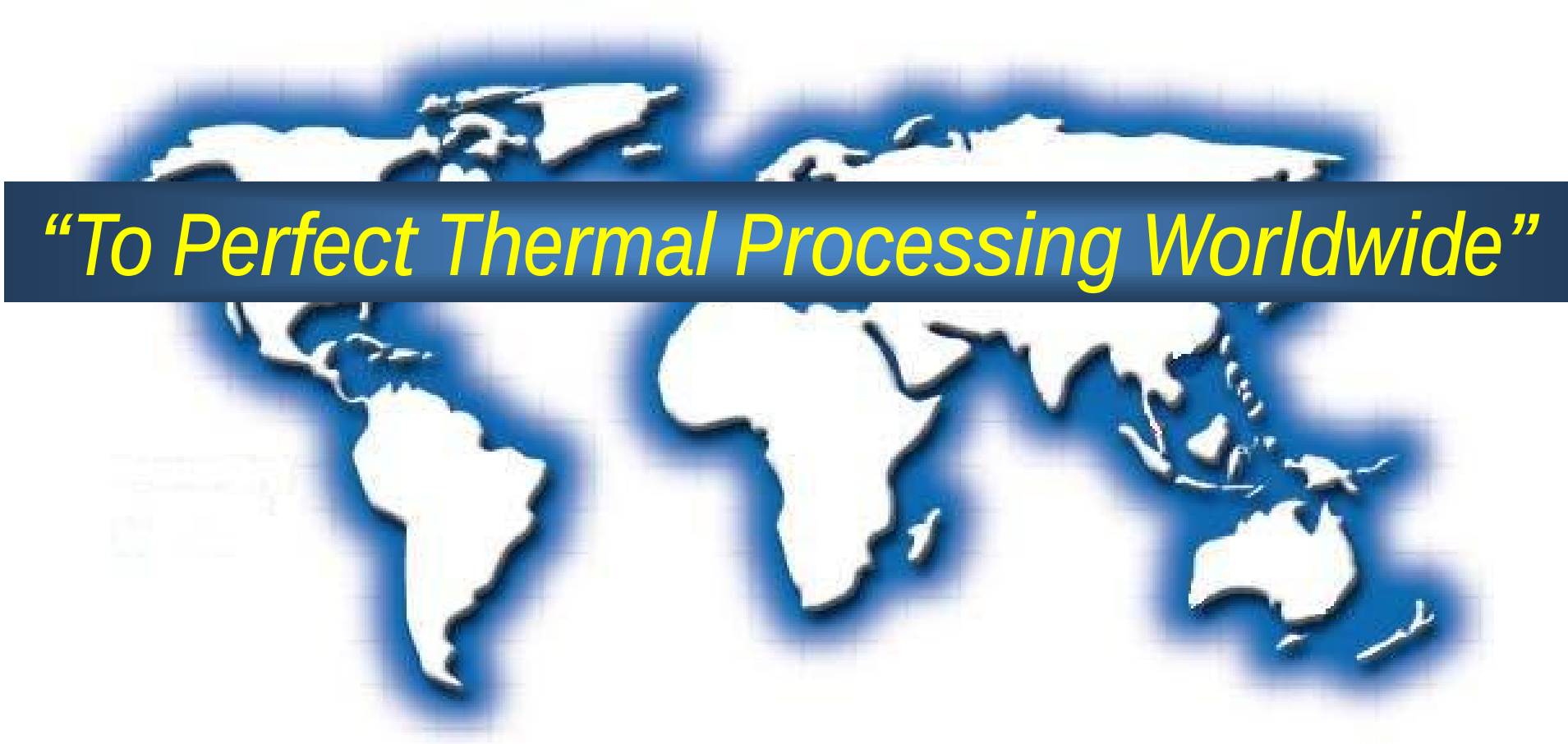
Drying key impacts for now and the future!

Graintec 25 years!

Our Mission Statement



Aeroglide History

- Nearly 70 Years of continuous improvement…beginning in 1940
- Acquired CG Sargent & Sons in 1990
- Acquired FEC in 2002
- Acquired The National Drying Company in 2004
- Joined The Bühler Group in June, 2008

Markets Served

40% Foods and Grains

30% Fishfood &Petfood

30% Industrial Applications

Drying key focus points

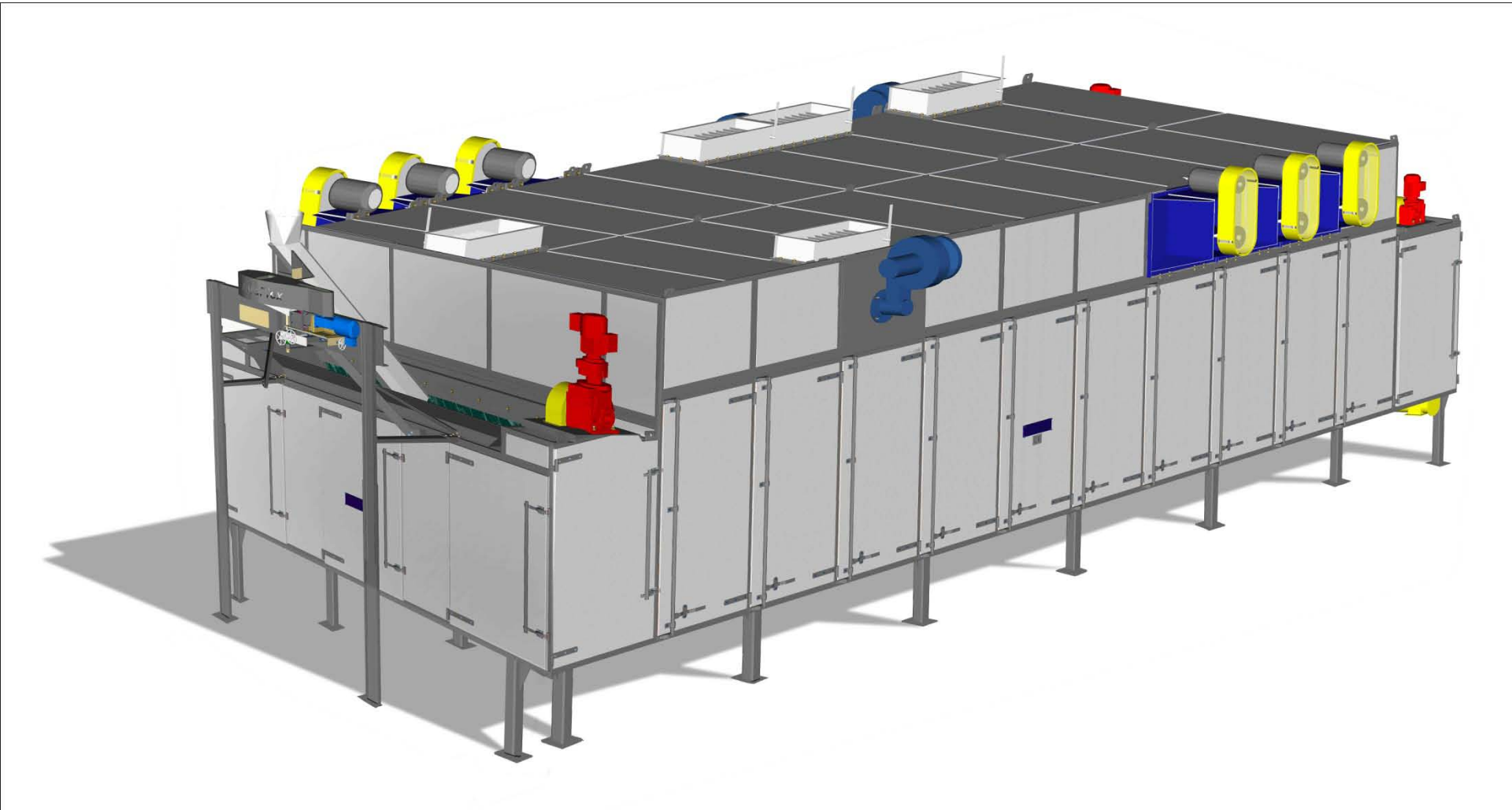
Key Criteria in Fish Feed Drying

- Pellet Temperature
- Drying Uniformity
- **Energy Consumption**
- Sanitary Drier Design
- Durability & Dependability
- **Food Safety**

Drier simulator !

Science – Heat and Mass Balance- specialist applications engineers SCIENCE

2-Pass Fishfeed Drier




35 ton/hr, 3-pass, fishfeed drier/cooler

Energy

Energy Management

- Each heat zone has independent control of make up and exhaust air. Therefore allowing control of g/kg of water in exhaust. (Absolute Humidity)
- Drier design ready for heat recovery and or cooler exhaust air systems , therefore dramatically reducing energy usage.

Energy Recovery options

- Take room air at ambient conditions = 100
- Take cooler exhaust air into drier make up, reduce overall building exhaust plus energy = 90
- Take cooler exhaust through a air to water / water to air heat exchanger to recover heat from exhaust into make up energy = 83

AquaFeed Energy Consumption

Energy Consumption

- Need to be very critical of energy consumption numbers being quoted
- There is a lot of confusing information and even some “misinformation” out there

Energy Consumption

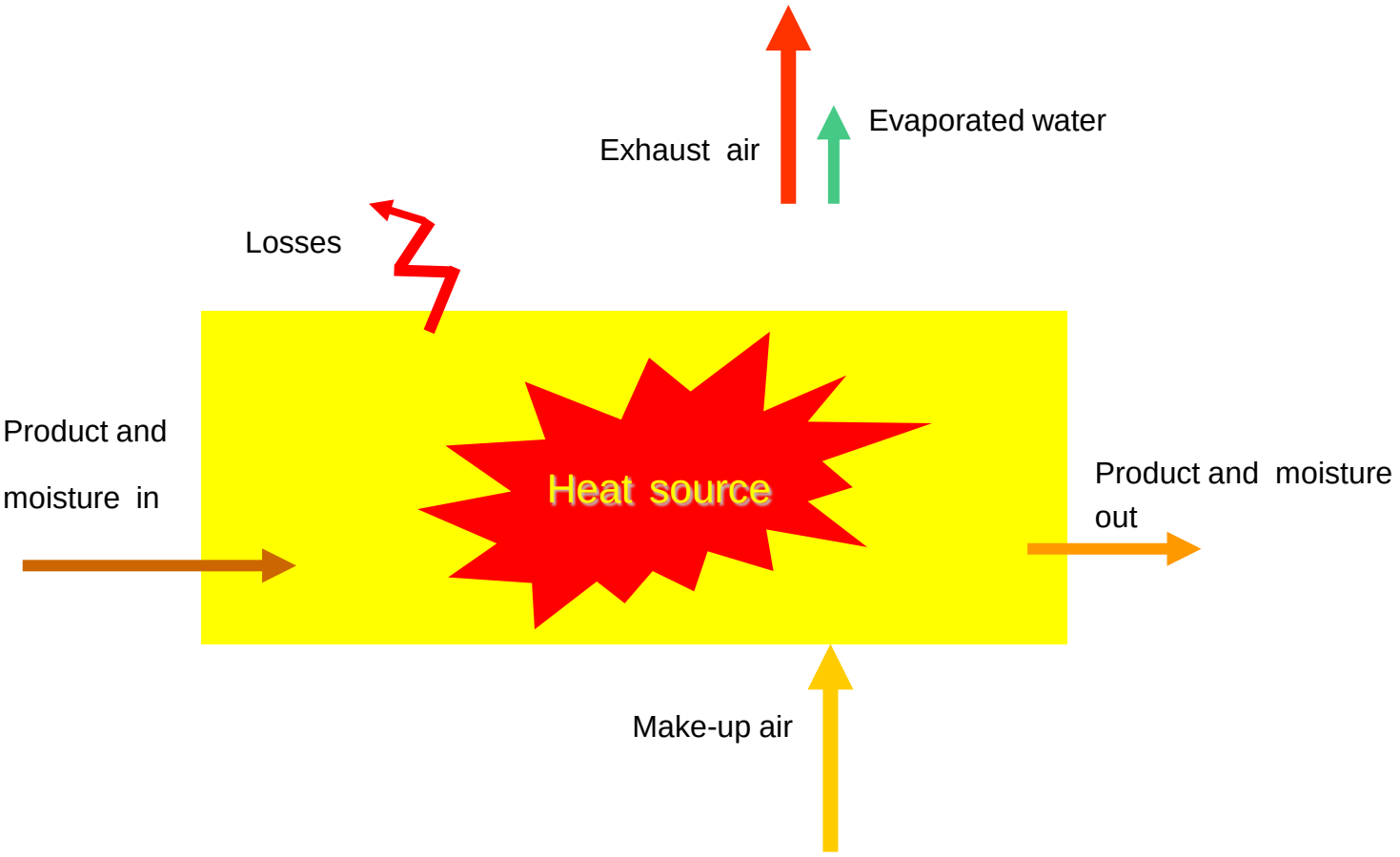
Test Case

- 22,050 lbs/hr (10000 kg/hr) input to drier
- 18415 lbs/hr (8352 kg/hr) discharge from drier
- Drying from 24% to 9%
- 3635 lbs/hr (1648 kg/hr) evaporation

Where Does the Energy Go?

- Warming up the product
- Evaporating water
- Heating of make-up air and products of combustion to exhaust temperature
- Losses

Where Does the Energy Go?



Warming Up the Product

- For the test case conditions, pellets typically enter the drier around 155°F (68°C) and leave at about 190°F (88°C)
- This requires:

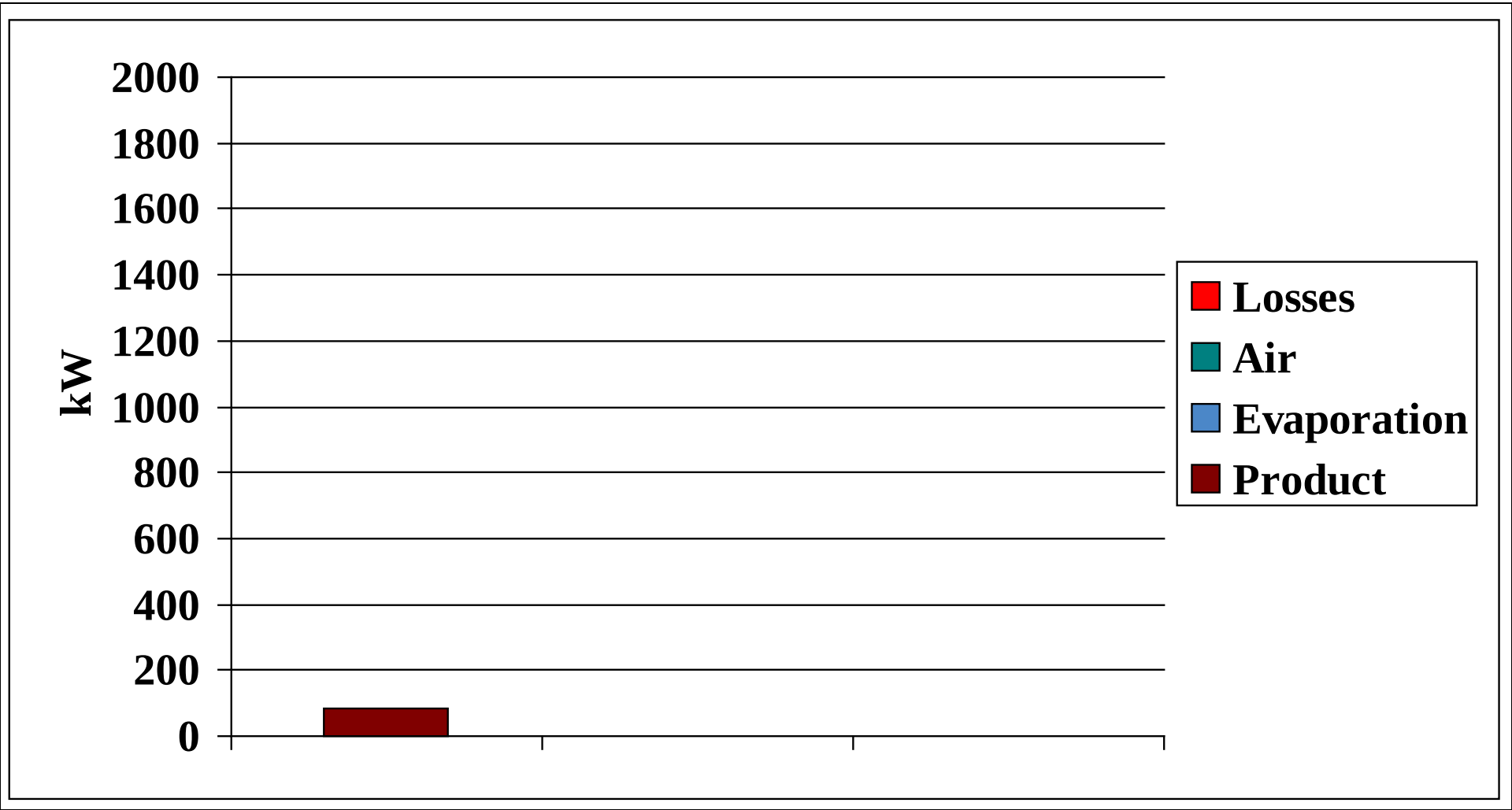
(18415 lbs/hr) x (0.45 BTU/lb-F) x (190-155 F)

(8352 kg/hr) (1hr/3600sec) x (1.83 kJ/kg-C) x (88 – 68 C)

= 290,036 BTU/hr (85 kW)

This is the same for all driers!

Where Does the Energy Go?



Evaporating Water

- For the test case conditions, 3635 lbs/hr (1648 kg/hr) water are evaporated
- This water enters the drier as liquid water at 155°F (68°C) (enthalpy=123 BTU/lbs, 286 kJ/kg) and leaves as water vapor at the exhaust temperature of 200°F (93°C) (enthalpy=1146 BTU/lbs, 2666 kJ/kg)
- This requires:

(3635 lbs/hr) x (1146 -123 BTU/lbs)

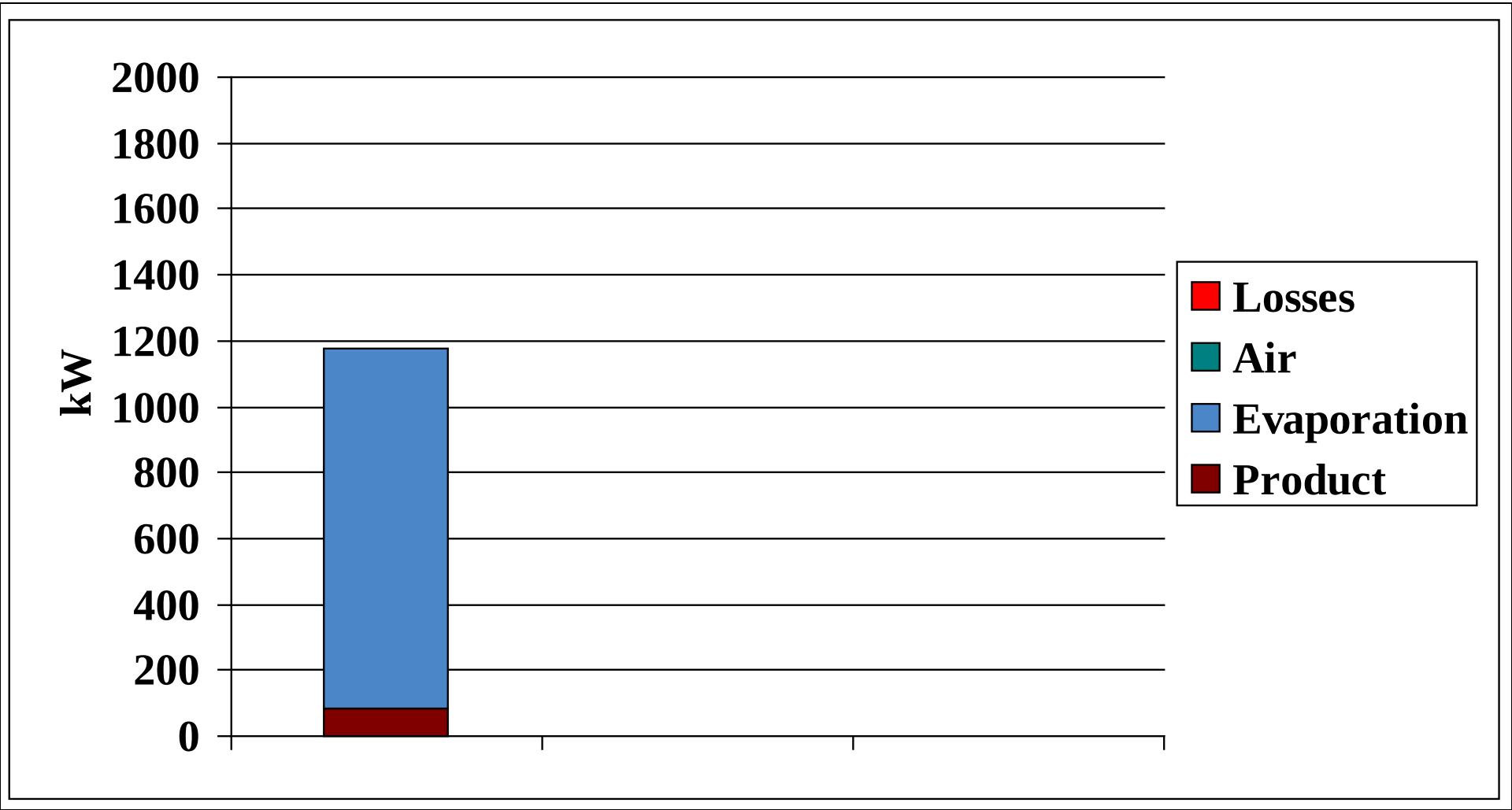
(1648 kg/hr) x (1hr/3600sec) x (2666 – 286 kJ/kg)

= 3,718,605 BTU/hr (1,090 kW)

Note that 96% of this is latent heat, therefore the exhaust temperature is almost irrelevant.

This is the same for all driers!

Where Does the Energy Go?



Heating of Make-up Air and Products of Combustion to Exhaust Temperature

- The amount of exhaust depends on the ambient and exhaust humidity, as well as the water from combustion.

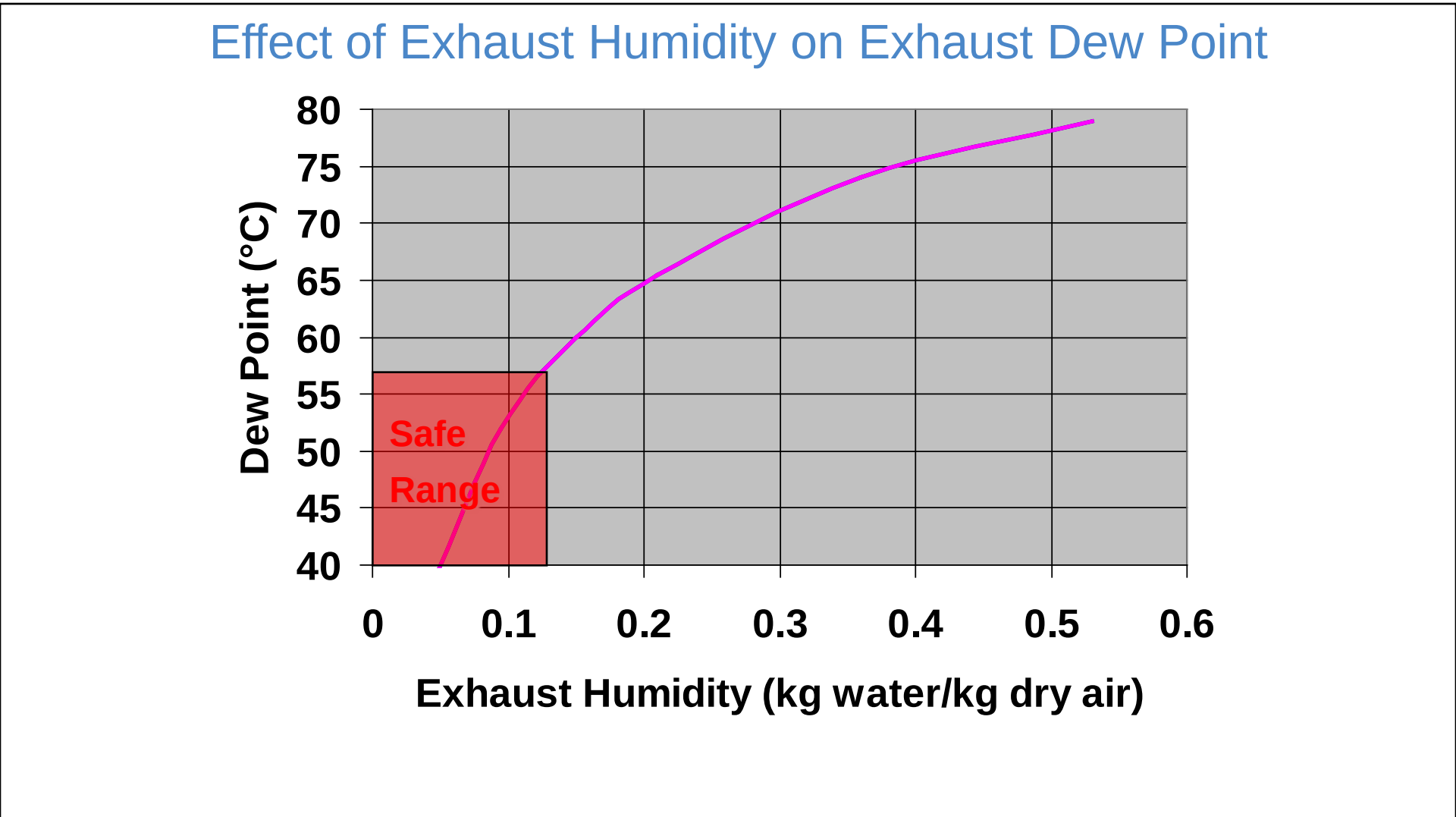
Exhaust Fan Sizing

- Exhaust fan size is based on **ambient humidity, evaporation rate, combustion water and design exhaust humidity**
- Evaporation is known, how do we determine the other 3 terms?

Exhaust Fan Sizing

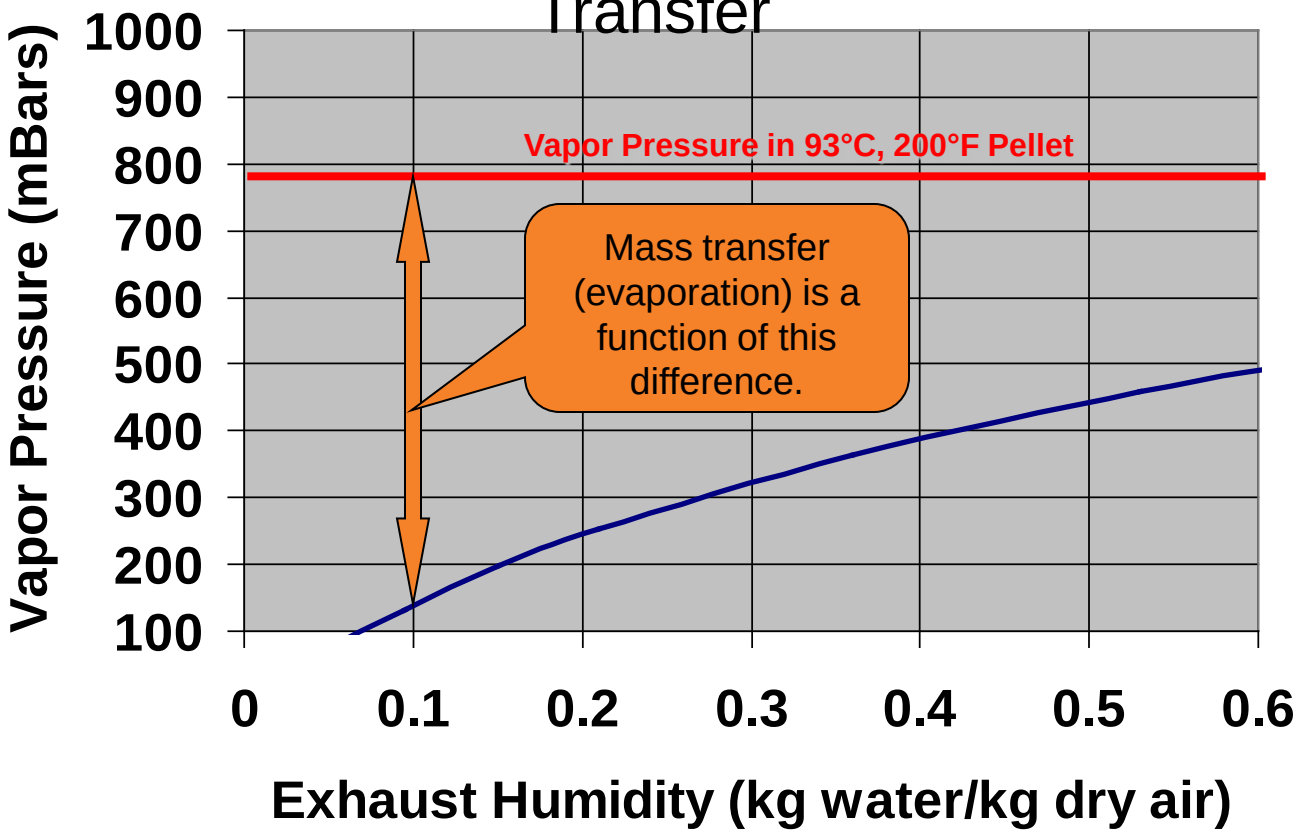
- Aeroglide exhaust fans are sized for the 3 most humid days in the summer months based on ASHRAE data for the drier location

Exhaust Humidity



Exhaust Humidity

Effect of Exhaust Humidity on Driving Force for Vapor Mass Transfer



Exhaust Fan Sizing

- Design for make-up air conditions of 11 g water/kg dry air, based on ASHRAE data for ambient conditions in location.

Heating of Make-up Air and Products of Combustion to Exhaust Temperature

- The amount of exhaust depends on the ambient and exhaust humidity, as well as the water from combustion. The ambient humidity is 0.011 lbs water/lbs dry air (11 g/kg) and the exhaust humidity is designed to be 0.1 lbs/lbs (100 g/kg)
- The amount of exhaust required to maintain these humidity levels is 788 lbs dry air/min (358 kg dry air/min)
- The energy required to heat the make-up air to the exhaust temperature depends on the make-up and exhaust temperature. The make-up is 120°F (49°C) and the exhaust is at 200°F (93°C)

Heating of Make-up Air and Products of Combustion to Exhaust Temperature

- This requires:

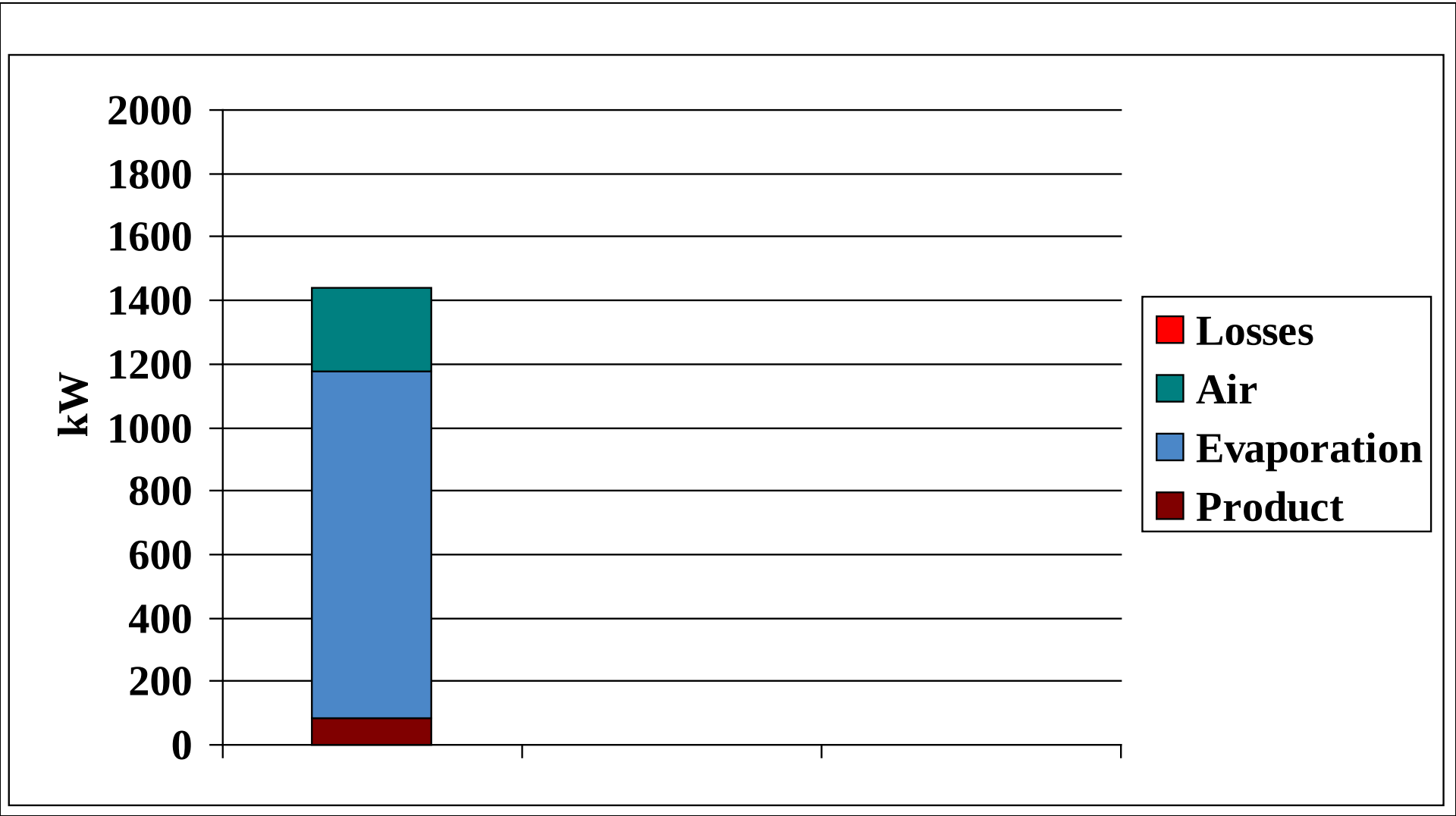
(788 lbs/min) x (60min/hr) x (0.24 BTU/lb-F) x (200-120 F)

(358 kg/min) x (1min/60sec) x (1.01 kJ/kg-C) x (93 – 49 C)

= 907,776 BTU/hr (266 kW)

This value depends on the amount of exhaust and the temperature of exhaust. The amount of exhaust is purely a function of the targeted humidity level in the drier.

Where Does the Energy Go?

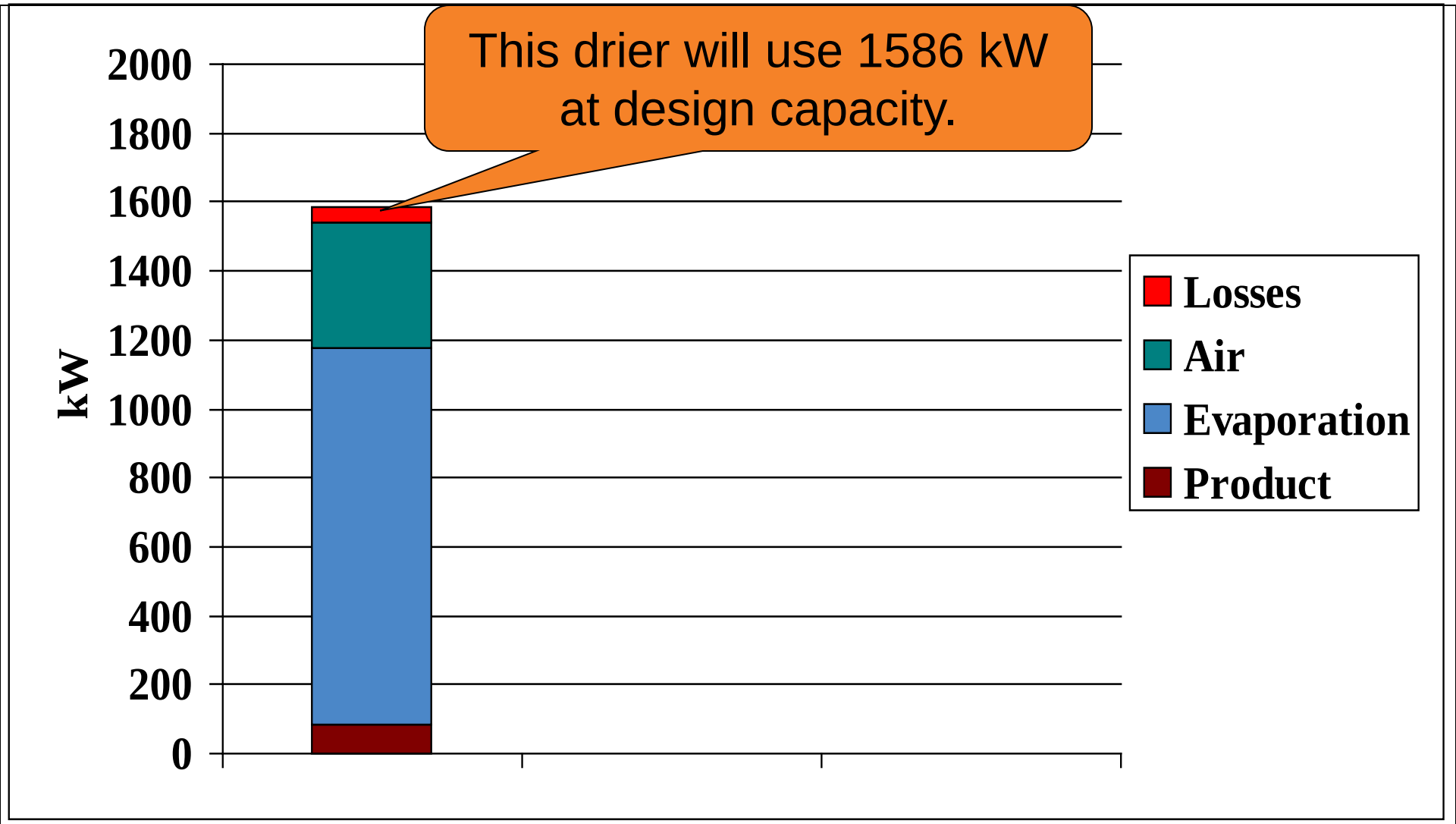


Losses

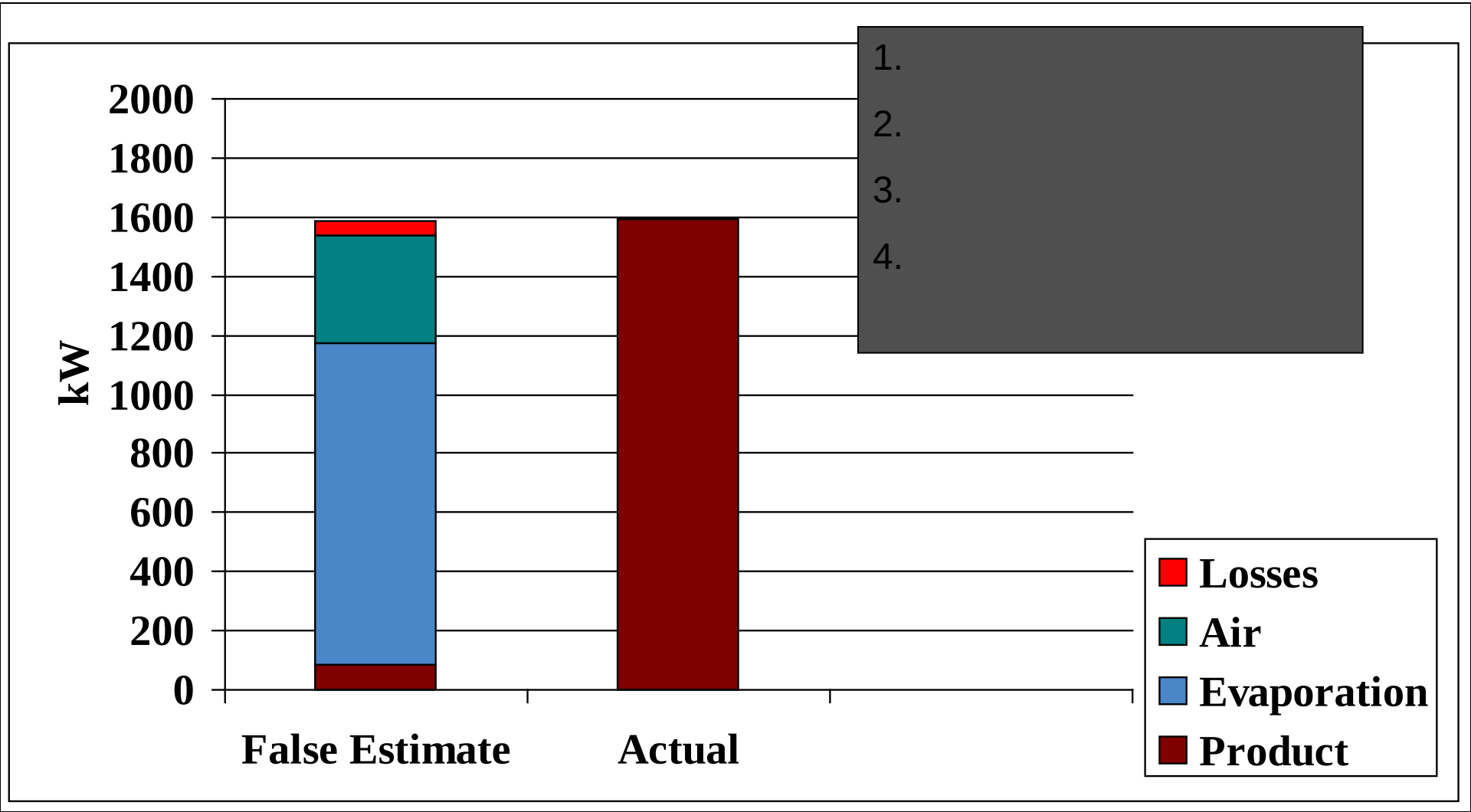
- All driers have some losses. The losses depend on the exposed area, inside and outside temperatures and insulation. The calculation of the losses is very involved, but this term typically is around 3% of the total heat for a feed drier.
- This requires:

152,450 BTU/hr (45 kW)

Where Does the Energy Go?



How Could I Make My Calculated Energy Consumption Seem Better?



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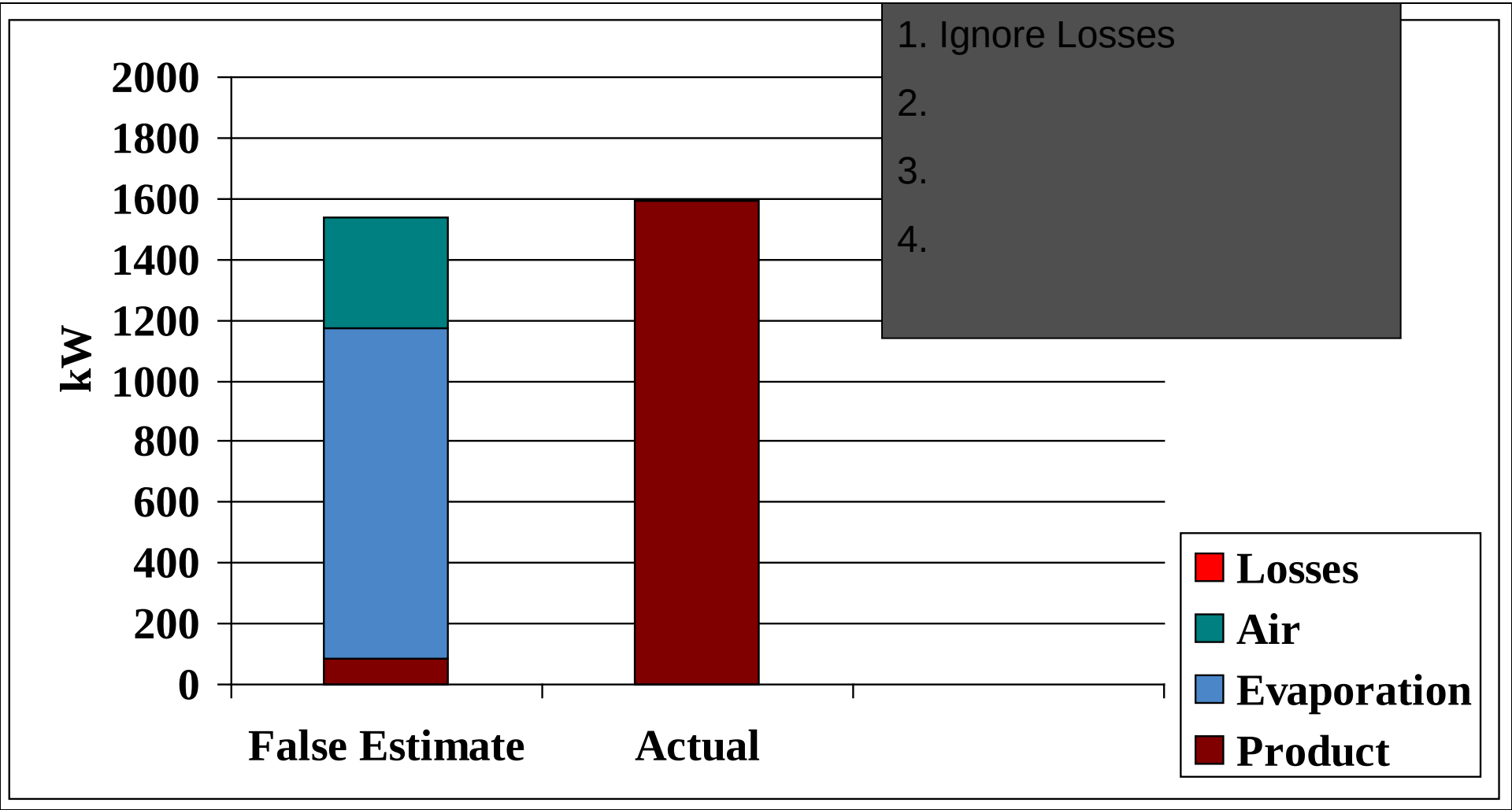
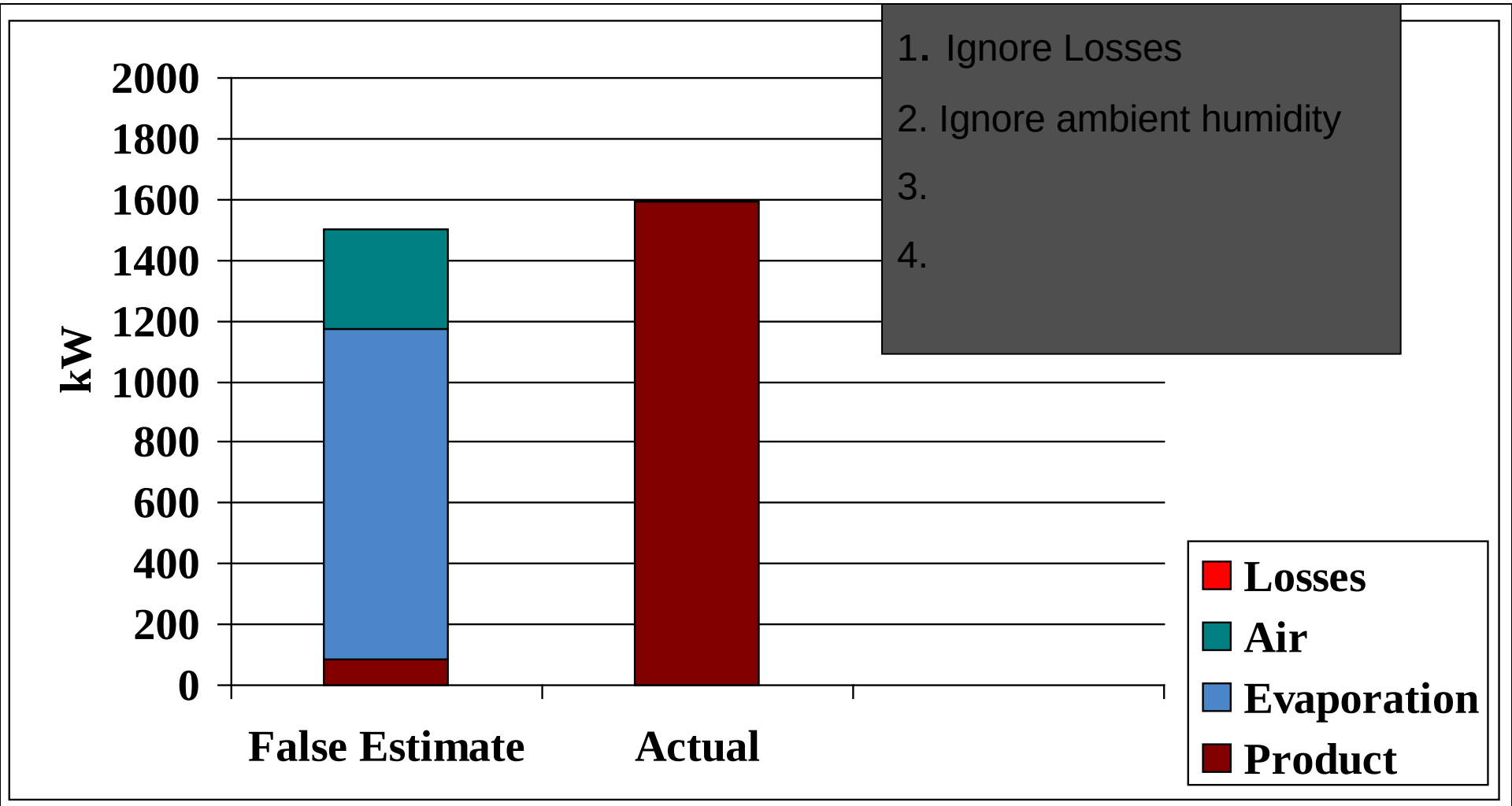


How Could I Make My Calculated Energy Consumption Seem Better?

1. Ignore Losses
2. Ignore ambient humidity
3.
4.



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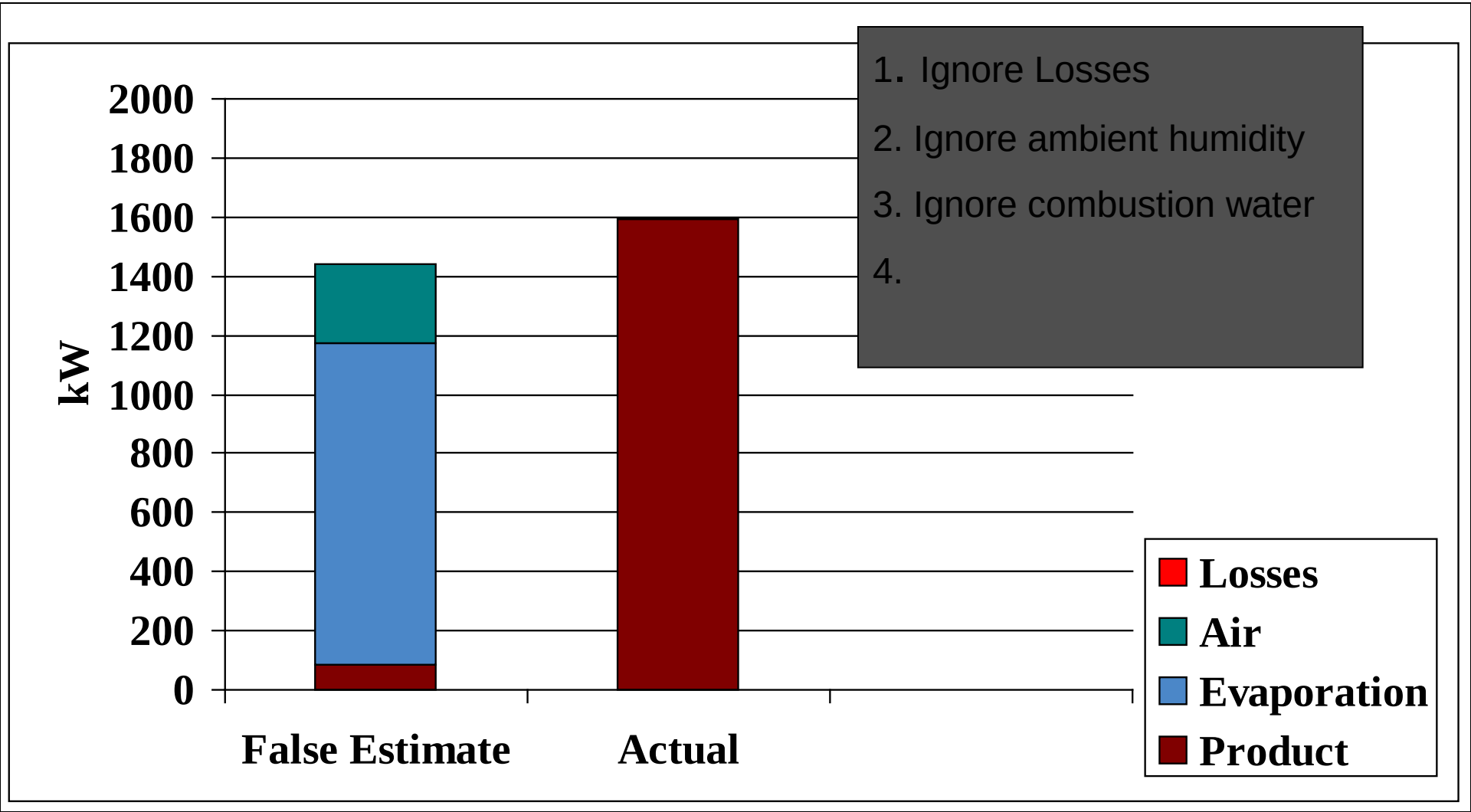
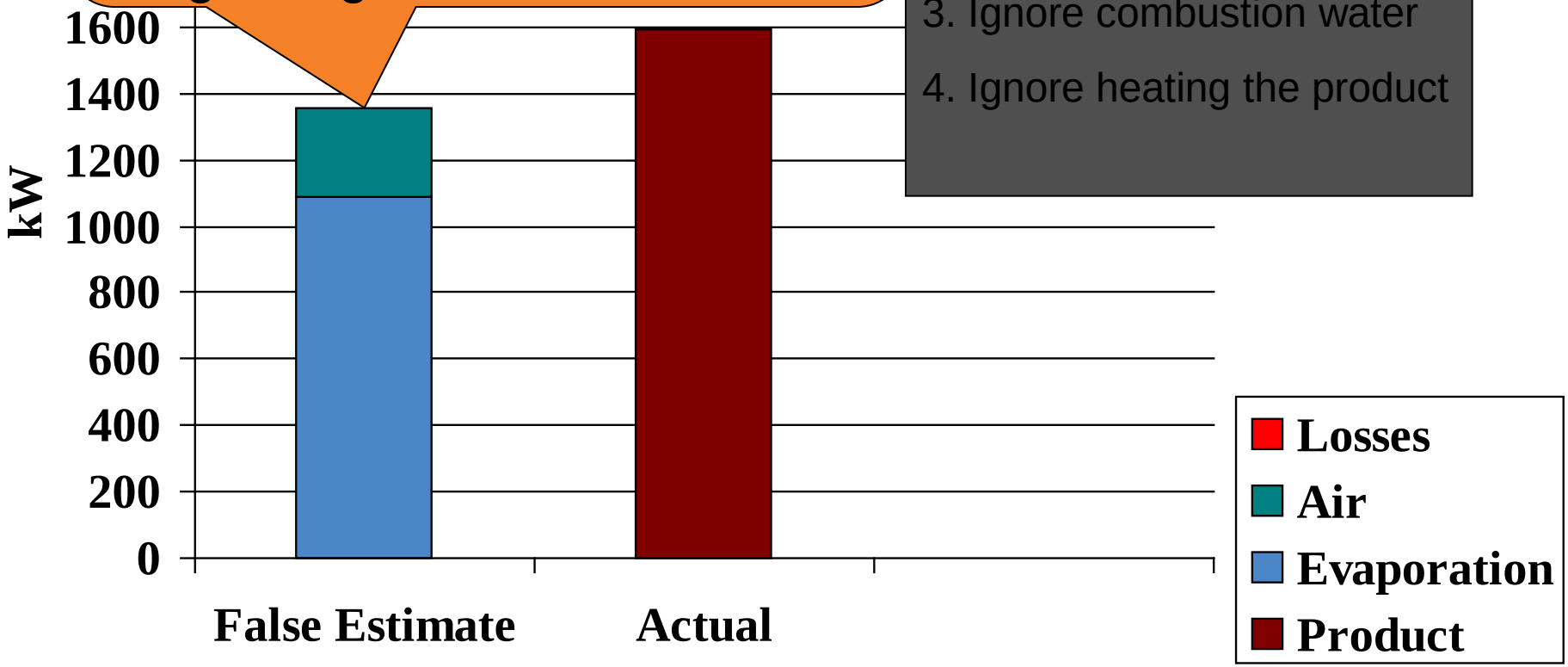


How Could I Make My Calculated Energy Consumption Seem Better?

The calculated energy consumption has gone from 1586 kW to 1346 kW by ignoring these four terms.

1. Ignore Losses
2. Ignore ambient humidity
3. Ignore combustion water
4. Ignore heating the product



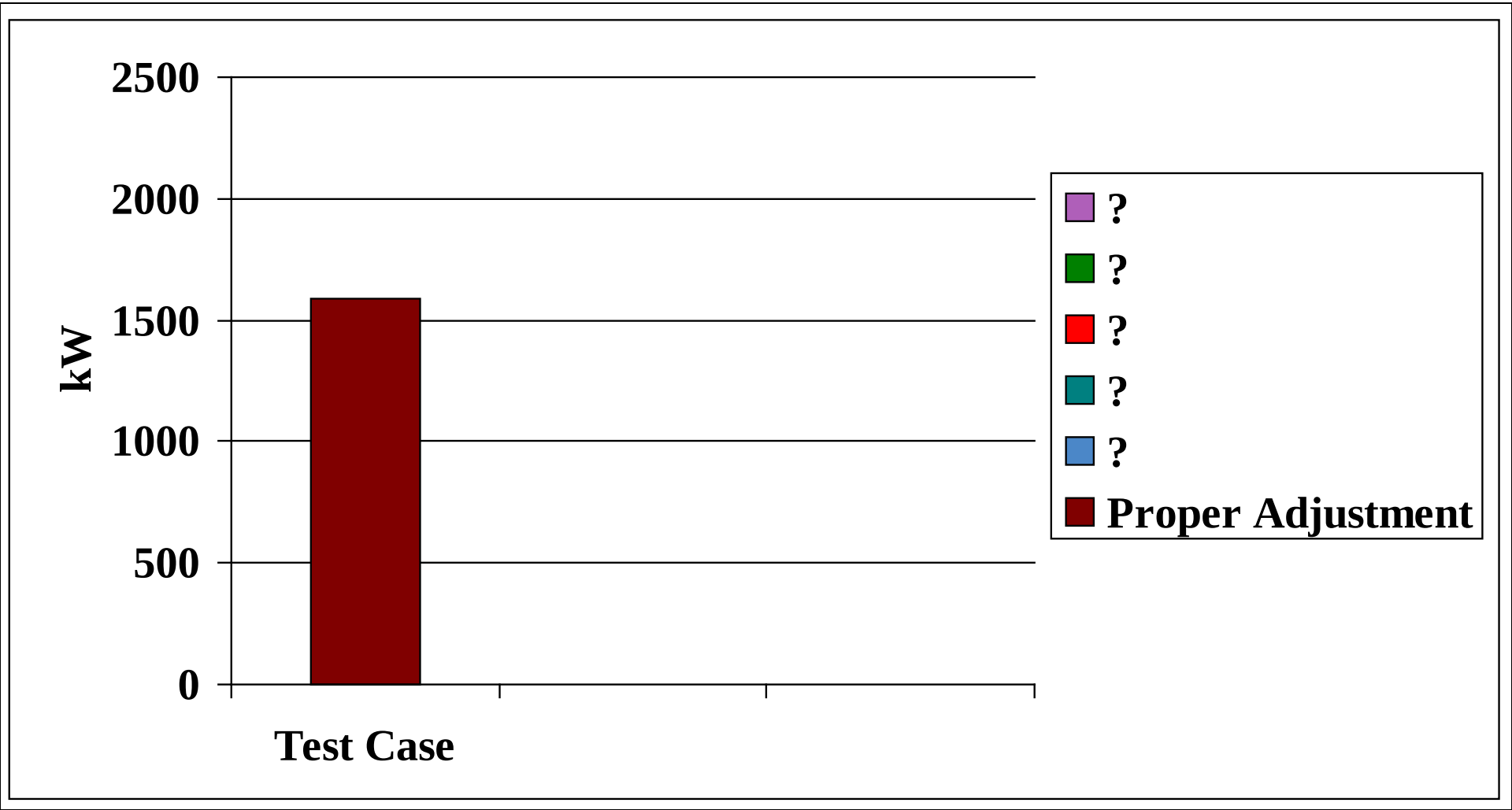
What is the Bottom Line?

- There is a lot of confusing information out there about energy consumption
- Any drier must be well insulated and properly sealed for high energy efficiency
- If the drier is well designed and well operated, energy efficiency will be high

What is the Bottom Line?

- In a well designed drier, **drier operation** is one of the most critical parameter in determining drier energy consumption

What Can Affect Energy Consumption?



Impact of Moisture Content

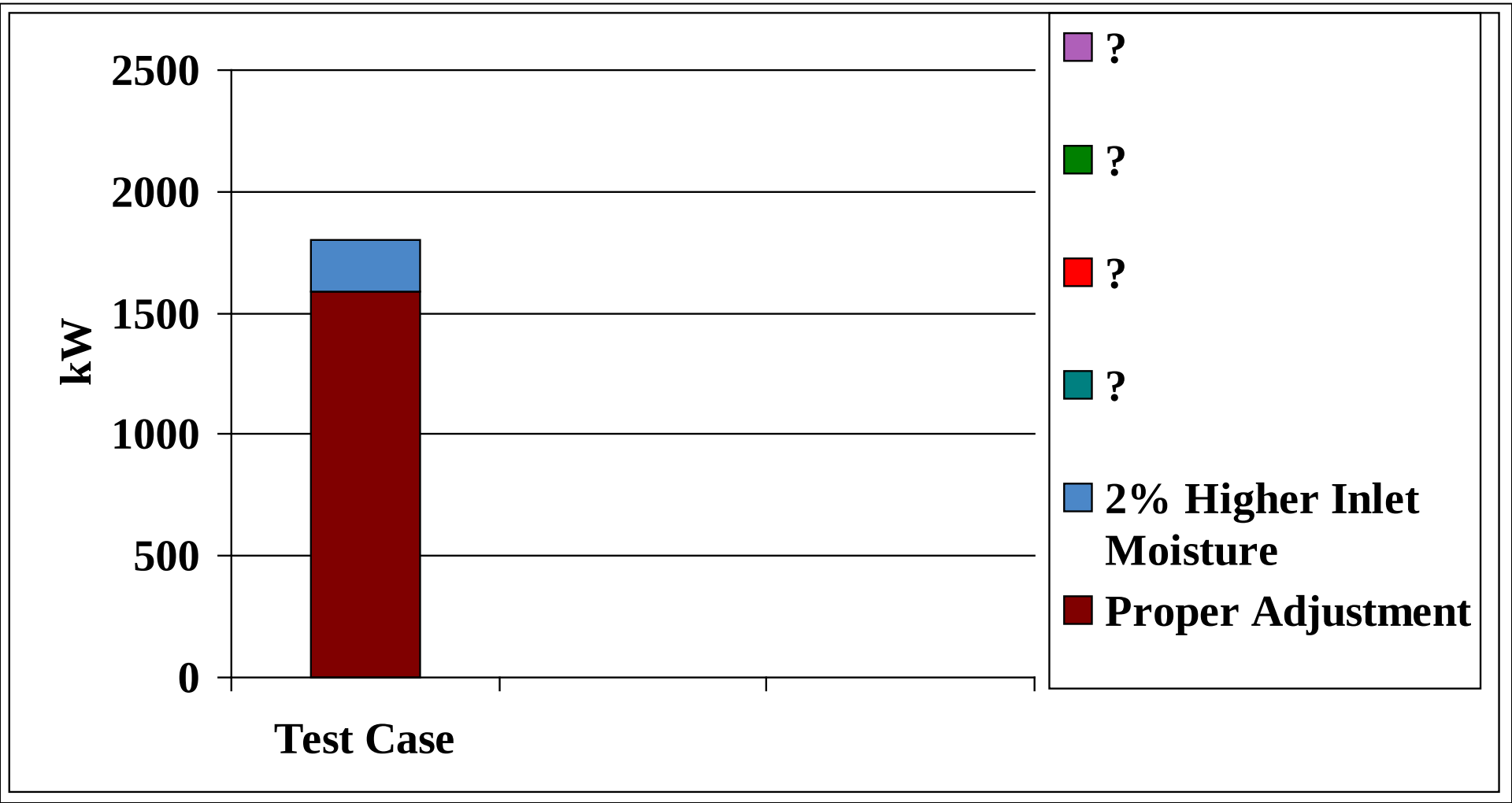
Weight In	Moisture In	Moisture Out	Output	Water Evaporated	% Increase
1200 kg	25%	10%	1000 kg	200 kg	-------
1267 kg	25%	5%	1000 kg	267 kg	33%
1233 kg	27%	10%	1000 kg	233 kg	17%
1302 kg	27%	5%	1000 kg	302 kg	51%
1286 kg	30%	10%	1000 kg	286 kg	43%
1357 kg	30%	5%	1000 kg	357 kg	79%

Here's Where the Work Is!!!!

Our customers think in kg of product out...

Aeroglide thinks in kg of water removed!

What Can Affect Energy Consumption?



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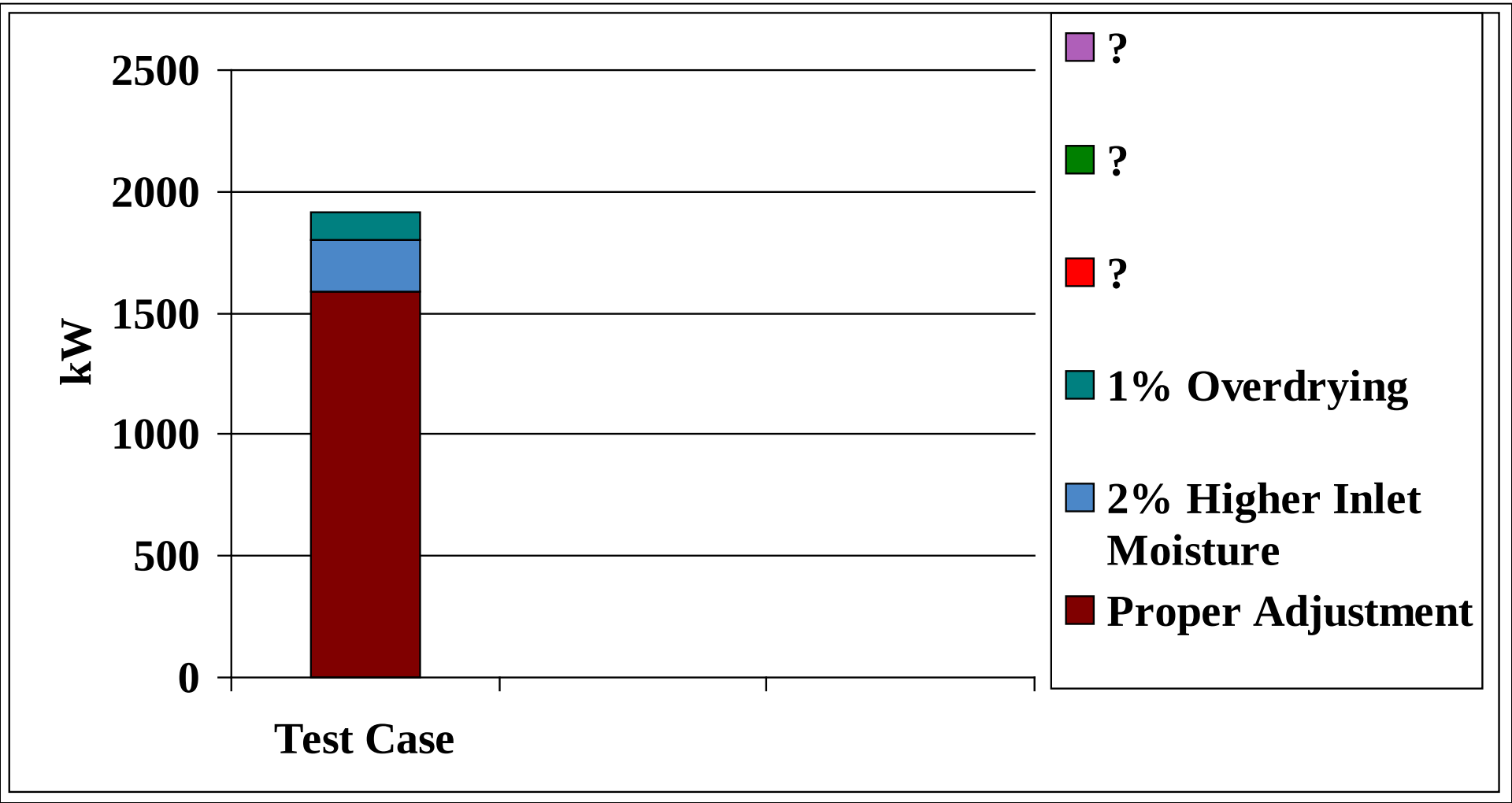

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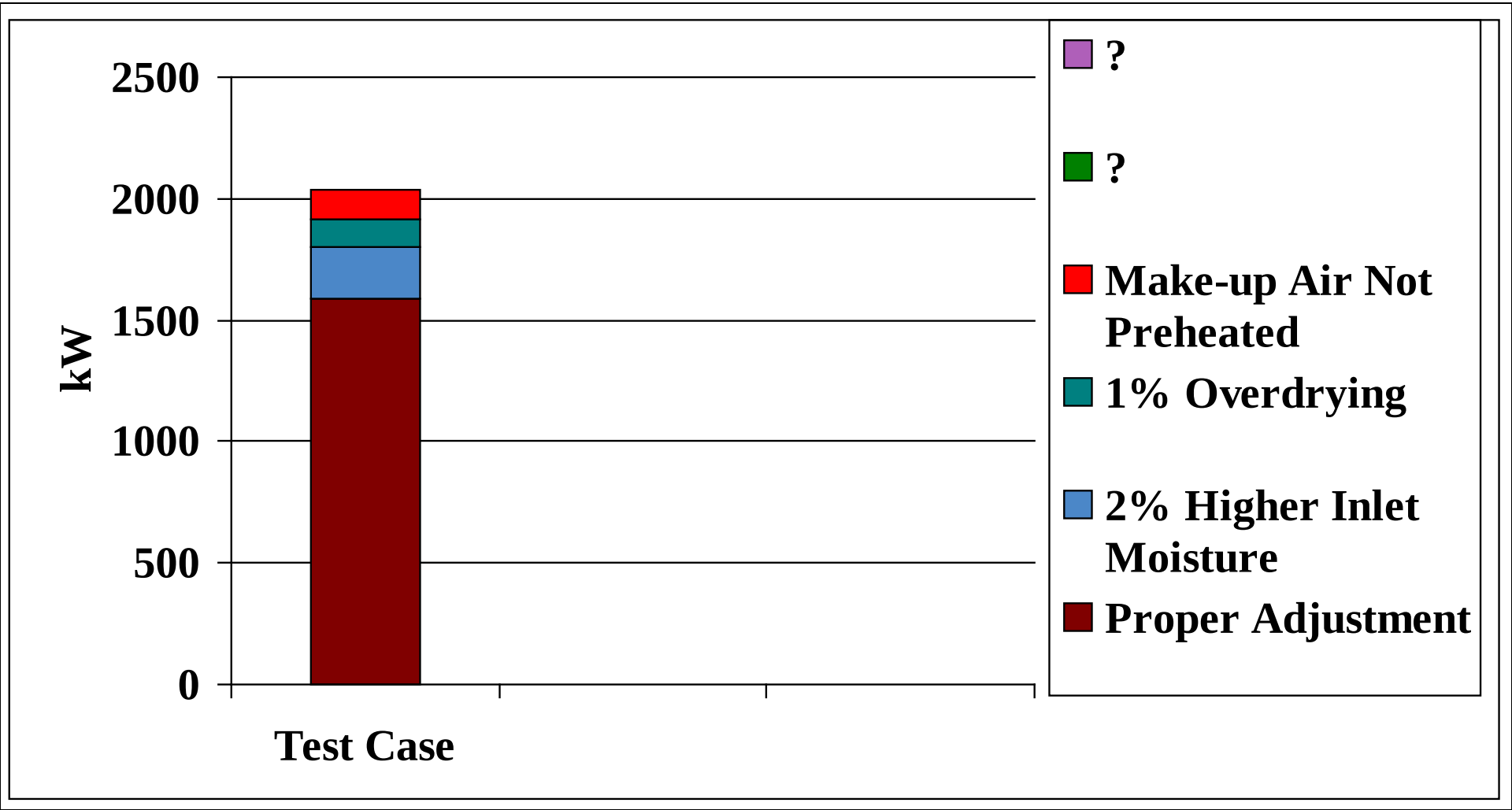

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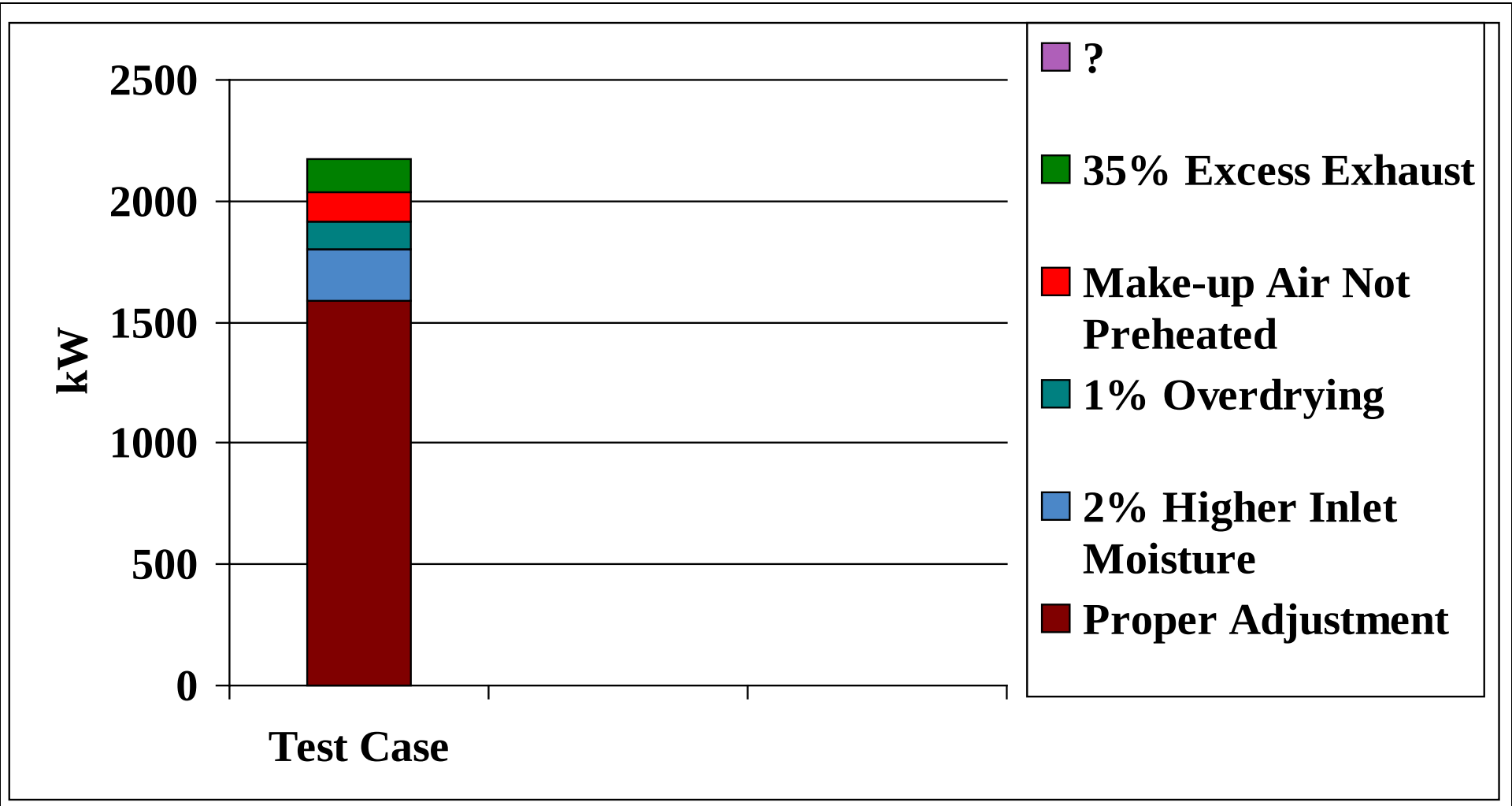

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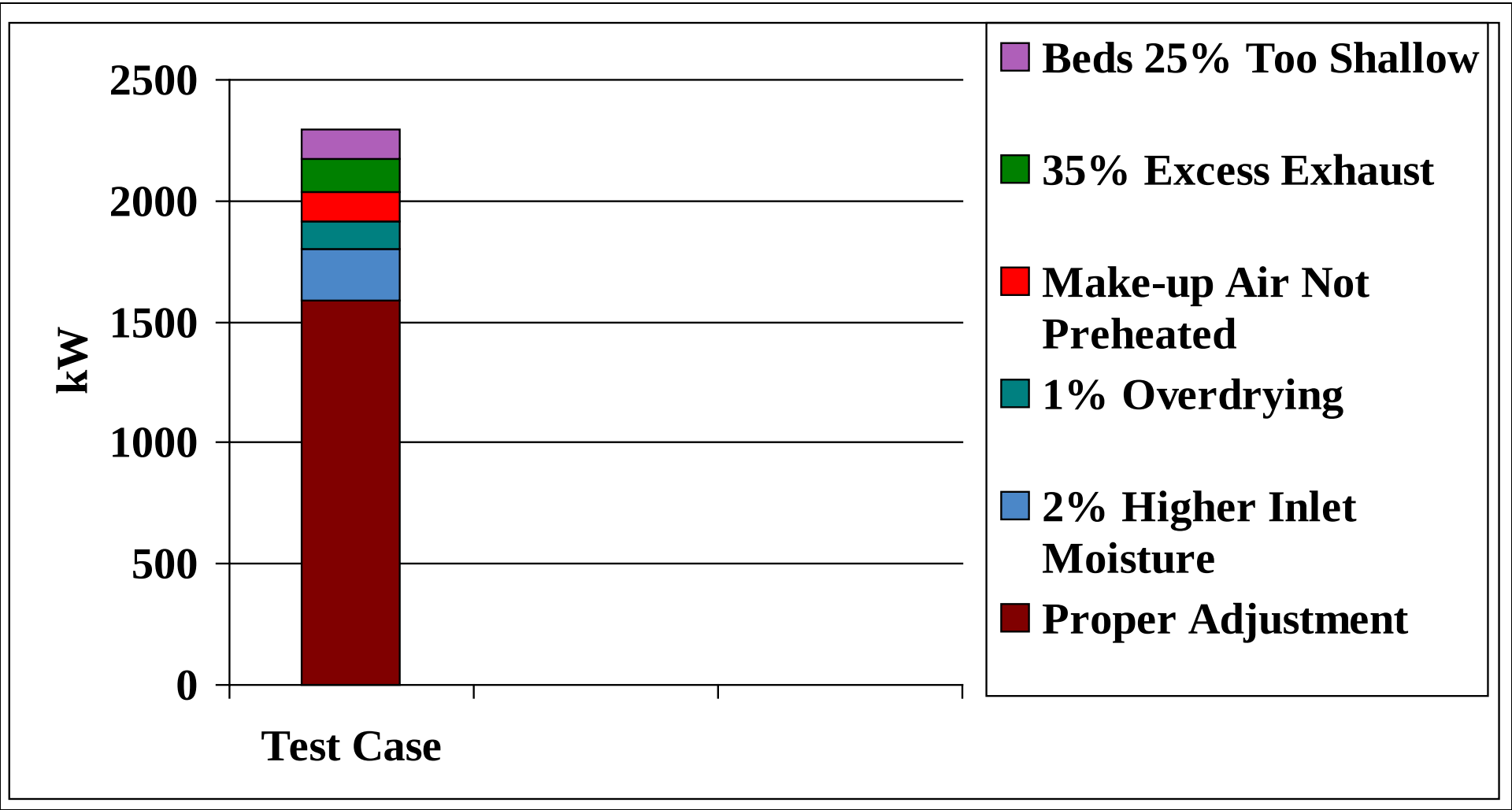

What Can Affect Energy Consumption?

- Energy consumption in this example has gone from 1586 kW to 2300 kW due to improper drier adjustment and poor line moisture control
- This represents **45% more energy** than what the properly adjusted drier uses

Conclusion

- Any drier, regardless of how well it is designed must be operated properly in order to achieve energy efficient processing.

Food Safety

Food safety

- Buhler has established global food safety groups
- Aeroglide have appointed a food safety manager
- Aeroglide have already produced a number of new innovations
- Such as …..

“Sani Lite” doors

- Continuous welded seam and no penetrations.
  - Eliminates risk of contamination to interior of panel.
- 2 B finish on both inner and outer surfaces.
- Welded on hardware with no fasteners to penetrate doors
- Approximately 10% increase in insulation value
- 1/3 weight of traditional doors

New “Sani lite” door design

Food Safety

- The next big thing!
- Buhler Aeroglide cover three major segments Food and Feed cover approximately 70% of our annual turnover.
- Key major food manufacturers have created working groups in North America which are focusing upon improving food safety in drying operations.
- This focus started in the Nut roasting industry and has gathered pace in both Snack foods and RTE Breakfast cereal.
- Buhler Aeroglide are uniquely placed to offer the latest in food safety design and best practice for your industry!

Questions?

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