

# GEOTHERMAL ENERGY DEVELOPMENT IN ALBERTA

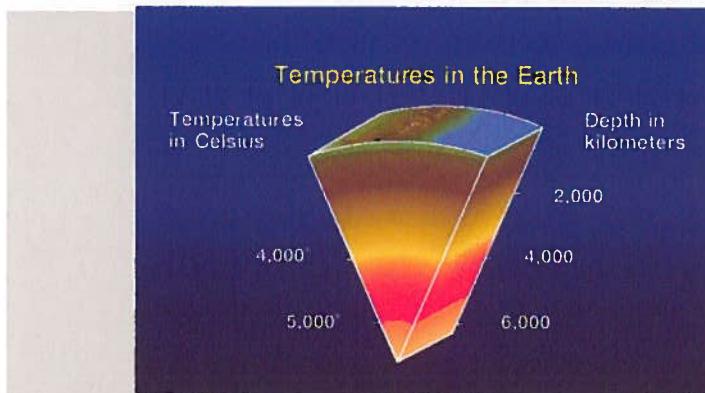
PRESENTED BY  
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WITH SUPPORT FROM  
THE UNIVERSITY OF ALBERTA  
AND  
ALBERTA INNOVATES - ENERGY AND ENVIRONMENT  
SOLUTIONS

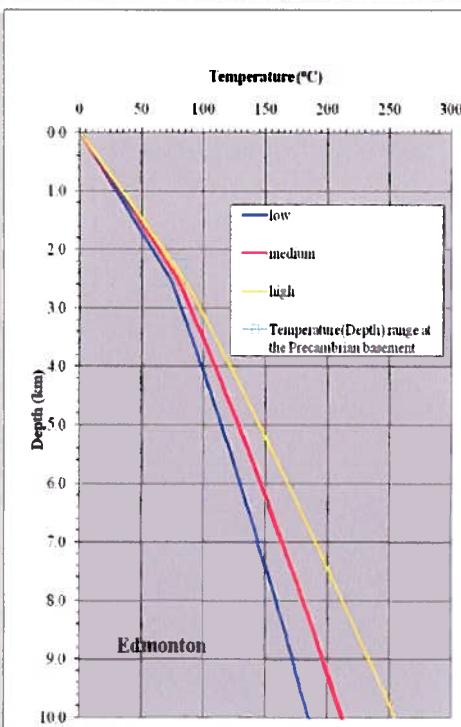
## OVERVIEW

- What is geothermal energy and how is it produced?
- Stages of geothermal energy development
- Geothermal resources in Alberta
- Our Proposal
- Long-term outlook and development strategy
- Discussion

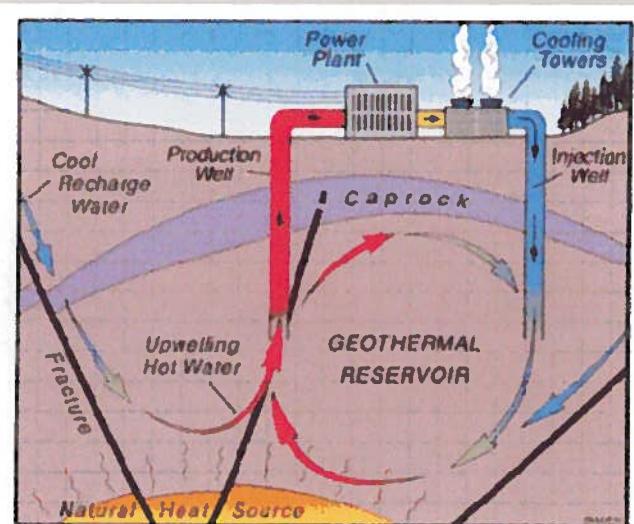
## WHAT IS GEOTHERMAL ENERGY?



- Geothermal energy' refers to the Earth's internal heat content
- 99% of Earth is hotter than 1000 ° C
- Depth at centre is ~ 6700° C (surface of the Sun is 5000 ° C)
- Geothermal gradient is rate at which temperature increases with depth
- Average in Western Canada 20 - 50° C per km

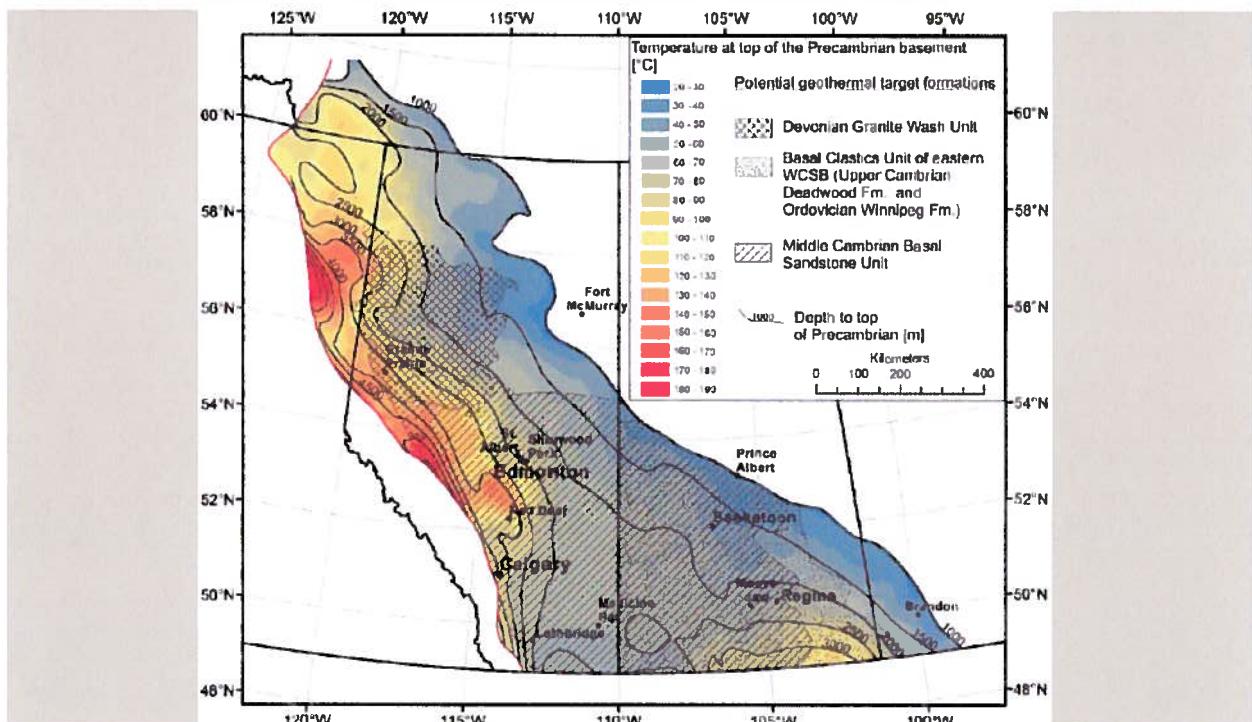


## HOW IS GEOTHERMAL ENERGY PRODUCED?



- Hot water is pumped to the surface in one or more 'production' wells
- Thermal energy is extracted from the water and used directly as heat or converted to electricity
- Cold water is pumped back into the reservoir in an 'injection' well
- 1 production well may produce 20 - 100 MW of thermal energy (2 - 10 MW of electricity)

## ALBERTA'S GEOTHERMAL REGIME AT THE PRECAMBRIAN SURFACE



## ALBERTA'S GEOTHERMAL ELECTRICITY RESERVOIRS

Reservoir	Municipality	Temp	Depth
Lower Mannville	Yellowhead	110 – 130 °C	< 4000 m
Banff Formation	Yellowhead	120 – 150 °C	< 4500 m
Wabamum Group	Grande Prairie	100 – 120 °C	< 3500 m
Nisku Formation	Yellowhead	110 – 130 °C	< 4000 m
Leduc Formation	Grande Prairie	110 – 130 °C	< 3750 m
Swan Hills / Slave Point	Yellowhead	120 – 140 °C	< 5000 m
Granite Wash	Grande Prairie	120 – 140 °C	< 4500 m
Basal Sandstone	Yellowhead	160 – 180 °C	< 5500 m
Basal Sandstone	Clearwater (West)	110 – 130 °C	< 4000 m
Basal Sandstone	Clearwater (East)	110 – 120 °C	< 4000 m

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## PROPOSED RESERVOIR MODELS

- A static geologic model, depicting the areal extent of the reservoir in the subsurface and the reservoir's boundary conditions temperature, depth, thickness and stress regime.
- A volumetric assessment of the total thermal energy in (joules or megawatt hours) available in each reservoir.
- A Monte Carlo, or other probabilistic simulation, to predict the amount of power (in megawatts) that may be produced from the reservoir.

## VIABILITY MATRIX

*Assesses non-geotechnical aspects of a projects viability*

**Completed for each of the three regions containing the reservoirs (Grande Prairie, Yellowhead County, Clearwater County)**

- Environmental Issues
- Finances
- Market Factors
- First Nation Involvement
- Infrastructure (electrical and non-electrical)
- Community Issues

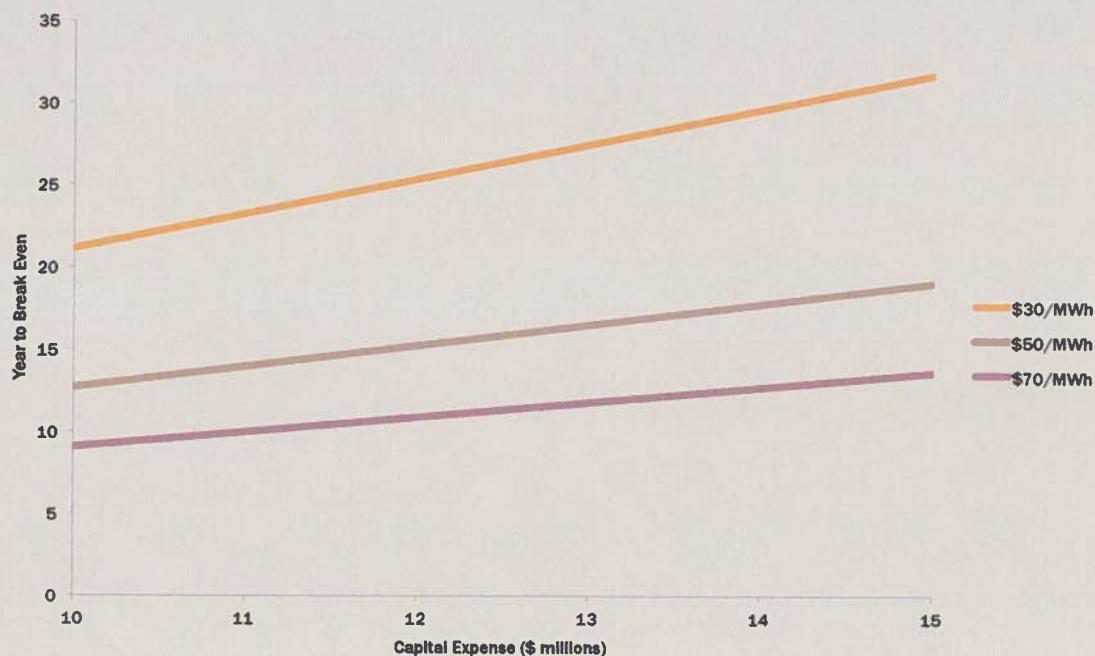
## ESTIMATED PROJECT COSTS

Expense	Cost
Salaries & Benefits	\$80,000
Consulting Fees	\$15,000
Software	\$3,000
Travel	\$10,000
Overhead (20%)	\$21,600
<b>TOTAL</b>	<b>\$129,600</b>

## POTENTIAL SUPPORT

- The Canadian Geothermal Development Corporation
- Peace Power
- IRAP-NRC
- Local Municipalities
- U of A Energy Management and Sustainable Operations

## ECONOMICS OF 2 MW DEMONSTRATION PLANT



## THE BIGGER PICTURE

At 100 °C, pore fluid has a heat capacity of

**4.2 megajoules per  $m^3K$**

A 30 km x 20 km x 0.1 km reservoir with 8% porosity contains

**4.8 billion  $m^3$  of pore water**

The total energy available from the pore fluid in this reservoir, if cooled to 50 °C is

**1 trillion megajoules, or ~278,000 gigawatt hours**

If 10% of this energy can be recovered, it could generate enough power to run Hinton for  
**nearly 1,650 years**

## THE BIGGER PICTURE

**With current technology, there may be at least 10x this much geothermal energy available in Alberta**

**THANK YOU FOR YOUR CONSIDERATION**

## **DISCUSSION**