio Del Oro, NM, U.S.A.

- Reuse Quality
  - Achieves Class 1A effluent for reuse
- Increased Capacity
  - From 100,000 gpd to 200,000 gpd with a potential of ***800,000 gpd using existing tankage!!!***
- Constructed Cost (Incremental Flow)
  - Phase 1 - 200,000 gpd at $1,300,000. $13.00 a gallon
    - Ancillary equipment & tankage installed for phase 2
  - **Phase 2 – 400,000 gpd expected at $5.00 a gallon**

EWT's View on Sustainability thru Technology Innovations

- **We view the focus on sustainability as an excellent investment that will bring transformational rewards and dramatic benefits.**
- **We can use efficiency and resource reduction to provide a fundamental cost advantage in the operation of MBR plants to our clients.**
- **EWT is not seeking a carbon neutrality but instead we are seeking a carbon advantage with our MBR technologies thru innovation.**
- **We would like to share with you our Detailed Mechanical and Electrical design information on "Best Engineering Practices for Sustainable MBR systems Globally".**

EWTMBR Facility Effluent