SuperSuburb

A Future Cryo-powered Residential Community

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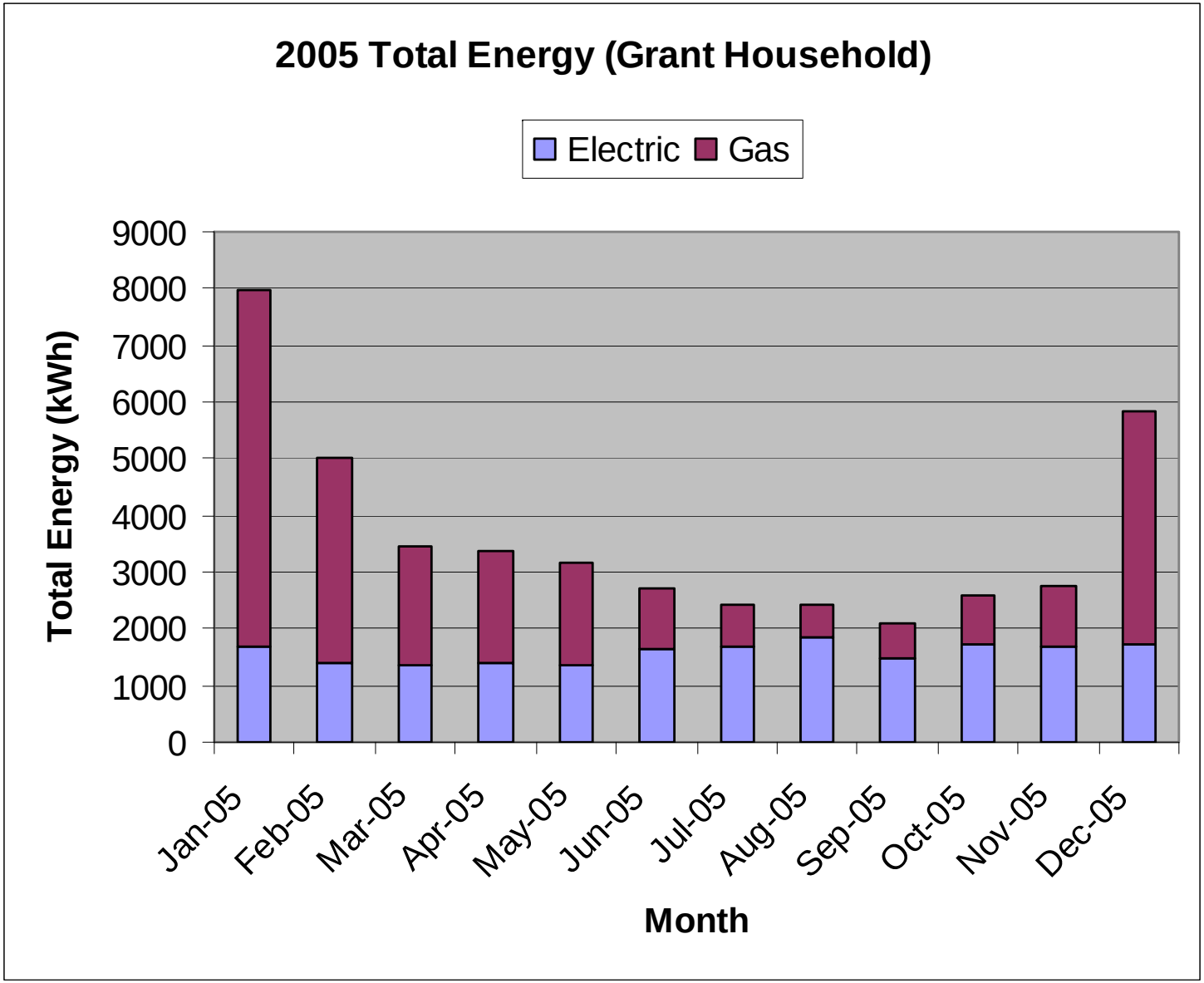

2005 Total Energy (Grant Household)
Electric
Gas
Total Energy (kWh)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-05
Feb-05
Mar-05
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Month

Table II. 2005 GHE Power Requirements Based on Monthly Time Interval

Power (kW)	*Electricity*	*Natural Gas*	*Total*
Monthly Mean	2.16	2.84	4.99
Standard Deviation	0.24	2.39	2.39
Mean + STD	2.39	5.23	7.39
Mean - STD	1.92	0.45	2.60

Table III. Baseline Electric Power and Energy Storage Requirements per GHE in SuperSuburb

Baseline Power (kW)	Energy Stored (kWh)	Hydrogen Mass Equivalent (kg)	Volume as Liquid (21 K, 14.7 psia) (cube edge in meters)	Volume as Gas (300 K, 2000 psia) (cube edge in meters)
5.99	6129	187	1.38	2.63

Miles/Year	DOE H_2 Mileage (kWh/mile)	H_2 Daily Mass Consumption (kg)	SuperCable H_2 Delivery Power (kW)
30,000	0.76	1.91	2.61

Table IV. GHE Transportation Energy Consumed‡

‡ The GHE mileage estimate may be too conservative. At one time, GHE had six family vehicles. At present, there are two...one a small roadster that gets 31 mpg,

and an SUV that gets 15. The table figure reflects only the latter two vehicles. Adjustments can be made on the SuperSuburb Excel Spreadsheet.

Table V. Number of GHEs per H_2 Station and Individual Station Capacity[§]

US Households (2005)	Number of Stations (1998)	Households per Station	Turnover Rate (days)	H_2 Mass (kg)	Liquid "cube" (meters)	Gas "cube" (meters)
75,000,000	187,000	401	3	2298	3.2	6.1

[§] The data in Table V were derived from the US Census Bureau and various retail gas station associations. The household number is roughly that of unattached single family dwellings nationwide. The actual number of gas stations has declined slightly from 1998. The "turnover" rate, that is, the number of day's supply at each station, has anecdotal origins.

Table VI. Baseline Electric and Hydrogen Power Needs of a "San Jose" SuperSuburb of GHEs

GHE Households	Base Electric Power (MW)	Electricity to be Stored as H_2 (tonnes)	Base H_2 Power (MW)	H_2 Stations
300,000	1798	56,104	782	748

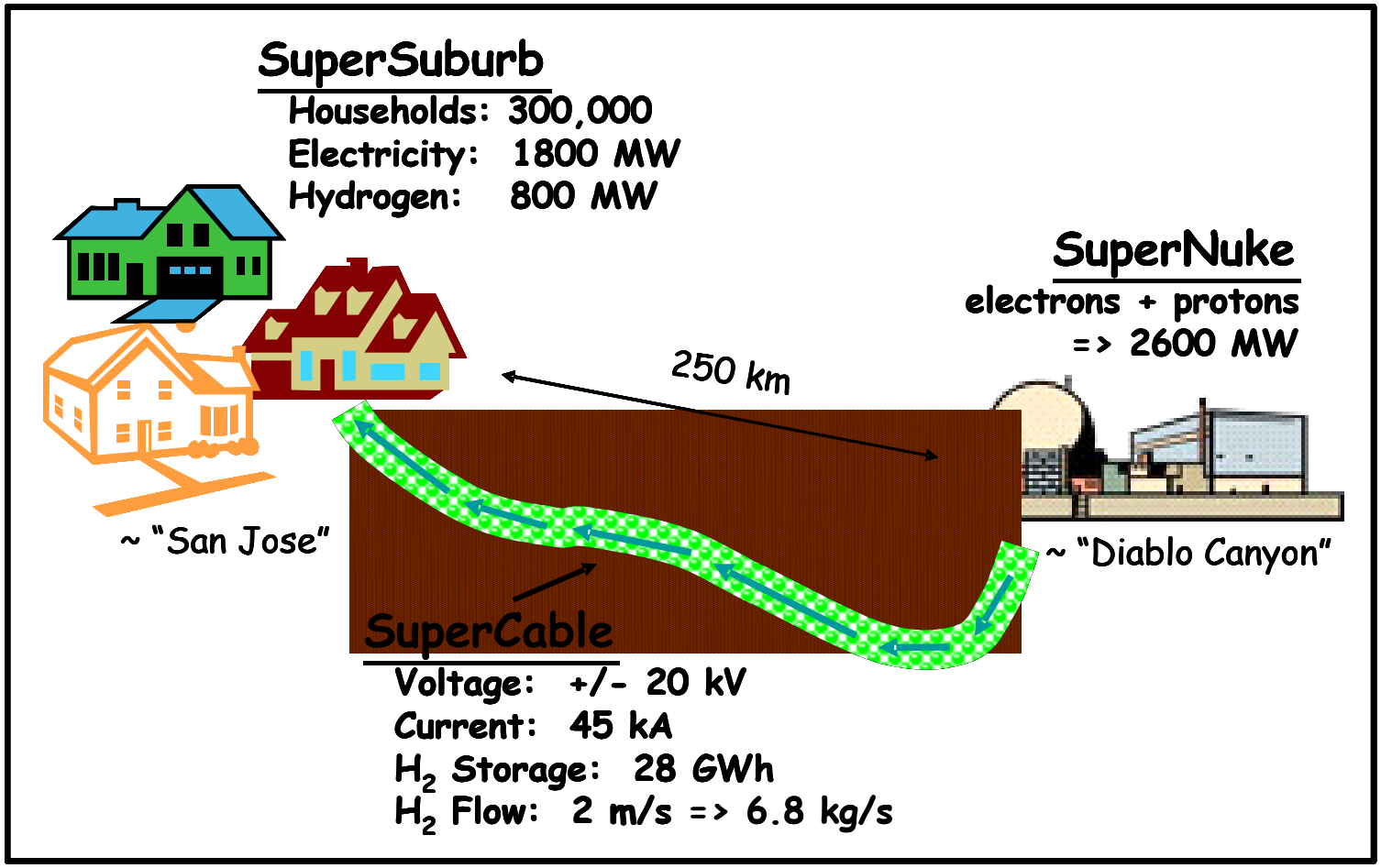
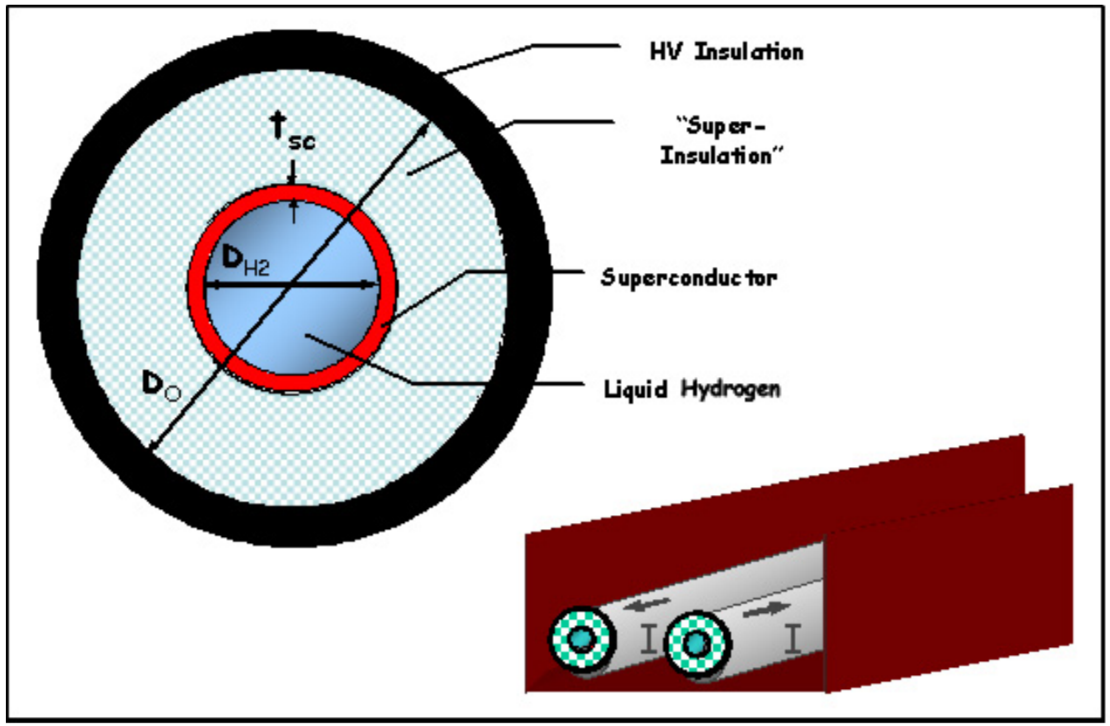

SuperSuburb
Households: 300,000
Electricity: 1800 MW
Hydrogen: 800 MW
SuperNuke
electrons + protons
=> 2600 MW
250 km
~ "San Jose"
~ "Diablo Canyon"
SuperCable
Voltage: +/- 20 kV
Current: 45 kA
H_2 Storage: 28 GWh
H_2 Flow: 2 m/s => 6.8 kg/s

Fig. 3. The Monopole SuperCable. Note that this embodiment requires two units.



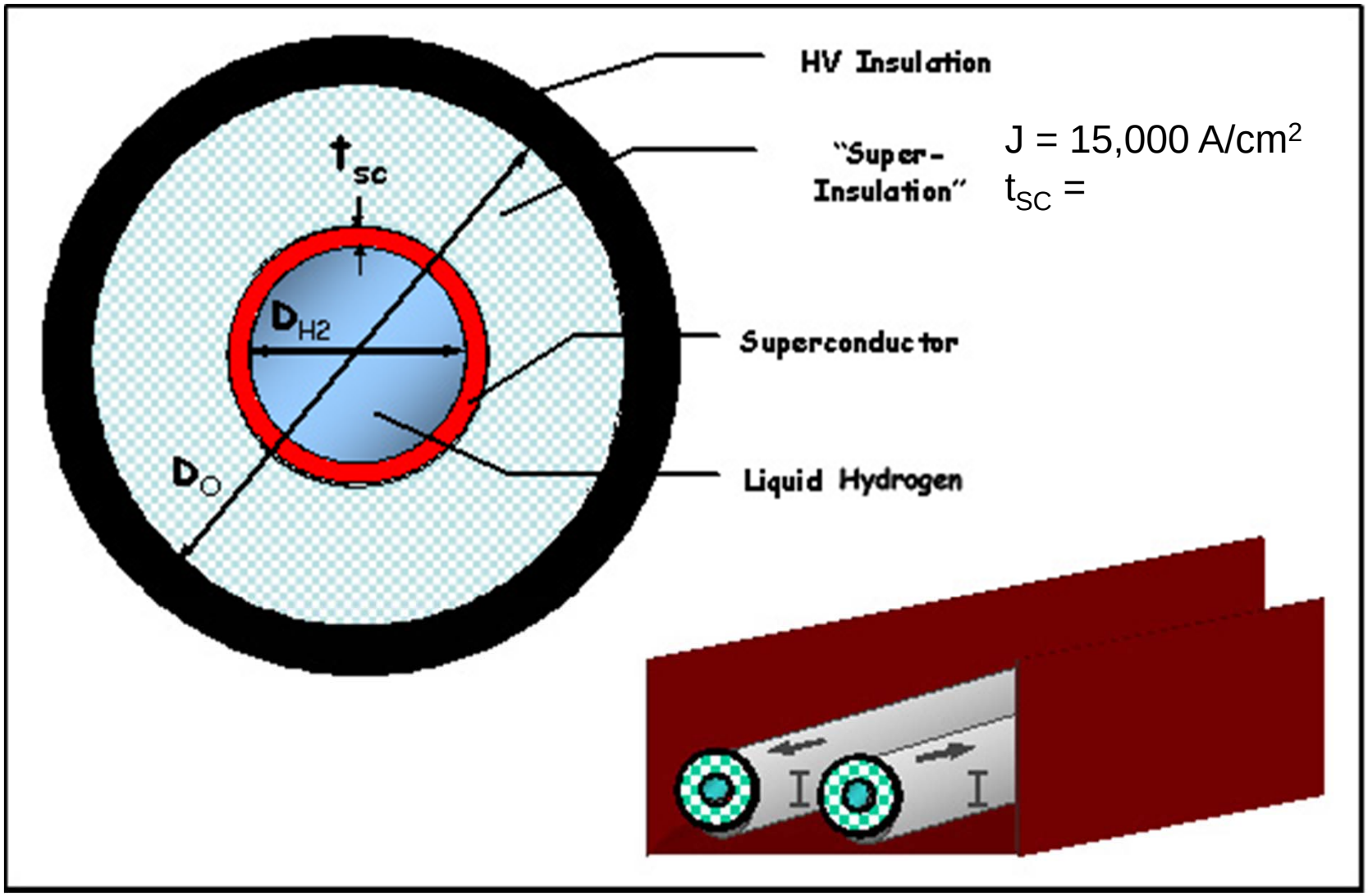

HV Insulation
"Super-
Insulation"
J = 15,000 A/cm2
tSC =
tSC
DH2
Superconductor
DO
Liquid Hydrogen
I
I

Table VII. SuperSuburb SuperCable Monopole Physical Parameters (See Figs. 2-3)

Operating Current Density, J (A/cm^2)	t_{SC} (cm)	Hydrogen Flow Rate (m/s)	D_{H2} (cm)	Maximum Magnetic Field (T)
15, 000	0.05	2	17.5	0.10

Table VIII. SuperSuburb SuperCable Monopole Minutia and Costs (See SuperSuburb Excel Spreadsheet)

HTSC Tape Parameters							
Width (mm)	Thickness (mm)	Length (m)	Total No. Tapes	Tape Req'd (km)	Approx. No. Splices	Tape C/P ($/kA×m)	HTSC Cost (M$)
4	0.25	800	~300	~80,000	~100,000	50	591

Table IX. SuperSuburb SuperCable Monopole Thermal Loss Budget Based on Specifications and Dimensions from Figs. 2-3 and Table VII (All units in W/m - See SuperSuburb Excel Spreadsheet)

Radiation	Flow Friction	Addenda Loss	1.0 % Ripple	Total
0.70	0.49	0.20	0.09	1.48

Table X. SuperSuburb SuperCable Monopole Refrigeration Requirements Based on Specifications and Dimensions from Figs. 2-3, Table VII and Table IX (See SuperSuburb Excel Spreadsheet)

Temperature Rise (K/km)	Total Rise for 250 km SuperCable (K)	Permissible Rise Prior to Re-Cool (K)	Total Number of Cooling Stations Required
0.045	11	1	11

Station Spacing (km)	Cooling Power per Station (kW)	Cost of Heat Uplift ($/kW)	Per Station Cost (K$)	Total Station Cost (M$)
22.25	32.9	5	164	1.85

Table XI. SuperSuburb SuperCable Economic Factors. Note that the Capital Equipment Costs from Tables VIII and X have been doubled to reflect that two monopoles are actually in service. (See SuperSuburb Excel Spreadsheet)

Cost of Electricity ($/kWh)	Line Losses in Conventional Transmission (%)	Annual Value of Losses on 1800 MW Transmission Line (M$)	Additional Capital Costs for HTSC and Refrigeration (M$)	FRB Discount Rate (%)	Period for ROI (Years)
0.05	5 %	39.4	1185	5.5 %	18