What are the MAJOR

PROBLEMS, THE WORLD

IS FACING TODAY

MAJOR PROBLEMS

- GLOBAL WARMING
- DEMAND FOR MORE ENERGY
- FINITE SUPPLY OF FOSSIL FUEL

GLOBAL WARMING;

- OVER HALF OF SCIENTISTS BELIEVE GLOBAL WARMING IS MAN MADE BY CO_2 RELEASE TO ATMOSPHERE.
- GLOBAL WARMING AND ENERGY DEMAND ARE INTER RELATED
- THEIR GROWTH IS IN THE SAME DIRECTION

WHAT IS CO2 ?

CO2 IS AN EMITION POLUTION GAS

AS THE RESULT OF

BURNING FOSSIL FUEL, SUCH AS, CRUDE OIL,

RESIDUAL OIL, COAL, AND NATURAL GAS

HOW MUCH CO_2 POWER PLANTS RELEASE TO ATMOSPHERE ?

1- THE HIGHEST EFFICIENCY OF POWER PLANTS PRESETLY IS 30 %

2- FOR 1 KWH ELECTRICITY CONSUMED, EQUIVALENT OF

4.16 KWH FOSSIL FUEL IS BURNED.

3- FOR 1 KWH ELECTRICITY 2.18 LB (near 1kg) CO_2 IS

RELEASEED ALONG WITH OTHER TOXIC GASES such as

CO, SO_2, AND NO_2 INTO THE ATMOSPHERE.

ENERGY DEMAND

WORLD ENERGY DEMAND WILL INCREASE

DUE TO,

- POPULATION GROWTH OF AT LEAST 1.25 % ANNUALLY
- WORLD WIDE DESIRE FOR BETTER STANDARD OF LIVING
- FINITE SUPPLY OF FOSSIL FUELS

RESULTING TO,

- HIGHER ENERGY COST

- SAVING THE ENVIRONMENT IS EVERY BODY'S CONCERN.

AND

- ENERGY COST HAS BEEN AND IS GOING TO INCREASE.

THEREFORE

WHAT IS THE SOLUTION ?

SOLUTIONS :

1- ENERGY CONSERVATION, OR

SMARTER USE OF ENERGY

2- SOLAR ENERGY

3- WIND POWER

4- HYRO POWER

5- NUCLEAR ENERGY

CONSERVATION IS THE BEST SOLUTION

1- NO CAPITAL INVESTMENT, (TURBINE, DAMS, SOLAR PANEL, NUCLEAR REACTOR, …)

2- IT IS FOR EVER, THE OTHERS HAVE LIMITED LIFE

3- DOES NOT DEPENT ON MOTHER NATURE, SUN SHINE, WIND, WATER BEHIDE THE DAM

4- NO NUCLEAR MELT DOWN

INNOVATION

IN ORDER TO CONSERVE ENERGY WE NEED

TO BE

INNOVATIVE

Example:

LIGHTING:	LED
CARS	HYBRID
LIFT-STATIONS	GREEN-LIFT

WATER from TREATMENT PLAN to WATER TOWER then to BUILDINGS

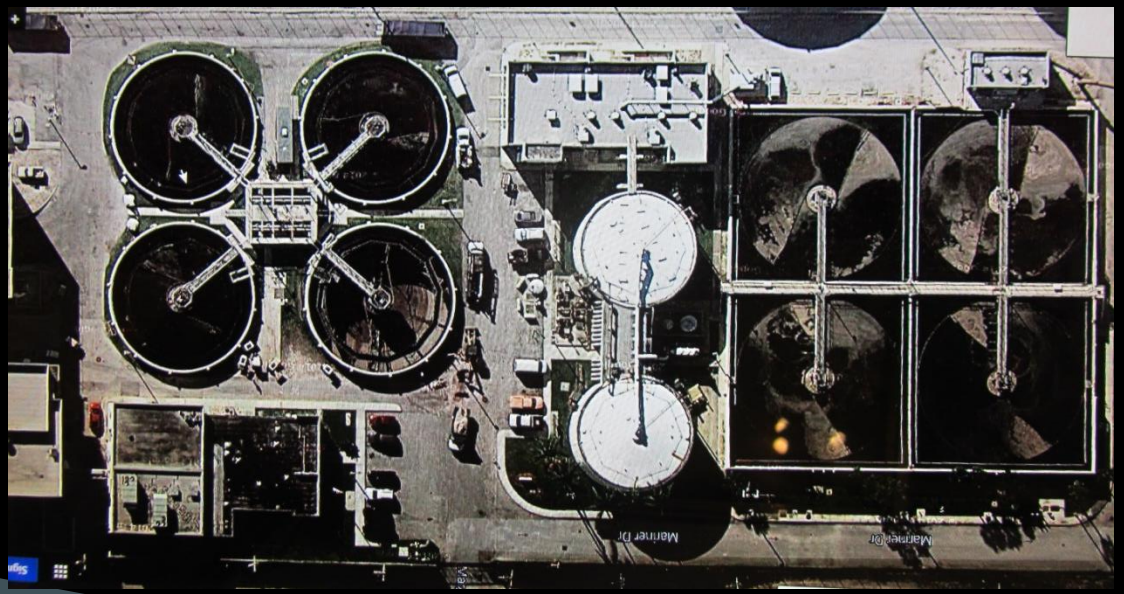
From buildings to Treatment Facilities:

1. Wastewater moves from a building to a gravity lateral
2. A gravity lateral merges to a gravity main in an angle
3. Gravity mains bring the wastewater to lift stations
4. Each lift station has pumps that lift the incoming water (inflow water) and pump it out (outflow water) to a force main
5. Finally, the wastewater reaches the treatment facility by force mains

LIFT STATION BRING

SEWER TO SEWER

TREATMENT PLANT



CITY's SEWER SYSTEM ENERGY USE from Sept 2014 to Sept 2015

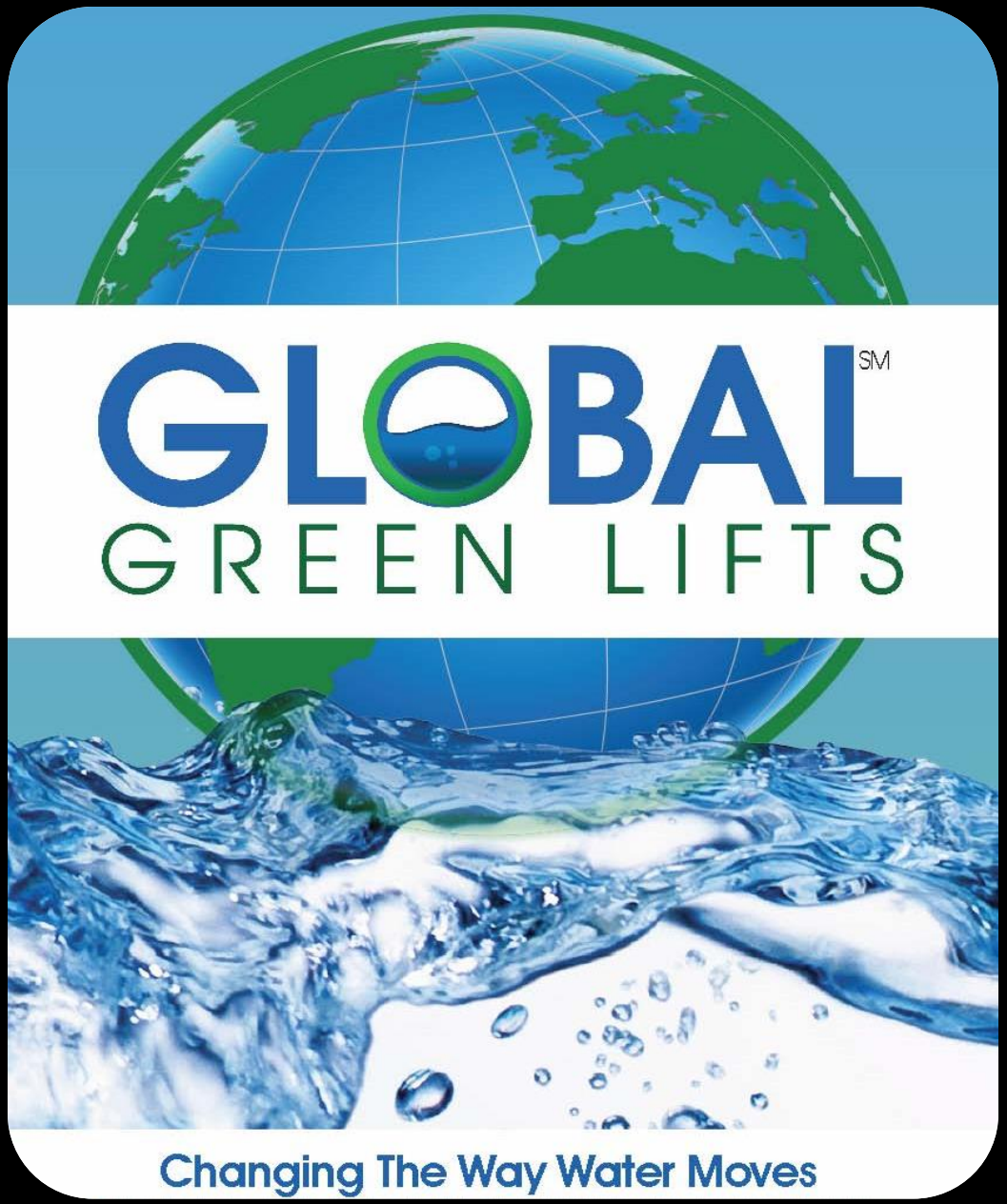
- TOTAL ENERGY USED 37,575,515 KWH
- PUMP – STATIONS ENERGY USED 10,382,792 KWH
- DEEP – WELL INJECTION PUMPS 20,313,670 KWH
- TOTAL PUMPING POWER USED 30,696,462 KWH
- PUMPING ENERGY % OF TOTAL 81.69 %

THE LIFT- STATIONS IN A CITY WITH

170,000 POPULATION

CONTRIBUTE APROXIMATELY

1,886,000 pounds CO2 PER MONTH.(865,267kwh x 2.18 Lb.)


GLOBAL SM
GREEN LIFTS
Changing The Way Water Moves

GREEN LIFT IS THE RESULT OF

1- OBSERVATION

2- BACK GROUND KNOWLEDGE

3- RESEARCH AND DATA GATHERING

4- DEVELOPMENT

WHAT IS GREEN LIFT ?

GREEN LIFT IS PATENTED REVOLUTIONARY

AND INNOVATIVE DESIGN, WHICH WILL

SAVE 30 % TO 60 % OF ENRGY USED IN

EXISTING LIFT– STATIONS .

Energy Saving Green Lift Station

The First Real Breakthrough In Wastewater Lift Station Operating Design Since The 1940's

Inventor: Fred Mehr, PhD

Patent Awarded January 23, 2013 – Control Panel

Patent Awarded July 15, 2014 – Green Lift-Station Design

Patent Awarded June 17, 2014 – Green Recycled Wet Well

US008777584B2

(12) United States Patent
Mehr

(10) Patent No.: US 8,777,584 B2
(45) Date of Patent: Jul. 15, 2014

(54) **ENERGY SAVING GREEN WASTEWATER PUMP STATION DESIGN**

(76) Inventor: **Nasser Fred Mehr**, Fort Lauderdale, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 257 days.

(21) Appl. No.: **13/335,908**

(22) Filed: **Dec. 22, 2011**

(65) **Prior Publication Data**

US 2013/0164149 A1 Jun. 27, 2013

(51) **Int. Cl.**
F04B 49/04 (2006.01)
F04B 41/06 (2006.01)

(52) **U.S. Cl.**
USPC **417/8**; 417/41; 417/12; 417/53

(58) **Field of Classification Search**
USPC 417/36, 40, 41, 53, 5, 7, 8, 12
See application file for complete search history.

(56) **References Cited**

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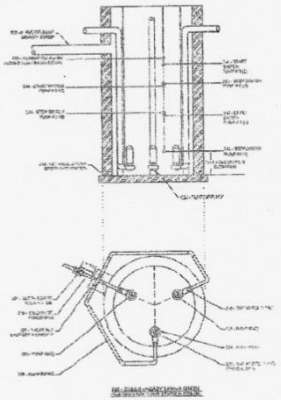
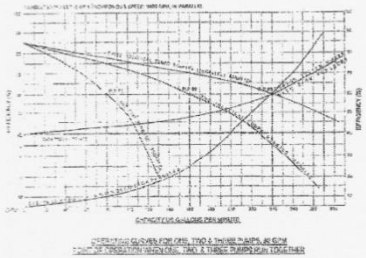
Primary Examiner — Charles Freay

(57) **ABSTRACT**

An energy saving three pump waste water pump station design that eliminates the high energy usage of traditional waste water pump stations, reduces maintenance costs to the pumps and increases the useful lives of the pumps by having a primary pump running continuously, a second pump mining during high demand periods and a third pump functioning primarily as a back up pump. Unlike conventional pump-station designs, the Energy Saving Green Pump Station Design utilizes a single float switch panel. Whereas independent float switches trigger start-stops in conventional pump station designs, the Green design incorporates a remote controllable panel for rotating the primary, secondary and third pumps on a schedule. This design also provides a process for determining in-flow rates for a pump station and efficiency operating points of pumps so that the most efficient pumps with the lowest horsepower can be selected.

1 Claim, 18 Drawing Sheets





US008371821B1

(12) United States Patent
Mehr

(10) Patent No.: US 8,371,821 B1
(45) Date of Patent: Feb. 12, 2013

(54) **GREEN WASTE WATER PUMP STATION CONTROL SYSTEM**

(76) Inventor: **Nasser Fred Mehr**, Fort Lauderdale, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/588,840**

(22) Filed: **Aug. 17, 2012**

(51) **Int. Cl.**
F04B 41/06 (2006.01)
F04B 49/04 (2006.01)

(52) **U.S. Cl.** **417/8**; 417/7; 417/12; 417/40

(58) **Field of Classification Search** 417/5, 7, 417/8, 12, 40
See application file for complete search history.

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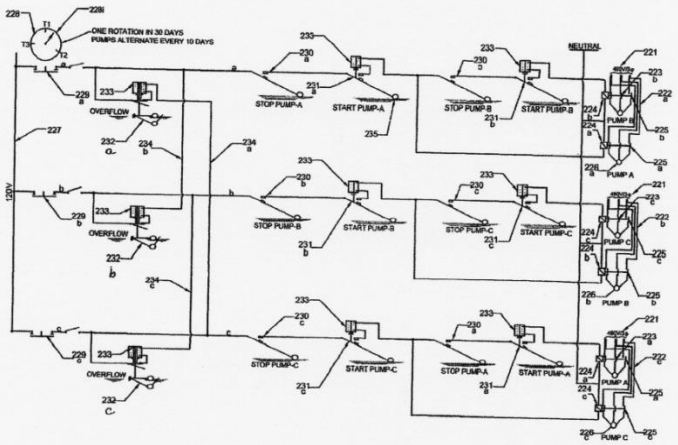
Primary Examiner — Charles Freay

(57) **ABSTRACT**

An electrical control system for energy efficient pump stations providing for continuous operation of a single primary pump with a second pump functioning as the support pump and a third pump acting as the standby/emergency pump. All pumps are of equal horsepower and horsepower selection is determined by the system curve to select the lowest, most efficient horsepower necessary to discharge water at the highest inflow rate while not allowing the water level to drop below the submerged pump level during continuous running of the primary pump. A timer having an indicator arm rotates one full revolution every thirty days changing the pump sequence to reduce wear and tear on individual pumps. Each pump functions as the primary, secondary and backup/emergency pump for the same number of hours during the monthly cycle. Adding control circuits enables one or more pumps to be added when necessary.

2 Claims, 3 Drawing Sheets

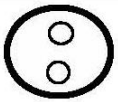


ANALOGY

1	AUTOMOBLE	HIGH WAY MILES/GA	CITY MILES/GA	KINETIC ENERGY LOSS IN CITY
2	TOYOTA– YARIS	35	25	40 %
3	TOYOTA – SIENA	25	17	47 %
4	DIFFERENCE	10	8	7 %

- BIGGER THE ENGIN, THE MORE FUEL WASTE
- CITY LOWER MILLAGE IS DU TO LOSS OF KINETIC ENERGY BY MULTIPLE START & STOP

Matrix of Analogy And Comparison

MATRIX OF ANALOGY AND COMPARISON				
DESCRIPTION	2010 H2	2014 MATRIX	Traditional Lift Station	New Green Lift-Station
				
TRAVEL DISTANCE	300 MILES	300 MILES	65 FEET HEAD	65 FEET HEAD
CAPACITY	5 PERSON	5 PERSON	5760 GALLON	5760 GALLON
TRAVEL TIME	5 HOURS	5 HOURS	24 HOURS	24 HOURS
SPEED	120 MPH	60 MPH	2X400 GPM	200 & 400 GPM
NO. OF STOPS & STARTS	16	1	280 to 321	6 to 8
STOPPAGE TIME	2.5 HOURS	0 HOURS	16.8 HOURS	NO 1 - 0 & NO 2 -19
DRIVING TIME	2.5 HOURS	5 HOURS	7.20 HOURS	NO 1 - 24 & NO 2 - 5
ENGINE POWER	300-375 HP	132-150 HP	2X25 HP	3X10 HP
FUEL EFFICIENCY	10 MILES/GAL	25 MILES/GAL	15.7 GAL/KwH	32.8 GAL/KwH
LOSS PER STOP & START	0.01 GAL/STOP	0.004 GAL/STOP	0.4 KwH/STOP	0.11 KwH/STOP
FUEL USED TOTAL	30 GAL	12 GAL	367.4 KwH	175.4 KwH
FUEL LOSS TOTAL	0.16 GAL	0.004 GAL	112 KwH	0.9 KwH
TOTAL FUEL FOR TRIP	30.16 GAL	12.004 GAL	479.4 Kwh/24HR	176.3 Kwh/24 HR
ENERGY CONSERVATION	100% USED	39.8% USED	100% USED	36.8% USED
MAINTENANCE (ANNUAL)	100%	31.40%	100%	33.50%
CO2 RELEASED (POUNDS)	598.5 LBS/TRIP	238.2 LBS/TRIP	1045 LBS/24HR	384.3 LBS/24HR

THE EXCESS FUEL CONSUPTION IN THE CITY IS DUE TO

FREQUENT START & STOP

AND

LOSS OF KINETIC ENERGY

NO DIFFERENCE BETWEEN CAR ENGIN OR

ELECRIC MOTOR– PUMP

GREEN LIFT DESIGN ;

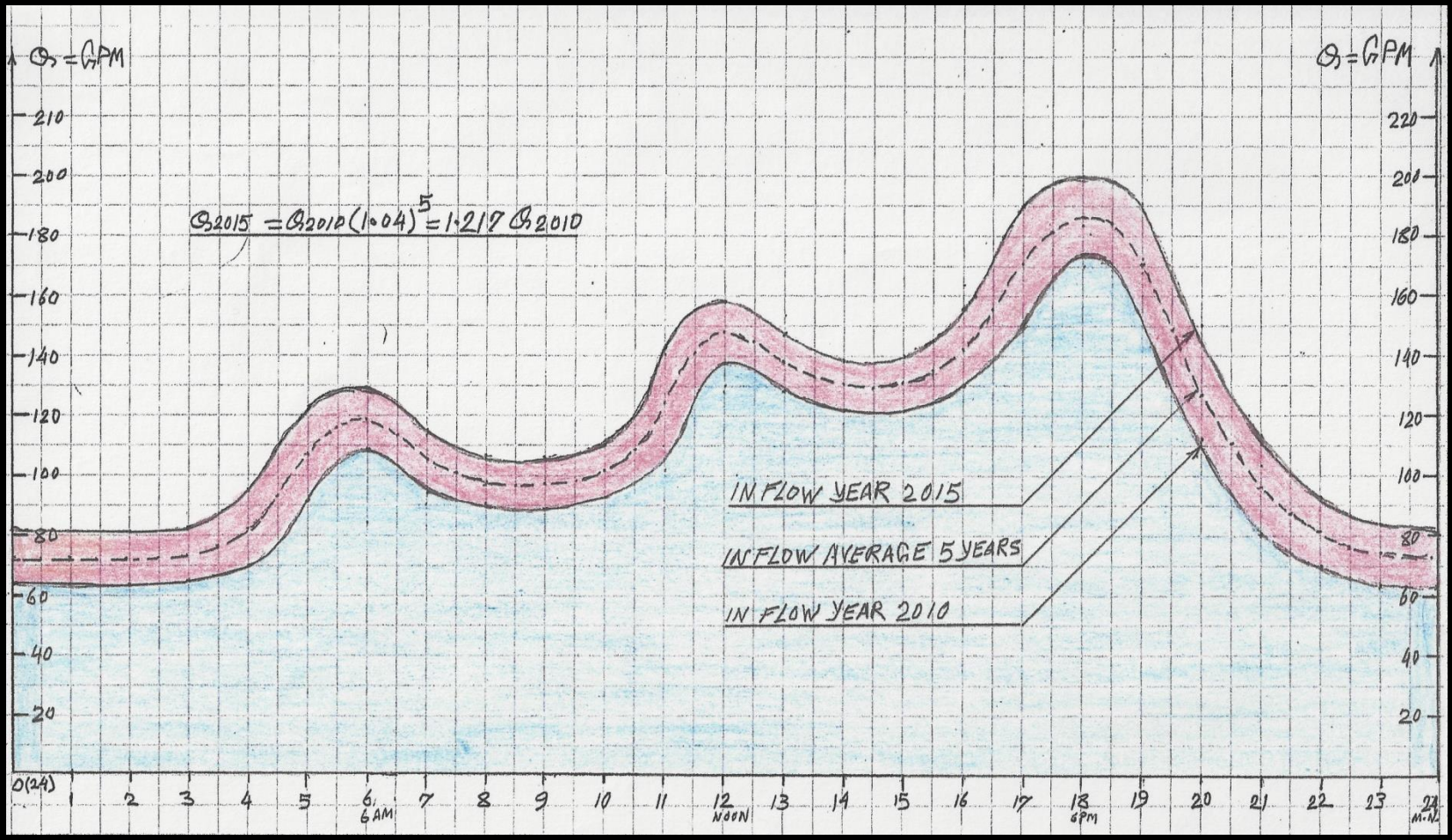
1- MINIMIZE START & STOP

2- HAS SMALER PUMPS ACORDING TO INFLOW

3- USES LESS ELEVATION, (TOTAL HEAD) TO PUMP

4- REDUCE GROUND WATER INFILTERATION

INTO THE LIFT STATION



24 Hour Inflow Into Lift Station

COMPARISON

OF

EXISTING (TRADITIONAL) LIFT-STATION

WITH

GREEN LIFT-STATION

A-1, IDEA,

TRADITIONAL LIFT-STATIONS ARE BASED ON 1940'S DESIGN

WITH

1- LIFT-STATION TO HAVE A STANDBY PUMP.

2- OVER SIZED PUMPS IN order to prevent, WELL OVER FLOW .

3- ENERGY COST was NOT A CONCERN (75 cents/barrel of crude oil).

4- CO_2 POLUTION WAS NOT AN ISSUE AT ALL.

A-2, IDEA,

GREEN LIFT-STATION ADDRESSES

TWO IMPORTANT ISSUES.

1- GLOBAL WARMING AND CO_2 ISSUES.

2-ENERGY COST

B-1, DESIGN,

TRADITOAL LIFT-STATIONS DESIGNED BASED ON,

1- PUMP 'S CAPACITY FOR MAXIMUM INFLOW

2- LIFT-STATIONS HAVE TWO OVER SIZED EQUAL PUMPS

3- EACH PUMP MUST BE CAPABLE OF PUMPING MAXIMUM INFLOW AT ANY TIME

B-2, DESIGN,

GREEN LIFT-STATIONS ARE DESIGNED

WITH

1- PUMP'S CAPACITY BASED ON MINIMUM INFLOW

2- LIFT-STATIONS HAVE MINIMUM THREE IDENTICAL PUMPS

3- PUMPS SIZED WITH 24 HOURS WELL STABLISHED INFLOW CURB

C-1, OPERATION,

IN TRADITIONAL LIFT STATION

1- AS WASTE WATER RISES TO PRE SET LEVEL, THE LEAD PUMP STARTS FIRST, FOLLOWED SHORTLY BY THE LAG PUMP

2- TWO PUMPS RUN TOGETHER UNTIL THE WATER LEVEL DROPS TO PUMP LEVEL, THEN BOTH PUMPS SHOT DOWN

C-2, OPERATION,

GREEN LIFT STATION OPERATION

1- THE PRIMARY PUMP RUNS CONTINUOUSLY WITH MAXIMUM EFFICIENCY

2- THE SECONDARY PUMP WILL STARTS, AND RUNS WITH MAXIMUM EFFICIENCY, IF THE FIRST PUMP IS UNABLE TO MAINTAIN LOW LEVEL WATER

3- THE THIRD PUMP IS STANDBY BACK UP

D-1, EFFICIENCY,

TRADITIONAL LIFT-STATION ARE VERY INEFFICIENT, BECAUSE

1- TWO HIGH POWER PUMPS MOVE WATER VERY QUICKLY,

THEY TURN ON & OFF FREQUENTLY AND CONSISTENTLY

2- THE PUMP'S PEAK ENERGY USE IS DURING START UP,

THAT CONVERT TO KINETIC ENERGY OF THE SYSTEM

3- EACH TIME THE PUMP STOPS, ALL THE STORED KINETIC

ENERGY OF THE SYSTEM IS LOST AS HEAT

D-2, EFFICIENCY,

GREEN LIFT-STATIONS ARE VERY EFFICIENT BECAUSE

1- USE ONLY SIGLE SPEED PUMPS

2- HAVE ATLEAST THREE PROPERLY SIZED IDENTICAL PUMPS

3- TOTAL (HP.) INSTALLED ARE 50% TO 75% OF TRADITIONAL

4- ONE PUMP RUNS CONTINUOUSLY, SECOND PUMP WILL START IF THE FIRST PUMP IS UNABLE TO MAINTAIN A LOW LEVEL

5- THE THIRD PUMP IS STANDBY BACKUP

6- PUMPS RUN ALWAYS IN MAXIMUM EFFICIENCY

7- THE NUMBER OF STARTS & STOPS IS 30% OF TRADITIONAL

E– PUMP LIFE COMPARISON,

1- Conventional Two Pump Lift Station

Pump	Starts/Year	Total/Year
1	3285	
2	3285	6,570

Expected life of each pump 20,000/3,285 = 6.09 Years

2- Green Three Pump Lift Stations

Pump	Starts/Year	Total/Year
1	856	
2	856	
3	856	2,568

Expected life of each pump 20,000/856 = **23.36 Years**

(Based on 20,000 lifetime starts and stops

Why Not Variable Speed Pumps

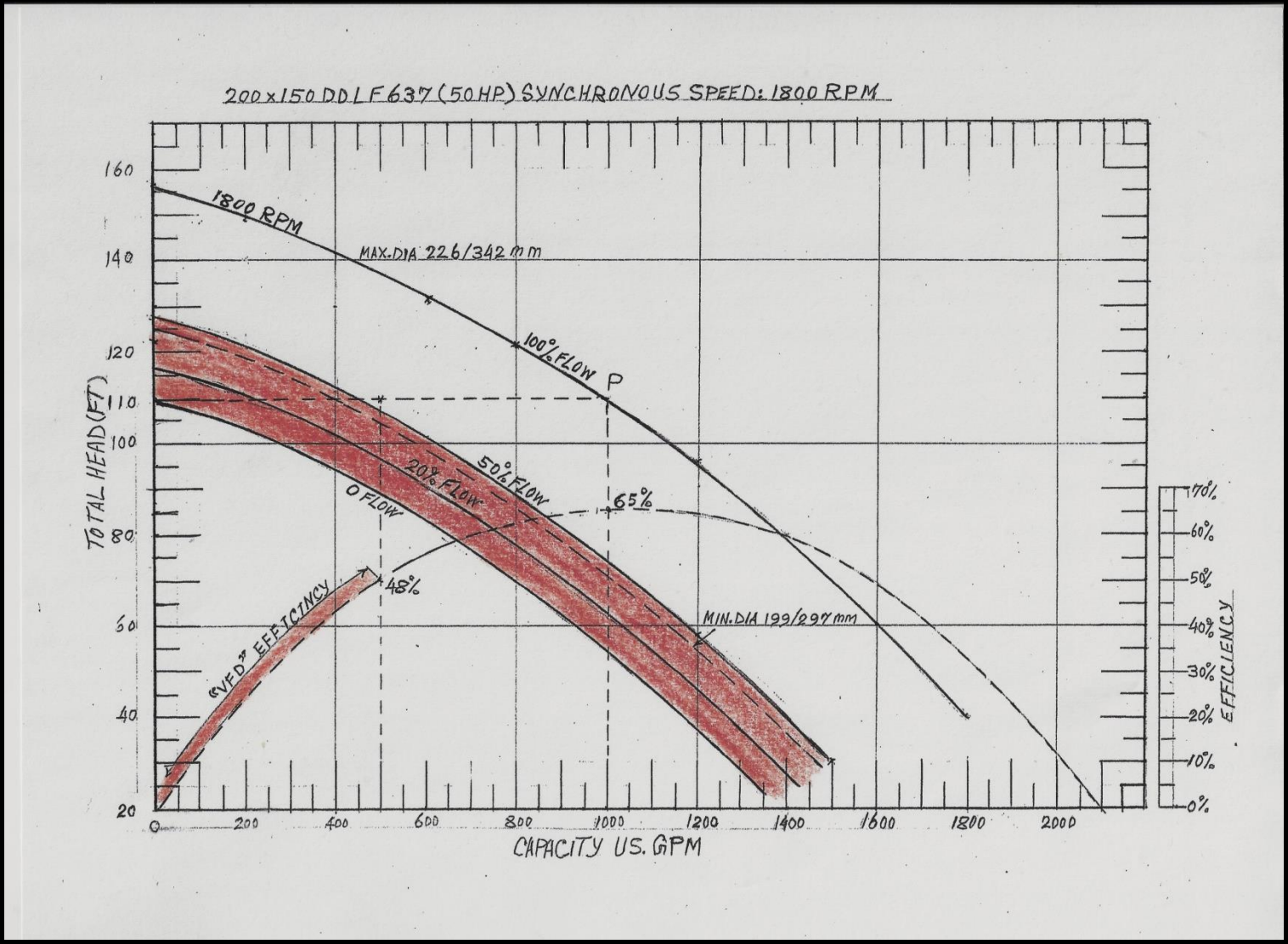
- Variable speed pumps have been used in lift stations SUPPOSEDLY to save energy
- On the contrary, they are less efficient than single speed pumps and do not accomplish energy or cost savings
- Dr. Thomas Walski is one of the most published and recognized water-resources modeling experts and educators in the world
- His research concludes: **In sewage pump station wet well** variable speed pumps approach their maximum efficiency only when their variable frequency drive (VFD) is totally bypassed and the pumps run at constant speed.

TWO PUMP

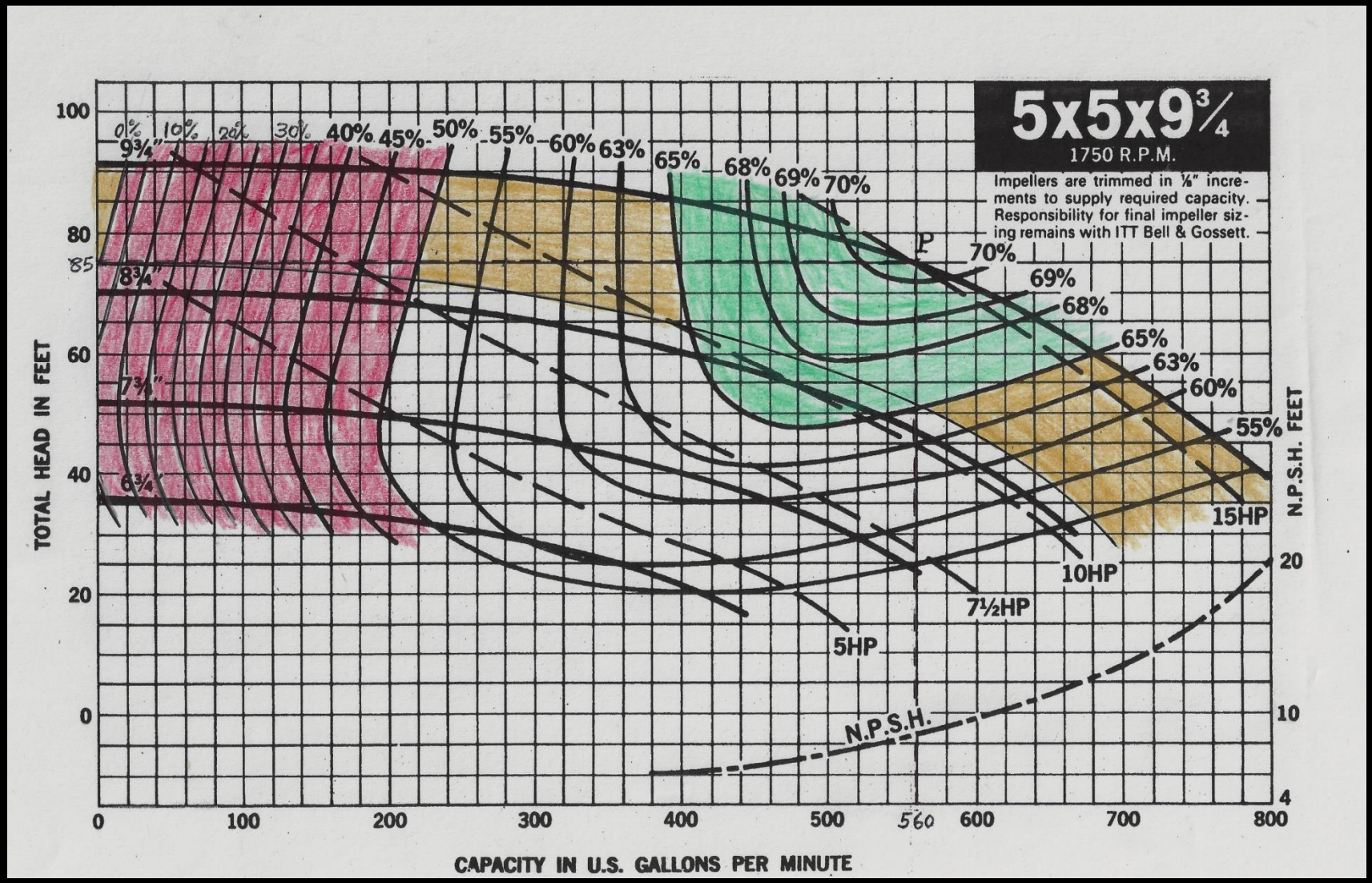
LIFT- STATION

EFFICIENY

0% to 48%



VARIABLE SPEED PUMP 'S CURVE (LIFT-STATION WITH TWO PUMPS)

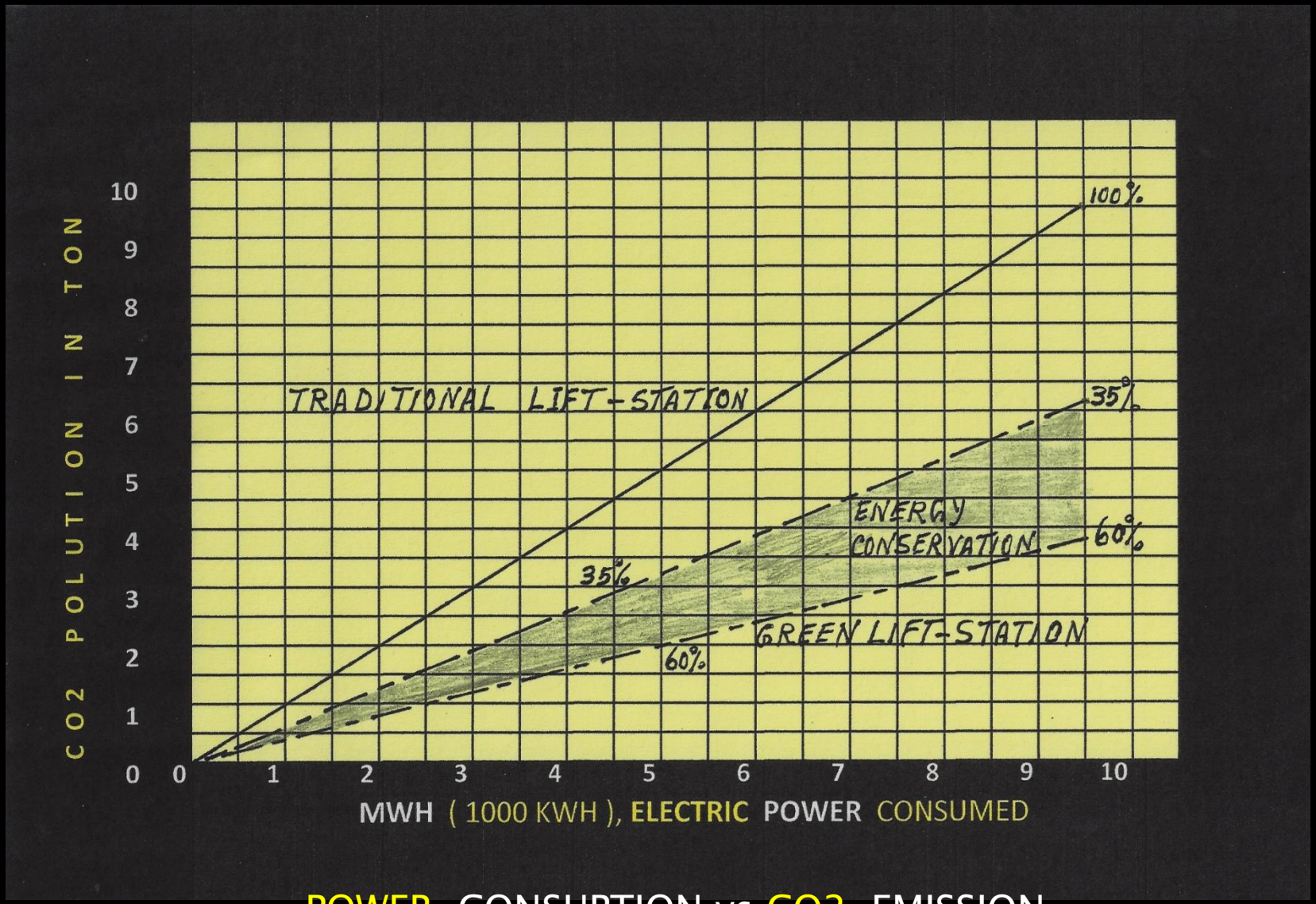


EFFICIENCY – VARIABLE SPEED, 0% to 50% – SINGLE SPEED, 65% to 70%

How Much Energy Is Saved

33% to 60%

- 33% is conservative - it is based upon two pumps have been properly sized and designed which is rare
- 60% is based upon two pumps have been poorly sized and designed which is common



POWER CONSUPTION vs CO2 EMISSION

Maintenance Cost savings

Up to 66%

- Wear and tear of the pumps including electrical system is directly related to number of starts & stops, therefore, green lift station's maintenance is only a fraction of the traditional
- Due to green lift pumps' extended life, its replacement cost is 30% of the traditional
- The total maintenance cost is 33% of the traditional

INFLOW & INFILTRATION " I & i "

- INFLOW AND INFILTRATION REFER TO RAIN WATER AND UNDER GROUND WATER ENTERING INTO SEWER SYSTEM
- I & I CAUSES INCREASE OF WASTE WATER ENTERING TO LIFT STATION, TREATMENT PLANT, AND DEEP WELL INJECTION

I & i REDUCTION

IN COASTAL CITIES, GREEN LIFT-STATIONS COULD REDUCED

INFILTRATIONI OF TRADITIONAL SEWER SYSTEM FROM 100 %

TO 25 % .

RESULTING TO;

SAVING OF 40 %

IN ENERGY CONSUPTION of SEWER SYSTEM

AND

ELIMINATING THE NEED OF I & i IMPROVING PROJECTS

HOW MUCH SAVING BY REDUCTION OF (I & I)

WITH GREEN LIFT STATIONS ?

(Sept 2014 to Sept 2015)

- SEWER SYSTEM ENERGY USED 37,575,515 KWH
- RAIN & U.G. WATER INFIL–

  TRATION 35 % OF WASTE WATER 11,272,655 KWH
- GREEN LIFT SAVING 80 % of 100 % 9,018,124 KWH
- $ SAVING /YEAR IF $ 0.10/KWH $ 901,812./ YEAR

GREEN LIFT-STATION with THREE CONSTANT SPEED PUMPS, A-12

VERSUS

TRADITIONAL L. STATION with THREE CONSTANT SPEED PUMPS

GREEN -LIFT " **HP** " CAPACITY installed/ TRADITIONAL " **HP** " installed = 3x 30/3x 60 = **50 %**

GREEN-LIFT **ENERGY** SHAFT BHP/TRADITIONAL **ENERGY** SHAFT BHP = 643.7/1,053.7 = **61.1 %**

GREEN-LIFT **ERERGY** INPUT/ TRADITIONAL **ENERGY** INPUT = (51.83 % /63 %) x 61.1 % = **57.6 %**

MAINTENANCE IS RELATED TO NUMBER OF PUMP'S " ON & OFF " or the NUMBER OF CYCLES

TRAD. PUMP " **LIFE** "/GREEN PUMP " **LIFE** " = TRAD.CYCLES/ GREEN CYCLES = 53/ 164.5 =**32.7 %**

MAINT. G.L.STATION / **MAINT.** TRADITIONAL = 53/(120.15+44.35) = 53/164.5 = **32.7 %**

GREEN-LIFT " **CO2** " RELEASE /TRADITIONAL " **CO2** " RELEASE = 643.7/1,053.7 = **61.1 %**

ONLY GREEN LIFT-STATION CAN RECEIVES FEDERAL **GRANT**

CASE STUDY

We have performed a case study of an existing, traditional design, re-pump station. The study compared criteria and specifications (Table 1 below) of the traditional station with those of an energy efficient green designed station. Comparative costs of the construction of the traditional and green designed stations are presented in Table 2. Finally, the maintenance and energy cost savings of each designed station are provided in Table 3.

TABLE 1

Item Description	Traditional Design	Green Design
Wet Well		
Inner Diameter X Wall Thickness	12'x1'	12'x1'
Depth	30'	24'
Pumps		
Average Operating Efficiency	**12%**	**63%**
Maximum Inflow to Well	1750 GPM	1750 GPM
Pump Rated Power	85 HP	30 HP
Voltage	480 V	480 V
Nominal Rated Amps	109 A	36 A
Rush in Current (LRA)	685 A	231 A
Rated Speed	1185 RPM	1755 RPM
Impeller Diameter	15.875"	5.9375"
Pump Height	56.5"	39.25"
Pump Wieght (With/Without Jacket)	2066/1900	665/600

CRITERIA AND SPECIFICATIONS
TRADITIONAL RE-PUMP STATION VS. GREEN DESIGN

TABLE 2

Item Description	Compiling Cost Items	TRADITIONAL		GREEN DESIGN		GREEN DESIGNED STATION SAVINGS	
		Materials	Labor	Materials	Labor	Materials	Labor
Cost Of Construction							
Wet-Well	13/C.I.	$29,767	$14,034	$23,054	$11,417	22.55%	18.65%
Pumps & L	2/C.I.	$144,426	$15,865	$73,316	$6,831	49.24%	56.94%
Piping & Valves	12/C.I.	$43,996	$22,000	$24,474	$12,237	44.37%	44.38%
Electrical	16/C.I.	$158,028	$62,070	$96,720	$38,795	38.80%	37.50%
Emergency Generator	3/C.I.	$70,820	$18,665	$52,480	$13,500	25.90%	27.67%
Coffer Dam	9/C.I.	$40,022	$16,000	$34,653	$16,000	13.42%	0.00%
Excavation	11/C.I.	$8,307	$8,667	$6,069	$6,429	26.94%	25.82%
Dewatering	6/C.I.	$6,400	$7,680	$4,800	$5,760	25.00%	25.00%
Wet-Well Installation	20/C.I.	$24,454	$23,077	$17,512	$17,727	28.39%	23.18%
Totals		$526,220	$188,058	$333,078	$128,696	36.70%	31.57&
Total Cost Materials & Labor		**$714,278**		**$461,774**		**35.35%**	

CONSTRUCTION COST COMPARISON

TABLE 3

COST OF OPERATION (25 YRS)	TRADITIONAL	GREEN DESIGN	GREEN DESIGNED STATION SAVINGS
Maintenance	$1,435,516	$300,482	**79.07%**
Operating Energy Cost	$6,072,525	$1,602,660	**73.61%**

GREEN LIFT-STATION with (4x 30) HP CONSTANT SPEED PUMPS,

VERSUS

TRADITIONAL L. STATION with (3x85) HP VARIABLE SPEED PUMPS

GREEN -LIFT " **HP** " CAPACITY installed/ TRADITIONAL " **HP** " installed = 4x 30/ 3x 85 = **47 %**

GREEN-LIFT **ENERGY** CONSUMPTION/ TRADITIONAL **ENERGY** USE = 64,106/242,901 = **26.4 %**

TRADITIONAL MAINTENANCE IS **VERY COSTLY** DUO TO VFD 'S HEAT SENSITIVITY AND VFD'S SHORT LIFE. ALSO LOWERING SPEED COULD CAUSE RESONANCE OF NATURAL FREQUENCY

MAINT. G.L. STATION / **MAINT.** TRADITIONAL = $12,019 monthly/$57,421 monthly = **32.7 %**

GREEN-LIFT " **CO2** " RELEASED/TRADITIONAL " **CO2** " RELEASED = 64,106/242,901 = **26.4 %**

GREEN L.-STATION'S PUMP **EFFICIENCY** IS **63 %** , TRADITIONAL L.-STATION AVERAGED **12 %**

ONLY GREEN LIFT-STATION CAN RECEIVES FEDERAL **GRANT**

The Median City

- If the median city with a population of 170,000 completely retrofitted to green lift stations, then the benefits in 20 years is as follows :

A- With two pump stations

• Total hp installed	=	2770 hp		
• Total energy savings	=	$14,800,000	=	34.7%
• Total maintenance savings	=	$8,200,000	=	66.5%
• CO2 reduction	=	53,000 Tons	=	34.7%

The Median City
(continued)

B- With three & four pump stations

- Total hp installed = 6,700 hp
- Total energy savings = $30,000,000 = 35.8%
- Total maintenance savings = $19,800,000 = 66.5%
- CO2 reduction = 107,670 Tons = 35.8%

C- All pump stations (A+B)

- Total hp installed = 9,470 hp
- Total energy savings = $44,800,000 = 35.4%
- Total maintenance savings = $28,000,000 = 66.5%
- CO2 reduction = 160,670 Tons = 35.4%

APPLY GREEN LIFT TO 274 U.S. s‘ CITIES

RESULTS IN 20 YRS AFTER RENOVATION WILL BE;

1- REDUCTION OF CO2 CONTRIBUTION

61,976,178 TONS

2- ENERGY OPERATION COST SAVING

17,302,269,400 $

3 – MAINTENANCE COST SAVING

10,623,176,000 $

4 –TOTAL OPERATING COST SAVING

27,925,445,400 $

5 – JOB CREATION 2,012,140,235 $

6 – REQUIRED CAPITAL

5,000,000,000 $

Calculated Savings from Conversion to Green Lift In 274 Cites (2 pumps)

TRADITIONAL TWO PUMP LIFT-STATIONS CONVERTED TO GREEN LIFT-STATIONS
274 STAGE 1 U.S. CITIES

ITEM	DESCRIPTION	UNIT	MEDIAN CITY CITY OF FORT LAUDERDALE	MULTI-PLIER	STAGE 1 CITIES POPULATION OF 100,000 & HIGHER
1	NUMBER OF CITIES	CITY	1	-	274
2	CITIES OF THIS SIZE AS A % OF US POPULATION	% OF POPULATION	-	-	27%
3	POPULATION IN 2010	# OF INHABITANTS	165,521	507.8	84,051,564
4	AREA OF OCCUPANCY	$MILE^2$	34.8	-	25,680.3
5	POPULATION DENSITY	INHABITANTS / $MILE^2$	4756.4	-	3,284.3
6	TOTAL EXISTING 2 PUMP STATION CAPACITY IN 2004	HP	2,768	507.8	1,320,280
7	TOTAL EXISTING 2 PUMP STATION CAPACITY CONVERTED TO GREEN	HP	2,491	507.8	1,320,280
8	**TOTAL ENERGY OPERATING COST SAVINGS OVER 20 YEARS**	**$ / 20 YRS**	**$14,794,000**	**507.8**	**$7,512,393,200**
9	**TOTAL MAINTENANCE COST SAVINGS OVER 20 YEARS**	**$ / 20 YRS**	**$8,200,000**	**507.8**	**$4,163,960,000**
10	**US SAVINGS AS OPERATING POWER AS IMPORTED OIL AS FUEL FOR POWER PLANTS TO CONVERT TO USABLE ENERGY**	**BARRELS / 20 YRS**	**124,490**	**507.8**	**63,216,022**
11	**US SAVINGS IN IMPORTED OIL COSTS AS FUEL TO POWER PLANTS TO FEED LIFT-STATIONS**	**$ / 20 YRS**	**14,690,000**	**507.8**	**7,459,582,000**
12	**TOTAL SAVINGS OVER 20 YRS BY CONVERTING 2 PUMP LIFT-STATIONS TO THE GREEN LIFT-STATION DESIGN**	**$ / 20 YRS**	**22,994,000**	**507.8**	**11,676,353,200**
13	COST ESTIMATE OF RENOVATING TO THE GREEN LIFT-STATION DESIGN	$ / 20 YRS	3,675,000	507.8	1,866,165,000
14	FEDERAL LOAN (P & I) @ 4% RATE	$ / 20 YRS	5,439,900	507.8	2,762,381,220
15	FEDERAL LOAN (I) PAID TO US GOVT	$ / 20 YRS	1,764,900	507.8	896,216,220
16	**JOB CREATION BASED ON LABOR BEING 60% OF THE PROJECT COST**	**$ / 20 YRS**	**2,205,000**	**507.8**	**1,119,699,000**
17	**REDUCTION IN CO2 EMITTED FROM POWER PLANTS (1 TON CRUDE = 3.15 CO2)**	**TON CO2 / 20 YEARS**	**52,992**	**507.8**	**26,909,541**

Your actual municipality numbers may vary slightly

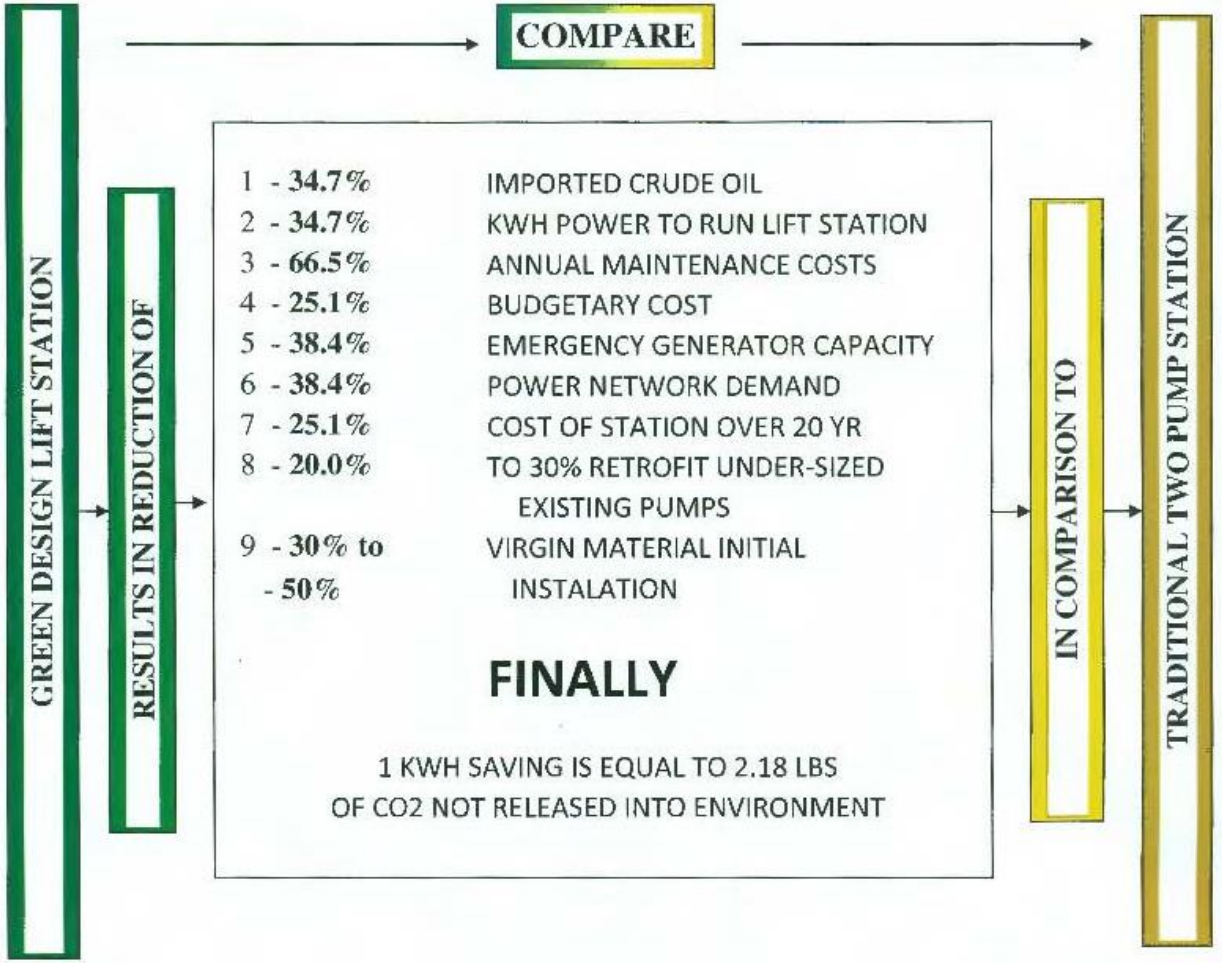
Calculated Savings from Conversion to Green Lift In 274 Cites (3 pumps)

TRADITIONAL THREE PUMP LIFT-STATIONS CONVERTED TO GREEN LIFT-STATIONS
274 STAGE 1 U.S. CITIES

ITEM	DESCRIPTION	UNIT	MEDIAN CITY CITY OF FORT LAUDERDALE	MULTI-PLIER	STAGE 1 CITIES POPULATION OF 100,000 & HIGHER
1	NUMBER OF CITIES	CITY	1	-	274
2	CITIES OF THIS SIZE AS A % OF US POPULATION	% OF POPULATION	-	-	27%
3	POPULATION IN 2010	# OF INHABITANTS	165,521	507.8	84,051,564
4	AREA OF OCCUPANCY	$MILE^2$	34.8	-	25,680.3
5	POPULATION DENSITY	INHABITANTS / $MILE^2$	4756.4	-	3,284.3
6	TOTAL EXISTING 3 PUMP STATION CAPACITY IN YR 2004	HP	6,692	507.8	3,398,198
7	TOTAL EXISTING 3 PUMP STATION CAPACITY CONVERTED TO GREEN	HP	4,292	507.8	2,179,478
8	**TOTAL ENERGY OPERATING COST SAVINGS OVER 20 YEARS**	**$ / 20 YRS**	**$30,057,000**	**507.8**	**$15,262,944,600**
9	**TOTAL MAINTENANCE COST SAVINGS OVER 20 YEARS**	**$ / 20 YRS**	**$19,830,000**	**507.8**	**$10,069,674,000**
10	**US SAVINGS AS OPERATING POWER AS IMPORTED OIL AS FUEL FOR POWER PLANTS TO CONVERT TO USABLE ENERGY**	**BARRELS / 20 YRS**	**252,941**	**507.8**	**128,443,440**
11	**US SAVINGS IN IMPORTED OIL COSTS AS FUEL TO POWER PLANTS TO FEED LIFT-STATIONS**	**$ / 20 YRS**	**29,847,000**	**507.8**	**15,156,306,600**
12	**TOTAL SAVINGS OVER 20 YRS BY CONVERTING 3 PUMP LIFT-STATIONS TO THE GREEN LIFT-STATION DESIGN**	**$ / 20 YRS**	**49,887,000**	**507.8**	**25,332,618,600**
13	COST ESTIMATE OF RENOVATING TO THE GREEN LIFT-STATION DESIGN	$ / 20 YRS	4,363,744	507.8	2,215,909,200
14	FEDERAL LOAN (P & I) @ 4% RATE	$ / 20 YRS	6,459,216	507.8	3,279,989,885
15	FEDERAL LOAN (I) PAID TO US GOVT	$ / 20 YRS	2,095,472	507.8	1,064,080,682
16	**JOB CREATION BASED ON LABOR BEING 60% OF THE PROJECT COST**	**$ / 20 YRS**	**2,618,246**	**507.8**	**1,329,545,319**
17	**REDUCTION IN CO2 EMITTED FROM POWER PLANTS (1 TON CRUDE = 3.15 CO2)**	**TON CO2 / 20 YEARS**	**107,671 T**	**507.8**	**54,675,334 T**

Your actual municipality numbers may vary slightly

SAVINGS ACHIEVED BY CONVERTING THE TRADITIONAL 2 PUMP LIFT STATION TO THE ENERGY SAVING 3 PUMP GREEN DESIGN



CONCLUTION, GREEN LIFT-STATION

1- GREEN LIFT-STATIONS EASILY RECEIVE FEDERAL FUND

2- SAVES ENVIRONMENT BY NOT RELEASING CO_2 TO ATMOSPHERE WITH ENERGY CONSERVATION BY : 35%

3- GREEN LIFT REDUCES THE CAPITAL INV. BY : 20% to 25%

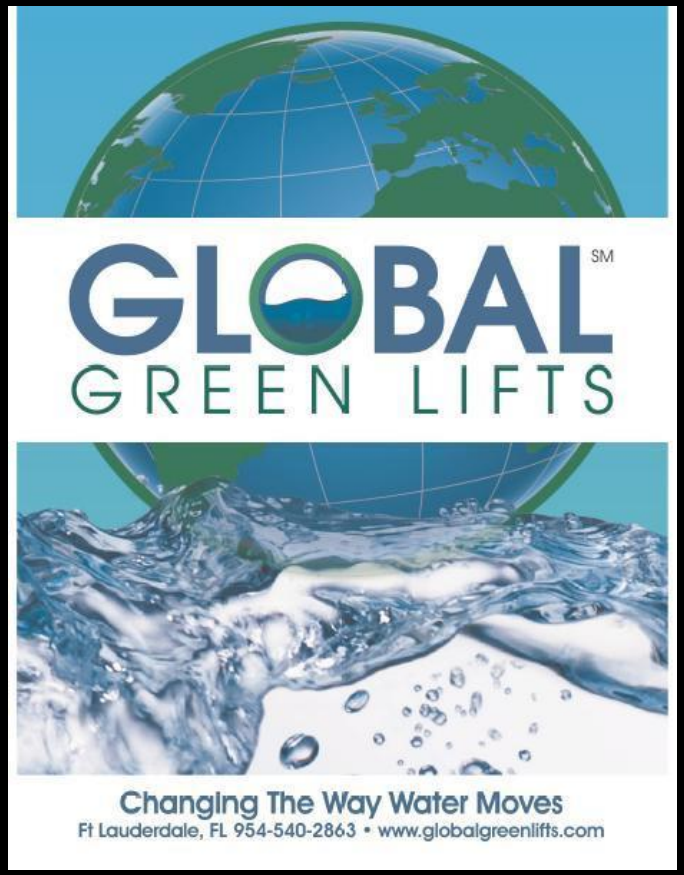
4- SAVES OPERATING ENERGY BY : 30% to 60%

5- SAVES MAINTENANCE COST BY : 50% to 66%

6- I & i SAVING OF OPERATING ENERGY OF SEWER SYSTEM BY : 40%

7- EXPANDABILITY OF L.S. BY FOURTH PUMP BY : 50%

Why Not Start



Today?

Q questions

&

A answers

Questions:

Q1) How green lift technology helps the environment?

Any process which conserves energy helps our environment to be cleaner for us and our generation to come. Saving of one Kwh energy in green lift stations is equal to 1.2 - 1.25 Kwh generated in power plants.

The efficiency of the conversion of natural gas (as cleanest fuel) to electric power in the most efficient plant is 30%. This mean for each consumption of 1 Kwh in the green lift stations is equivalent to the burring of 4.16 Kwh of fuel. Therefore for the saving of each 1 Kwh in green lift stations is equivalent to 4 - 4.17 Kwh of fuel not being burned.

For each 1 Kwh saving in green lift station 2.18 lb. of CO_2 will not be released to the environment. For example, if all of the 2 pump stations with 2,768 horse power were converted to green lift stations in a city with the population of 170,000, then 53,000 ton of CO_2 would be kept out of the atmosphere. In the same city, if all the 3 pump stations with 6,692 horse power were converted to green lift stations, then 107,670 ton of CO_2 would be kept out of the atmosphere.

Q2) Why municipalities should replace their tradition pump station with green lift?

By selecting green lift stations, municipalities will be benefited in many ways such as financing, initial cost, running cost, maintenance cost, and upgrading cost.

Q3) How does green lift stations help City project financing?

Since energy conservation of green lift is 40% to 50 % of the traditional stations, they will be in top priority to be qualified for federal grant from us department of energy and EPA. But there is no chance to secure federal grants for traditional renovations. Also power utilities in some states have incentive for power reducing retrofitting projects.

Q4) How does green lift stations effect the project's initial cost?

By selecting green lift stations in new projects, renovations, or even upgrading the existing ones, they will bring an overall saving of 20% to 25%.

Q5) What component of green lift stations have cost reduction

Almost all components will reduce the initial installation cost such as pumps, electrical panel and wiring, wet well structure, wet well top slab, and emergency generator. For example, the total horsepower in the installed pumps used in green lift stations are reduced by 15% to 50% in respect to the traditional.

Q6) How come green lift stations' wet wells are cheaper than traditional?

The cost of the wet wells increase with their depth. Green lift stations have the same diameter as the traditional, but they not as deep.

A green wet well with total depth of 24 feet will have 22 feet of useful depth. But a traditional wet well with total depth of 30 feet will only have 21 feet of useful depth

Unit price per foot of the extra 6 feet installation of the traditional well at the depth of 30 feet will cost 200% of the average unit price of the same well at the upper 24 feet. Instead of 30 feet, the Green lift stations are installed at 24 feet, therefore this extra 6 feet will be the saving.

Q7) Green lift stations have a minimum of three pumps, while the traditional stations have only two pumps. How do you justify installation cost saving by green lift?

The total installed horse power in green lift stations is from 12% to 50% less than the traditional.

For example, in our case study 4 identical 30 horse power pumps of green lift do the same job as the 3 identical 85 horse power pumps of the traditional system. In this case, horse power of the green lift is only 47% of the traditional

Q8) What is the effect of the green lift stations on electrical portion of the project?

In retrofitting projects, the existing electrical panel will remain as is. In the new installations, the power utility feeder and the power distribution panel will be reduced to 50% of the traditional due to much smaller rush-in current of the pumps

Q9) Why the initial cost of the emergency generator in green lift stations is less than traditional?

The emergency generator will be sized based on rush-in current of one pump plus the other loads. Since the green lift stations' pumps are much smaller, the rush-in current is almost 50% of the traditional which results in a much smaller generator

Q10) In the retrofitting process of the traditional stations to green lift stations, how do you add the third pump and how long it would take?

In this process, the top slab has to go and be replaced with a new cover that has three hatches. The existing 15000 to 30000 pound concrete top slab of the traditional stations needs to be removed and will be replaced by aluminum structure cover with three hatches. Two people will be able to fully assemble the cover in two days and the cost of the cover is at least 30% less than traditional concrete slab.

Q11) How does green lift stations reduce the running cost?

Green lift Stations are more energy efficient. The involving elements are:

a) Total installed motor horse power is 15% to 50% less in green lift stations due to smaller motors which consume less energy.

b) In traditional stations, the pumps start and stop 10 to 20 times per hour. In green lift stations this intermittent flow has been eliminated.

Start and stop energy waste:

During the start, while the energy of rushing current in used to increases the pump's kinetic energy majority of this energy converts to heat. During the stop, all of the kinetic energy of the pumps convert to heat. This process is inevitable, but it occurring 20 times in one hour is unnecessary.

During the start, the total body of water in the force main is stationary. The pump works to build up pressure differential of ΔP at the force main entry which results a water velocity of V, $\Delta P = \frac{v^2}{2g}$, with total kinetic energy of $\frac{MV^2}{2}$

During the stop, the total body of water in the force main stops and as a result, all of the kinetic energy will be converted to heat.

Therefore in each start and stop the equivalent of MV^2 energy is wasted.

Green lift stations will have lower pressure head because of higher positive suction pressure.

Green lift stations have perfected all of the issues mentioned earlier, which leads to a running energy cost saving of over 50%. In our case study, running cost of the green lift station has a total saving of 70%.

Q12) How does the maintenance cost of the green lift stations compare to traditional?

About one third because all causes of pump frailer in traditional lift technology have been identified and have been eliminated in green lift technology. So what are the cause that have been eliminated?

The most frequent cause which is about 95% of the time is the burn out of the motor, either directly or indirectly. A direct burn out is from the overheating of the motor due to frequent starts and stops. An indirect burn out is when the motor overheats as a result of being exposed in air and lack of cooling.

The second most frequent cause is mechanical seal failure. Cavitation and vibration causes the mechanical seal to loosen up and fail, which then the motor burns out by water leak.

And sometimes the motor's burn out is the impeller's sudden stop due to the suction of rodents.

There is also the erosion of impeller by silicon sand sediment.