Pumping Energy Efficiency for Turf Farms

Assessment or Audit

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Presented by

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Supporting NSW Land Services - Greater Sydney

From Modifications to: Pumping Energy Efficiency for Turf Farms
Pumping Energy Efficiency Audits Leads to mobile phone APP

Pumping Energy Efficiency

Assessment / Audit

QUESTIONS / CONSIDERATIONS Before an Assessment or Audit

FIVE - Main Conditions that Characterise A Well Managed Irrigation Enterprise

(addressing capacity to improve performance above existing levels)

- **Appropriate Design to Meet System Objective**
  - **Why Irrigating, Yield or Production Consideration, Agronomic , etc**
- **Appropriate Operations and Maintenance to Fulfill Targets (Objects)**
  - **Planning , operational and maintenance adequate to meet system objectives**
- **Adequate data Collection to enable performance monitoring**
  - **How do you currently collect data (what data) to assess your operation**
- **An effective process of evaluation and feedback**
  - **How do managers / operators use data (if any)**
- **An Organisation / Institution that recognises and rewards good performance –the will to manage**
  - **About Motivation within the organisation to improve the system**

***Reference: Merrey, D. J., et. al. 1995. Water Resources Development. Vol.11. No 1. 11 – 24.**

Pumping Energy Efficiency
Assessment / Audit

Components of an Irrigation System (Excluding Management considerations)

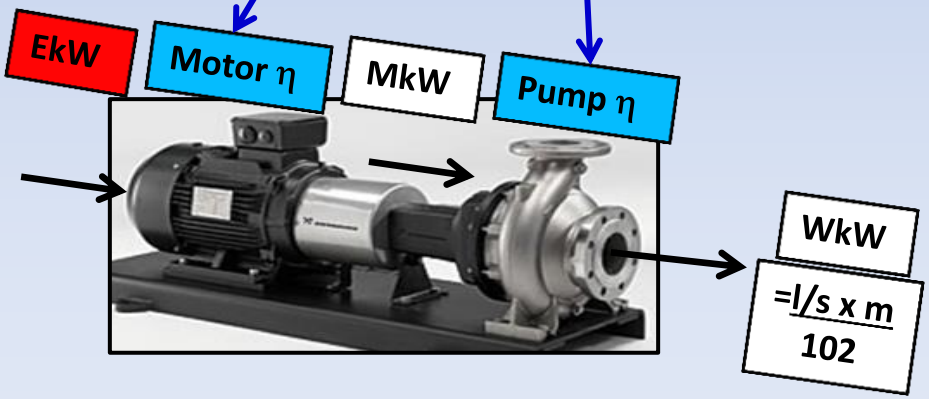
- Water Source (Quality, type, etc)
- Delivery Source (Rivers, Ground, piped etc)
- Storage
- **Pumps and Pumping (sometime more than one e.g. transferring water to dams)**
- **Filters and pump shed additions (valves, water meters, electric meters, other)**
- **Energy used (measured for the pump only? Electric, gas, petrol, diesel, other)**
- **Mainlines (including types, size, water quality effects, volume pumped, etc)**
- Valves / Gates / Water Meters – air release, control, etc
- **Sub mains (includes surface, subsurface or furrow)**
- **Emitter types (One type or multiple types e.g. Centre pivot and / or Gun type)**
- Crop Heights
- Soil characteristics
- Production Requirements / Crop Requirements (water, fertiliser, cultivation, harvesting, etc)
- Water quality / volume applicable to soil / plant characteristics and area irrigated
- **Water Volume to sprinkler type and area irrigated**
- **Property Elevation**
- **Irrigation Scheduling Methods** (including weather data and controller data)
- Agronomic Relationships – Yield vs Fertiliser vs Plant Water Use Efficiencies
- !!! DRAINAGE !!!

Pumping Energy Efficiency
Assessment / Audit

How is electric pumping costed ?

$$kWh/ML^{*} = \frac{2.73 \times \text{metre head}}{\text{motor } \eta \times \text{pump } \eta}$$

- Elevation
- Filter head loss
- Emitter head loss
- Main line head loss
- Laterals head loss
- Layflat hose head loss
- Residual head



*Refer www.talle.biz/data.html

Pumping Energy Efficiency
Assessment / Audit

Where can energy be saved? (pumping only)

Pump efficiency

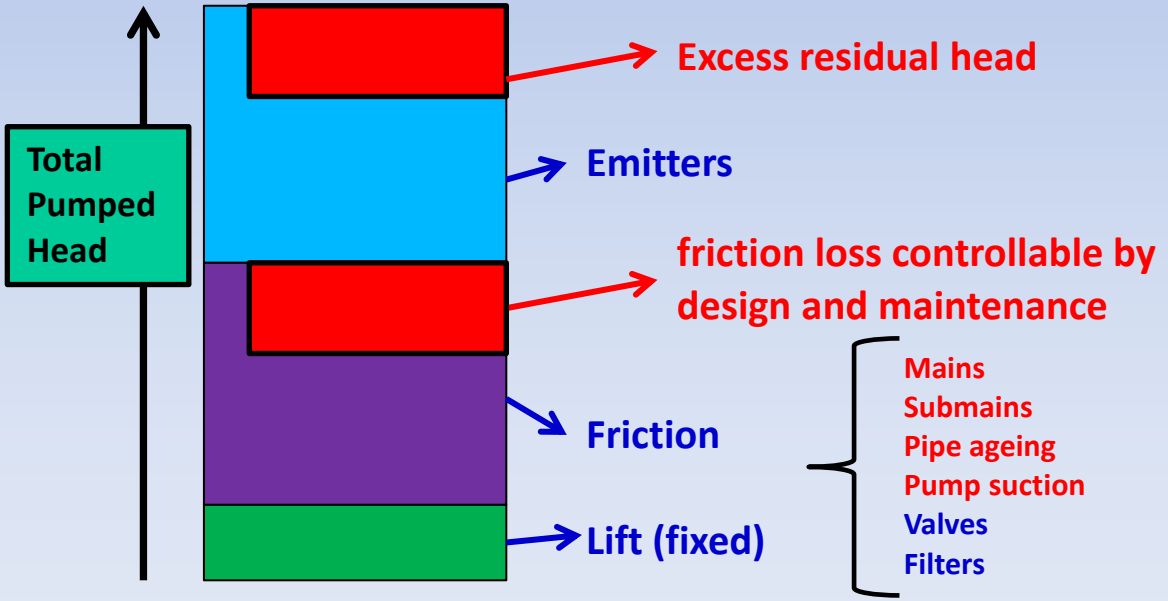
Typically < 50% Recoverable energy losses

Motor efficiency

Pump efficiency

Hydraulic efficiency

Excess Friction losses + excess residual
Typically > 50% recoverable energy losses



Pumping Energy Efficiency

Assessment / Audit

How are energy savings measured?

(what is the accuracy of measurements? and what is measured?)

Pump efficiency

Head Flow Power RPM

PUMP TEST only

Time: ½ day
Cost: $500-$1000 + Report

Hydraulic efficiency

Friction Residual

PUMP TEST + HYDRAULIC TEST

Time: 1½ day
Cost: $1500-$2500 + Report

Risk depends on spend level

How is the risk mitigated?

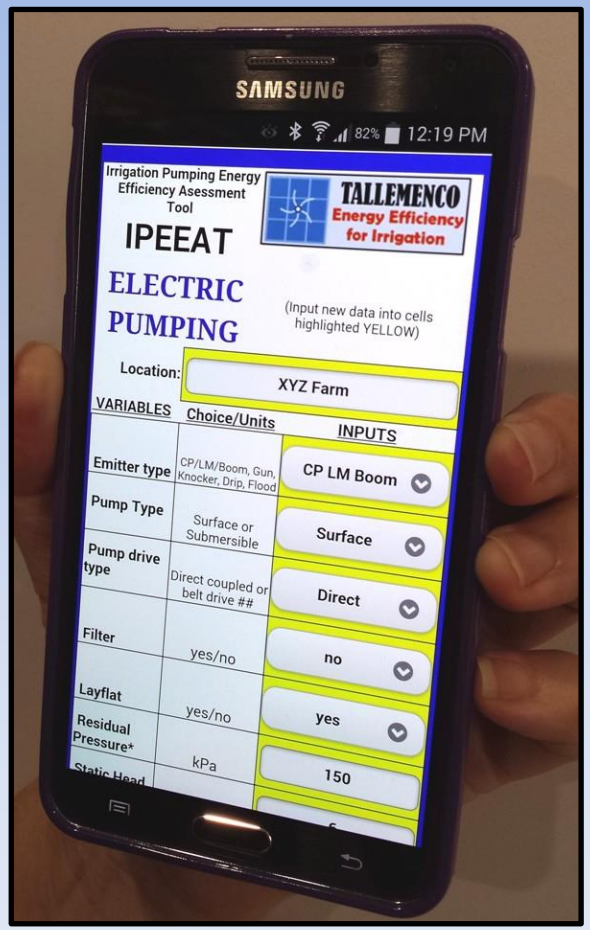
Pumping Energy Efficiency
Assessment / Audit

IPEEAT:

Irrigation Pumping Energy Efficiency Assessment Tool

An APP based program designed to:

- **assess the pumping energy efficiency of an irrigation pumping system (electric)**
- **compare it to a similar irrigation system designed to best practice**
- **determine the commercial viability of pursuing further pumping energy auditing.**

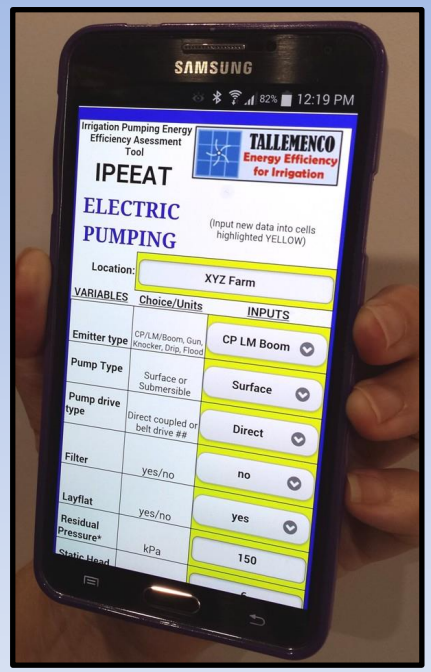


Pumping Energy Efficiency
Assessment / Audit

How does IPEEAT work?

Divides Irrigation into 8 distinct types

- CP/LM, Boom,
- Gun
- Knocker, Rotor, Under Tree (Spray)
- Drip
- Flood
- Pipe & Riser
- Transfer
- Marine

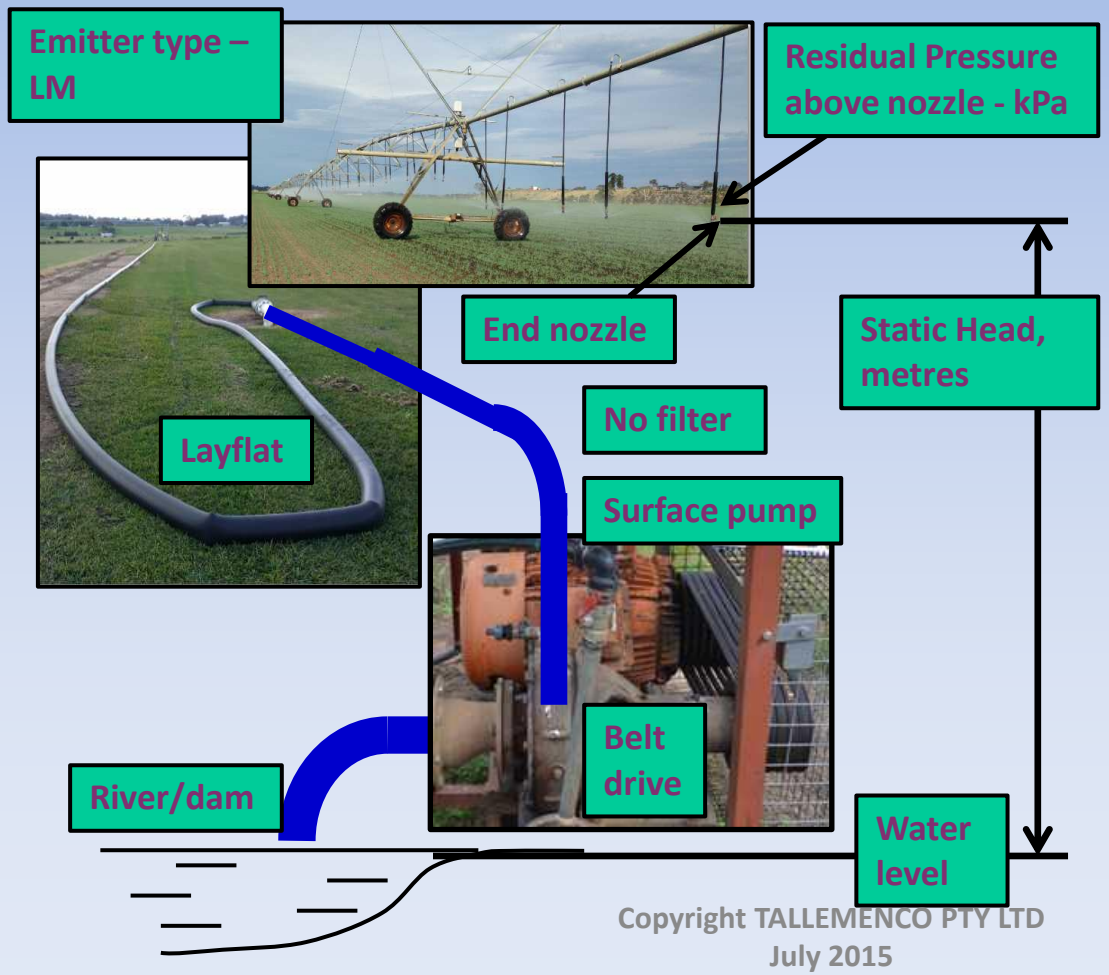


Each type has a unique hydraulic signature

IPEEAT assesses overall pumping energy efficiency considering both pumping efficiency and hydraulic efficiency by comparing existing on farm performance with a similar type irrigation system built to best practice design in its class

Pumping Energy Efficiency
Assessment / Audit

Case Study 1: Lateral Move



140 ML /yr,
approx $12,800/yr
electricity cost
ave 24c/kWh.
Pumped head 84m

Pumping Energy Efficiency
Assessment / Audit

Case Study 1: Lateral Move

Component.	Pump effy	Elevation m	Residual head m	Sum of head components	$/ML annual pumping cost
Measured	65%	6m	15m	84m	**91**
Expected	75%	6m	15m	48m	**45**

Major findings: Mainline with 55m head loss, pump effy 65%

Irrigation Pumping Energy Efficiency Assessment Tool

IPEEAT©Rev 02

TALLEMENCO Energy Efficiency for Irrigation

ELECTRIC PUMPING

Input raw data into cells highlighted YELLOW

Location: Turf Farm 1, Hawkesbury River, NSW

VARIABLES	Choice/Units	INPUTS
Emitter type	CP/LM/Boom, Gun, Knocker/Rotor, Drip, Flood, Transfer, Marine	CP LM Boom
Motor Type	Surface or Submersible	Surface
If surface motor	Direct coupled or belt drive ##	Belt
If subby, configuration	Bore hole pump: Yes/No ###	no
Filter	yes/no	no
Layflat	yes/no	yes
Residual Pressure*	kPa	150
Static Head **	metres head	6
Electricity tariff***	cents/kWh	24
Water pumped****	ML/yr	140
Actual Elect cost ****	$$/yr	12,800
Actual Pumping cost	$$/ML	91.4
Achievable Electric. cost	$$/yr	$5,982
Achievable Pumping cost	$$/ML	42.7
Potential Savings Elect	$$/yr	$6,818
Potential Savings Elect	%	53%
NPV (whole years) #	10	$70,336

Potential annual savings $6,818
Justifies pumping energy audit

Pumping Energy Effy
Assessment / Audit

Farm 1: Pigging to Clean Pipes

Rehabilitation conducted for Farm 1 by Tallemenco Pty Ltd

"Pigging" Pipeline on 25/8/14

a) 2 x Foam pigs pumped thru pipe

b) Removed extensive sludge and biofilm buildup

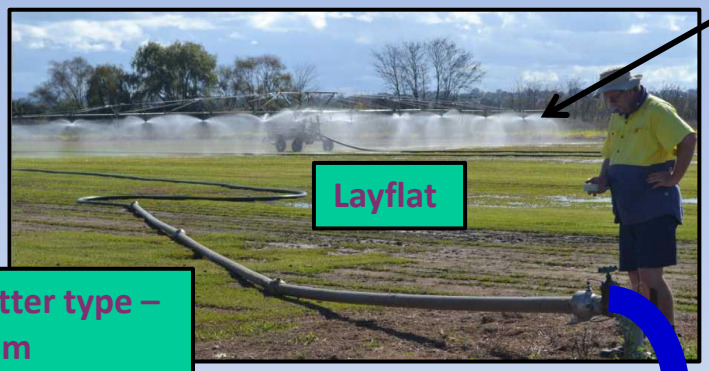
c) Work in Progress

d) Results not confirmed yet

Photos: R&S Welke

Pumping Energy Efficiency
Assessment / Audit

Case Study 2: Soft Hose Boom



Residual Pressure above end nozzle - kPa

Layflat

Emitter type – Boom

Static Head, metres

No filter

Surface pump

Direct drive

River/dam

Water level

100 ML /yr,
approx $10,800/yr
electricity cost
ave 30c/kWh.
Pumped head 55m

Pumping Energy Efficiency
Assessment / Audit

Case Study 2: Soft Hose Boom

Component.	Pump effy	Elevation m	Residual head m	Sum of head components	$/ML annual pumping cost
Measured	45%	6m	15m	55m	**108**
Expected	75%	6m	15m	37m	**44**

Major findings: Layflat hose with 28m head loss, pump effy 45%

Irrigation Pumping Energy Efficiency Asessment Tool

IPEEAT©Rev 02

TALLEMENCO Energy Efficiency for Irrigation

ELECTRIC PUMPING

Input raw data into cells highlighted YELLOW

Location: Turf Farm 2, Hawkesbury River, NSW

VARIABLES	Choice/Units	INPUTS
Emitter type	CP/LM/Boom, Gun, Knocker/Rotor, Drip, Flood, Transfer, Marine	CP LM Boom
Motor Type	Surface or Submersible	Surface
If surface motor	Direct coupled or belt drive ##	Direct
If subby, configuration	Bore hole pump: Yes/No ###	no
Filter	yes/no	no
Layflat	yes/no	yes
Residual Pressure*	kPa	150
Static Head **	metres head	6
Electricity tariff***	cents/kWh	30
Water pumped****	ML/yr	100
Actual Elect cost ****	$/yr	10,800
Actual Pumping cost	$/ML	108.0
Achievable Electric. cost	$/yr	$4,968
Achievable Pumping cost	$/ML	49.7
Potential Savings Elect	$/yr	$5,832
Potential Savings Elect	%	54%
NPV (whole years) #	10	$60,173

Potential annual savings $5,832
Justifies pumping energy audit

Pumping Energy Efficiency
Assessment / Audit

Case Study 3: Flood

5,600 ML /yr,
approx $20,400/yr
electricity cost
ave 10c/kWh.
Pumped head 5.3m

Emitter type - Flood

Direct drive

Surface motor

No filter

Residual Pressure at centre line of outlet 0 kPa

Static Head, metres

River level "mean"

Pumping Energy Efficiency
Assessment / Audit

Case Study 3: Flood

Component.	Pump effy	Elevation m	Residual head m	Sum of head components	$/ML annual pumping cost
Measured	43%	5.1m	0m	5.4m	**3.8**
Expected	75%	5.1m	0m	5.4m	**2.2**

Major findings: pump effy 43%

Irrigation Pumping Energy Efficiency Asessment Tool

IPEEAT©Rev 02

TALLEMENCO Energy Efficiency for Irrigation

ELECTRIC PUMPING

Input raw data into cells highlighted YELLOW

Location: Flood Irrigation Pump, Riverina, NSW

VARIABLES	Choice/Units	INPUTS
Emitter type	CP/LM/Boom, Gun, Knocker/Rotor, Drip, Flood, Transfer, Marine	Flood
Motor Type	Surface or Submersible	Submersible
If surface motor	Direct coupled or belt drive ##	Direct
If subby, configuration	Bore hole pump: Yes/No ###	no
Filter	yes/no	no
Layflat	yes/no	no
Residual Pressure*	kPa	0
Static Head **	metres head	5.1
Electricity tariff***	cents/kWh	10
Water pumped****	ML/yr	5600
Actual Elect cost ****	$$/yr	20,400
Actual Pumping cost	$$/ML	3.6
Achievable Electric. cost	$$/yr	$13,753
Achievable Pumping cost	$$/ML	2.5
Potential Savings Elect	$$/yr	$6,647
Potential Savings Elect	%	33%
NPV (whole years) #	10	$68,576

Potential annual savings $6,647
Justifies pumping energy audit

Pumping Energy Efficiency
Assessment / Audit

Energy Savings for pumps are about:

•The pump and the associated suction, pump efficiency (BEP), delivery pipe work and emitters or outlets (not just the pump curve).

•Not fixed electrical charges but energy used

Further Energy (and water cost $$/ML) saving can be found by

•Irrigation systems designed to apply water within appropriate water windows for soil / plant growth and energy tariffs.

•The volume of water pumped in relation the crops actual water needs (irrigation scheduling – water volumes variable due to rainfall events).

•Uniform Water applications by irrigation systems (estimated savings of 10 – 20% on volumes pumped – seasonally variable).

NEEDS ORGANISATIONAL WILL TO CHANGE

Using Appropriate tools / models to ascertain potential efficiencies e.g.

Pumping Energy Efficiency
Assessment / Audit

IPEEAT

VIDEO

(2m 15s)

"Helping growers to help themselves"

www.youtube.com/watch?v=GbxHqmQlyX8

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