# AMERICAN VANADIUM

THE CRITICAL ELEMENT

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TSX.V: AVC







#### AMERICAN VANADIUM

The Gibellini Project- Nevada A Unique New Type of Deposit Americas Only Primary Vanadium Mine

Alan Branham Director





#### Safe Harbour

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Nevada

**Sole US Primary Producer** 

Q4 2012 production target

**5% of Global Production** 

Open pit

**Heap leach** 

0.2 Strip Ratio

Mid 2011 Final Feasibility Study

\* Scoping Study & NI 43-101:

**AMEC 2008** 

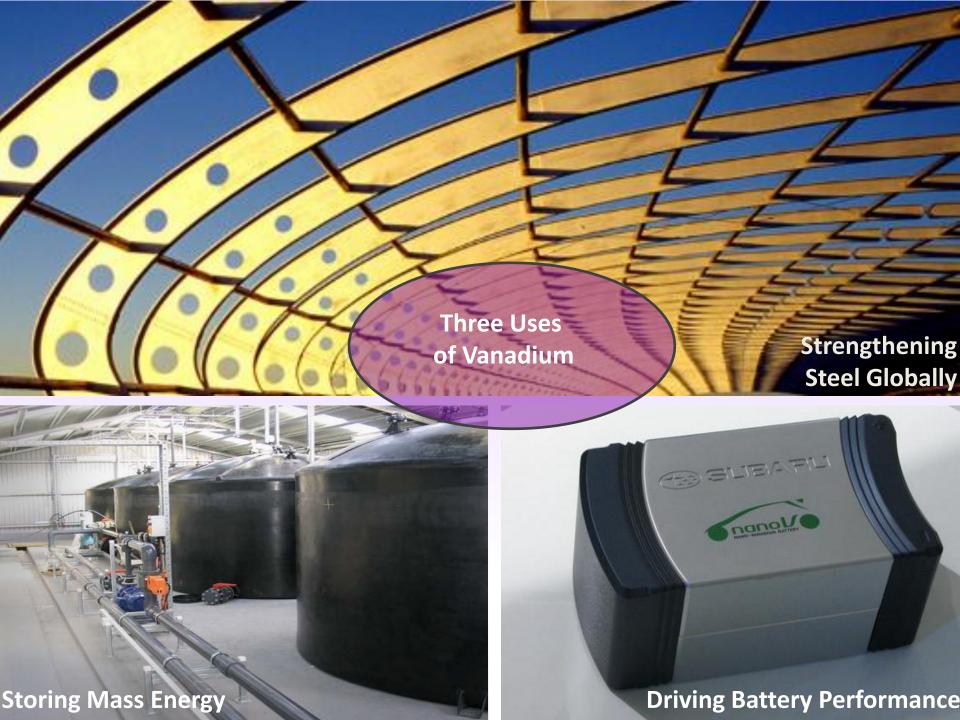
\$90M Cap Ex

40% After Tax IRR

\$89,000,000 NPV

	Resource	Expansion	Grade	Mrkt Price per	<b>Unit Cost</b>	Production 2013
Vanadium	122 M lbs	366 M lbs	0.339%	\$7.50 lb	\$3 lb	14,000,000 lbs pa







#### **Vanadium in Steel**

Primarily used to strengthen steel

Lighter, stronger, corrosion resistant, wieldable

90% High Strength, Low Alloy Steels

- 1 lb HSLA = 1.4 lb carbon steel
- Buildings, bridges, cranes, trucks, pipelines, ships, engines

5% Alloy steels – tools, alloys, air fames, jet engines

5% Catalysts - primarily used in sulfuric acid production

Sulfuric acid required for production of rare earths





# **Grid Level Energy Storage**



#### **President Obama**

"Vandium Redox Fuel cell"

"that's one of the coolest thing I've

ever said out loud"

Forum on small business: Closing session. Cleveland, OH, Feb 22, 2011





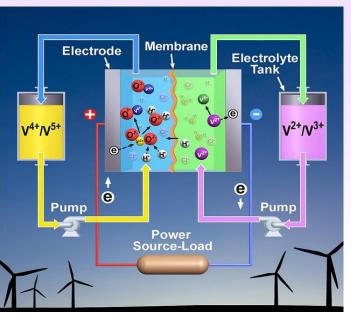




## **Vanadium Mass Storage Battery**







#### **Problem**

- Massive storage capability required for Off-Peak usage to manage base load power balancing
- Grid Power surging with solar and wind

#### The Only Economic Solution

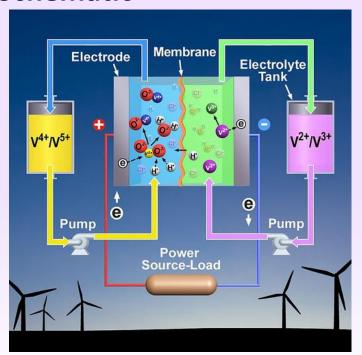
#### Vanadium Redox Batteries (VRB's)

- >20 year battery life. Only battery that rapidly charges and discharges with little effect on battery life
- No limit on size. Huge scalability potential
- > 10,000 cycles per battery. No chemical reaction batteries do not degrade or get "consumed" over time
- Cheapest scalable solution
- High volumes of vanadium required



# Vanadium Redox Batteries

#### **Schematic**











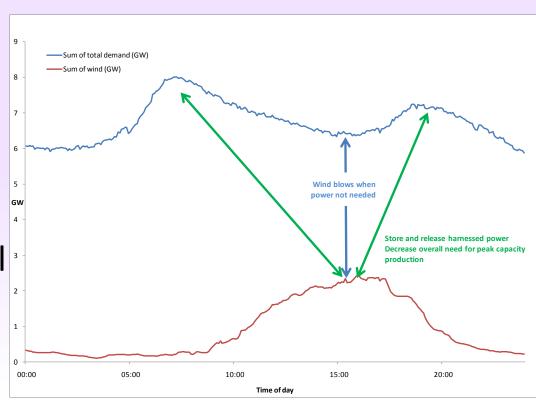




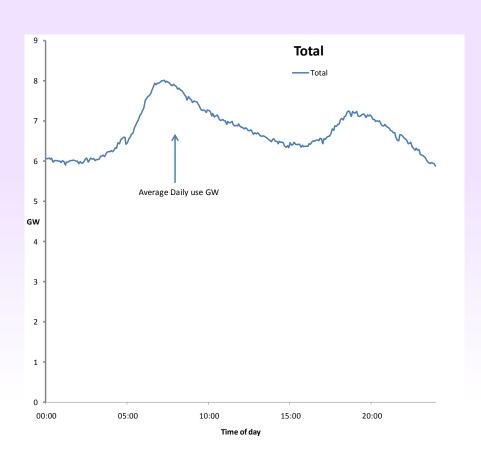
# **Alternative Energy Application**

- Eliminate
   intermittent supply
   issues by storing and
   releasing as needed
- Store when spot rates are low and sell when they are high





# Power utility application



- Add local capacity
  - Eliminate need to increase size of power generation to only meet peak demand
    - Power generation scaled to average demand
    - Peak demand satisfied with storage
  - Reduce need to send excess power down the lines just in case it is needed. Unexpected demand drawn from storage
  - Buy cheap power based on time of day and store

# **Industrial Applications**

- Generate their own power through alternative means and store it for when needed
- Buy power at times of day when cheap, store and use as needed



# Vanadium in energy storage

- In CA, average annual electricity usage is > 270,000 GWH
- In CA average peak daily demand is about 65,000 MW
- CA AB 2514 5% of peak demand in storage by 2015
  - 3,250 MW of storage
  - 52M lbs of vanadium

# Electric Vehicles (EV)

- Many technologies competing for adoption
- Significant investments in technology
- Many wide ranging projections on adoption
  - DOE predicts
    - 2015 800,000 vehicles worth \$8B to the battery business
    - 2020 6M vehicles worth \$30B to the battery business
- Lithium not limited but worries on scarcity drove significant increases in prices and stock value

### **Existing VRB Mass Storage Facilities**

A 1.5 MW UPS system in a semiconductor fabrication plant in Japan.

Using 75 tons of V2O5 solution worth approximately \$1,000,000.

A 275 kW output balancer in use on a wind power project in the Tomari Wind Hills of Hokkaido.

Using 13.7 tons of V2O5 solution, worth approximately \$180,000

• A 200 kW, 800 kW·h (2.9 GJ) output leveler in use at the Huxley Hill Wind Farm on King Island, Tasmania.

Using 50 tons of V2O5 solution worth approximately \$660,000

A 250 kW, 2 MW·h (7.2 GJ) load leveler in use at Castle Valley, Utah.

Using 112 tons of V2O5 solution, worth approximately \$1,500,000

• Two 5-kW units installed at Safaricom GSM site in Katangi and Njabini, Winafrique Technologies, Kenya.

Using 0.50 tons of V2O5 solution worth approximately \$6000

 Two 5-kW units installed in St. Petersburg, FL, under the auspices of USF's Power Center for Utility Explorations.

Using 0.50 tons of V2O5 solution worth approximately \$6000









# **Lithium Vanadium Battery**



**Subaru G4E Concept** 

Cathode	Voltage (V)	Energy (kWh/kg)	Cost (\$, relative)
LiCoO <sub>2</sub>	3.7	0.518	1
LiMn <sub>2</sub> O <sub>4</sub>	4	0.4	0.04
LiFePO <sub>4</sub>	3.3	0.495	0.03
Li <sub>2</sub> FePO <sub>4</sub> F	3.6	0.414	0.08
Li <sub>3</sub> V <sub>2</sub> (PO <sub>4</sub> ) <sub>3</sub>	4.8	0.624	0.4
LiVPO <sub>4</sub> F	4.1	0.492	0.84







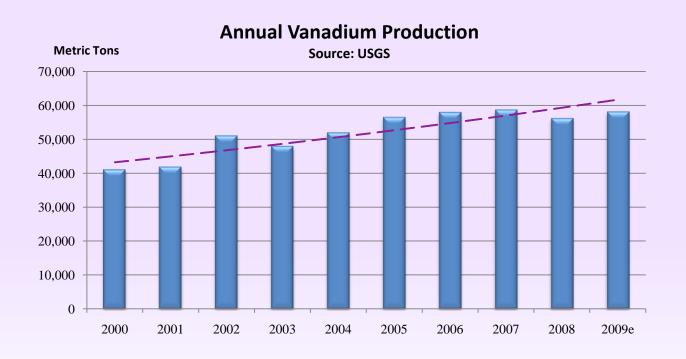
# **Lithium Vanadium Battery**

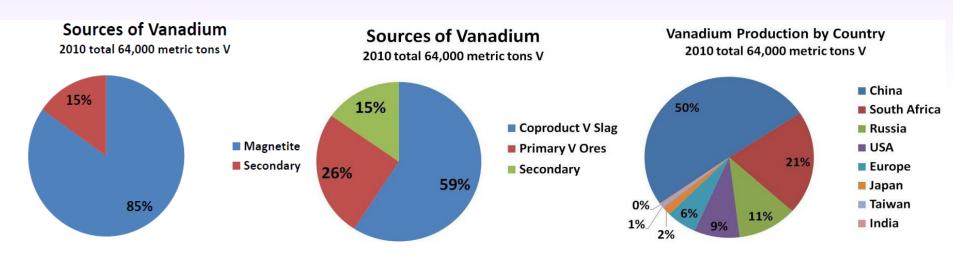
	Lithium Vanadium	Lithium Cobalt	
Life Cycles	35,000 (30-50 years)	300 (3-5 years)	
Rapid Charge and Discharge	Minutes	Hours	
Self Discharge	Low (stays charged)	Normal	
Metal Demand	High	Low	
Application Size	Larger	Smaller	
Heat Generation	Low	High	



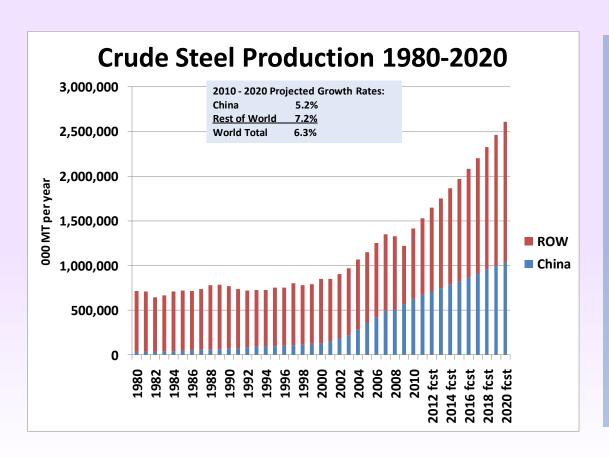


## **Vanadium Supply**





## **Steel Production MT/yr.**

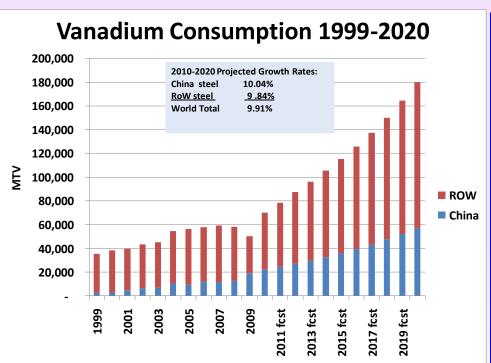


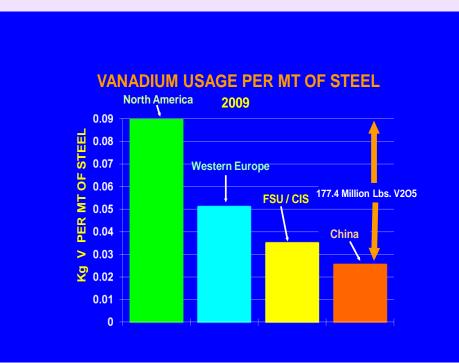
Global Steel Production 1980-2010 (MT/yr.)

BRIC countries account for more than

90% of the growth in global steel production since 1980.

### **Quality vs. Quantity**

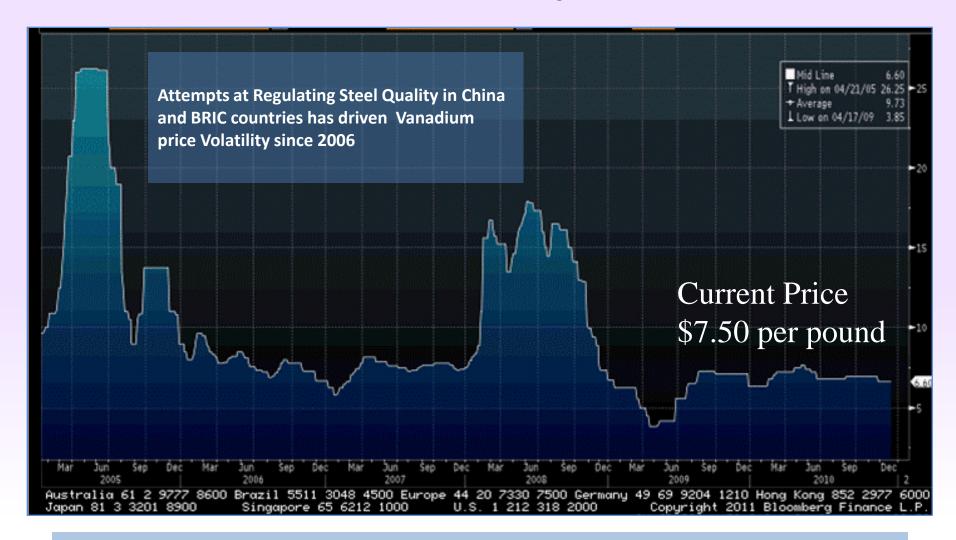




Global Vanadium Consumption is predicted to double by 2025.

This is due to the forecasted Specific Vanadium Consumption Rates in the BRIC countries that are expected to equalize to the rest of the world by the year 2025.

## **Vanadium Price Expectations**



#### **Rational Vanadium Price 2010-2015**

- •Low -US\$6.00/pound V2O5 based on cash cost of production
- High –US\$13.50/pound V2O5 based on value to major end users

### **Gibellini Project**

100% owned by American Vanadium Corp.

- 3,400 acres 298 unpatented claims
- \$145,000 AnnualPrepaid Royalty, 2.5%NSR

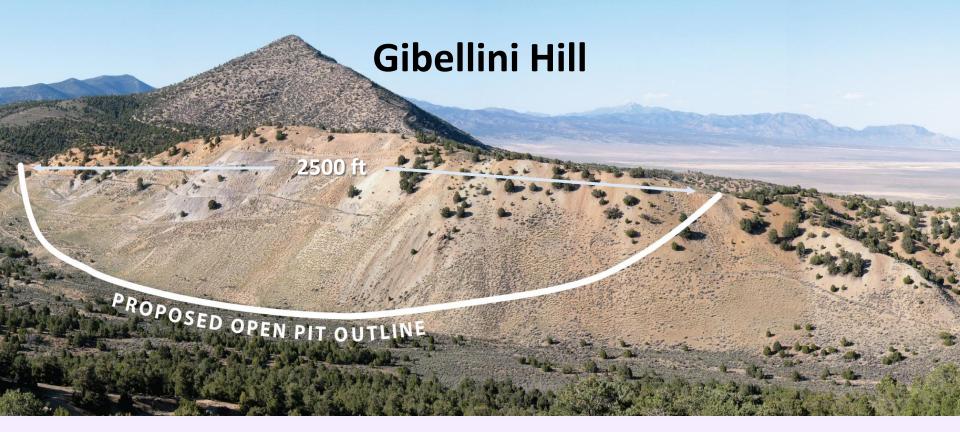
Historic exploration drilling > 160
holes by several operators
including Noranda and Union
Carbide

**AMEC Scoping Study in 2008** 

Potentially lowest cost primary vanadium producer in the world

Could supply 5% of world's current demand for vanadium for 15 years.

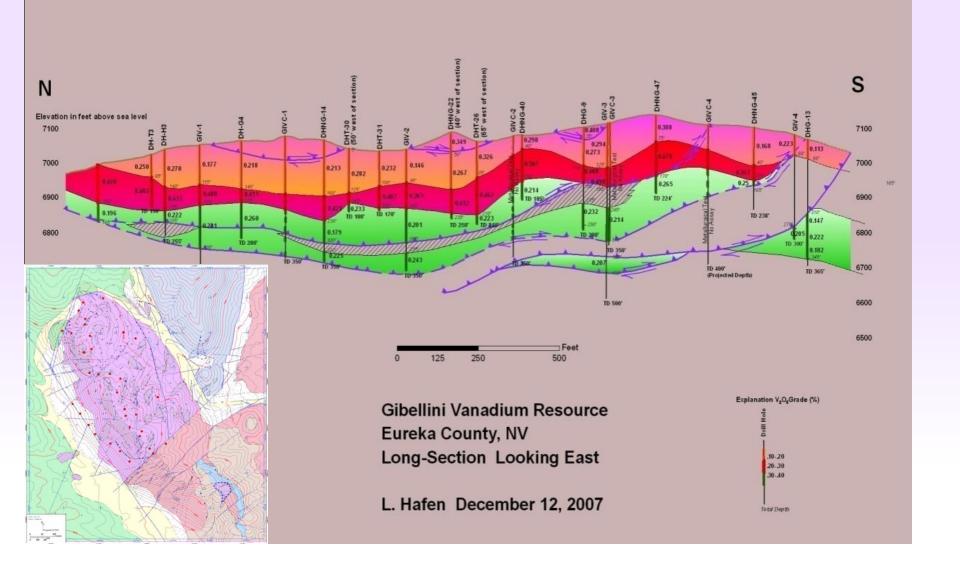


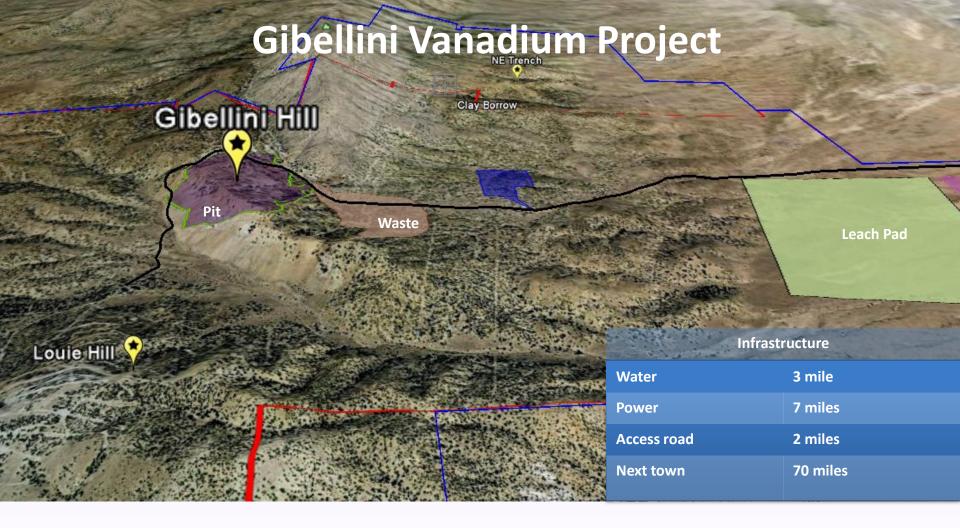


NI 43-101 Compliant Resource						
Category Tons (MM) Grade V <sub>2</sub> O <sub>5</sub> (%) Pounds V <sub>2</sub> O <sub>5</sub> Contain						
Total Indicated	18.0	0.339	122 million			
Total Inferred	2.8	0.282	16 million			



## **Gibellini Project**





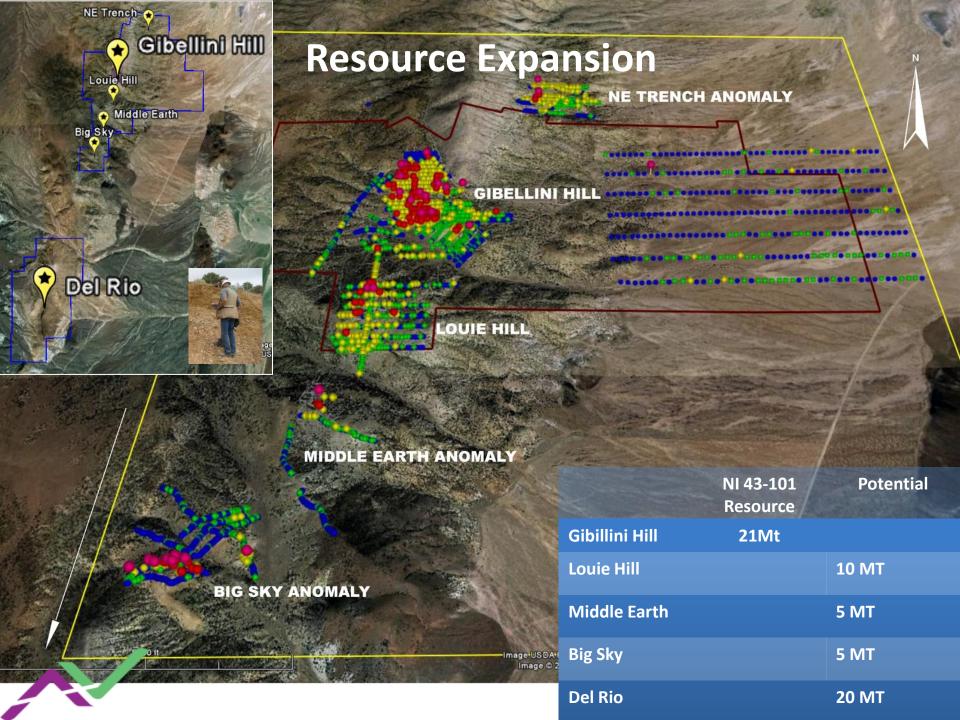
Feasibility Study AMEC underway

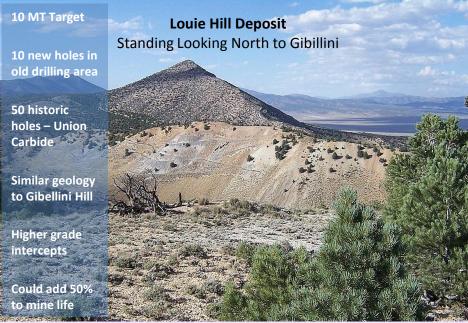
Metallurgical testing program underway

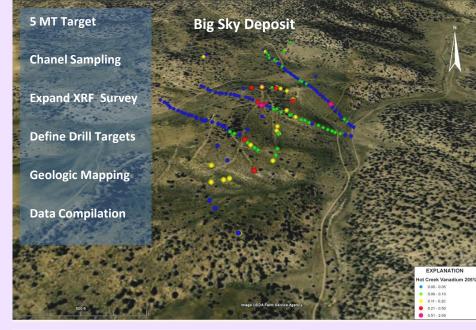
**Environmental permitting underway:** 

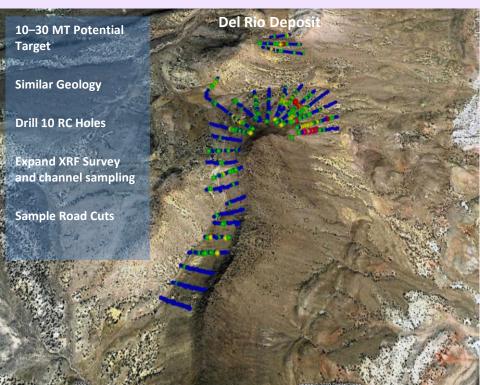
Biological, cultural and spring/riparian field studies completed













2011-2012 Exploration Plan

\$1,000,000 Committed

**Very Similar Geology** 

All Above Ground

Low Cost Exploration

Fast & Cheap Drilling



#### **Process Flow Sheet**

#### **Sulfuric Acid Heap Leach**

Heap

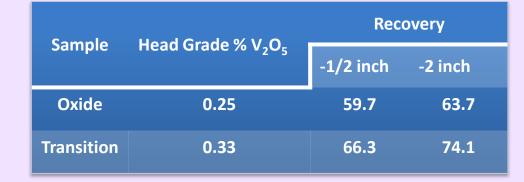
Building

Barren

Pond

 $V_2O_5$ 

Production



Secondary
Crushing

Agglomeration

Ore Delivery

Primary Crushing

No magnetite
No grinding
No roasting

\*No longer required

Two Products onsite



Ore

Curing



Preg

Pond

Solvent

Extraction

Organic Stripping

AMV

Precipitation

Vanadium Electrolyte



## **AMEC Scoping Study**

Annual Tonnage, short tons	3,000,000
Vanadium Production, lb V2O5/yr	14,000,000
Capital Cost	\$89,000,000
Operating Cost, /ton	\$14
Operating Cost, /lb V2O5	\$3
NPV @ 5% Discount	\$89,000,000
IRR After Tax	40%

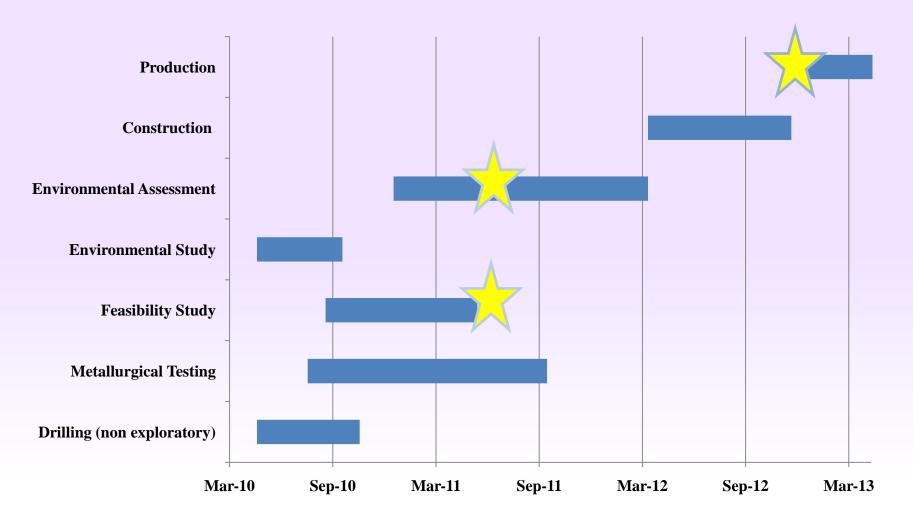
Scoping Study and 43-101 Technical Report by AMEC, Oct 2008

#### **Opportunities to improve:**

- Reduce sulfuric acid consumption
- Remove crushing stages
- Conveyor vs trucks
- Power capital/operating cost



## **Milestones and Target Dates**





### **Competitive Advantages**

#### **Excellent capital structure**

One of the lowest cost & easiest vanadium operations in the world

- Favorable geology
- Open pit with 0.2 strip ratio
- Heap leach with minimal, if any, crushing
- Low capital cost

Best mining jurisdiction in the world

First to production

**Lowest risk** 

**Project expansion opportunities** 

**Strategic opportunities and exits** 



## **Peer Comparison**

Company	Market Cap	Deposit	Grade	Recovery	Op Cost	Cap Ex	Annual Production	Stage	Product
Apella APA:TSX.V Quebec	\$27M	26 MT	0.48%	51% - 74%	Unknown	Unknown	Unknown	Exploration Drilling	V <sub>2</sub> O <sub>5</sub>
Largo LGO:TSX.V Brazil	\$113M	22.5 MT M&I 13.1 MT P&P	1.26% 1.25%	71% Grinding Roasting	\$2.61 /lb	\$250M	16.5 MM lbs 2013-2014	Feasibility	FeV
Energizer EGZ:TSX.V Madagascar	\$72M	21 MT Ind. 4.2 MT Inf.	0.76% 0.66%	75% Grinding, Pre-roast Alkaline Leach	Unknown	>\$300MM	2015	NI 43-101	V <sub>2</sub> O <sub>5</sub>
Windimurra Australia	N/A	46 MT M&I	0.46%	Unknown	Unknown	\$120M+	Unknown	Past Producer	FeV & V <sub>2</sub> O <sub>5</sub>
American Vanadium Nevada	\$32M	18 MT Ind 3 MT Inf	0.339% 0.282%	72% Heap Leach	\$2.96 /lb	\$90M	14 MM lbs 2013	Bankable Feasibility Q2 2011	V <sub>2</sub> O <sub>5</sub> & Electrolyte & FeV



### **Key Value Drivers**

**Analyst Coverage** & Independent Reports

**Off take Agreements** 

**Steel production** 

Metal traders, Producers: China, India

**Battery production** 

Vanadium Redox

Lithium Vanadium Phosphate

**Bankable Feasibility Study Mid 2011** 

**Project Finance** 

**Resource Expansion** 





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