# Total Recycle, Zero Liquid Discharge (ZLD) Dry Grind Fuel Ethanol Production

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U.S. WATER
ETHANOL PROCESS TECHNOLOGIES

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# PEI- Business Model

- Develop Western US Plant Sites
- Locate Near to Wet DG&S Markets
- Rail Corn Feedstock
- Locate Sites with Facilities & Infrastructure
- << Limits of US, State & Local Regulations

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# CA Environmental Regulations

- Very Low NOx Emissions
- PM10 Site Limits- include Tower "Drift"
- Stringent VOC Limits-RTO on Scrubbers
- Protect "Waters of the State"

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# Madera County Requirements

- Minimize VOC, NOx < 10ppm, No HAPs
- NO Liquid Discharge
- HMIS driven Chemical Approvals
- "Haul it In, but Haul It All Out"

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# Local Air & Water Characteristics

- San Joaquin Valley VOC & Haze Initiatives
- Insufficient Surface Water for Irrigation
- Deep Well Irrigation Sources
- County Monitoring & Site Approvals
- No Industrial POTW Hook-ups

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# Fuel Ethanol H2O Requirements

- 3 to 6 Gallons Water per gallon Ethanol
- Utility & Process "Water on Demand"
- Different Water Quality for
  - Process- varies per design
  - Steam- per ABMA pressure requirements
  - Cooling- allowances for operation > nameplate
- Design Pretreatment & Chemistry for Discharge Requires MSDS and Toxicity Data

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# ZLD-H2O Treatment Process Design

- Complete Process Flow Diagram (PFD)
- By-product Prediction for Mass & Composition
- Ionic Mass Balance by Specific Unit Operation
- “Fate” Review of Conserved Ions & Limiting Pairs (e.g. gypsum & talc)
- Drift Projection for Cooling Tower PM10 Emissions

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# ZLD Process & Instrumentation Diagram (P&ID)

- Hydraulic & Piping Design
- Controls Narrative
- Chemical Addition Systems & Amounts
- By-product Solids Removal
- Conserved ion “sinks”

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# ZLD Process Equipment Strategy

- Satisfy process water on-demand
- Solids storage & recycle capacity
- Solids Removal Plans
- Limited addition of “salts”
- Oversized, variable capacity cooling tower basin

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# The PEI-Madera ZLD Process

- Front End Cold Lime Softening (CLS) System
- Redundant (permeate recycle) RO systems
- Continually Raked Sludge Thickener
- Stand-alone, Remote Access Control System

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# Madera Total Recycle ZLD Fuel Ethanol Production

- Start-up - 4th Quarter 2006
- Use ~3 gallons H2O/gallon Ethanol Production
- Produces ~2.5 gals/min calcium rich sludge
- Met PM10 cooling water TDS drift requirement
- Utility ZLD & Process ZLD Remain Completely Separate Systems

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