Energy and Water required for Health
in Housing on the Anangu Pitjantjatjara Lands, North West of South Australia

Produced for UPK, Nganampa Health Council November 1997

P A U L P H O L E R O S

PO Box 495 Newport Beach, 2106 NSW: PH (02) 9973 1316 FX (02) 9973 1316 November 1997

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Example of what quantity of services will be required and what it will cost to ensure access to the health benefits ONLY of an individual house

(with energy costs from the Office of Energy January 1997 and notes on all assumptions regarding use)

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Table 1 Energy and Water required for Health in Housing on the Anangu Pitjantjatjara Lands: Prepared for Nganampa Health Council November 1997

Health Concern and associated health hardware	POWER MIN kW/DAY	POWER MAX kW/ DAY	TOTAL WATER MIN. LITRES / DAY	TOTAL WATER MAX. LITRES / DAY	MIN. COST OF ELECTRICITY $/kWhr (estimated from tariff schedule)	MAX. COST OF ELECTRICITY $/kWhr (estimated from tariff schedule)	ELECTRIC $ COST /YEAR MIN	ELECTRIC $ COST /YEAR MAX	MIN WATER USE /YEAR Kilolitres	MAX WATER USE /YEAR Kilolitres
Washing people: the shower and hot water	1.8	4.8	150	400	0.17	0.33	$ 111.34	$ 578.86	54.75	146
Washing people: the basin or laundry tub	0	0.6	25	50	0.17	0.33	$ 18.56	$ 72.36	9.125	18.25
Washing clothes and bedding: washing machine	0.42	4.11	90	450	0.17	0.33	$ 25.98	$ 495.65	32.85	164.25
Removing Waste: the flush toilet	0	0	30	140	0.00	0.00	$ -	$ -	10.95	51.1
Removing Waste: Total GREY WATER to be removed from the house	0	0	348	1186	0.00	0.00	$ -	$ -	0	0
Removing Waste: Total BLACK WATER to be removed from the house	0	0	30	140	0.00	0.00	$ -	$ -	0	0
Improving Nutrition: Preparing food the KITCHEN SINK cold water	0	0	43	156	0.00	0.00	$ -	$ -	15.695	56.94
Improving Nutrition: Preparing food the KITCHEN SINK hot water	1.2	1.65	40	130	0.17	0.33	$ 59.38	$ 376.26	14.6	47.45
Improving Nutrition: Cooking food the KITCHEN STOVE (4X burner cooktop)	6.4	12.8	0	0	0.17	0.33	$ 395.87	$ 1,543.63	0	0
Improving Nutrition: Cooking food the KITCHEN STOVE (OVEN)	4.8	4.8	0	0	0.17	0.33	$ 296.91	$ 578.86	0	0
Improving Nutrition: Storing food the KITCHEN FRIDGE (small-large)	1.84	2.11	0	0	0.17	0.33	$ 113.81	$ 254.46	0	0
Temperature Control: Evaporative Cooling	4.8	25.1	262	455	0.17	0.33	$ 146.57	$ 1,506.69	47.684	82.81
Temperature Control and Nutrition: Shading & food plants	0	0	200	2000	0.17	0.33	$ -	$ -	36.4	364
Temperature Control: Active Heating of the house	18.56	82.64	0	0	0.17	0.33	$ 377.44	$ 3,276.51	0	0
Lighting : access to all health Hardware:	2.1	3.1	0	0	0.17	0.33	$ 129.90	$ 373.85	0	0
Improving Nutrition: Storing food the OPTIONAL FREEZER	1.04	1.04	0	0	0.17	0.33	$ -	$ 125.42	0	0
TOTALS per HOUSE	43	143	840	3781			$1,676	$9,183	222	931

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SUMMARY NOTES
TO EXPLAIN TABLE 1 FOR FULL DETAILS SEE THE LAST SECTION OF THIS REPORT

* Estimated minimum and maximum costs of electricity ($ /kWhr) in Table 1 are based on the South Australian Government's Office of Energy Power Tariff policy for Remote Areas dated 1/1/97.

* Minimum Power use is based on the following assumptions
  - cold water washing machine use (assumes efficient washing machine as per NTRC)
  - standard 50 litre electric hot water unit (using min. water use /house /day)
  - Evap cool 6 hrs / day at lowest fan speed
  - Electric cooking 2 of 4 hot plates for 2 hours /day
  - Electric cooking Oven for 2 hours /day
  - Electric heating 4 x 2.4 kW blow heaters 4 hrs /day
  - Fluoro/energy saving bulbs

* Maximum Power use is based on the following assumptions
  - hot water washing machine use (assumes efficient washing machine as per NTRC)
  - standard 50 litre electric hot water unit (using max. water use/ house/ day)
  - Evap cool 18 hrs / day at highest fan speed
  - Electric cooking 2 of 4 hot plates twice a day for 2 hours /day
  - Electric cooking Oven for 2 hours /day
  - Electric heating 4 x 2.4 kW blow heaters 8 hrs /day
  - Incandescent bulbs

Examples of what quantity of services are currently being used at Pipalyatjara in two Anangu Houses and two non-Anangu Teachers houses with large differences in populations using the houses

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Table 2 Actual Power Use in 2 Anangu Houses and 2 Teacher Houses compared with Actual Remote Area Power Costs
Prepared for UPK, Nganampa Health Council November 1997

Costs from Office of Energy 1/1/97 Comparison of 2 teacher houses and 2 Anangu Houses at Pipalyatjara House during a summer and winter period 1995 .	Electricity Meter reading 3/7/95	Electricity Meter reading 25/10	Electricity Meter reading 31/1	Actual kW used over first 3 month period and winter period and heating required	Actual kW used over second 3 month period teacher holidays and summer period little heating	kWh/day first quarter	kWh/day second quarter	Actual Remote Area Power Tariff Cost of Power/ kWh	Total Cost of Power first quarter	Total Cost of Power second quarter	Total Cost of Power per year (est= 2 x Min qtr + 2 x Max qtr)
Anangu House 3	18982	22223	25015	3241	2792	28.43	28.49	domestic	$584.07	$462.64	$2,093
Anangu House 6	27847	32492	36163	4645	3671	40.75	37.46	domestic	$1,196.50	$719.09	$3,831
Teachers House 6953	17955	19986	20441	2031	455	17.82	4.64	state	$ 649.41	$ 160.85	$1,621
Teachers House 6913	29955	30625	30999	670	374	5.88	3.82	state	$ 227.50	$ 135.74	$726
Estimates from Existing Survey Data(assumes heating and cooling energy) See Chart 1											Min. per year $1676 Max. per year $9183
Method for Calculating Total Cost of Power/quarter											
Power used/quarter kW	4645										
Total Cost of Power/Quarter	$1,196.50										
Domestic Tariff Schedule	kWhrs	Rate $									
Supply Charge / qtr		19.8									
First 2000kWh/qtr@$0.1343	4645	0.1343									
Next 1000kWh/qtr @ $0.22	2645	0.0857									
Next 1000kWh/qtr @ $0.314	1645	0.094									
All additional kWh/ qtr @ $0.58	645	0.266									

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Energy and Power Costs of Existing and Ideal Houses

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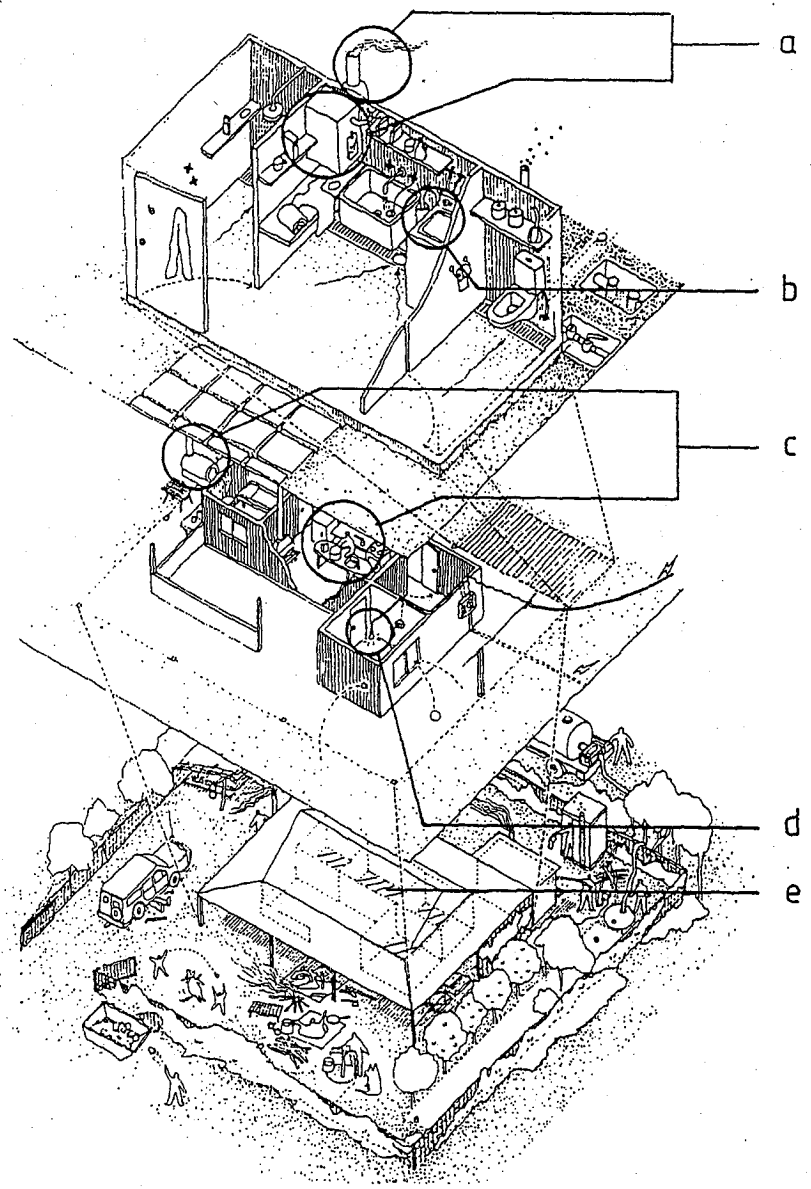

	Health Hardware and Quantities required / day / house	Existing Houses	Ideal Future House
a	**Ability to wash people and clothes and bedding** (Hot Water) **440 litres(max)** (includes hot water used in shower, basin/tub, kitchen and washing machine)	**Electric hot water system** (50 litre storage unit) cost to heat 440 litres of water: **= $3.48** /day	**Heat Exchange type unit** 250 L cost to heat 440 litres of water: **=$2.07** /day **Optional Chip Heater** timber used/day/house toheat 440litres of water **= 14kg**
b	**Ability to wash clothes and bedding**	**Washing Machine** **$0.17** /day for 3 cycles/day @ 100 litres/ cycle	**Washing Machine** **$0.17** /day for 3 cycles/day @ 100 litres/ cycle
c	**Ability to Store,prepare and cook food**	**Large fridge** 400-500 litre with combined freezer 2-3 star energy rating with fair seals **=$2.00** /day	**Large fridge** 400-500 litre with combined freezer 5 star energy rating **=$0.70** /day
		Stove to run 2 electric cooktop burners (one large one small) twice a day for two hours **= $4.22** / day	**Stove** gas cooktop with similar cooking times and overall energy use **=$0.70c** / day
		Oven electric oven run for 2hrs/day **=$1.58**	**Outside drum oven** timber to heat outside oven for 2hrs/day **= 1.2 kg**
d	**Lights to ensure access to Health hardware**	**Lights** assumes 50w fluorescent in essential wet areas and bedrooms **=$0.69c** /day	**Lights** assumes 50w fluorescent in essential wet areas and bedrooms **=$0.69c** /day
e	**Heating and Cooling**	**Winter Heating (for 120 days per year)** the total house using electric blow heaters for 8 hrs of each day **= $27.25** / day	**Winter Heating (for 120 days per year)** the total house using an electric heat pump system for 8 hrs of each day **=$9.57** / day
		Summer Evaporative Cooling (for 180 days per year) of the total house using electricity for 18 hrs of each day **=$8.25** / day	**Summer Cooling (for 180 days per year)** of the total house using an electric heat pump for 18 hrs of each day **= $2.89** /day
	Total/day in winter **Total/day in summer** **Total/day in midseason**	**$39.40** **$20.40** **$12.15**	**$13.90** **$7.22** **$4.33**

Total maximum electricity cost @ $0.33/kWh* for an existing house on the Anangu Pitjantjatjara Lands = $9186/year/house with periods of heating and cooling

Total maximum electricity cost @ $0.33/kWh* for an ideal future house on the Anangu Pitjantjatjara Lands = $3249/year/house with periods of heating and cooling

* Estimate of average cost and quarterly charges based on the South Australian Government's Office of Energy Power Tariff policy for Remote Areas dated 1/1/97

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Energy and Water Use graphs

(Note: all power costs based on maximum $0.33 /kWh and minimum $0.17 /kWh)

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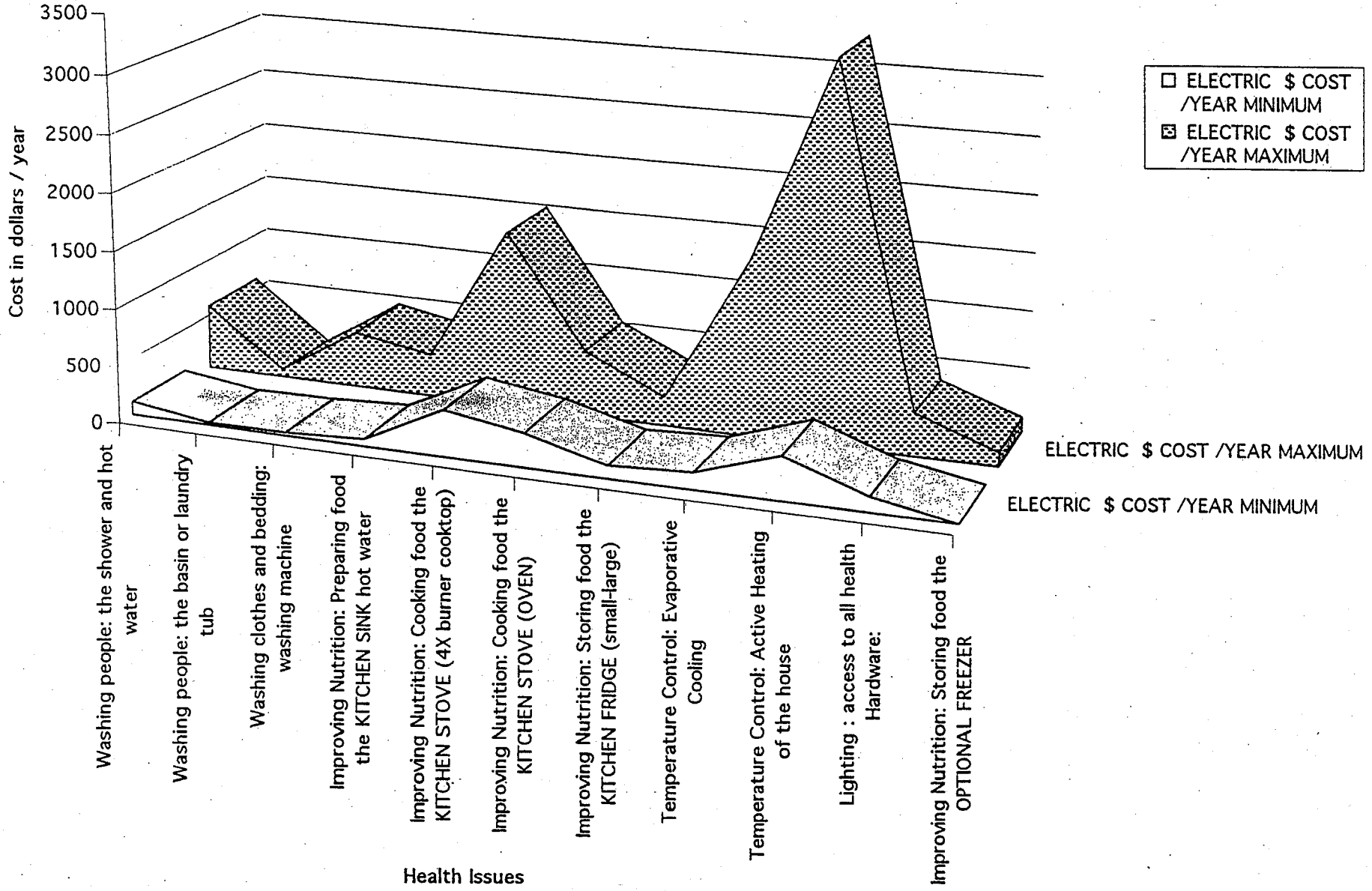
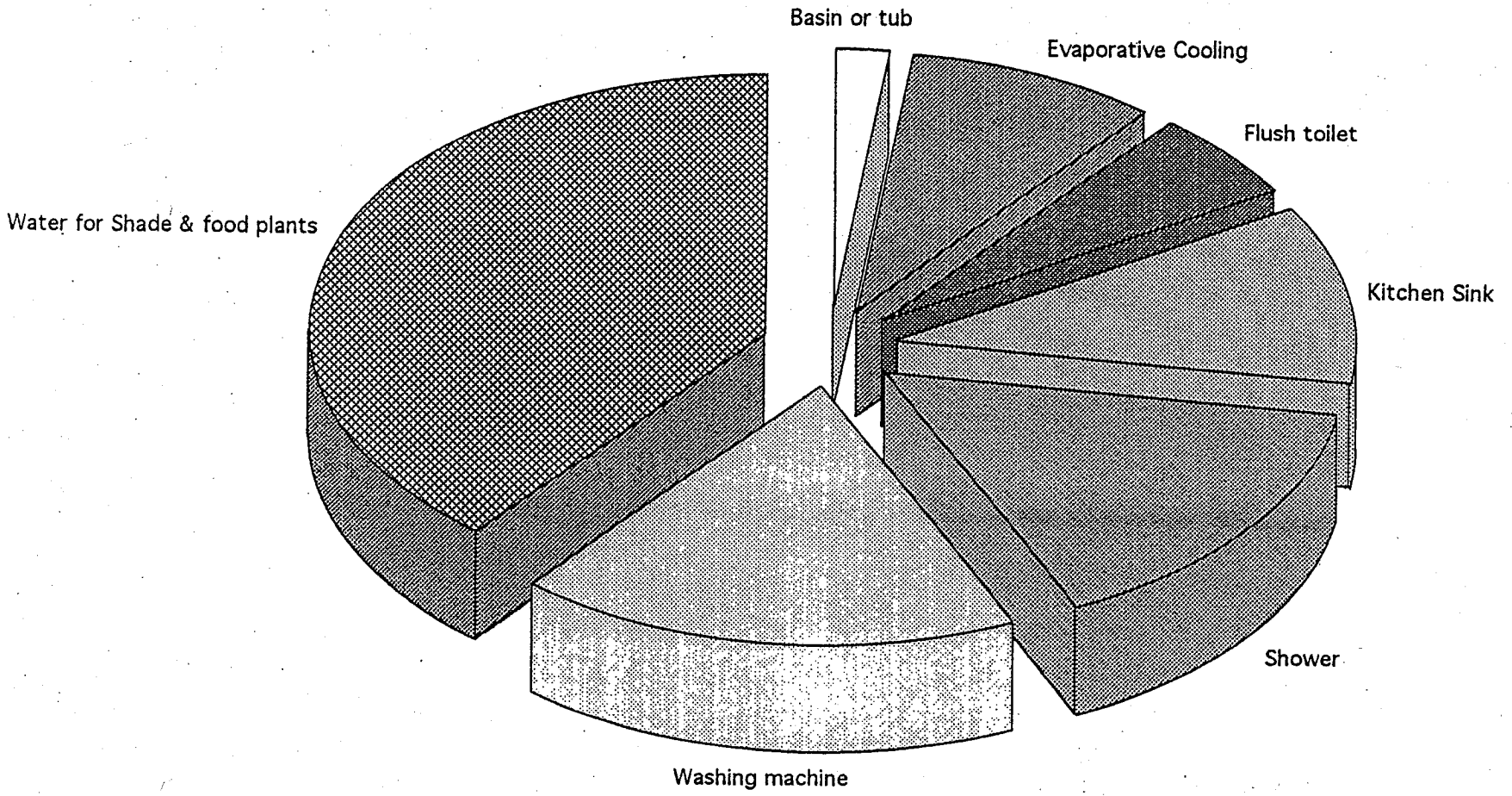
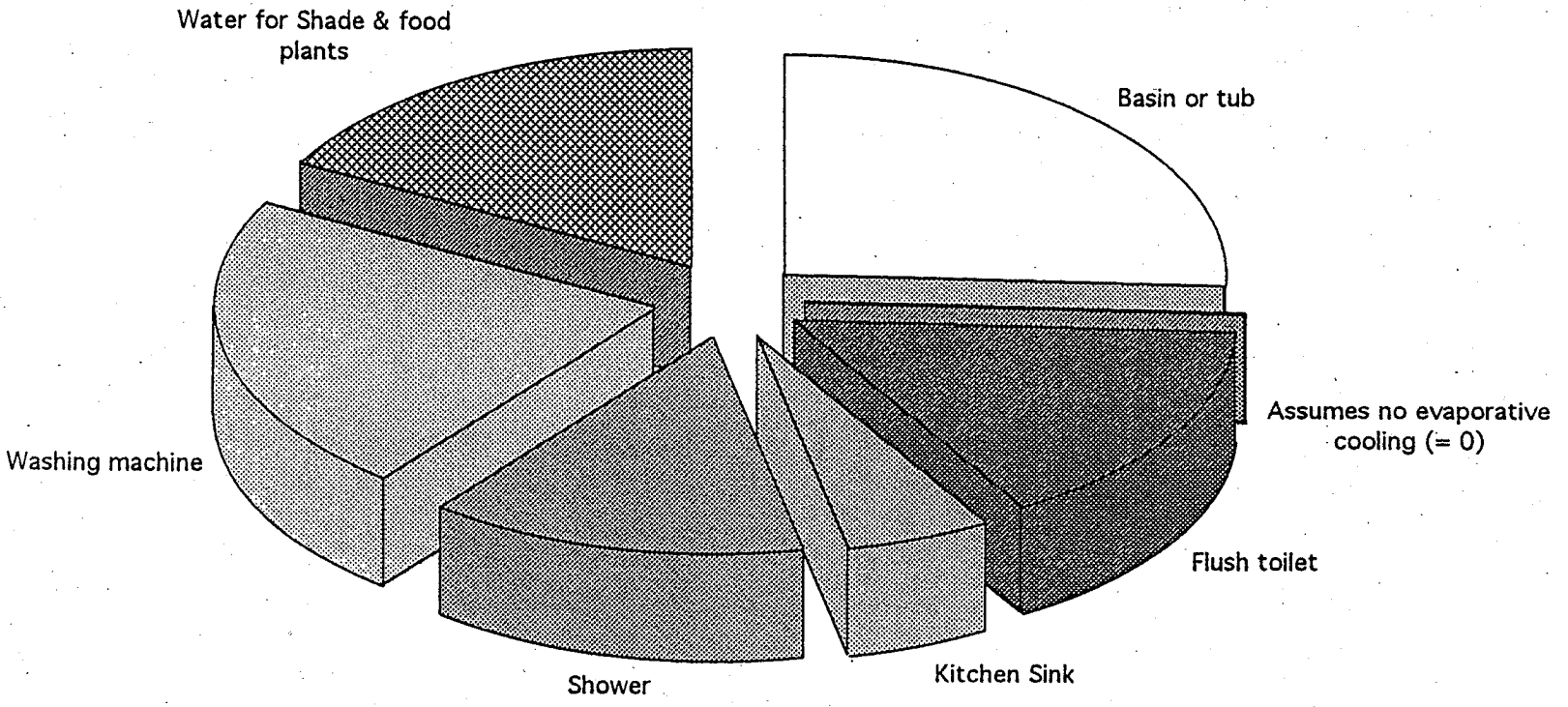
Chart 1 Maximum and Minimum energy Costs

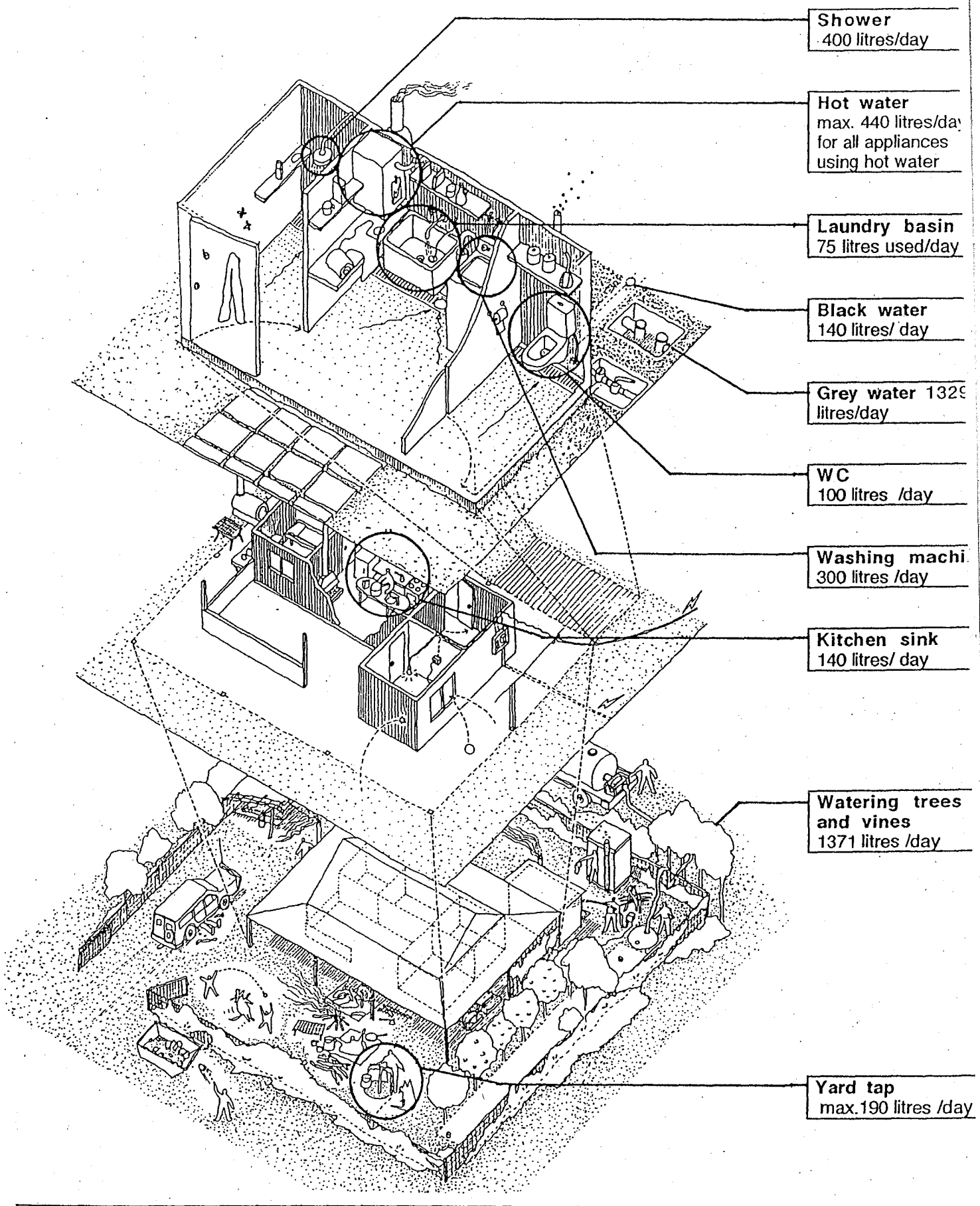


Proportion Of Water Use for Maximum Water Consumption in an Anangu House on the AP Lands (Total Maximum Water Use=928,000 litres/ year)



Proportion of Water Use for Minimum Water Consumption in an Anangu House on the AP Lands / Year
(Total Minimum Water Used = 209,000 litres / year)





Total max. water used = 2575 litres/day/house
Total max. hot water for all appliances = 440 litres/day/house
Total Grey water= 1329 litres/day/house
Total black water= 140 litres/day/house

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Summary of Research Data and assumptions regarding use and costs

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Power and Water for Health in Houses on the AP Lands

These notes were prepared for Nganampa Health Council detailing previous research and assumptions for estimating the energy and water required to be used in housing to ensure the ability of Anangu to carry out the most essential UPK Healthy Living Practices on the Anangu Pitjatjantjara Lands, North West South Australia.

Health issue and related hardware	Water Use Min - Max l/h/d and information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Water Use for future design and comments	Power Required / day and comments
Shower Washing Hot Water	86 - 466 litres / day Waste Water Report 1997 Hot water system recharge times from H for H 1992 * Hot Water Trial currently commenced by the NTRC may indicate lower energy use HWS able to perform in poor water conditions etc How to ration water in large capacity units (200-300 litre) to ensure access to showering by many people ?	Due to the large variation in use patterns assume a range of 150 - 400 litres/house/day of shower water Assume the split of cold to hot water for showering is 50 % hot 50% cold	To heat 75 -200 litres of hot water to 60C System 1 (generally the existing system) 50 litre electric unit estimate 1.5 recharges / day for 75 litres @ 1/2 hour per recharge x 2.4 kW element = 1.8 kW / day 4 recharges / day for 200 litres @ 1/2 hour per recharge x 2.4 kW element systems hours / recharge = 1.8 - 4.8 kW / day System 2 250 L Heat Exchange unit (info from Quantum Link Energy Systems Catalogue July 1995) 3.6 kWhrs to heat 250l, therefore 0.0144 kWhrs to heat 1 litre. estimate 1.1 kWhrs /day to heat to 75l 2.9 kWhrs/day to heat 200 litres. System 3 185L Gas unit info from Hardie Dux Technical Manual March 1996 28 MJ/hr gas consumption. 113 l/hr recovery rate 113/28 =1MJ to raise 4 litres of water to 60C 19MJ to heat 75 litres 50 MJ/hr to heat 200l.

Health issue and related hardware	Water Use Min - Max l/h/d and information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Water Use for future design and comments	Power Required / day and comments
Washing children basin and or Laundry tub Hot Water	No Data Available from the following Waste Water Report 1997 as it was difficult to estimate quantities from "lost water" figures	assume 50 litres cold water and 25 litres hot water for all functions / day	To heat 25 litres of hot water to 60C System 1 (existing) 50 litre electric unit estimate .5 recharges / day for 25 litres @ 1/2 hour per recharge x 2.4 kW element = .6 kW / day System 2 250 L Heat Exchange unit (info from Quantum Link Energy Systems Catalogue July 1995) 3.6 kWhrs to heat 250l, therefore 0.0144 kWhrs to heat 1 litre. estimate 0.4 kWhrs /day to heat to 25l System 3 185L Gas unit info from Hardie Dux Technical Manual March 1996 28 MJ/hr gas consumption. 113 l/hr recovery rate 113/28 =1MJ to raise 4 litres of water to 60C 6 MJ to heat 25 litres

Health issue and related hardware	Water Use Min - Max l/h/d and Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Water Use for future design and comments	Power Required / day and comments
Washing Clothes and Bedding Hot Water	Washing machine total water usage max 2.4 -6.2 cycles average of 4.8 at approx 100 litres /cycle approx 480 litres /day Washing Machine Report NTRC April 1997 179-584 litres Waste Water Report 1997	Assume 300 litres per day total water use If cold wash is used NO hot water component. If hot wash is selected approx 50% of water is supplied from the HWS =150l/h/d total hot water usage.	To heat 150 litres of hot water to 60C System 1 (existing) 50 litre electric unit estimate 3 recharges / day for 150 litres @1/2 hour per recharge x 2.4 kW element =3.6 kW / day System 2 250 L Heat Exchange unit (info from Quantum Link Energy Systems Catalogue July 1995) 3.6 kWhrs to heat 250l, therefore 0.0144 kWhrs to heat 1 litre. estimate 2.4 kWhrs /day to heat to 150l System 3 185L Gas unit info from Hardie Dux Technical Manual March 1996 28 MJ/hr gas consumption. 113 l/hr recovery rate 113/28 =1MJ to raise 4 litres of water to 60C 36 MJ to heat 150 litres

Health issue and related hardware	**Water Use Min - Max l/h/d and information source** *New Data / info that may lead to future adjustment of these estimates	**Estimated Water Use for future design and comments**	**Power Required / day and comments**
Preparing Food Kitchen Sink Hot water	Kitchen sink 65 litres /house /day Waste Water Report 1997	Kitchen sink 65 litres /house /day hot water only	To heat 65 litres of hot water to 60C System 1 (existing) 50 litre electric unit 1.3 recharges / day for 65 litres @1/2 hour per recharge x2.4 kW element =1.56 kW /day System 2 250 L Heat Exchange unit (info from Quantum Link Energy Systems Catalogue July 1995) 3.6 kWhrs to heat 250l, therefore 0.0144 kWhrs to heat 1 litre. estimate .9 kWhrs /day to heat to 65l System 3 185L Gas unit info from Hardie Dux Technical Manual March 1996 28 MJ/hr gas consumption. 113 l/hr recovery rate 113/28 =1MJ to raise 4 litres of water to 60C 16 MJ to heat 65 litres

Health issue and related hardware	Water Use Min - Max / house /day and information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Water Use for future design and comments	Power Required / day and comments
Summary **Total hot water use** for washing, clothes, food preparation	Minimum from shower(min), basin &/or laundry tub, kitchen sink, and assume washing machine uses cold water only Maximum from shower(max), basin &/or laundry tub, kitchen sink, and assume washing machine uses hot water Wood chip heater as by CAT fuel figures from H for H 1992 testing at Pipalyatjara Water raised to around 45 C only but similar volumes used for this calculation	Min 165 litres /day Max 440 litres /day	To heat 165-440 litres of hot water to 60C System 1 (existing) 50 litre electric unit estimate 3.3 recharges / day for 165 litres @1/2 hour per rechargex 2.4 kW element= 4kW /d. min 8.8 recharges / day for 440 litres @ 1/2 hour per recharge x 2.4 kW element systems hours / recharge = 10.5 kW / day max System 2 250 L Heat Exchange unit (info from Quantum Link Energy Systems Catalogue July 1995) 3.6 kWhrs to heat 250l, therefore 0.0144 kWhrs to heat 1 litre. estimate 2.3 kWhrs /day to heat to 165 litres min 6.3 kWhrs/day to heat 440 litres.max System 3 185L Gas unit info from Hardie Dux Technical Manual March 1996 28 MJ/hr gas consumption. 113 l/hr recovery rate 113/28 =1MJ to raise 4 litres of water to 60C 41 MJ to heat 165 litres min 110 MJ/hr to heat 440 litres max System 4 Wood chip heater as by CAT 135 litre total water 50%cold,50% hot takes 2kg wood to heat 65 litres water, takes 0.0325 kg to heat 1 litre of water 5.36 kg to heat 165 litres min 14.3 kg to heat 440 litres max

Health issue and related hardware	Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Use for future design and comments	Power Required / day and comments
Washing Clothes and bedding : washing machine power	2.4 -6.2 cycles average of 4.8 at approx 100 litres /cycle approx 480 litres /day Washing Machine Report NTRC April 1997 Washing Machine Report NTRC *Energy Guide 1992 assumes 1 use per day on warm water 90% of this figure is water heating **NTRC Washing Machine Report (Speed Queen , Maytag)	3 cycles / day and water use (total) of approx 100 litres / cycle More machines in communities may decrease cycles per house per day in the future Kilogram load capacity of the commercial machines is significantly greater as is the ability to wash blankets etc for similar running costs	Domestic Range* Min Small Twin Tub 500 kW / year* 500/365=1.37kW/d* Less hotwater energy =90/100kw =1.23kW/load for hot water energy Nett energy for a cold wash =.14kWh/ cycle 3 loads per day =.42 kW/d for max 4kg loads or 0.11kW/kg/d Max automatic top loader 630 kWh / year * 630/365=1.73*90/100kW/d 1.56 kW =0.17 cold wash *3loads per day =.51 kW/d for max 5 kg or 0.10 kW/kg/d Commercial Top Loader Automatic as per NTRC Trial ** 0.10kWh per cycle *3loads per day =.30 kW/d this is for 7 kg loads .04kW/kg/d

Health issue and related hardware	Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Use for future design and comments	Power Required / day and comments
Store Prepare and cook food :Kitchen Stove Electric	Current houses have full electric stoves St George info sheet 1996 No current use data available	Cooktop Min Use assume: 2 burners for two hours (one large and one small) Max Use assume: 2 burners twice a day for 2 hours (one large and one small) Oven Assume oven used 2 hours a day (with timer switch set for 2 hr cut off)	Cooktop 2 x plates =(1x2kW +1x1.2kW) x2hrs =6.4kW/day min use 2 x plates =(1x 2kW +1 x 1.2kW) x 2hrs x twice a day =12.8 kW/day/ mijn use Oven 2.4kw *2hrs = 4.8 kW /day Increase fire wood cropping and growth and encourage fuel stoves and outdoor cooking
Store Prepare and cook food :Kitchen Stove Gas	Gas stove and oven No current use data available Possible future trial : full gas stove system OR gas cooktop and electric oven One large 45kg gas cylinder contains approx 2000 MJ or on the use rates shown about 50 days supply of cooking gas	Max Use assume cooktop 2 burners twice a day for 2 hours (one large and one small) and oven 2 hours a day	=6.4 kW/d *3.6MJ = 23.0 MJ/day =4.8 kW /d *3.6MJ = 17.3MJ/day Total gas use 40 MJ /day Increase fire wood cropping and growth and encourage fuel stoves and outdoor cooking

Health issue and related hardware	Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Use for future design and comments	Power Required / day and comments
Store Prepare and cook food: Kitchen Fridge	Info from NSW Energy Guide 1993	Medium 200-350 litre with 2 doors combined freezer Selected unit : 4 star energy rating 348 litre capacity Large 400-500 litre with combined freezer Selected unit :	Medium 670 kW/a = 670.00/365=1.84kW/d (or 1.8400/384 litres 0.0048 kW/litre) Large 770 kW/a= 770.00/365 = 2.11kW/d (or 2.110/442 litres 0.005 kW/litre)
	There is a large range of fridges and freezers with large power / litre variation NTRC should examine as for WM and HW trials	5 star energy rating 442 litre Chest Freezer Selected unit : 6 star rating for 276 litre	Chest freezers only (Use chest freezers only and insulated boxes for fridges) 380 kW/a = 380.00/365=1.04 kW/day (or 1.040/276litres 0.004 kW/litre frozen)

Health issue and related hardware	Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Use for future design and comments	Power Required / day and comments
Lights to all areas to support the above and bedroom lights	No current use data available Lights are a constant source of failure most commonly due to incandescent bulb failure NOT all compact fluoro energy saving lights are recommended for generated power by the manufacturers	Minimum essential lights only 1 x shower 1 x WC 1 x laundry 1 x kitchen 1 x living all on for 6 hrs / day Bedroom Lights: 4 bedrooms 1 light in each for 3 hrs / day	Maximum use with 75 w incandescent bulbs Essential 5 *6*.075=2.2 Bedroom 4*3*.075=0.9 Total =3.1kWh/day Minimum 50 w fluoro or compact fluoro(ES) Essential 5*6*.050=1.5 Bedroom 4*3*.050=0.6 Total =2.1kWh/day

Health issue and related hardware	Information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Use for future design and comments	Power Required / day and comments
Controlling Temperature Heating	Heating the House Volume of house for heating / cooling load 12*7.4+ main habitable rooms + 4.8*3.1 for kitchen not divided from lounge 88.8+14.9= 103.7 Wet Area 3.2*6=19.2 Total Enclosed Area 123 sqm For Heating: Primary 1) Main Living Area Lounge(5.1*7.4)+ kitchen(4.8*3.1) =52.6 sq m Secondary 2)Beds 3.3*7.4*2= 48.8 sq m 3) Wet areas Wet Area 3.2*6=19.2 sq m	Heating period to be minimum of 120 days per year Main Living Area Only Heat Loss Calculation through building elements (ACA guide) (based on a recent Nomadic Design) Ceilings 52.6*20= 1052.0 Ext Walls (5.2+4.8+3.2) *2.4=31.7*10= 317.0 Int to unheated rooms (7.4+7.4+4+3)*2.4=52.3*16 = 836.8 Windows 4.5*80= 360.0 Slab 52.6*10= 526.	Minimum Main Living Area Only 1052+317+836+360+526=3091+50%= 4637 Watts /1000 = 4.64 kW* energy required to heat main living area only/hr Electricity as power source efficiency of electric heat pump = 0.35kWh Say this heating is required 4 hours / day min = 4.64*0.35*4 = min 6.50 kW/day to heat main living area only using electric heat pump efficiency of electric bar radiator and electric blow heater = 1 kWh Say this heating is required 4 hours / day min = 4.64*1*4 = min 18.56 kW/day to heat main living area only using an electric bar radiator or an electric blow heater Gas as fuel efficiency of gas heater = 1.4kwh (* x3.6 to convert to Mega Joules) Say this heating is required 4 hours / day min = 4.64*1.4*4*3.6 =93.54 MJ/day to heat main living area only using gas heater Timber as fuel (divide MJ/15 to give an approximate weight in kg of timber required to provide the same energy = 93.54/15= 6.24kg/day)

Controlling Temperature Heating		Heating period to be minimum of 120 days per year	Maximum Total House approx additional 50% load By calculation energy required to heat total house/hr =10.33 kW h Electricity as power source efficiency of electric heat pump = 0.35kWh Say this heating is required 8 hours / day max = 10.33*0.35*8 =max. 29 kWh / day to heat total house using electric heat pump efficiency of electric bar radiator and electric blow heater = 1 kWh Say this heating is required 8 hours / day max = 10.33*1*8 = max 82.64 kW/day to heat main living area only using an electric bar radiator or an electric blow heater Gas as fuel efficiency of gas heater = 1.4kwh (x 3.6 to convert to Mega Joules) Say this heating is required 8 hours / day max 10.33*1.4*3.6*8 = max. 416 MJ /day to heat total house using gas heater Timber as fuel (divide MJ/15 to give an approximate weight in kg of timber required to provide the same energy = 416/15=28 kg/day)

Health issue and related hardware	Water Use Min - Max l/h/d and information source *New Data / Info that may lead to future adjustment of these estimates	Estimated Water Use for future design and comments	Power Required / day and comments
Controlling Temperature Cooling	evaporative cooling 262- 455 litres per day Water Use: Waste Water Report 1997 Power Use from Parafield Air	Cooling period to be minimum of 182 days per year 300 litres of water per day	Min 768w .768*6 =4.8kW/day Minimum assumes 6 hrs /day use and lowest speed Max 1390w 1.390*18 =25kW/day Maximum assumes 18 hrs per day use and highest speed (Fan speed and unit type varies power load)
	reverse cycle air conditioning No water Use main area of house Calculation of Load For cooling NSW Energy Guide Primary 1) Main Living Area Lounge(5.1*7.4)+ kitchen(4.8*3.1) =52.6 Secondary 2)Beds 3.3*7.4*2= 48.8 3) Wet areas Wet Area 3.2*6=19.2 Cooling Load for the Main Living Area Only 4812.0 watts or 4.8 kW required	Main Living Area Only Calculation through building elements (ACA guide) (based on a recent Nomadic Design) ceiling 52*10=520 floor 52*10=520 520 Int walls to non a/c areas 24.8*40= 992.0 Ext Walls 12*20 Windows 4.5*120= 540.0 +800 sitting room +1200 cooking Total = 4812.0watts	Both Units are designed and sized to cool a 5kW load for cooling the Main Living Area Only Minimum Use Larger more energy efficient split system Carrier 5 star rated 975 kWhs/ 500 hrs or 975.00/500=1.95kW / hour of use over 182 days an allowance of 2.75 hrs per day If the unit was run for 6 hours / day during the cooling period the energy use would increase to 1.95kW / hour x 6= 11.70 kW / day Maximum Use Small Less Energy Efficient in the wall unit 5 star rating Teco 6700 rated 1235 kWhs / 500 hours or 1235.00/500=2.47kW / hour of use over 182 days an allowance of 2.75 hrs per day If the unit was run for 18 hours / day during the cooling period the energy use would increase to 2.47kW / hour x18= 44.46 kW / day

	reverse cycle air conditioning		Cooling for total house Assume need 10kW load to cool total house, assume two units supply this. Min. use Larger more energy efficient split system Carrier 5 star rated 975 kWhs/ 500 hrs or 975.00/500=1.95kW / hour of use If the unit was run for 6 hours / day during the cooling period the energy use would increase to 1.95kW / hour x 6= 11.70 kW / day x 2 units = 23.4 kW/day to cool total house for 6 hrs/day Max. use Small Less Energy Efficient in the wall unit 5 star rating Teco 6700 rated 1235 kWhs / 500 hours or 1235.00/500=2.47kW / hour of use If the unit was run for 18 hours / day during the cooling period the energy use would increase to 2.47kW / hour x18= 44.46 kW / day x 2 units = 88.92 kW/day to cool total house for 18 hrs/ day

WATER SUMMARY

Health issue and related hardware	Total Water Current Min - Max l/h/d (hot and cold combined) *New Data / Info that may lead to future adjustment of these estimates	Estimated Load for future design per day and comments	Waste water generated per day and disposal method
Washing	Shower Waste Report 1997	150-400	150 - 400 grey water
Washing	Basin Tub Waste Report 1997	75	75 grey water
Washing	Clothes Waste Report 1997	300	300 grey water
Remove Waste	WC 36-139 Waste Report 1997 30-140 H for H 1992 dual flush units 6-3 litre being introduced	100	100 black water
Store Prepare and cook food Kitchen	Kitchen Sink 83-286 litres Waste Report 1997	140	140 grey water
Temp Control	Evap cooling Waste Report 1997	300	could go to landscaping NOT grey water
Temp Control Nutrition Dust Control	Planting Water required to establish 20 shade / fruit trees and 10 vines using drippers Mike Last Pitjatjantjara Council Projects provided planting water rates Min to Max 200* -2000* * all yard taps, tubs and all lost water Waste Report 1997 Min to Max 30** -190** ** yard tap only H for H 1992	1371	Based on 4 drippers / tree @4 litres / hour for 20 trees : 10 east 10 west and 10 vines (5 east and 5 west) @2 x drippers each @4 litres / hour 16L/hr*20trees*8hrs=2560 8L/hr* 10vines*8hrs =640 watering 3 days / week= (2560+640)*3 =9600/7= 1371 av. litres /day