



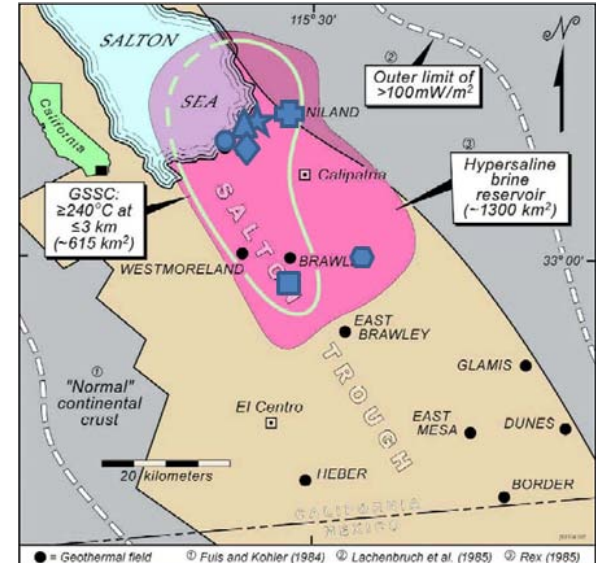
Technologies for extracting valuable metals and compounds from geothermal fluids

May 18, 2010

Principal Investigator
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Simbol Mining Corp.

Specialized Materials and Fluids and Power Plants

- Simbol Mining Corp. (Simbol) will produce battery chemicals
 - Lithium
 - Manganese
 - Zinc
- Salton Sea hypersaline geothermal reservoir, Imperial Valley, Southern CA
- Each 50 MW geothermal plant can produce annually:
 - 16,000 tonnes of lithium carbonate equivalent
 - 24,000 tonnes of electrolytic manganese dioxide
 - 8,000 tonnes of zinc metal
- Simbol initial resource agreement
 - Four plus 50 MW plants

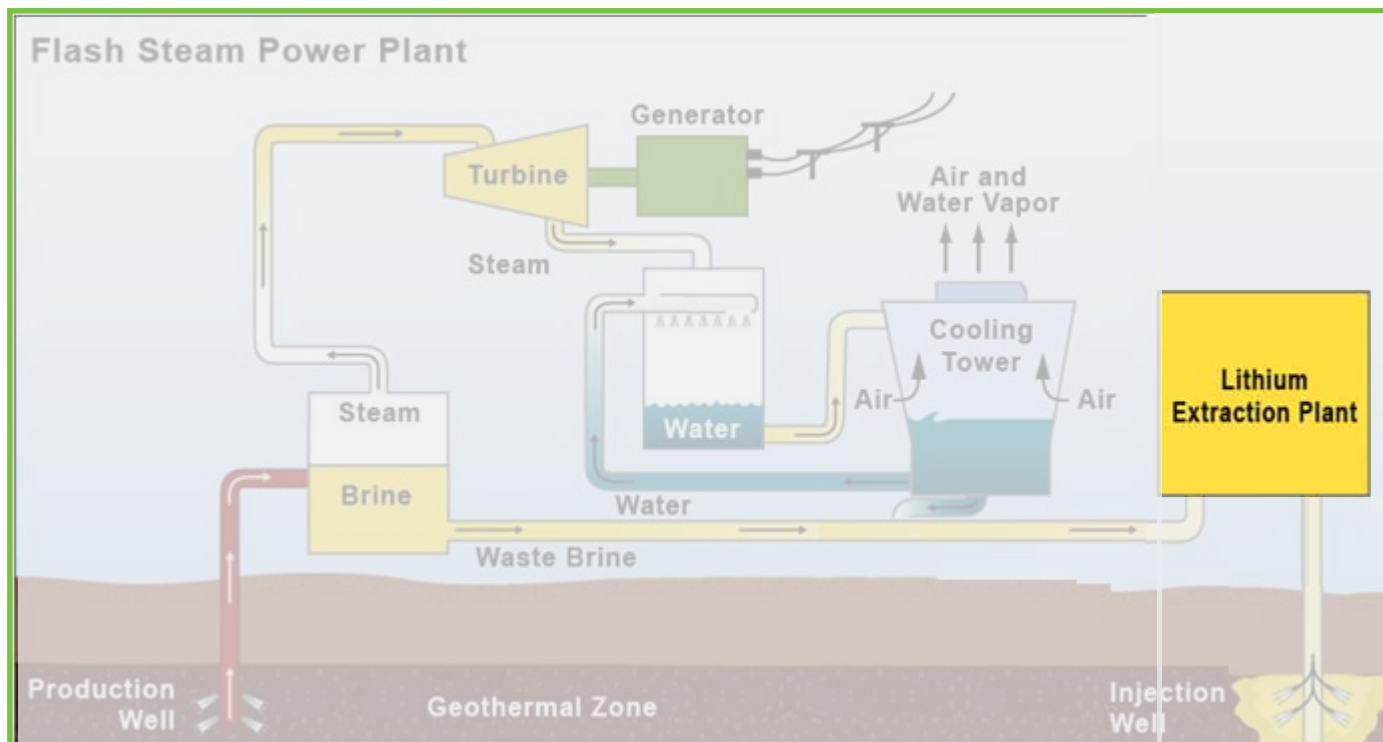


From J. Hulen in Gawell (2006)

	mg/kg		mg/kg
Na	53,000	Li	200
K	29,000	Mn	1,500
Ca	33,000	Zn	500
SiO ₂	200	Cs	20
Fe	1,500	Rb	100
TDS	31 wt%	Cl	180,000
pH	5		

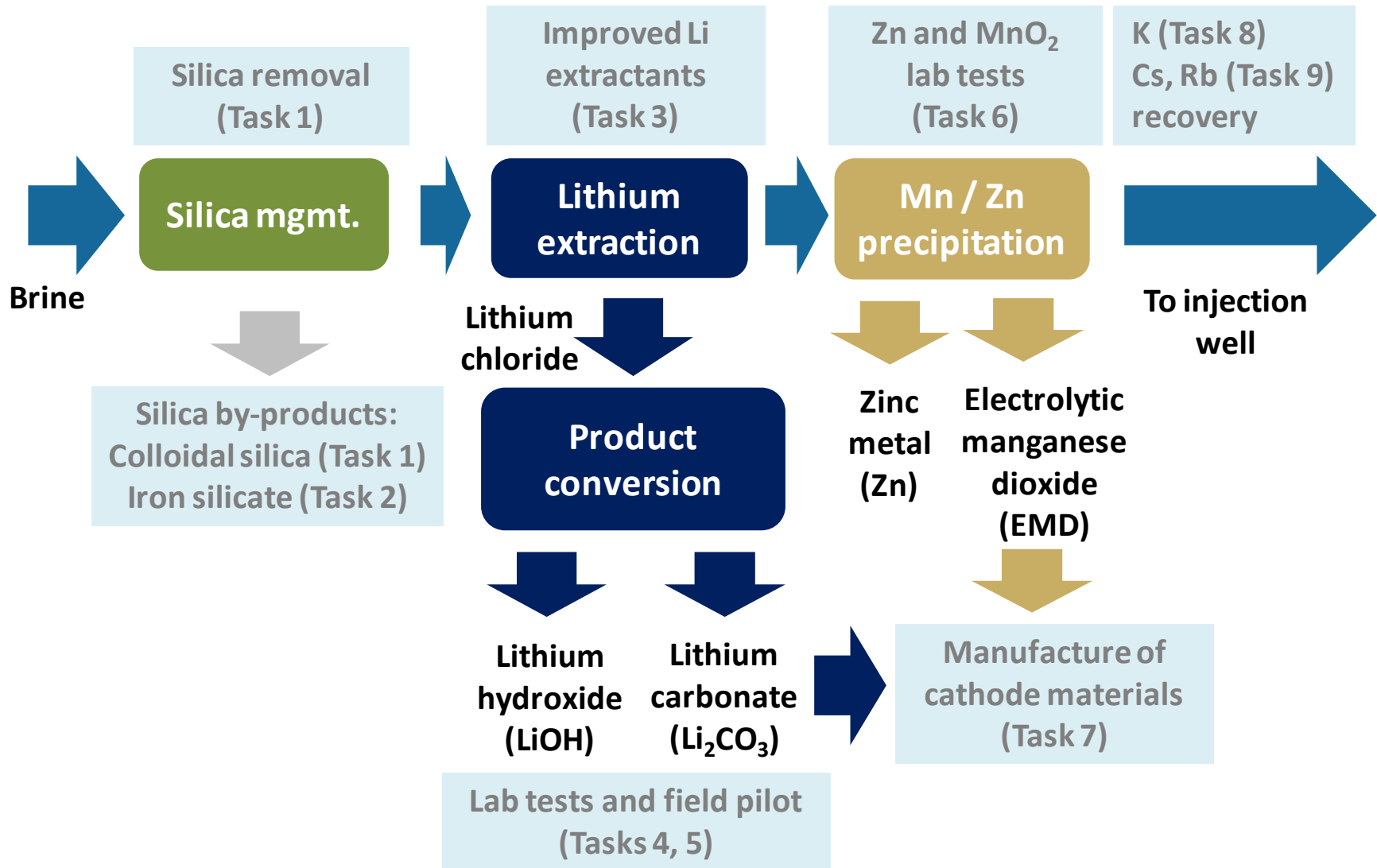
Representative brine chemistry

Metal extraction post-power production, pre-injection



Lowest cost of production and only green lithium production process

Overview of R&D plan

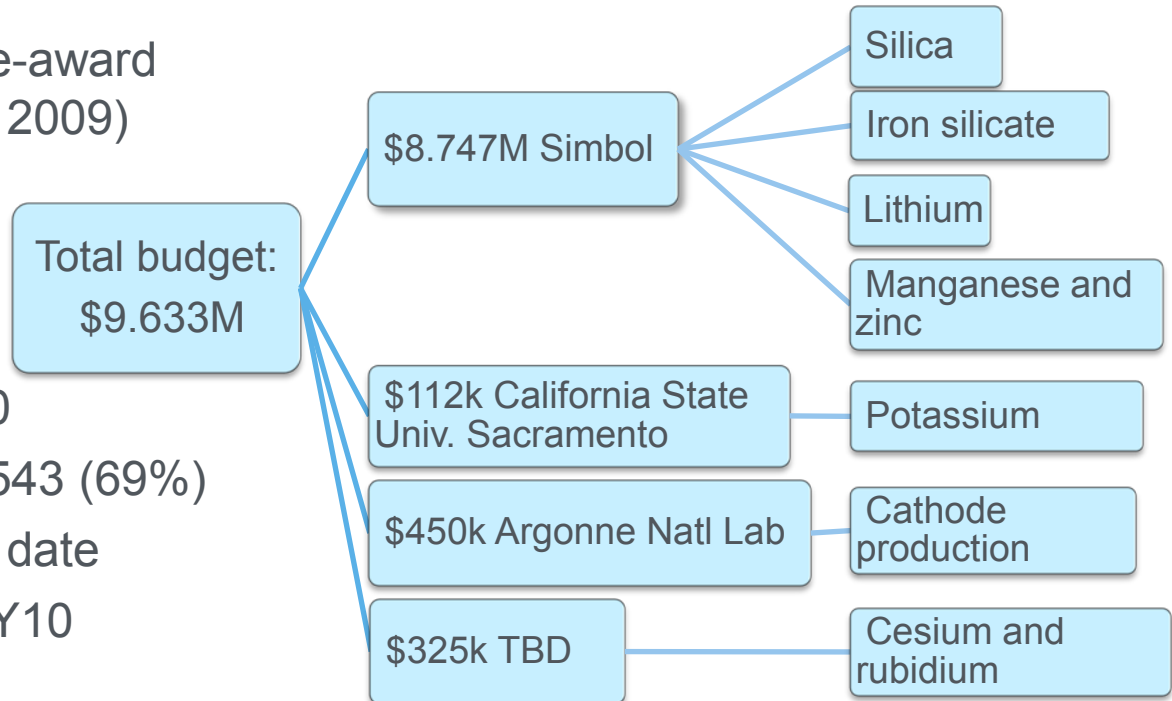


- Timeline

- Start May 1, 2010
- End April 30, 2012 (pre-award activities post-Oct. 22, 2009)

- Budget

- Total \$9,633,543
- DOE share \$3,000,000
- Simbol match \$6,633,543 (69%)
- \$0 funding received to date
- \$7,397,268 planned FY10 expenditures

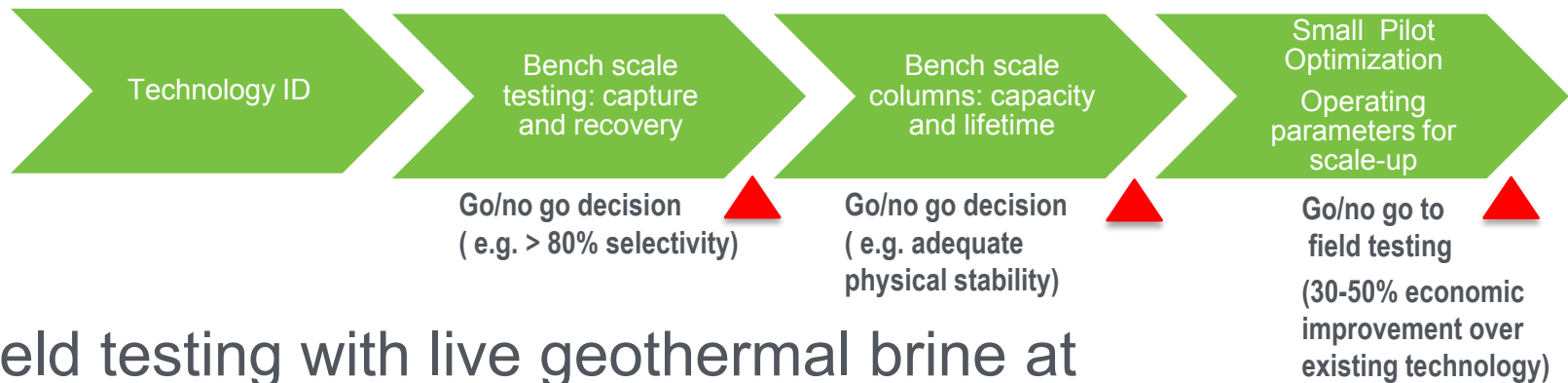


- Project goals
 - Demonstrate geothermal mineral extraction
 - Demonstrate technical and economic feasibility
 - Produce products for market development
 - Generate operational data and scale up data so a commercial scale plant can be designed and built
- Despite its economic potential, mineral extraction from geothermal brines has not been successfully commercialized
- Simbol's business model puts mineral extraction into a separate company, shielding the geothermal operator from risk and letting each company focus on its core competencies
- Simbol will fully commercialize its technology by partnering with geothermal developers and operators

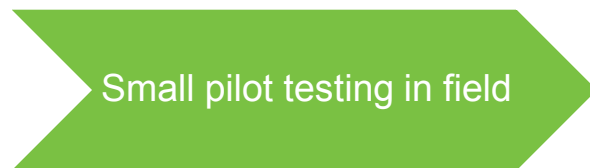
- This project may improve the economics of geothermal projects by creating new revenue streams for the geothermal operator through royalties from the sale of geothermal by-products
 - Offset the cost of geothermal electricity by up to 0.5¢/kWh per mineral
 - Provide mineral royalties of about \$4MM annually per 1% royalty to the geothermal operator
 - Annual revenues will be multiples larger than those from electricity sales
- U.S. geothermal power plants can satisfy the nation's need for an environmentally friendly and domestic source of lithium and other chemicals which are key components of batteries for electric vehicle and energy storage technologies

- Initial target: lithium extraction
 - Build a demonstration plant - 15 tonnes/year (6 gpm of brine flow)
 - Technical proof of process- at least 1,000 hours of operation
 - Economic proof of process- validate operating cost/capital estimates
 - Produce commercial grade products customer qualification
 - Demonstrate scalability
 - Optimization
 - Operations discipline & training

- Lab-based extraction technology development with surrogate brine (e.g. Li, K, Cs, Rb)

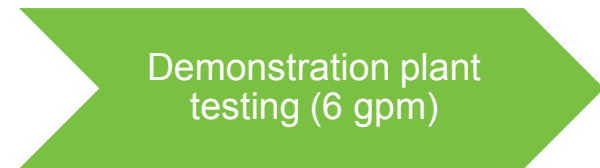


- Field testing with live geothermal brine at CalEnergy's Elmore geothermal power plant



- Next generation silica management
- Next generation lithium extraction

or



- Silica management /lithium extraction
- Lithium carbonate and lithium hydroxide production

- Accomplishments to date

- Manufacturing and lab testing of next generation lithium extraction materials
- Developed and validated end-to-end process to producing lithium chloride at lab scale
- 1/1,000-scale pilot operating with surrogate brine (6 gpm)
- Secured site access agreement with CalEnergy for on-site testing

Task 3: Manufacturing next generation of lithium extractants and conducting lab testing

- Created 7 new materials and tested 5 in bench scale tests
 - Up to 2,600 cycles
 - Mass selectivity of Li vs. divalent cations is > 500
 - Extraction varies from 50 to 90% depending on media
- Scaled two materials to field pilot scale



Task 5: Demonstrated silica management and lithium extraction technologies

- Surrogate geothermal brines (30 wt.% TDS)
- Constructed 6 gpm pilot
- Operated for >500 hours
- Silica decreased to ND
- Achieved >50% lithium extraction
- Confirmed chemical consumption and process efficiencies



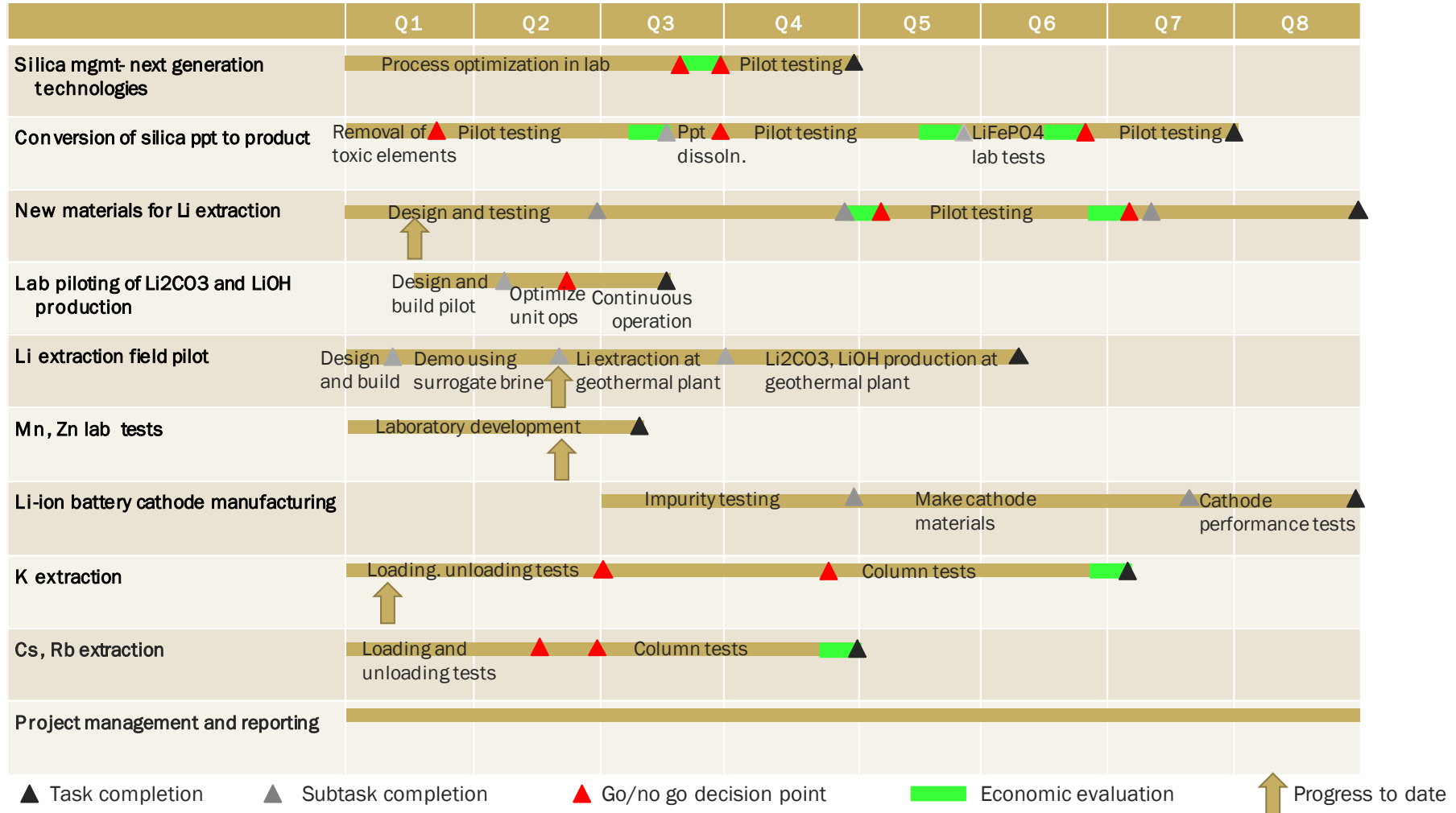
Task 6: SGS reports on manganese and zinc extraction

- Key steps in the process demonstrated at the bench scale
- Awaiting technical and economic reports from Independent Engineers

Task 8: Potassium extraction

- Begun synthesizing and characterizing variations of existing ion-exchange materials for potassium extraction

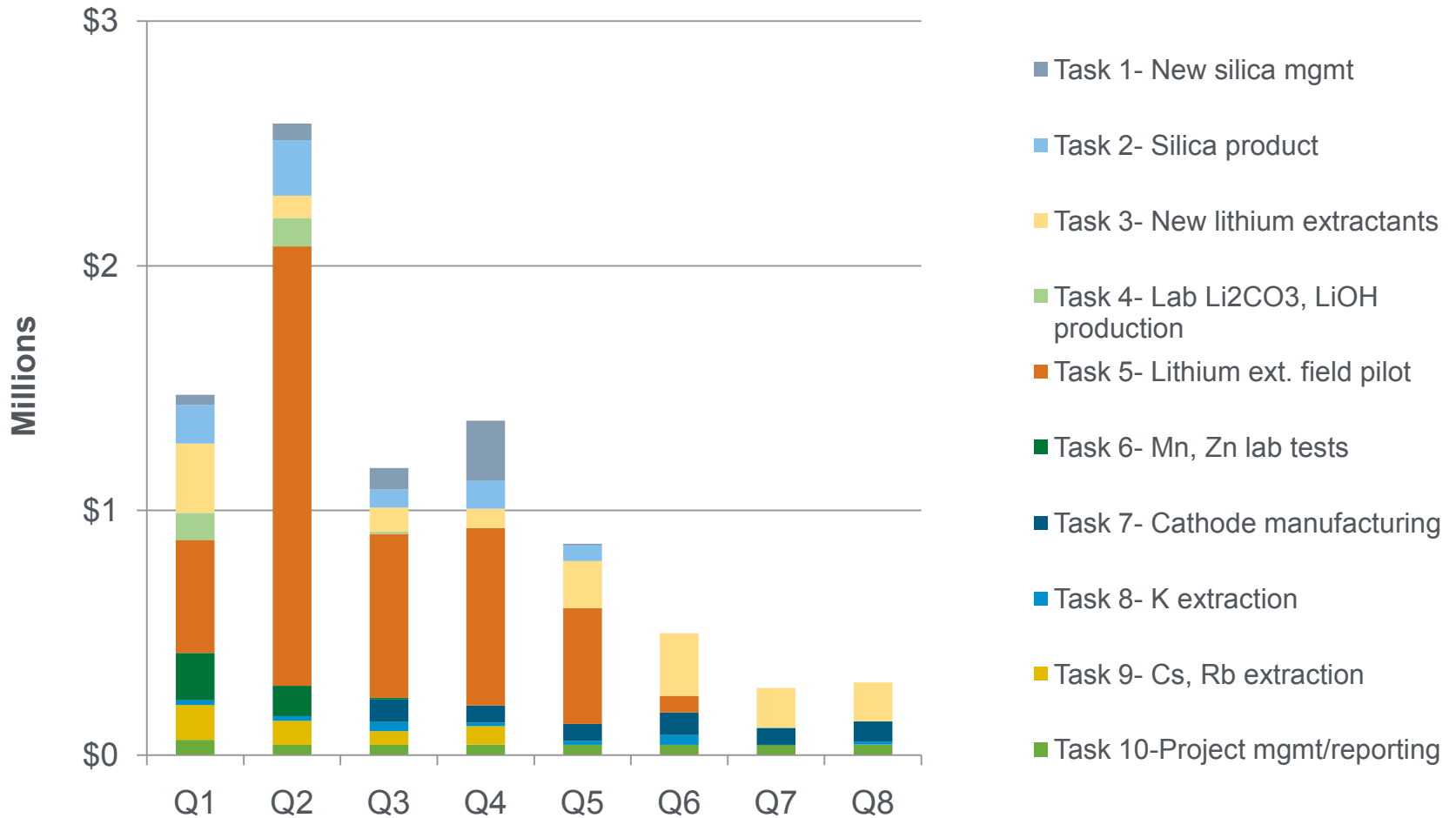
Project Management/Coordination



Task #	Task	Total funding (excl. indirect and fringe)	% of total project
1	Silica mgmt – next generation	\$ 449,892	5.3
2	Conversion of silica ppt to product	\$ 636,103	7.5
3	New materials for Li extraction	\$ 1,322,645	15.5
4	Lab piloting of Li ₂ CO ₃ and LiOH production	\$ 236,074	2.8
5	Li extraction field pilot	\$ 4,193,552	49.2
6	Mn, Zn lab tests	\$ 322,480	3.8
7	Li –ion battery cathode manufacturing	\$ 475,530	5.6
8	K extraction	\$ 160,564	1.9
9	Cs, Rb extraction	\$ 371,312	4.4
10	Project mgmt and reporting	\$ 359,844	4.2

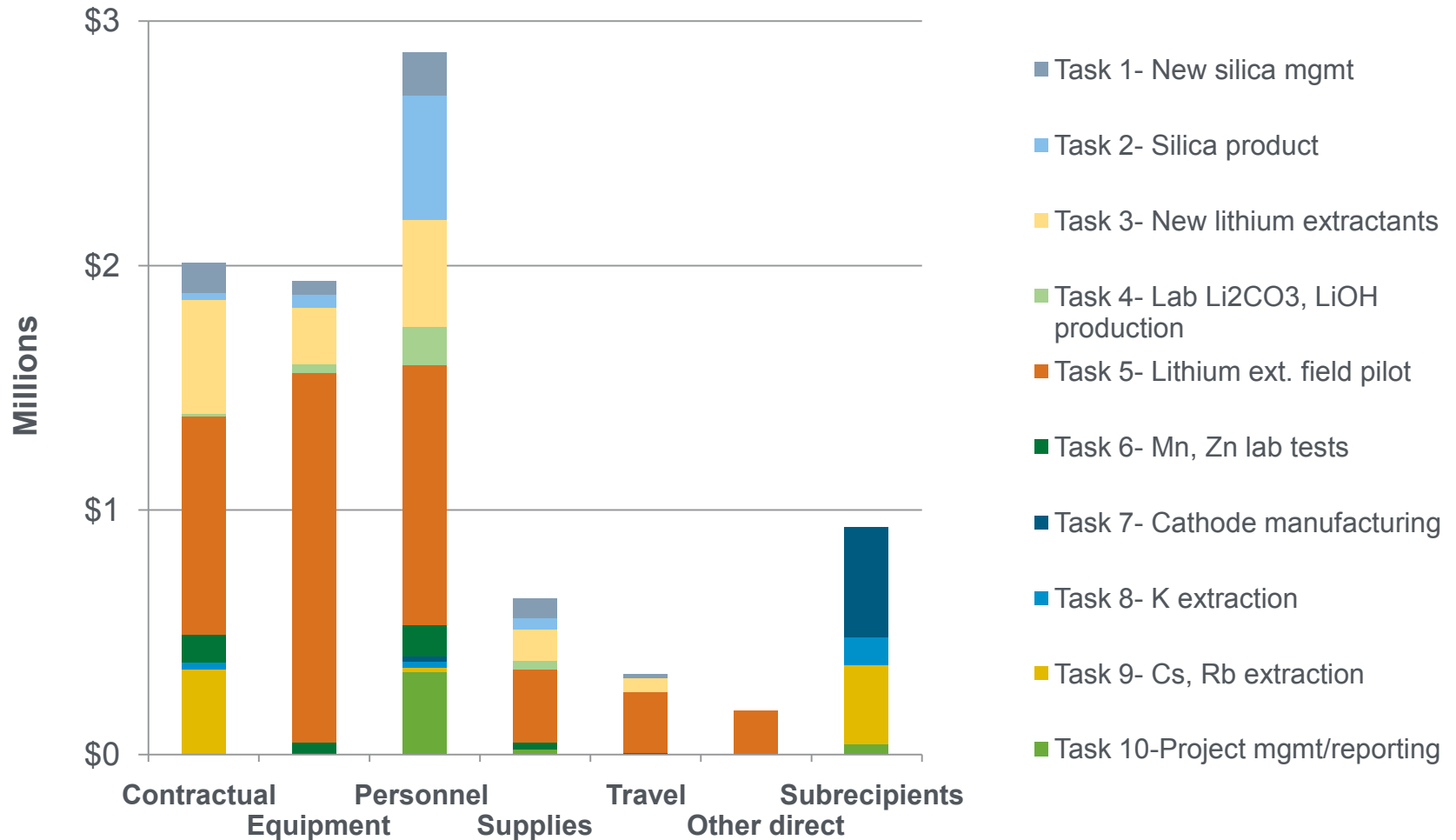
Simbol match: 69%

Spending plan per task and quarter



Total- \$9,633,543

Spending plan per category *



* excluding fringe and indirect

- Start Tasks 1, 2, 4 & 9
- Continue scale-up of Li extraction materials (Task 3)
- Li extraction (Task 5)
 - Transfer demo plant to CalEnergy's Elmore power plant
 - Operate 3rd quarter 2010
- Complete Task 6

- ✓ Simbol has made significant progress during 90 day pre-award period
- ✓ Ahead of schedule for field testing of first generation technologies in the demonstration plant
- ✓ Ready to commence remaining laboratory-based R&D activities