AUSTRALIA

ATMOsphere

business case

natural refrigerants

16 May, 2016 — Melbourne

Low Charge NH_3 Refrigeration Systems

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Energy consumption reduction of

~70% [1)]

Fact or fiction?

[1)] State of the art dual compression stage, low charge NH_3 refrigeration system with evaporative condenser in comparison with industry standard, single compression stage, air cooled HFC based refrigeration system

Business case

If you have one of these:

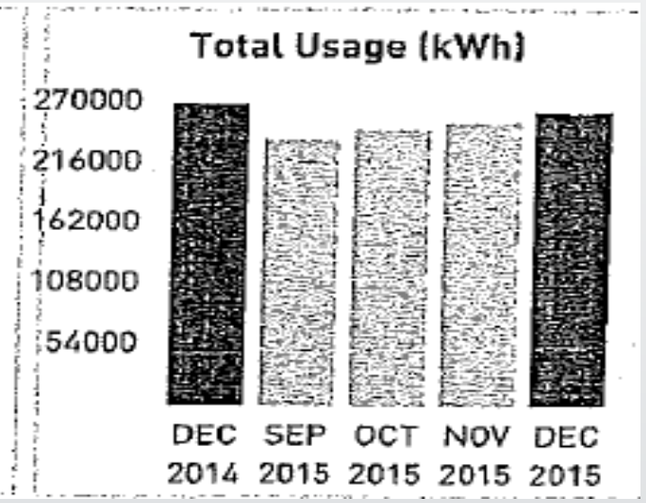
Industry standard, single stage, HFC based, air cooled refrigeration plant

Billing Period **(31 days)**	30/11/15 - 31/12/15
Security Deposit Held	NIL

Total Due	**$46 635.91**
Pay By	**25 JAN 2016**

and can continue to pay this every month for this:

Average daily cost (inc. GST)	**$1 504.38**
Average daily usage (kWh)	
This account	**8395.8**
Same time last year	**8641.7**



Business case

you can own one of these:

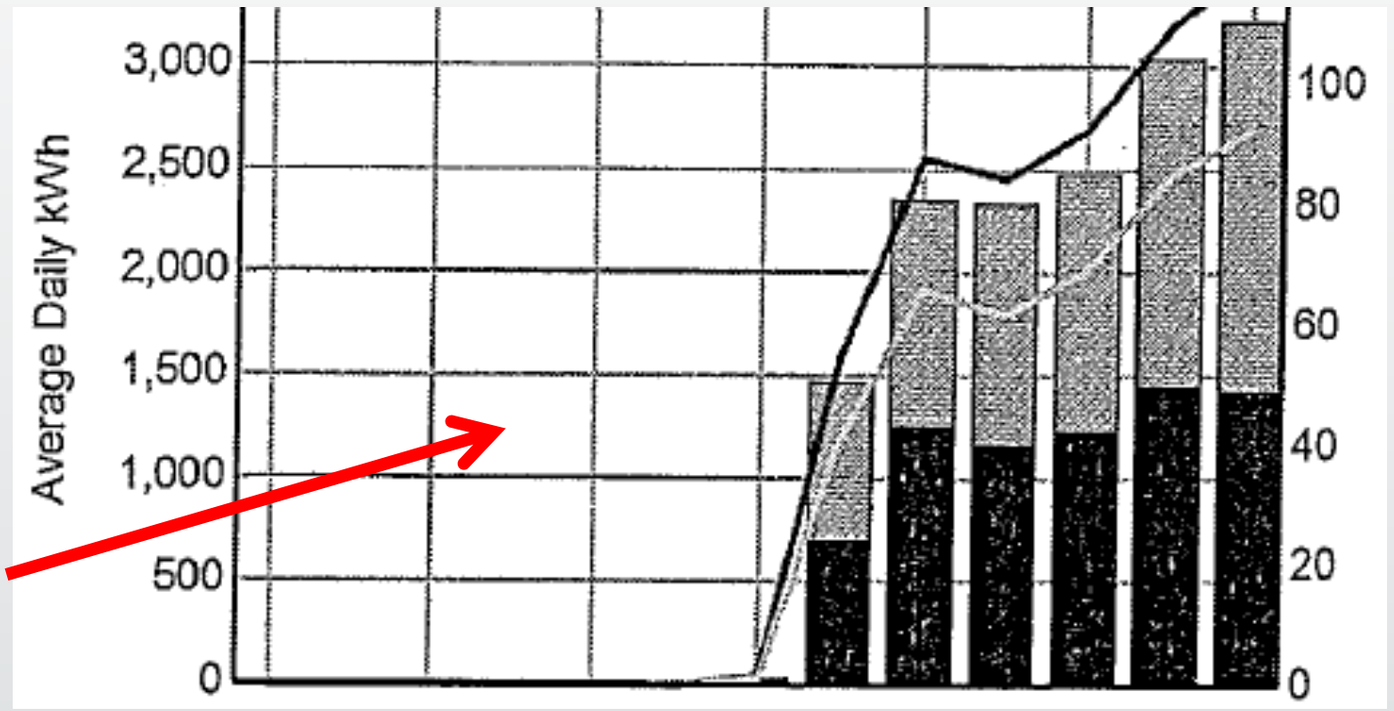
IN FIVE YEARS PAID FOR WITH ENERGY COST SAVINGS

and pay this per month after that:

Total Amount Payable	$13,382.39

State of the art low charge NH_3 refrigeration system

for this



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Business case

- Retrofit from multiple air cooled HFC units to central low charge NH_3 plant with glycol loop for medium temperature
- Investment ~A$1,900,000 (refrigerated volume ~21,000 m^3)
- Estimated SEC reduction from 143 to 38 kWh/m^3*a
- Annual cost savings A$400,000 (energy & maintenance)
- Current monthly electricity account A$43,000-A$48,000

Simple pay-back k$1900/k$400 < 5 years

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Business case

$42,000/month

Conversion cost $2,000,000

480 kg NH_3

$13,500/month

ROI = (42,000-13,500)*12/2,000,000*100=17%

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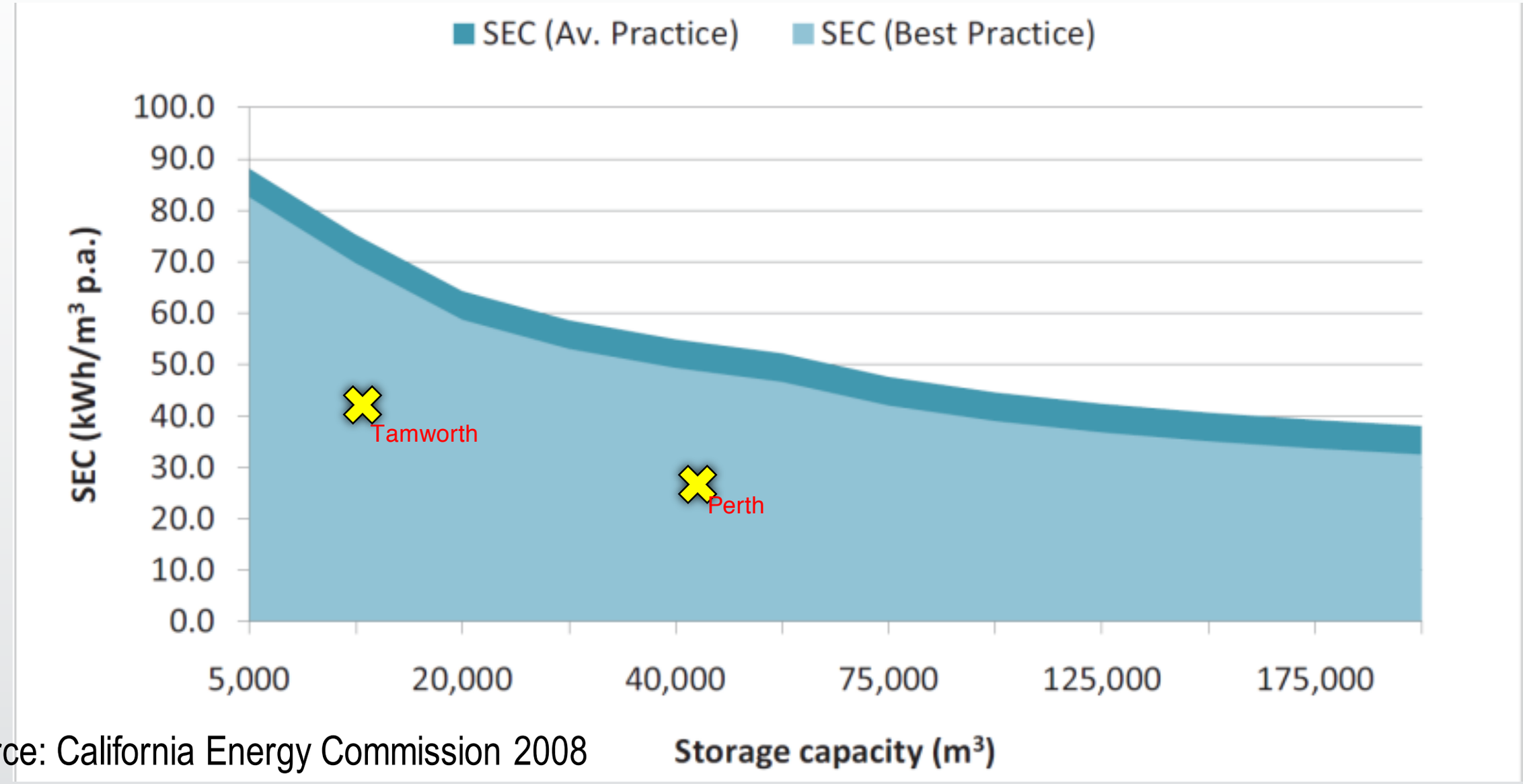
Energy Efficiency

$$SEC\ (kWh/ft^3)_{\text{average practice}} = 38.978 \times \text{storage volume}^{-0.2275}$$



Source: California Energy Commission 2008

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NH_3 versus NH_3

Plant	Annual energy consumption [MWh]	Recording period	Refrigerated volume [m³]	Spec. energy consumption (SEC) [kWh/m³*a]
Low NH_3	**410**	**1.7.14-30.6.15**	**9,474**	**43.2**
Screw	**1,135**	**1.7.14-30.6.15**	**10,748**	**105.6**

- Both building layouts ~identical
- Energy consumption is for entire facility not only NH_3 plant

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NH_3 versus NH_3

$8,000/mth.

43 kWh/m³*a

NH_3 low charge, dual stage, reciprocating compressors with VFD's

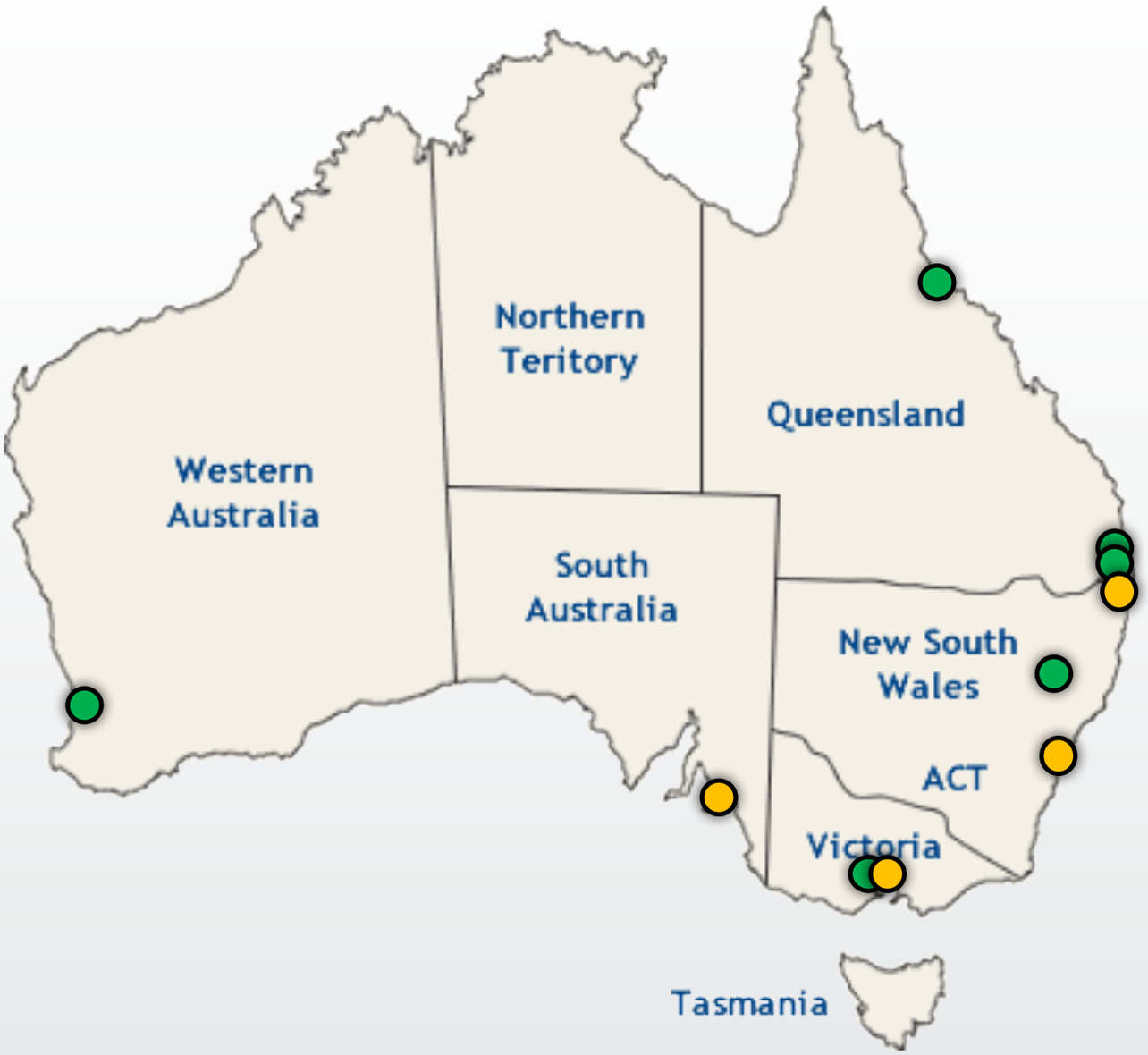
Same capital cost!

$22,000/mth.

106 kWh/m³*a

NH_3 flooded, single stage economized screw compressors

Market acceptance



- Completed
- Under construction

Discussion

- ~20% ROI on retrofits of HFC plants to low charge NH_3

- ~30-50% return on Δ investment between new low charge NH_3 and new industry standard HFC (HFC≈0.6*NH_3)

- NH_3 “inconveniences” gradually minimized/eliminated (oil, leakage risks, moisture, operators, specialist maintenance)

- Low charge NH_3 costs about the same as NH_3 liquid overfeed

- Lower than expected energy bills and 30-50 times lower air cooler NH_3 inventories drive market acceptance

“ONCE YOU GO AMMONIA YOU NEVER GO BACK”

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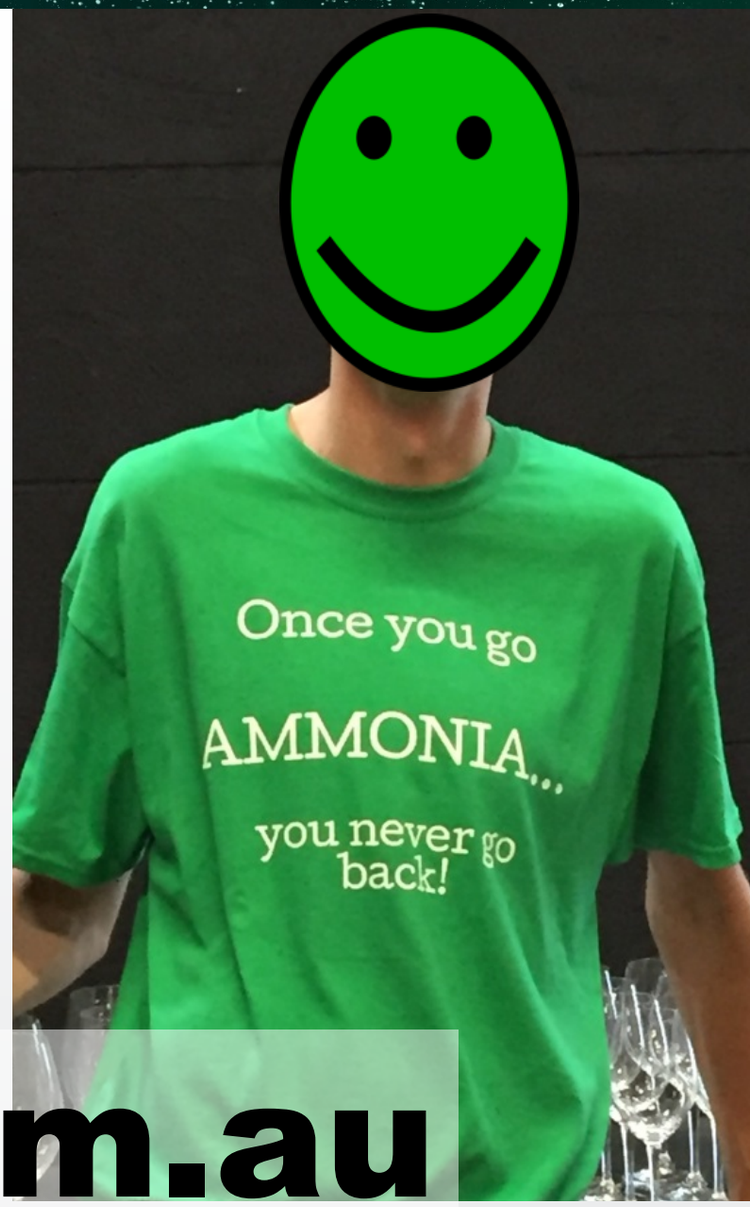
REFRIGERATION TECHNOLOGIES



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QUESTIONS?