

*Cost Effectiveness of Green  
Technologies: are they worth it?*

Des Murphy

*Kovara Energy Consultants*

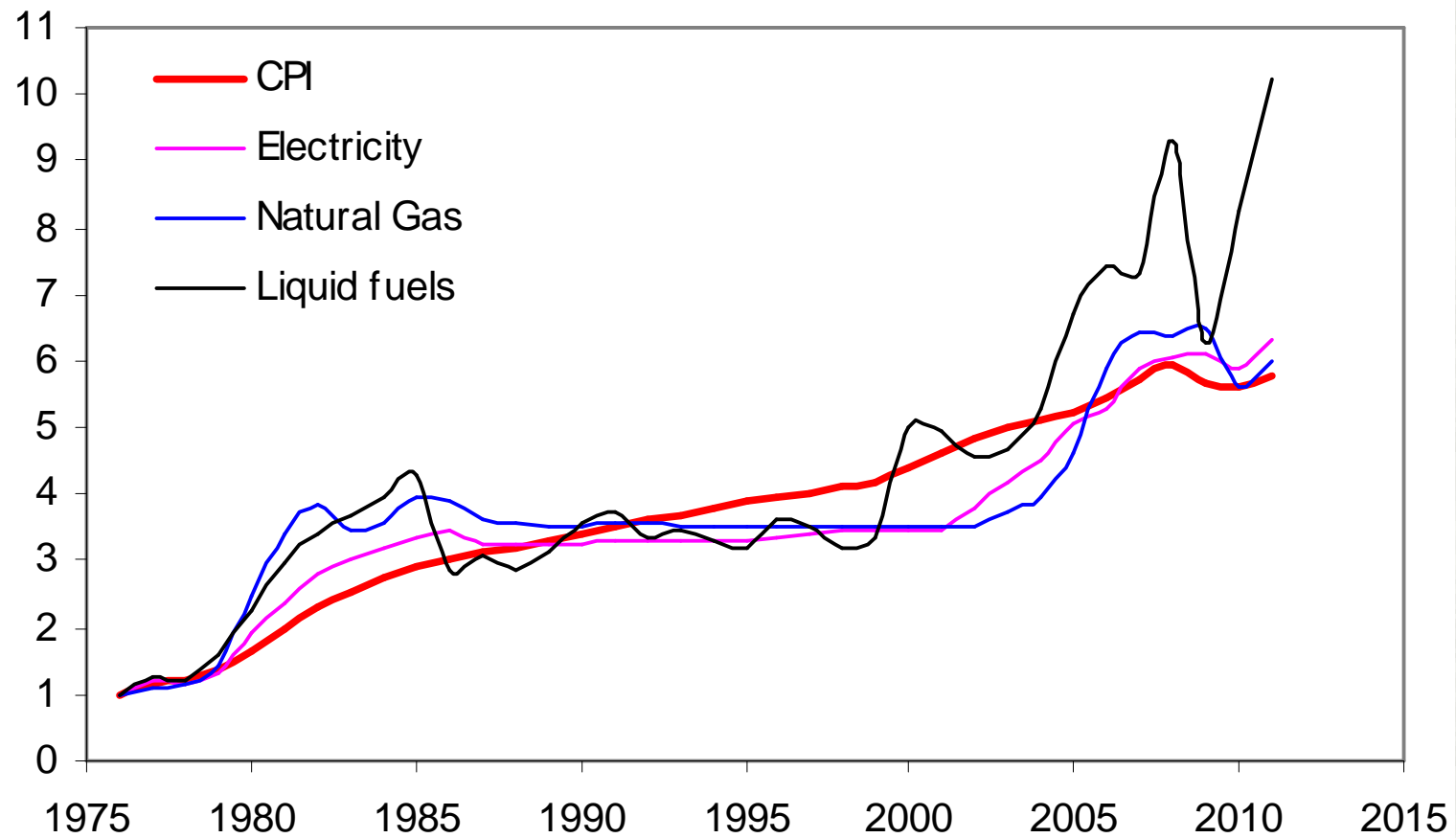
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- Energy Prices
- Solar water heating
- Space heating
- Lighting
- District heating
- Energy management

# Energy Prices - Historical

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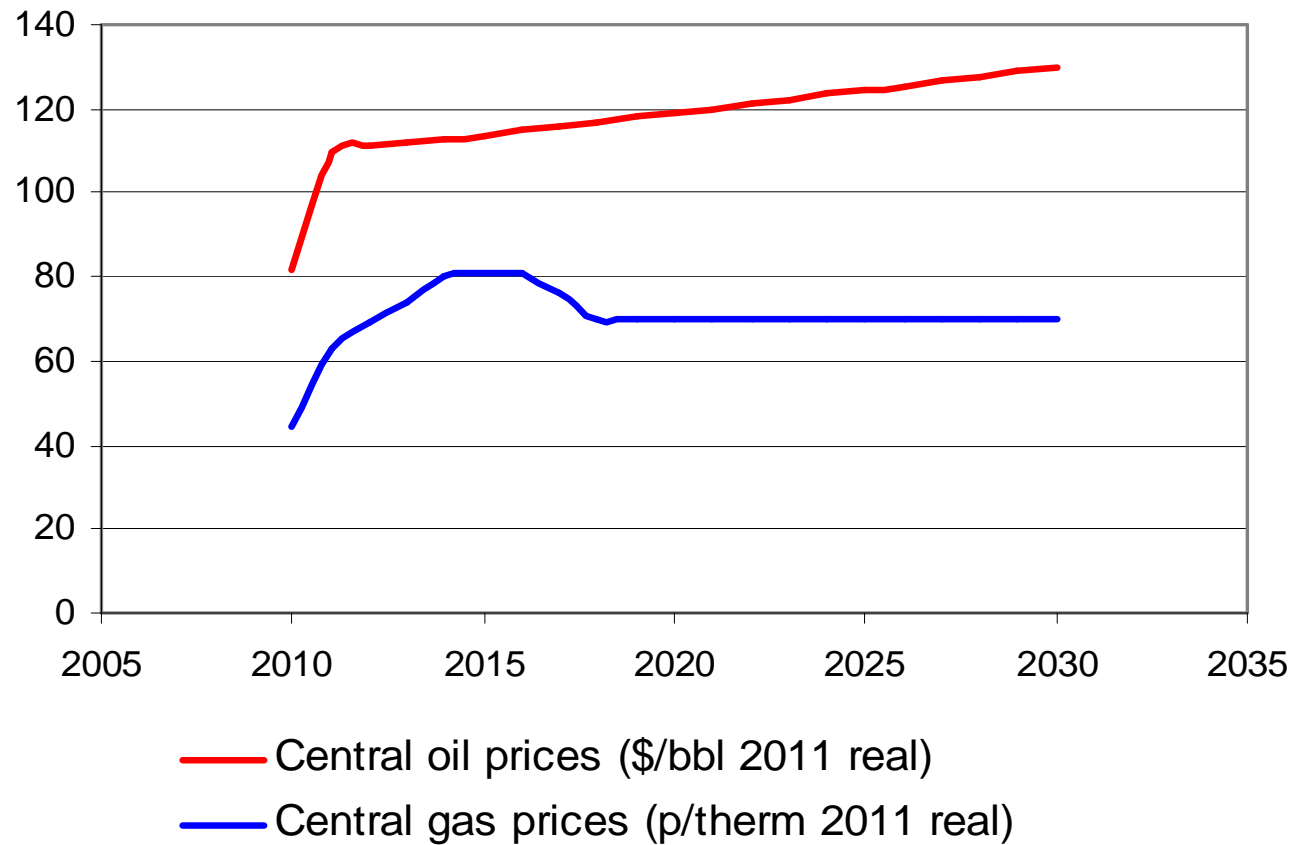
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# Energy Prices - Future

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**Source: UK Department of Energy & Climate Change**

# Solar Water Heating

*One square metre of solar panel receives the energy equivalent of 100 litres of oil per year.*

100 litres of oil = 1,020 kWh.

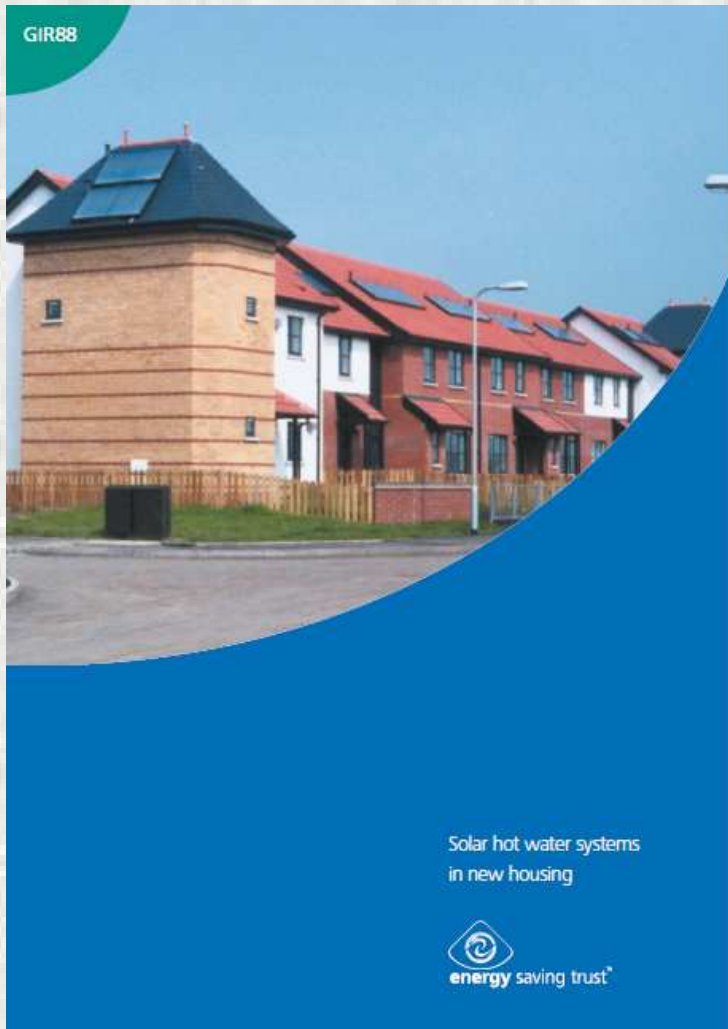
Solar radiation in Ireland = circa 1,000 kWh pa



**Here comes the sun:  
a field trial of solar water  
heating systems**

The Energy Saving Trust

- 88 sites in UK and Ireland.
- Average recovery per site of just 1,150 kWh.
- No difference between flat plate and evacuated tube.
- Provided around 39% of total hot water demand.
- Big variation across sites.



- Monitoring of 8 houses in UK with 4m<sup>2</sup> flat plate solar systems.
- The average saving was 294 kWh/m<sup>2</sup> per annum.
- Average Solar Fraction 55%
- Electric pump consumption of 21 kWh/m<sup>2</sup> per annum



## **Recent quotation from a reputable supplier in Ireland:-**

- Evacuated tube.
- 5 m<sup>2</sup>
- Annual recovery 1,840 kWh (368 kWh/m<sup>2</sup>)
- Water at 45 °C !
- Solar Fraction: 56%
- Cost circa €4,000 incl installation and VAT.

## **What is the solar panel recovery?**

My view is that a well designed, installed and maintained system, for a family of 4, will provide 50% of the hot water needs and cost about €4,000 incl VAT.

On this basis I will go on now to look at the saving and paybacks that one can expect from solar panels in different situations.

# Analysis

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Current method of hot water heating:	<b>Oil</b>	<b>NG</b>	<b>Heat Pump</b>	<b>Electric</b>
Day rate (cent/kWh)			17	17
Night rate (cent/kWh)			8	
% used at night for water heating			70%	
Fuel cost (cent/kWh)	9	6	11	17
Boiler/HP Efficiency	70%	75%	350%	100%
Cost per useful kWh (cent/kWh)	13	7	3	17
Annual saving (gross)	€220	€129	€54	€286
Maintenance (€ pa)	-€117	-€117	-€117	-€117
Pump electricity (€ pa)	-€15	-€15	-€15	-€15
<b>Net saving before capital repayments</b>	<b>€88</b>	<b>-€2</b>	<b>-€78</b>	<b>€154</b>
System cost (incl VAT)	€4,000	€4,000	€4,000	€4,000
Less grant	-€800	-€800	-€800	-€800
<b>Net cost</b>	<b>€3,200</b>	<b>€3,200</b>	<b>€3,200</b>	<b>€3,200</b>
<b>Simple payback (years)</b>	<b>36</b>	<b>Never</b>	<b>Never</b>	<b>21</b>
<b>Annual saving/loss (20yrs, 6.0%int)</b>	<b>-€191</b>	<b>-€281</b>	<b>-€357</b>	<b>-€125</b>

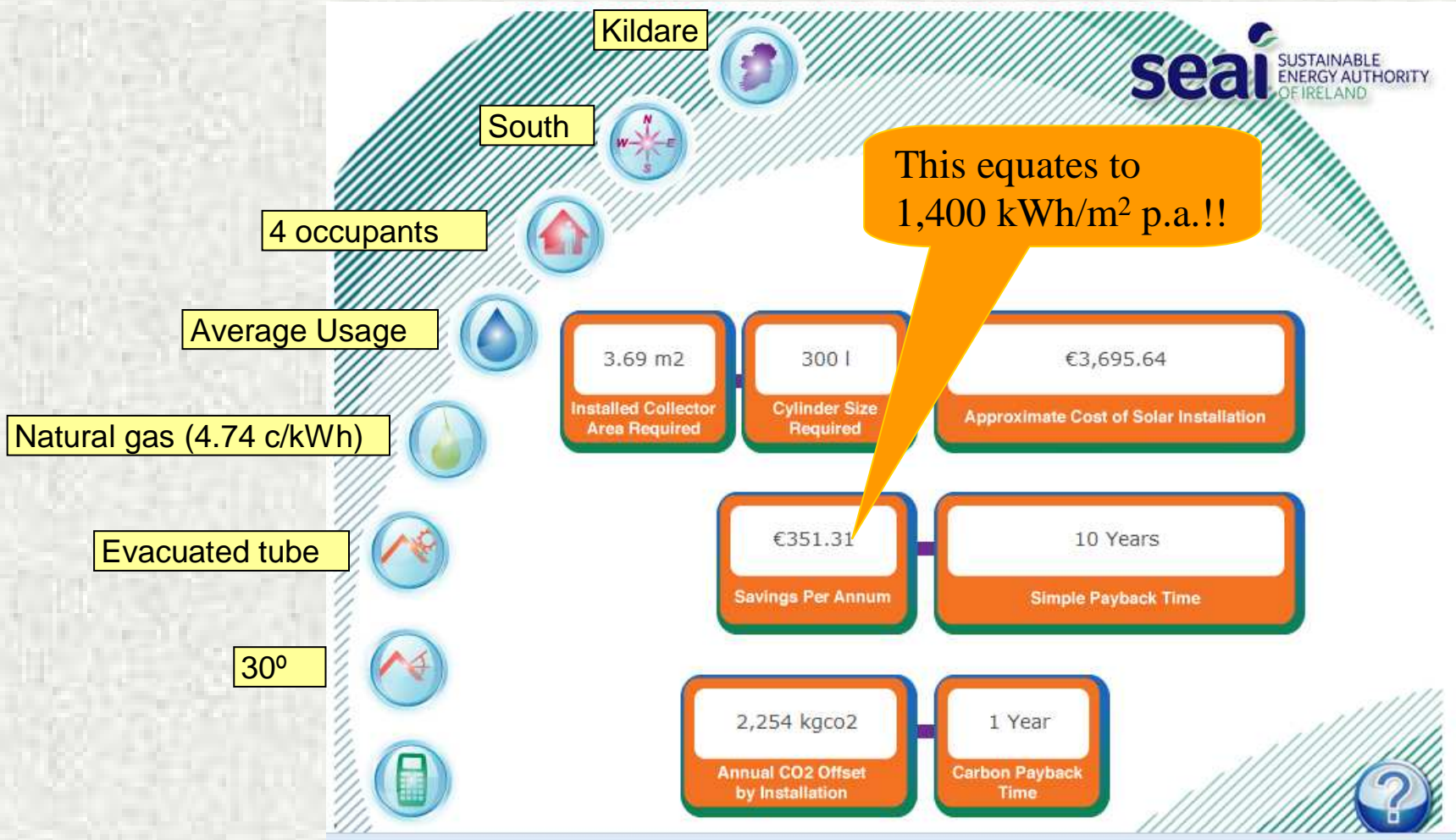
## Analysis (energy prices x 2)

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Current method of hot water heating:	<b>Oil</b>	<b>NG</b>	<b>Heat Pump</b>	<b>Electric</b>
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% used at night for water heating			70%	
Fuel cost (cent/kWh)	9	6	11	17
Boiler/HP Efficiency	70%	75%	350%	100%
Cost per useful kWh (cent/kWh)	25	15	6	33
Annual saving (gross)	€440	€259	€107	€571
Maintenance (€ pa)	-€117	-€117	-€117	-€117
Pump electricity (€ pa)	-€30	-€30	-€30	-€30
<b>Net saving before capital repayments</b>	<b>€293</b>	<b>€112</b>	<b>-€39</b>	<b>€424</b>
System cost (incl VAT)	€4,000	€4,000	€4,000	€4,000
Less grant	-€800	-€800	-€800	-€800
<b>Net cost</b>	<b>€3,200</b>	<b>€3,200</b>	<b>€3,200</b>	<b>€3,200</b>
<b>Simple payback (years)</b>	<b>11</b>	<b>29</b>	<b>Never</b>	<b>8</b>
<b>Annual saving/loss (20yrs, 6.0%int)</b>	<b>€14</b>	<b>-€167</b>	<b>-€318</b>	<b>€145</b>

# Solar Heating Claims



## Conclusions

- Solar water heating is not attractive in Ireland.
- Saving will be lower for offices (5 day week).
- Saving will be considerably lower for schools.
- What is the real hot water demand nowadays?

# Space Heating

# Space Heating Options and Costs

- Gas Boiler + Radiators
- Oil Boiler + Radiators
- Wood Pellet Boiler + Radiators
- Heat Pump (air source) + Underfloor Heating
- Heat Pump (ground source) + Underfloor Heating



# Heat Pump Trials

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Getting warmer: a field trial of heat pumps



energy saving trust

Recent UK field trials on 83 sites showed:

- » Air Source heat pumps efficiency mid-range: 220%
- » Ground source heat pump efficiency mid-range: 240%
- » Highest recorded: 300%

## **Other Points to Bear in Mind:**

- Servicing costs are high (specialist required).
- Underfloor heating is “permanently on everywhere”
- With ground source or borehole source there is a risk of costly collector problems.

# Space Heating Cost Comparison

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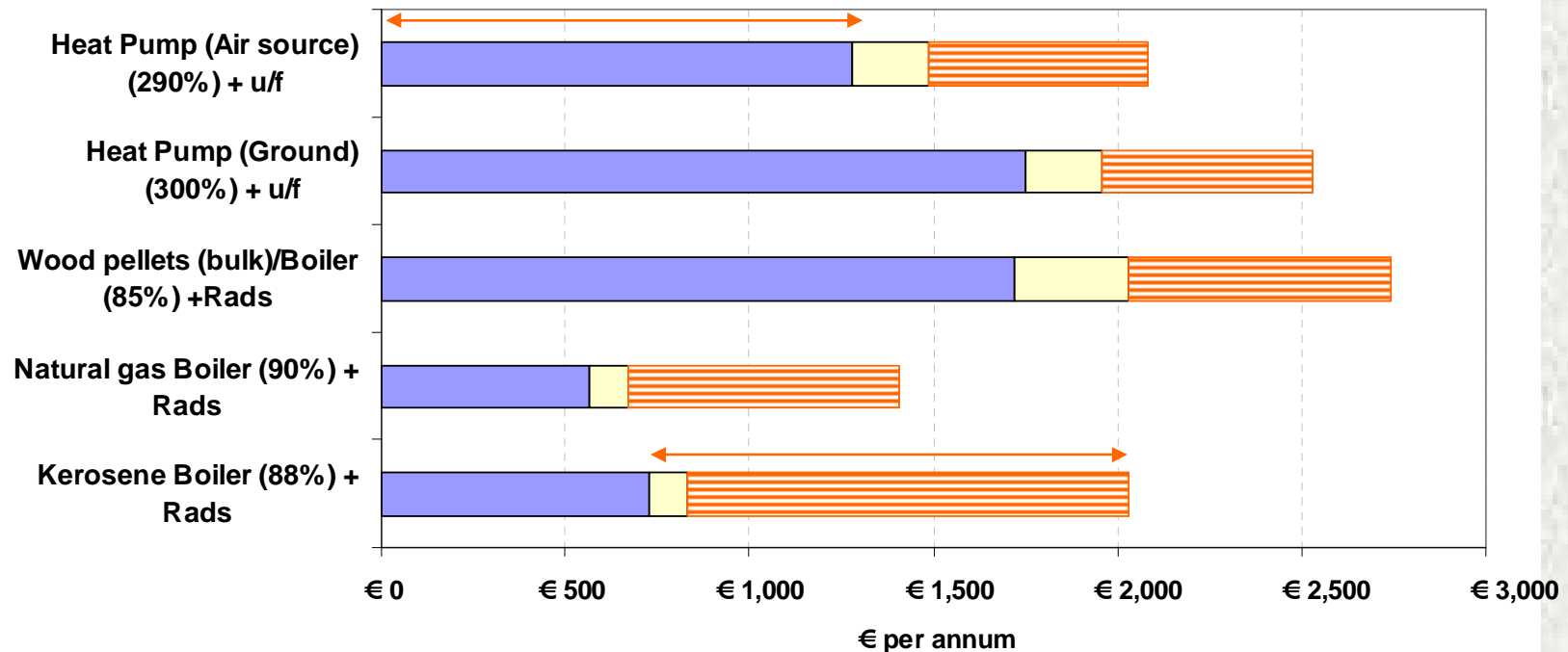
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## Annual Cost (House, 200 m<sup>2</sup>, 30W/m<sup>2</sup>, Energy escalation: 1.0)

■ Capital repayments [15yrs @ 6%]

■ Service

▨ Energy cost pa



# Space Heating Cost Comparison

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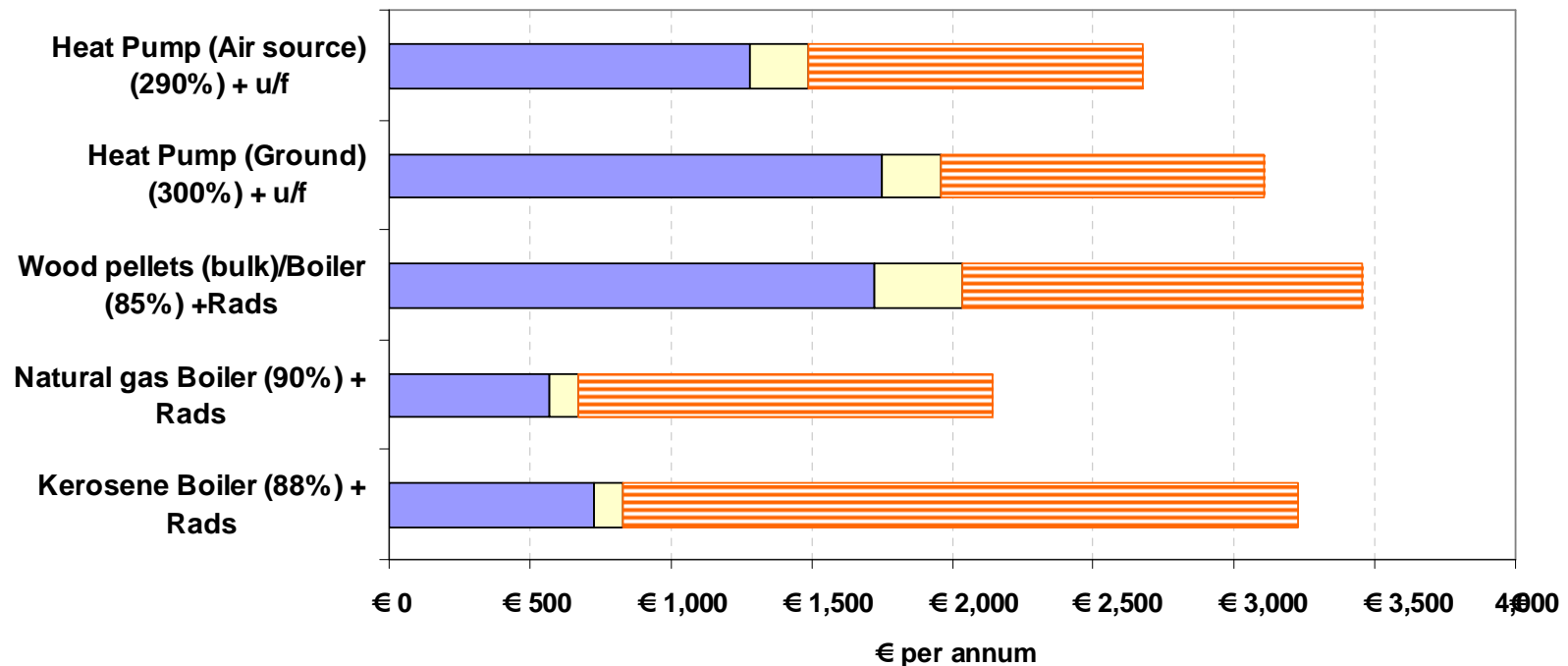
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## Annual Cost (House, 200 m<sup>2</sup>, 30W/m<sup>2</sup>, Energy escalation: 2.0)

■ Capital repayments [15yrs @ 6%]

■ Service

▨ Energy cost pa



# Space Heating Cost Comparison

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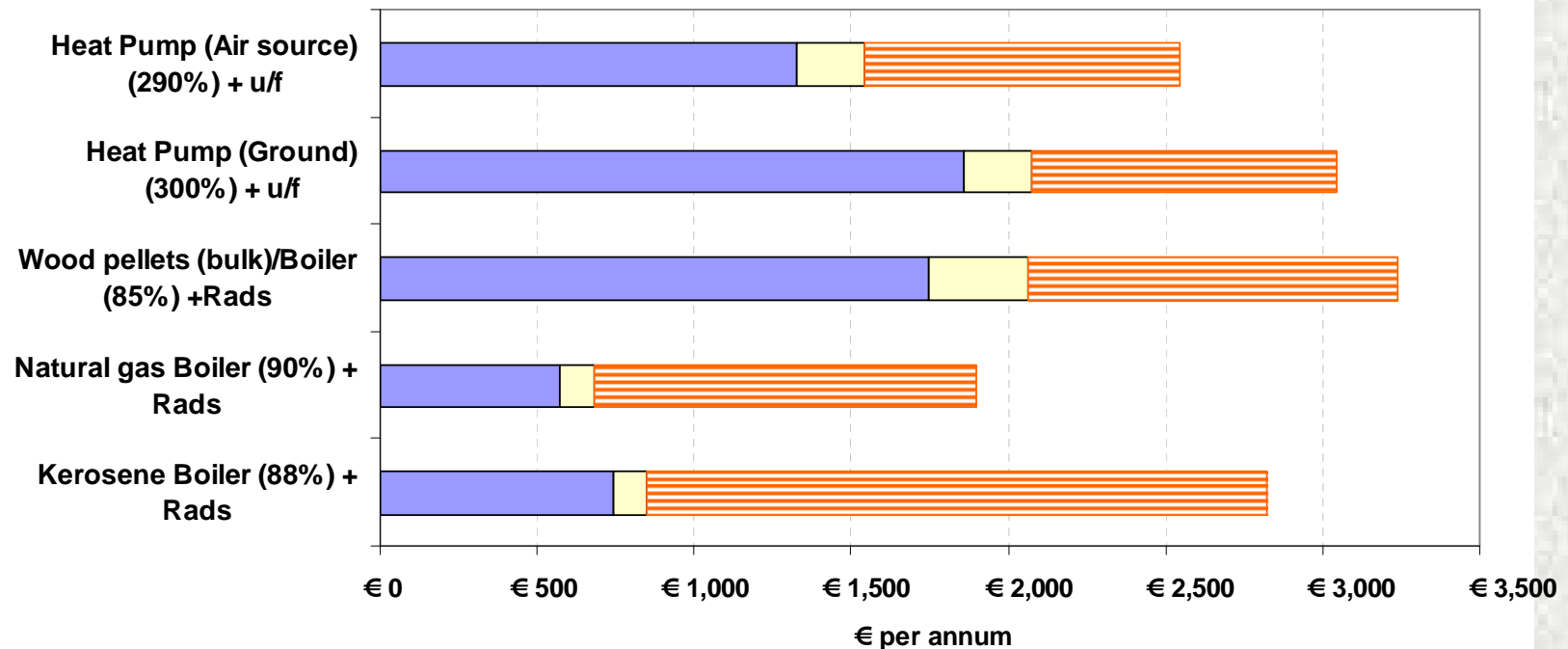
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## Annual Cost (House, 200 m<sup>2</sup>, 60W/m<sup>2</sup>, Energy escalation: 1.0)

■ Capital repayments [15yrs @ 6%]

■ Service

▨ Energy cost pa

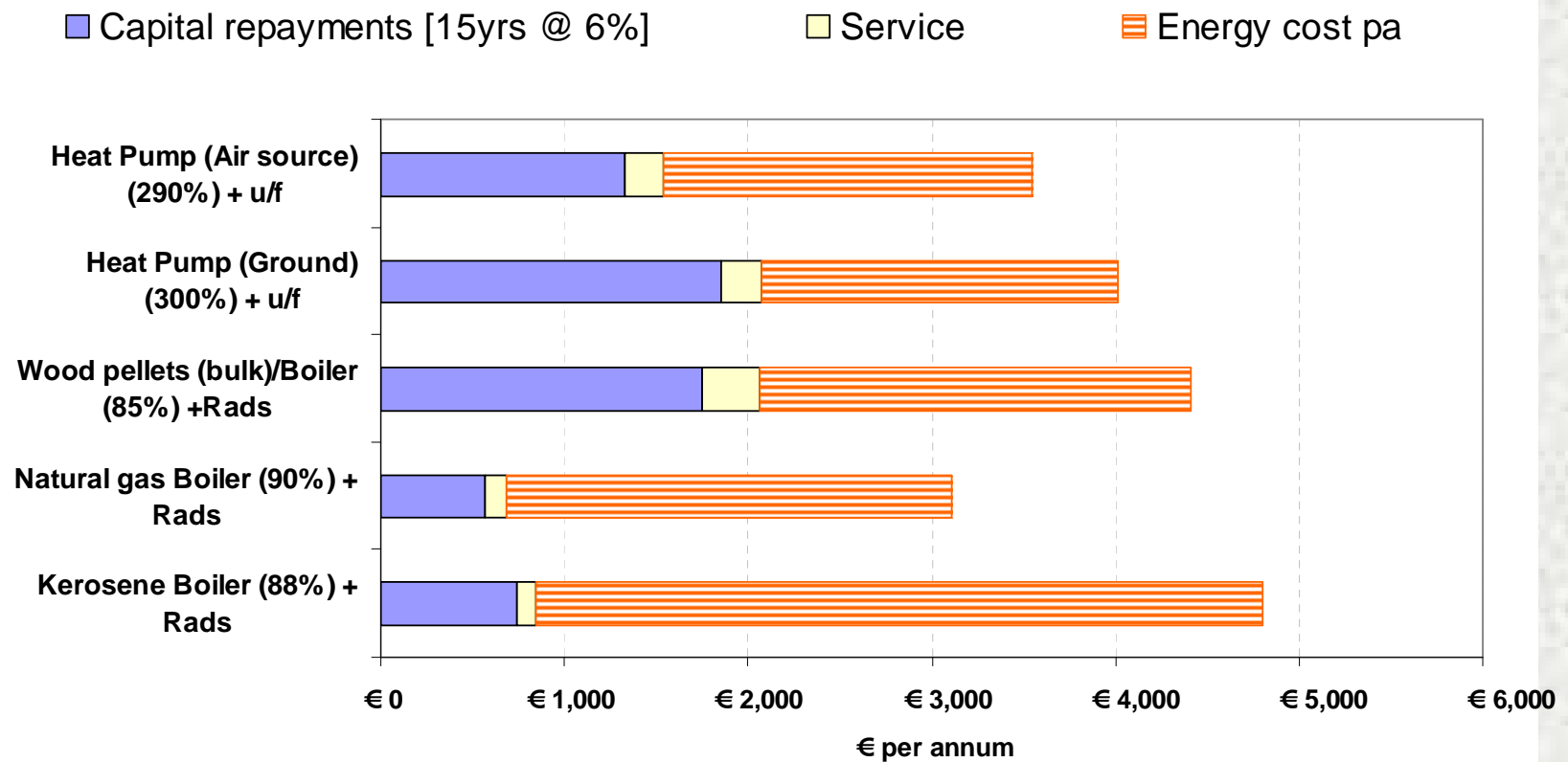


# Space Heating Cost Comparison

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## Annual Cost (House, 200 m<sup>2</sup>, 60W/m<sup>2</sup>, Energy escalation: 2.0)



# Nursing Home Conversion from Oil to Biomass Boiler

# Nursing Home Changes from Oil to Biomass

- Old oil boiler (75% efficiency)
- New pellet boiler + LPG gas boiler for backup/summer
- Very good load profile: 24 hr x 40+ week heating season.
- No natural gas



# Nursing Home Changes from Oil to Biomass

- Simple payback: 6 years
- Breakeven: If all savings were used to make loan repayments, then it would be year 10 before the loan is paid off.

# Lighting Upgrading



**Replace  
standard 4 x 18 W,  
electromagnetic ballast (90 W)  
with  
4 x 14 W electronic ballast  
(60 W)**

Power saving: 30 W per fitting

Hours pa:  $11 \times 5 \times 52 = 2860$  hours

Saving: 86 kWh = €12 pa

Cost: €75 for fitting + €50 installation = €125

Simple payback: 10 years

Breakeven: (10 years @ 6%) = 17 years



**Replace  
standard 4 x 18 W,  
electromagnetic ballast (90 W)  
with  
4 x 14 W electronic ballast  
(60 W)**

Power saving: 30 W per fitting

Hours pa: 8,700 hours

Saving: 261 kWh = €37 pa

Cost: €75 for fitting + €50 installation = €125

Simple payback: 3 years

Breakeven: (10 years @ 6%) = 4 years



### Add controls to the new lights

Power saving: **40%** of the new consumption = 69 kWh = €10

Additional Cost: €100

Simple payback: 10 years

Breakeven (10 years @ 6%) = 17 years

## Conclusions

- Long payback period unless high occupancy hours, eg, hospitals, some car parks, etc.
- But, check to see if lighting levels can be reduced.
- Payback would be longer for buildings with shorter occupancy periods (schools).
- Consider the addition of modern controls especially where long and intermittent occupancy is involved.

# District Heating

- What is District Heating?
- History
- Where is it used?



## Advantages:

- Fuel diversity: Biomass, Incineration
- Combined Heat & Power can be used
- Can dump excess wind electricity into the system

## Disadvantages:

- High initial cost
- High distribution losses (15 – 20% for a new system!)
- Do customers like to be tied to one supplier?

## **The issues:-**

- Heat Density (kWh sold per annum per hectare)
- Connection Density.
- Upgrading of buildings ↔ District Heating.
- Industry is going electric.
- The long investment period ..... Financing??
- There are strong vested interests pushing district heating.

# Tallaght District Heating Study:

- **Large area but low heat density.**
- **Good mix: Hospital, civic offices, retail, housing, etc.**
- **Existing natural gas network (competition).**
- **Cost of network: 4.7 (7.5) cent/kWh of heat sold.**
  - » Does not include the fuel cost.
  - » Does not include the boiler house capital cost (+ 0.8 cent/kWh).
  - » Based on borrowing at 10% pa over 20 years .
  - » Total network capital cost: €120,000,000.

### **Tallaght (small) District Heating Study:**

- **Just the Co. Co. office complex and Tallaght Hospital.**
- **Small network (600 m apart).**
- **Good mix: Hospital, civic offices.**
- **Existing natural gas (to compete with).**
- **Cost of network and boiler house: 3.0 cent/kWh of heat sold.**
  - » Does not include the fuel cost
  - » Based on borrowing at 10% pa over 20 years

### **Docklands District Heating Study (RPS):**

- **Heat from new incinerator to Financial Services Area**
- **Medium size network**
- **Heat from incinerator at low cost (0.7 cent/kWh).**
- **Existing natural gas in competition**
- **Cost of network: 3.0 cent/kWh of heat sold.**
  - » Does not include the fuel cost.
  - » Based on borrowing at 10% pa over 20 years .

## Conclusion:

As matters stand not very attractive, but...

# Energy Management



- Typical General Office Building:
  - » Uses €200 pa of energy for a 10 m<sup>2</sup> space.
  - » Staff cost, say, €30,000 x 2 for overheads = €60,000
  - » Energy represents 0.3%!
  - » A 20% energy saving represents 0.06% of staff costs.

- Typical Irish Company:
  - » Energy is <5% of total operating costs.
  - » “Structured” energy management might reduce energy costs by an extra 10% compared with just conventional management, ie extra saving of 0.5%!
  - » But at what cost?

- Energy should not be wasted ..... It should be managed.
- But remember the 80/20 rule

*All this applies to companies/individuals ..... wider criteria will apply to major climate change related investments and policy decisions*

*Thank you*

Des Murphy

*Kovara Energy Consultants*

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