SYMBIOTICS, LLC

Presentation to NWPCC (10/17/2008)

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October 17,2008

Agenda

- Overview of Symbiotics
- Run of the River Projects
- Utah Pumped Storage Projects- Detailed Descriptions
- Parker Knoll-800MW
- North Eden-700MW
- Other WECC Opportunities
- Discussion

How We Got Here

- **We in the Northwest know the beauty and value of hydrogeneration. It is the rest of the world that needs an education.**
- **Symbiotics is the story of Persistence.**
- **Calvin Coolidge 1932:**
  - **"Nothing in the world can take the place of Persistence.**
  - **Talent will not; nothing is more common than unsuccessful men with talent.**
  - **Genius will not; unrewarded genius is almost a proverb.**
  - **Education will not; the world is full of educated derelicts.**
  - **Persistence and determination alone are omnipotent.**
  - **The slogan 'Press On' has solved and always will solve the problems of the human race."**
  - **Pumped Storage is hydrogeneration its most engineered form:**
    - **Clean**
    - **Inexpensive**
    - **Flexible**
    - **Efficient**
    - **Plentiful**
    - **Environmentally responsible**
    - **A perfect complement to wind (and nuclear)**
- **-Alan Eddison 2007:**
  - **Modern technology owes ecology an apology.**

. If you had to identify, in one word, the reason why the human race has not achieved, and never will achieve, its full potential, that word would be "meetings."

Symbiotics Experience

Symbiotics LLC was formed to become a clean and significant, hydro-based Independent Power Producer in the western U.S.

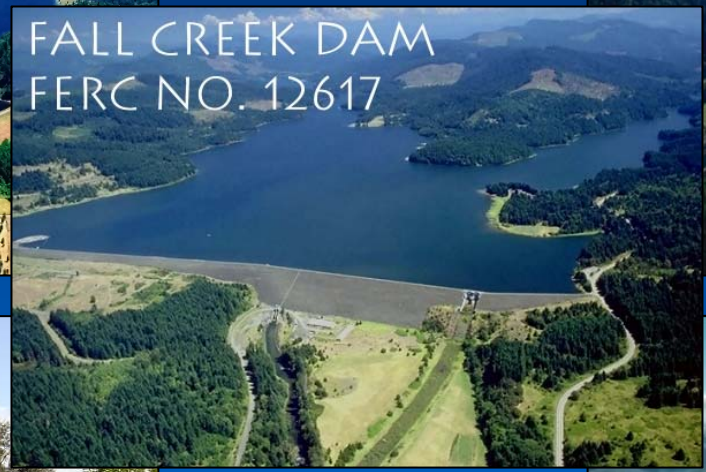
- Formed by combining the resources and expertise of Ecosystems Research Institute and Northwest Power Services with leading power industry commercial expertise; Principals each have a 30 year track record in hydroelectric, environmental and energy projects
- 250 environmental projects since 1975
- Environmental studies on 19 FERC projects for third-party owners
- 4 hydroelectric plants currently operated for third-party owners
- Chester license granted July 08; Dorena License expected Fall 08
- We hold Preliminary permits on 2 pumped storage sites in Utah{ Parker Knoll and North Eden}
- 8 RoR projects in the FERC licensing process
- 34 permits in development
- 11 FERC licensing Contracts
- 60+ years of utility, regulatory, trading and structuring expertise, ***including PPA and Financing***

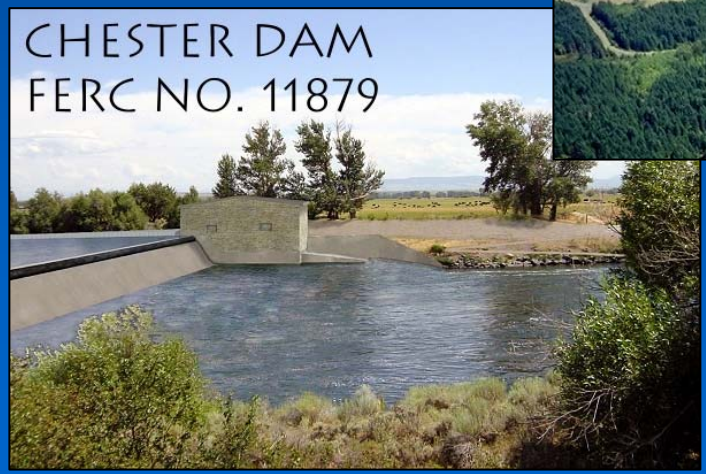
▪There are 10^11 stars in the galaxy.
▪That used to be a huge number.
▪But it's only a hundred billion.
▪ It's less than the national deficit! We used to call them astronomical numbers.
▪Now we should call them economical numbers.
▪Richard Feynman, physicist, Nobel laureate (1918-1988)

Symbiotics' In-house Expertise

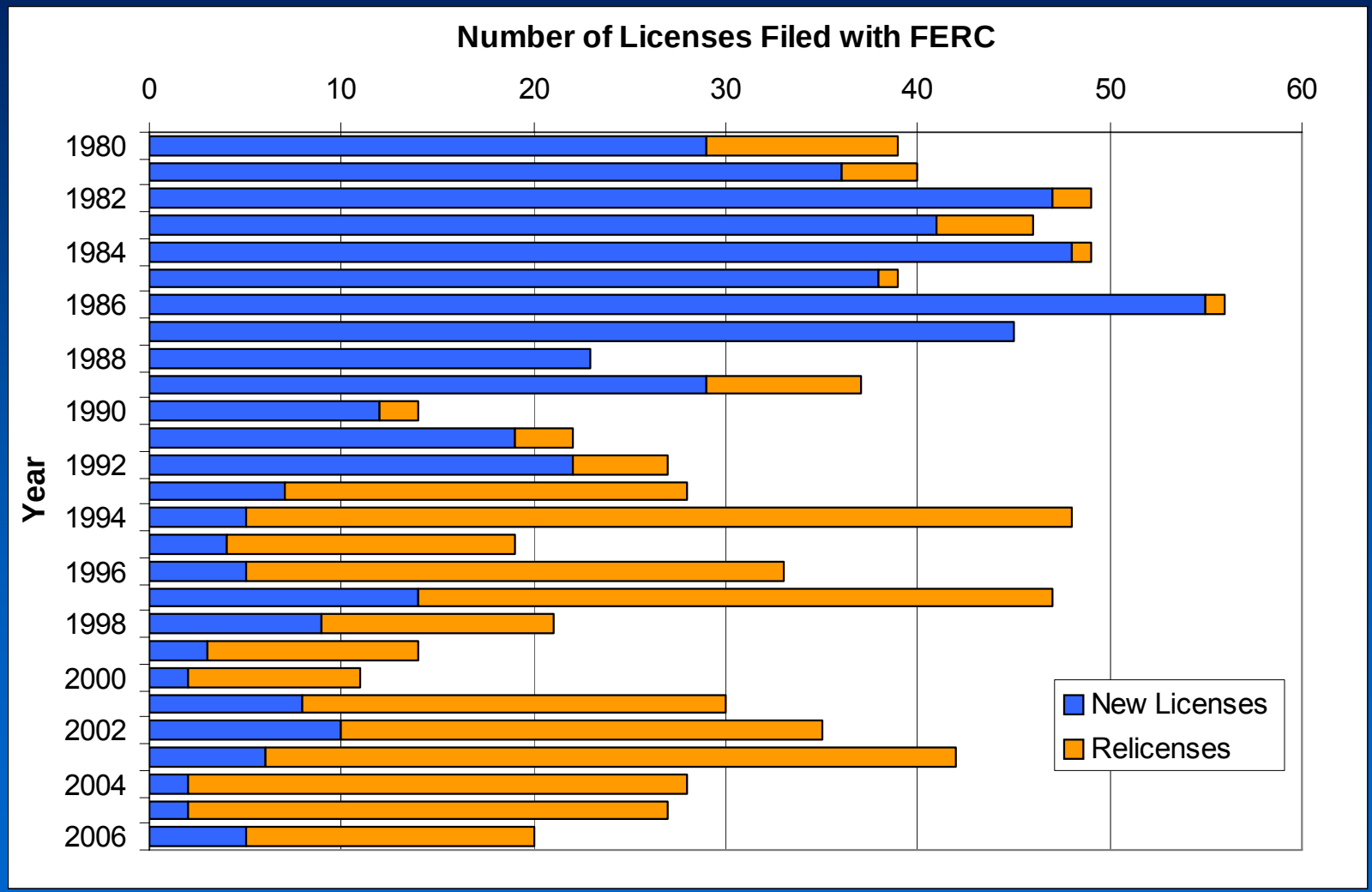
- **Opportunity Identification**
  - Database Development
  - Model Development
  - Site Location
- **Preliminary Permit Application**
  - Vetted by Cost/Benefit
  - Vetted by Environmental Liabilities
- **Licensing Process**
  - Environmental Investigations
  - Consultations
  - Mitigation Agreements
  - License Application
- **Detail and Final Design**
  - Project Engineering
  - Final Mitigation Design
- **Project Construction**
  - Power Plant
  - Transmission Lines
  - Environmental Mitigation
  - Capacity and Energy Marketing
  - Interface with Community
- **Project Operation**
  - Plant Maintenance/Operation
  - Mitigation Monitoring
- **Project Contracting**
  - Extensive PPA Negotiation Expertise
  - Senior contacts at most major utilities, IPPs, and munis

Run-of-River Projects

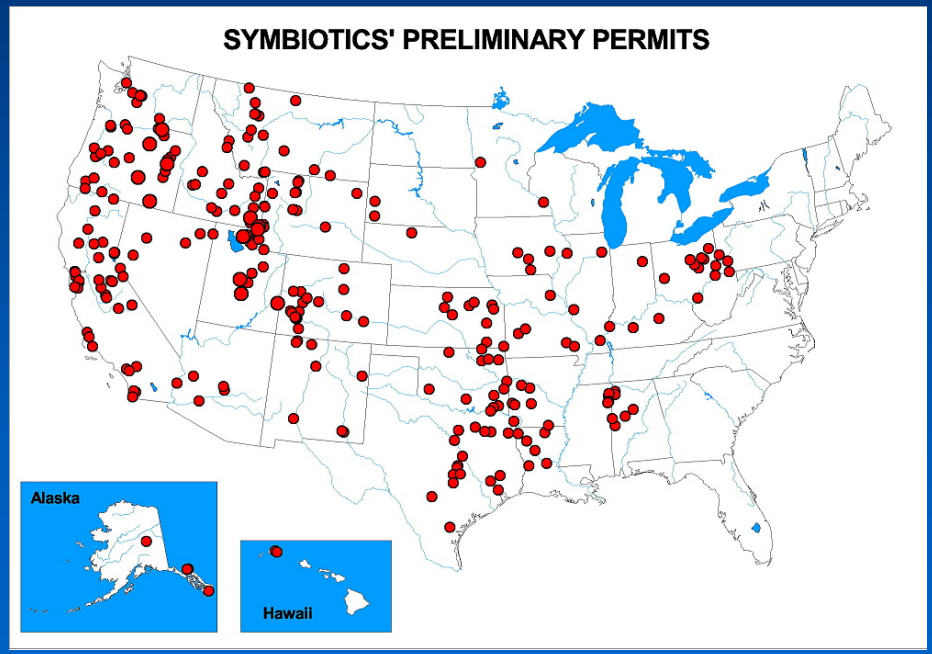


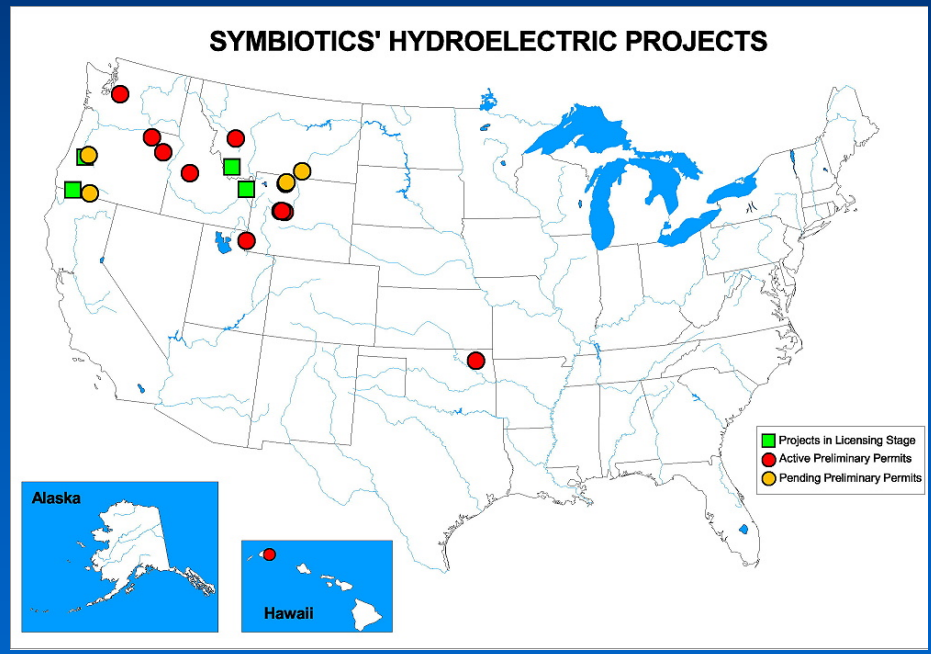


Historical Perspective of Hydro Development

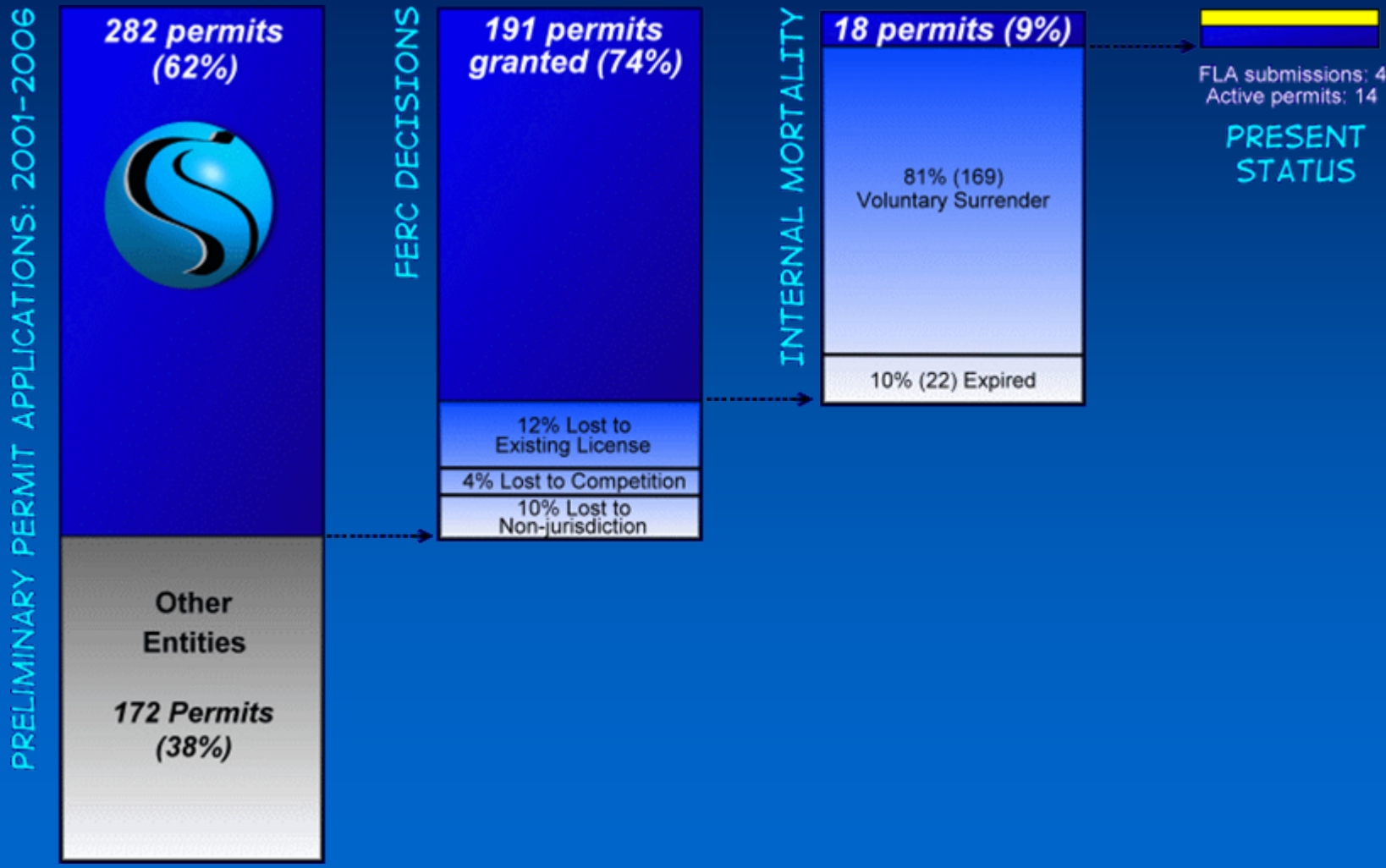


Phase I
Mechanized Selection and Permitting Process (2001-2006)





Summary of Symbiotics' Permitting Efforts 2001-2006



Phase I
Summary of Existing Projects (75 MW)

Project	FERC No.	Permit Filed	Expected License Date	Capacity (kW)	Status
Chester	11879	06/1/01	**Granted July 08**	3.3	**License Issued**
Applegate	11910	09/25/01	Winter 08/09	10	License filed, FERC Final EA Published
Bowman	11925	03/28/01	Feb-11	6.8	Waiting on WSR boundary change from the BLM (winter 2008/09)
Dorena	11945	07/27/01	Fall-08	8.3	License filed, FERC Final EA Completed, License Pending Issuance
Clark Canyon	12429	08/15/03	Summer 09	4.8	License filed, Anticipated EA December 2008
Wailua	12534	03/25/05	Apr-11	6.6	Negotiating State Lands use
Oologah	12538	03/03/08 refiled	Jan-12	25.7	PAD filed in February 2008, Second PPA Public Noticed
Fall Creek	12778	06/21/07	Sep-11	6	PAD Accepted, Studies Implemented
Wickiup	12965	08/17/07	Jan-12	7.2	PAD completed, Negotiating Study Plans

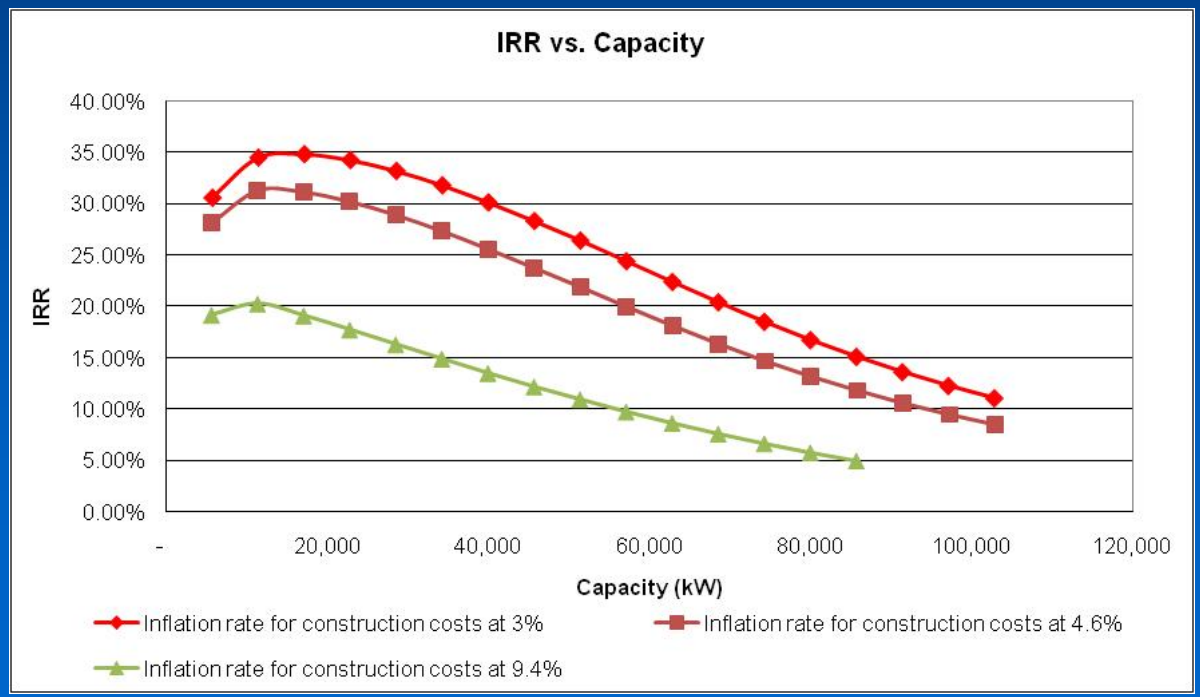
Symbiotics is Using Proprietary and Public Databases to Select and Site Additional Projects for *Phase II*

- **ROR Sites Started with over 2,000 projects**
- **Collected publicly available Flow and Head daily data**
- **Calculate Preliminary Estimated IRR by:**
  - ***Generation***
  - ***Costs by INEEL's 2003 report***
  - ***Estimated revenue***
- ***Projects with above 5% Preliminary Estimated IRR moves to Phase II***

- **Added Pumped Storage Projects**
  - *** Geologic Features**
  - *** Land Ownership**
  - *** Location**

ROR Project Sizing

- An IRR vs. Capacity chart is completed under different scenarios.
- The common scenarios involve increasing the project's costs at different inflation rates but keeping the revenue sources constant



ROR ENVIRONMENTAL REVIEW (Phase II)

- Vetted Database to 170 projects, FERC Filings on 80 Sites
- Preliminary Environmental Review
  - FERC Jurisdiction
  - Water Quality compliance (*maintain status quo*)
  - Environmental issues that impact operation (*Exotic Zebra Mussels)*

Projects with preliminary estimated IRR greater then 20% continue to Phase IIC (Feasibility Study)

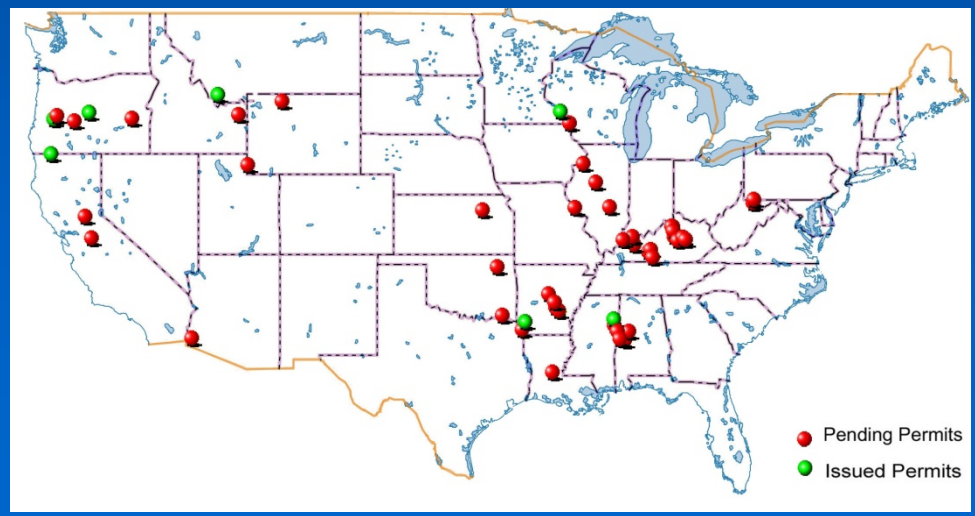
ROR Detailed Feasibility (Phase II)

- Flow
- Head
- Permitting difficulty
- Transmission Access
- Capacity and generation (Preferred Provider)
- Estimated costs
- Estimate annual revenue and O&M costs
- Select equipment configuration based on estimated IRR
- Firm up estimate for selected configuration and calculate IRR
- Review by separate engineering firm

ROR Mechanized Selection and Permitting Process (2007 to Current)

Identified Projects

Preliminary Permits



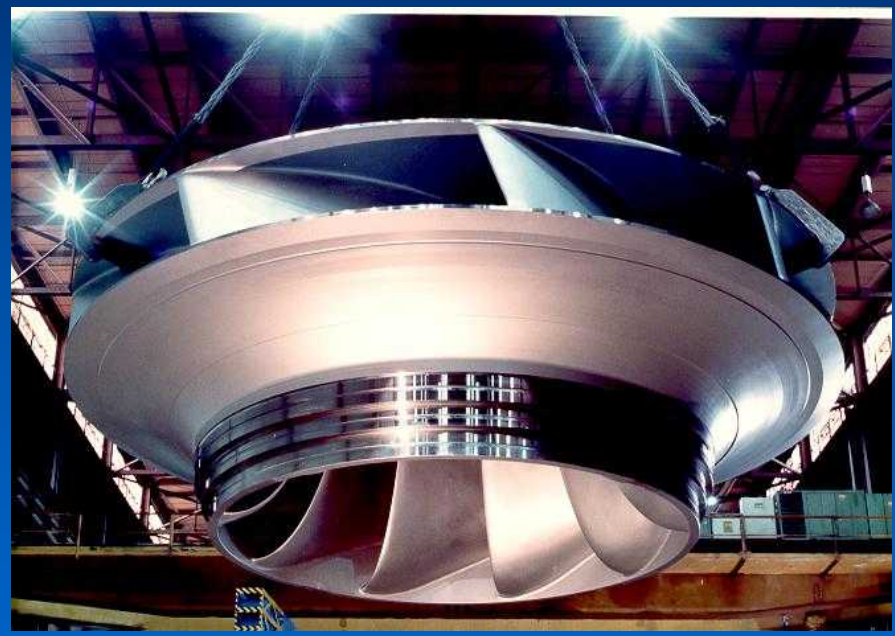
PUMPED STORAGE OPPORTUNITIES

- Concept
- Relative Cost
- Benefits
- Market Considerations
- Symbiotics Projects

New Pumped Storage Projects

* Symbiotics is applying its disciplined siting, licensing and permitting approach to pumped storage hydro.

* Symbiotics is seeking development partners for U.S. pumped storage hydro projects.



Pumped Storage Model –Concept

- **Open Loop**
  - Lower reservoir is a lake or river
- **Closed Loop (CLPS)**
  - Utilize topography to establish two adjacent reservoirs with sufficient height differential
  - Access ground water if necessary
- **Off Peak Load Utilization (Spread Option Model)**
  - Capture Delta Between On and Off Peak Power
    - Use tariff priced Off-Peak power.
  - Pumped Storage is a conservative “spread-play” on the on/off peak electricity price spread. For Utah area spread will grow slowly - capacity additions are difficult and California/Las Vegas demand is growing.
- **Designed for rapid switch between pumping and generation to allow sale of balancing and spinning reserve services.**
- **“Renewable" Wind Support:**
  - Exchange peak hour electricity for off peak hour wind for pumping electricity, converting the pumped storage plant into a renewable resource, eligible for renewable RFPs; enable increased wind integration.
- **Moody’s New Generation Report**
- **National Grid Renewables Report**
- **Value Buckets**
  - Fully Utilize Transmission Capacity {incremental peak hour sales}
  - Firm Non-firm Blocks {“Flex” pumped storage unit as wind varies}
  - Provide Balancing Service, Spinning Reserve Service, Sell Surplus Ancillary Services
  - Help prevent “ERCOT disasters”

Pumped Storage Model (Energy Cost Comparisons)

- **Run-of-River Hydro** ($1,500-$2,500/kW)
- **Natural Gas-Fired Thermal** ($1500-$2,500/kW)
  - $60-$80/MWh variable cost
  - GHG producer
- **Coal Fired Thermal** ($1,000-$5,000/kW)
  - $40-$60/MWh variable cost
  - GHG producer
  - Multiple technologies
  - Political confusion
- Wind {prime sites getting more scarce}($2,000-$3,000/kW)
  - Non dispatchable
  - Visual pollution and bird kill issues
  - Integration issues
- **Nuclear** ($3,000-$5,000/kW)
  - $10-$30/MWh variable cost
  - Unsolved nuclear waste disposal issues
  - Very long licensing and construction time
  - Multiple technologies
  - Political turmoil
  - Site remediation issues
  - Base Load source Only
- **Photo-voltaic Solar** ($3,000-$4,000/kW)
  - $10-$30/MWh variable cost
  - Dependent on solar conditions for dispatch
    - Clouds
    - Night
- **Pumped Storage** ($1,000-$1,500/kW)
  - $15-25/MWh variable cost
  - Fewer environmental concerns with CLPS
  - 50-year Federal License

Current FERC Pumped Storage Projects

North Eden

Parker Knoll

Geography


WASHINGTON
MONTANA
McNary
A
Walla Walla
OREGON
IDAHO
WYOMING
Hemingway
GATEWAY WEST
H
E
Borah/Brady
Dave Johnston
Windstar
Captain Jack
Midpoint
Jim Bridger
Aeolus
Populus
E
D
Bridger
B
F
Terminal
CALIFORNIA
NEVADA
C
UTAH
Mona
GATEWAY SOUTH
COLORADO
Sigurd
G
Red Butte
Crystal
ARIZONA
NEW MEXICO
PacifiCorp service area
Planned transmission lines
500 kV minimum voltage
345 kV minimum voltage
230 kV minimum voltage
Transmission hub
Substation
Generation plant/station

Parker Knoll Pumped Storage Project

- Project Description
- Physical Features
- Licensing Strategy
- Project Schedule
- Capital Cost Components

Parker Knoll Project Description

- Nominal 798 MW power project (Can be Upsized to 1,330 MW)
- FERC No. 13239-001
- Hydrologic Head 2,590
- Upper Reservoir on Parker Knoll
- Lower Reservoir on alluvial valley floor (Grass Valley)
- Power plant located adjacent to the lower reservoir
- Upper and Lower Reservoirs 13,000 feet apart
- Power plant ~ located near lower reservoir
- Total Water Volume : 7,800 ac ft initial fill, 400 ac ft annual depletion
- Water rights required for evaporation and initial fill only (Sevier River WCD)
- Terrestrial Impacts only
- Land Ownership
    - * SITLA – 950 acres
    - * BLM – 1,360 acres
    - * **No** Private land

Parker Knoll Pumped Storage Project
Physical Features(798 MW)

- 6 x 133 MW pump turbine machines
- Operating Range 2,590 to 2,440 vertical feet
- Upper Reservoir (125 acres and 148 ft tall) with 8,212 ac ft capacity
- Lower Reservoir (117 acres and 100 ft tall) with 8,689 ac ft capacity
- Power plant ~(450 ft x 120 ft x 45 ft) located adjacent to the lower reservoir
- Upper and Lower Reservoirs 13,000 feet apart
  - * 9,800 ft long 18 ft diameter tunnel
  - * 3,200 ft long 18 ft diameter above ground Penstock
- Power plant ~ located near lower reservoir
- Total Water Volume : 8,689 ac ft initial fill, 400 ac ft annual depletion
- 800 cfs per unit
- 0.3 mi 345 KV Transmission line, 50 mile Upgrade of RMP line
- At 10 hrs per day, 2.18 million kW hrs per year
- **Project Designed For 10-20 hour continuous operation depending on when reserve is needed**

Parker Knoll Capital Cost Components

Item #	Description	6x133 MW Total (2008 $)	6x133 MW Total (2011 $)
1.1	Upper Reservoir	$69,190,798	$77,830,000
1.2	Shaft/Tunnel/Penstock (Upper)	$201,373,000	$233,158,000
1.3	Lower Reservoir	$115,566,749	$129,996,000
1.4	Shaft/Tunnel/Penstock (Lower)	$7,710,000	$8,672,000
2.1	Powerhouse Major Electrical	$22,695,000	$25,528,000
2.2	Powerhouse Auxiliary-Mechanical	$29,000,000	$36,532,000
2.3	Powerhouse Auxiliary-Electrical	$16,490,934	$20,774,000
2.4	Powerhouse Turbine-Generator(6X133 MW)	$180,000,000	$226,748,000
3.0	Transmission Line	$82,098,044	$103,393,000
4.0	Water Rights/ROW	$3,560,000	$4,005,000
5.1	Contingency (Civil 25%)	$105,023,887	$119,797,250
5.2	Contingency (Electrical 15%)	$46,138,347	$58,117,050
6.0	Pre-design Engineering	$2,000,000	$2,250,000
7.0	Environmental/Permitting	$3,050,000	$3,431,000
	Total Project Construction Cost	$883,896,758	$1,050,231,300
8.0	Engineering Design Cost (5%)	$44,195,000	$52,512,000
9.0	Construction Mgt./Inspection Cost (5%)	$44,195,000	$52,512,000
	Total Project Design/Construction Cost	$972,286,758	$1,155,255,300
	Cost/kW with Transmission Line	$1,218	$1,448
	Cost/kW without Transmission Line	$1,116	$1,318
	Total Plant Capacity (MW)		
		798	798

Parker Knoll Permit Schedule

ACTION	DATE
Preliminary Permit Application Accepted	**June 2008**
Preliminary Permit Application Granted	**Dec 2008**
PAD Submitted (Request FERC for Determination)	**Feb 2009**
Final License Application Submitted	**March 2010**
Land Lease Agreements	**Feb 2009**
Purchase Water Rights	**Mar 2009**
401 Water Quality Certificate Application	**Mar 2010**
Start of Construction	***2012***
Project Operation	***2014-15***

North Eden Pumped Storage Project

- Project Description
- Physical Features
- Project Schedule
- Capital Cost Components

North Eden Project Description

- Nominal 700 MW power project
- FERC No. 13249
- Hydrologic Head 927 vertical feet
- Upper reservoir on the flank of Black Mountain
- Lower reservoir in North Eden Valley
- Power plant located adjacent to the lower reservoir
- Total Volume 13,716 ac ft initial fill, 400 ac ft annual depletion
- Water rights required for evaporation and initial fill only
- Terrestrial Impacts
- North Eden Creek Impacts
- 2.03 million MWh annually
- Land ownership
  - SITLA – 485 acres
  - Private – 225 acres
  - **NO Federal Land**

North Eden Pumped Storage Project
Physical Features

- 7 x 100 MW pump turbine machines
- Operating Range 745-927 vertical feet
- Upper Reservoir (132 Acres and 100 ft tall) with 10,510 ac ft capacity
- Lower reservoir (250 acres and 148 ft tall) with 13,716 ac ft capacity
- Power plant ~(350 ft x 120 ft x 45 ft) in size
- Total Volume 13,716 ac ft initial fill, 400 ac ft annual depletion
- 1,880 cfs per Unit
- 5.0 Miles new 500 KV line

North Eden Capital Cost Components

Item #	Description	Total - 2008$	Total - 2011$
1.1	Upper Reservoir	$142,989,000	$160,843,000
1.2	Shaft/Tunnel/Penstock (Upper)	$54,537,500	$68,359,000
1.3	Lower Reservoir	$35,180,000	$39,572,000
1.4	Shaft/Tunnel/Penstock (Lower)	0	0-
2.1	Powerhouse Major Electrical	$14,784,000	$16,630,000
2.2	Powerhouse Auxiliary-Mechanical	$42,750,000	$53,852,000
2.3	Powerhouse Auxiliary-Electrical	$24,212,500	$30,500,000
2.4	Powerhouse Turbine-Generator(7X100 MW)	$210,000,000	$264,540,000
3.0	Transmission Line	$9,010,000	$11,324,000
4.0	Water Rights/ROW	$328,500	$369,000
5.1	Contingency (Civil 25%)	$61,954,750	$71,443,250
5.2	Contingency (Electrical 15%)	$42,895,875	$54,032,400
6.0	Pre-design Engineering	$2,000,000	$2,250,000
7.0	Environmental/Permitting	$3,050,000	$3,050,000
	Total Project Construction Cost	$643,692,125	$776,764,650
8.0	**Engineering Design Cost (5%)**	$32,185,000	$38,838,000
9.0	**Construction Mgt./Inspection Cost (5%)**	$32,185,000	$38,838,000
	Total Project Design/Construction Cost	**$708,062,125**	**$854,440,650**
	Cost/kW with Transmission Line	**$1,012**	**$1,221**
	Cost/kW without Transmission Line	**$999**	**$1,204**
	Total Plant Capacity (MW)	**700**	**700**

North Eden Permit Schedule

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Preliminary Permit Application Accepted	**June 2008**
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Preliminary Application Document Submitted	**Jan 2009**
Final License Application Submitted	**Nov 2010**
Land Lease Agreements	**Mar 2009**
Purchase Water Rights	**May 2009**
401 Water Quality Certificate Application	**Mar 2010**
Start of Construction	***2012***
Project Operation	***2014-15***

Pumped Storage Model - Benefits

- Capture Delta Between On and Off Peak Power
- Reduce Transmission Costs for Wind Integration ($ 3.0-$24.0/MWhr)**
- Full range of Ancillary Services
  - Regulation, Load Following and Voltage Support
  - Dispatchable in 15 seconds (with units spinning)
  - Black start in 15 seconds
- Increased System Reliability
- Add Value To Wind and Other Renewable Energy Projects
  - Sale of both Capacity and Energy possible
  - Sales partitioned by turbine to preserve capacity opportunities

** *Northwest Wind Integration Action Plan, March 2007*

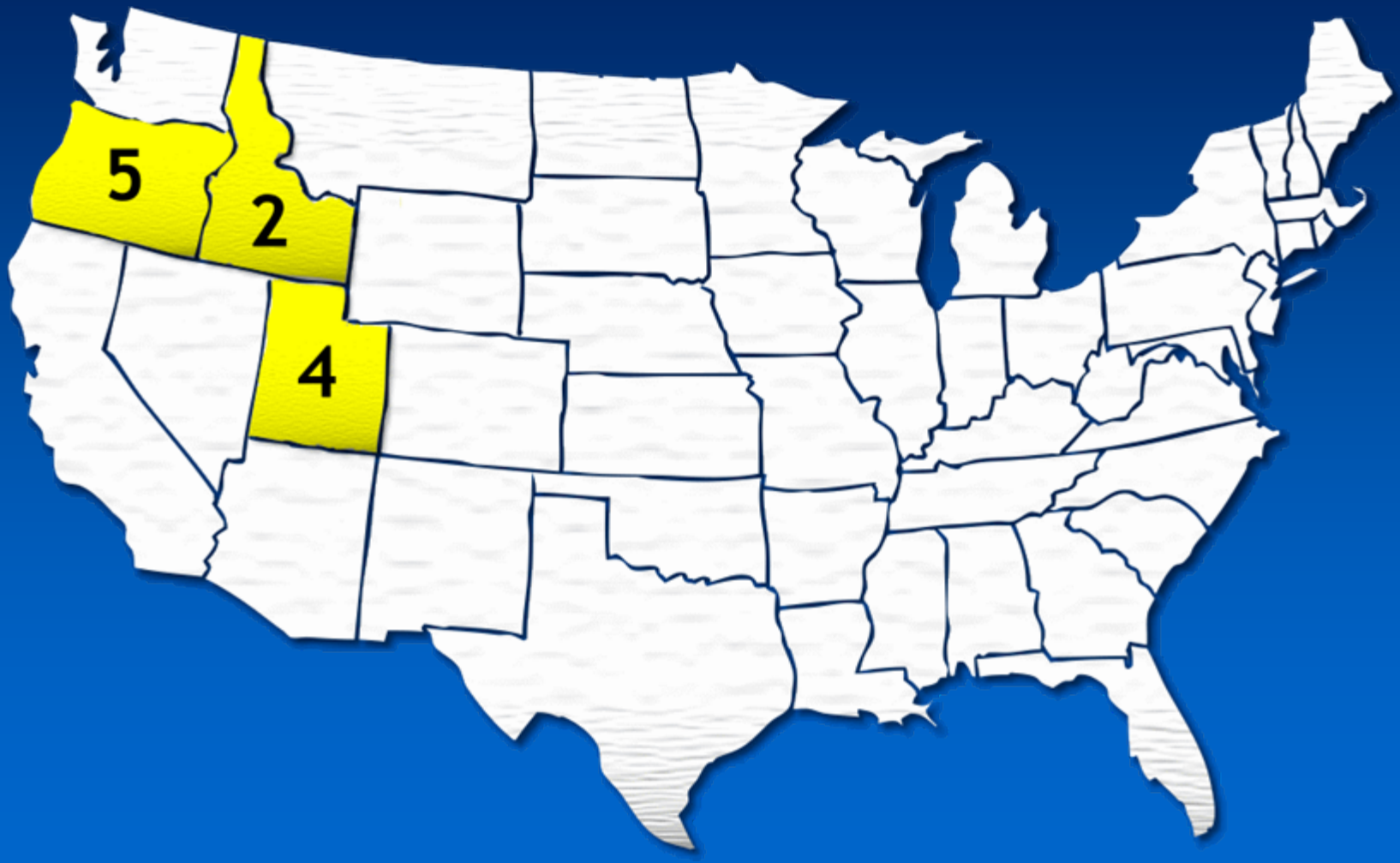
Electricity Market Considerations

- **Market Price Volatility: Electricity, Natural Gas, Oil**
- **Carbon Tax**
  - **($15 - $20/MWh upside impact)**
- **Natural Gas Market**
  - **In the U. S. marginal natural gas supply is LNG. Peak hour price will rise.**
- **Uranium Market**
  - **More uranium is consumed worldwide is consumed than is produced. The difference is made up by reprocessing surplus Russian missile warheads.**
    - **This source will run out.**
    - **Uranium price will rise.**
    - **Base load price will rise**

Additional WECC Opportunities

- Besides Parker Knoll and North Eden Symbiotics is pursuing additional WECC pumped storage opportunities
- They are few, difficult to identify and permit; but we will persist.

Selected Pumped Storage Project Sites within WECC



Discussion