Dimplex

Solutions for New Build – Part L

Solutions for Retrofit - SETS

Presentation aims and objectives

Aim

- To give you an understanding of heat pumps and solar photovoltaic technologies and there applications within the new Part L 2013 of the building regulations and the building control act 2013.
- The presentation will clearly identify cost effective solutions, in terms of fabric and mechanical solutions.
- To give you an understanding of Smart Electric Thermal Storage Systems (SETS) and there applications when retrofitting storage heaters.
- Understand the how heating systems can act as a energy store for wind energy
- Total credits available 5 Structured CPD points delivered over 5 hours

Presentation aims and objectives

Objectives

- By the end of this presentation you will have an understanding of:
  - The need for renewable energy and the legislation driving its adoption
    - Over View TGD Part L 2013
    - Building Control Act 2013
    - Fabric and mechanical systems the cost optimal solution
  - The key principles of Heat Pump technology and the key system components
    - What is a Heat Pump - Video
    - Introduction and overview of domestic air source heat pumps
    - Design Considerations – Sizing and Efficiency
    - Information technology and heating converge – Live System Demonstration
  - The key principles of solar photovoltaic technology and the key system components
    - How Solar PV Works
    - Micro inverters and string inverters
    - Grid certification for Ireland
    - PV in the Irish Climate How much energy – Live System Demonstration
  - The key principles of Smart Electric Storage systems and the key system components
    - Wind on the Irish Grid
    - Key system design and installation considerations
    - Why have SETS been delivered
    - Energy Savings
    - Information technology and heating converge – Live System Demonstration
  - Summary

Introduction

GLEN DIMPLEX

Privately owned Irish Company

Founded in 1973

Over 10000 employees with and Annual turnover of over €2 billion

Dimplex – full suite of part L solutions

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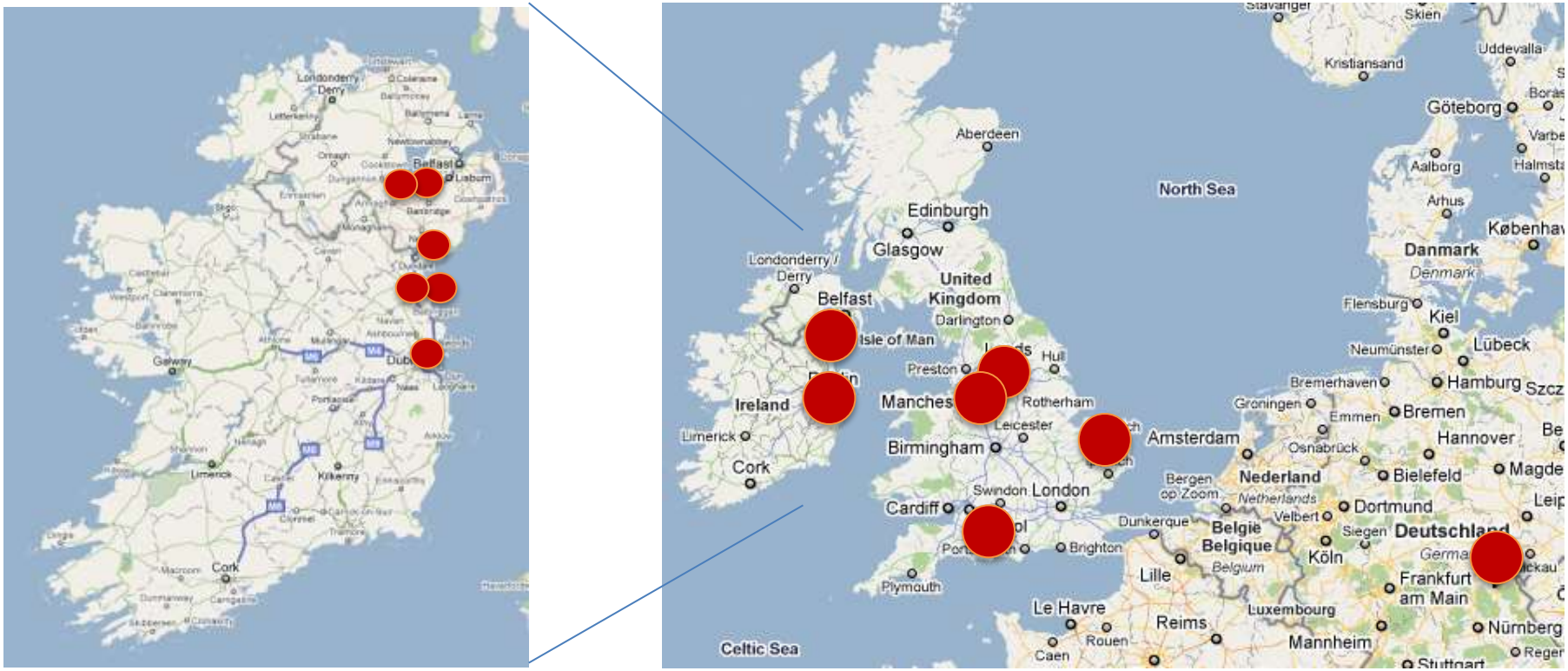

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Back Up – Dimpco sales and engineering

Jonathan Jennings
Business unit

David McConnell
Sales South

Paul Kane
Engineer

Jason Smith
Sales North

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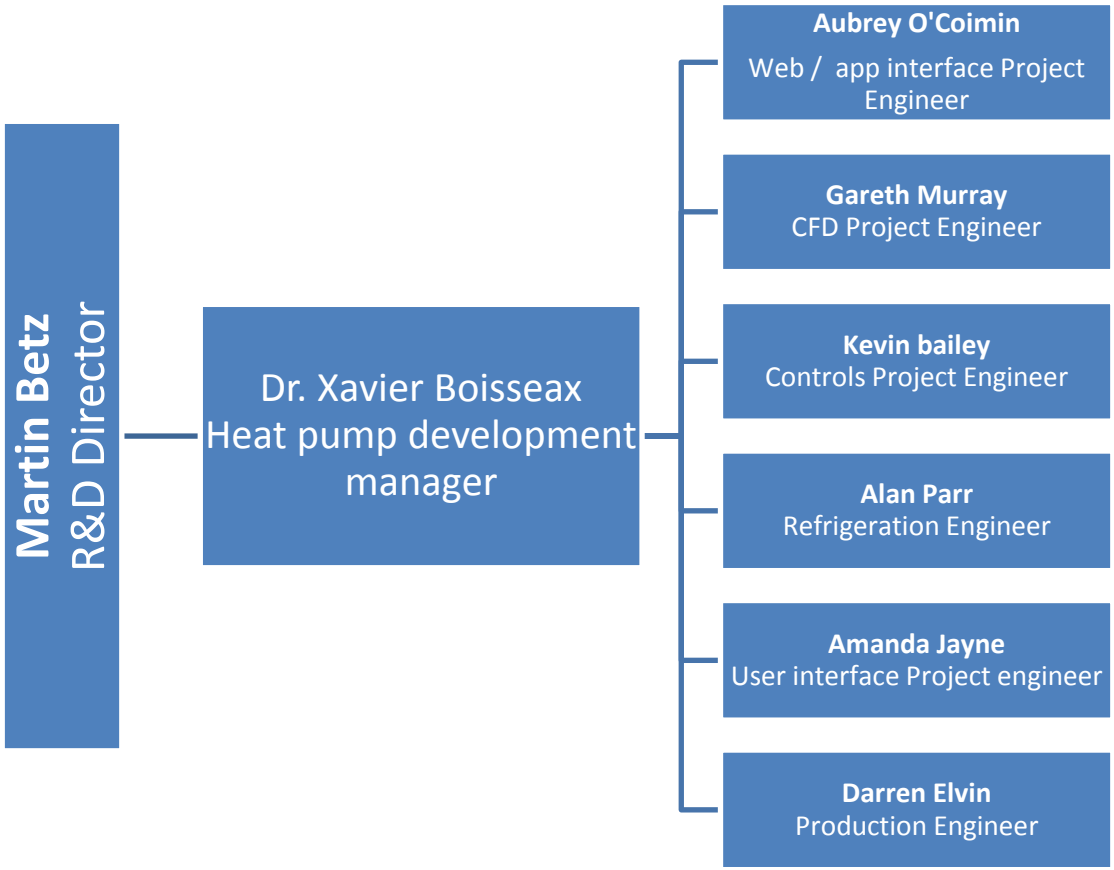
Back Up – Glen Dimplex R&D



Back Up - Service Engineers

- Experts in plumbing and refrigeration
- Services provided
  - 24 hour call out
  - Commissioning
  - Heat pump on site training
  - Service calls in and out of warranty
- Full van stock
- Covered by a service level agreement

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building regulations back ground

- **Building Regulations now require energy performance to be approximately 60% better than that of the 2005 standards.**
- Previously Solar thermal offered the solution of choice along side a boiler
- However under the new Part L 2011 a properly sized solar system will no longer do it on its own with a traditional boiler.
- Analysis of the new part L shows that a heat pump now provides the most cost effective solutions for all house types.

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Driver – building regulations

- All planning applications must be accompanied now by a pre building energy rating assessment
- Using DEAP you must show how you meet the requirements of Part L of the Building Regulations
- Boxes to tick
  - Renewable Energy Contribution
  - Energy performance targets
  - Carbon performance targets

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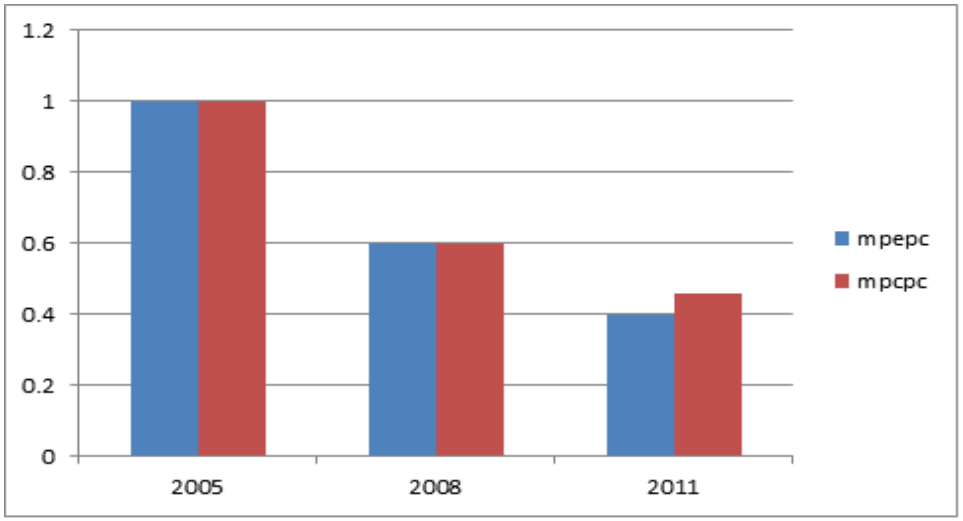
Driver – building control act

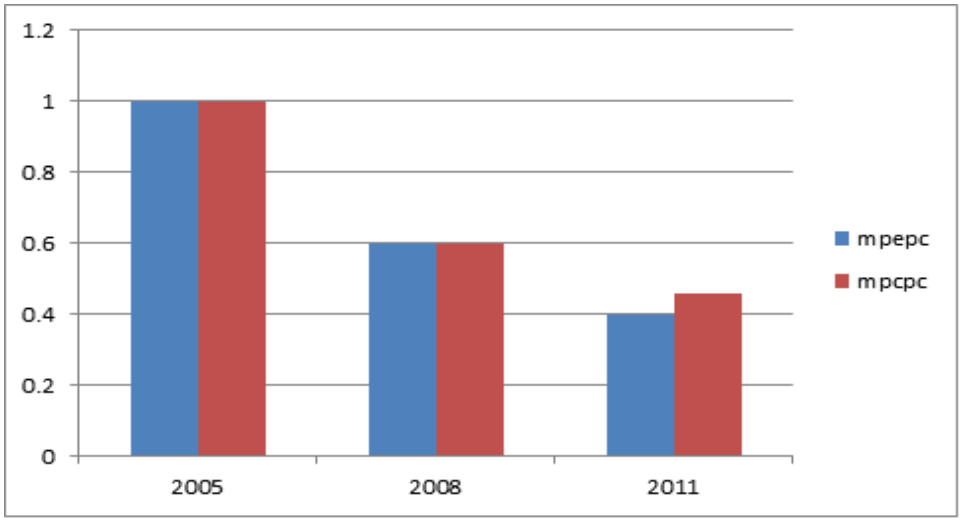
- From March 2014
- Certificates do what they claim to do: they certify compliance on a statutory basis – no more ‘opinions of compliance’
- Only the following can certify
  - Chartered Engineer
  - Chartered Architect
  - Chartered Building Surveyor
- Mandatory Certificates of Compliance:
  - Design Certificate at Commencement
  - Certificate of Undertaking to inspect and certify the work – assigned certifier
  - Certificate of Undertaking by builder
  - Completion Certificate

Part L Background



- 2005 building regulations
- 2008 revision 40% improvement
- 2011 revision 60% improvement
- Improvements on Energy Performance of dwellings
- EPC 0.4
- CPC 0.46
- The Challenge is no longer a renewable target of 10 kWh/m2/year

Part L Background



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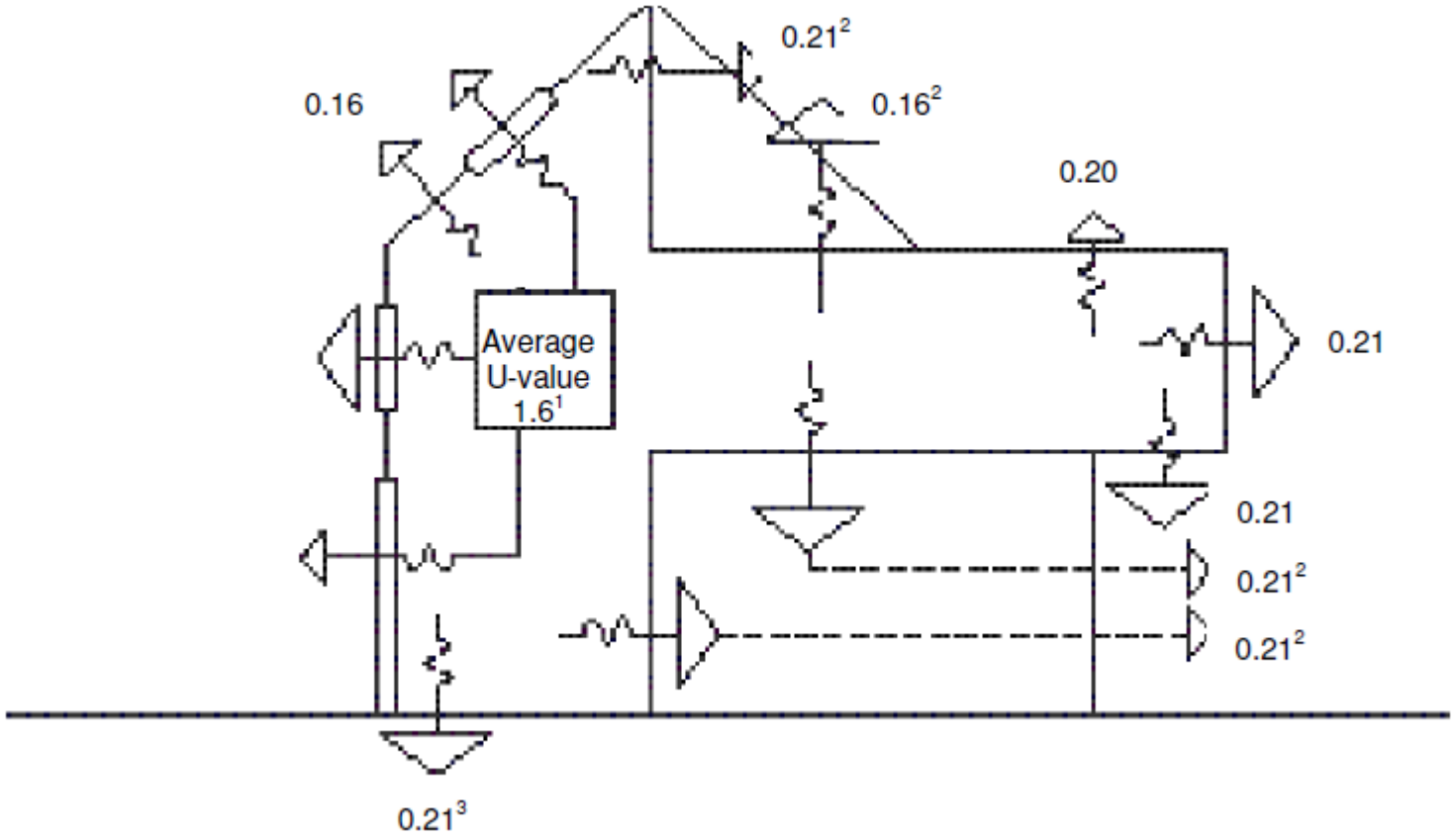
Part L the challenge



Part L the challenge

Table 2 – Table of dwellings achieving compliance with TGD L 2010

				Detached			Semi-Detached			Terrace	Apartments	
Dwelling ID				1	2	3	4	5	6	7	8	9
Description		Note		Bungalow	Det 2st small	Det 2st large	SD small	SD med	SD large	Terr 3-storey	Apt small (mid-f	Apt duplex (2 top floors)
Num storeys				1	2	2	2	2	2	3	1	2
Total Floor Area				104	126	280	96	126	160	105	54	84
	Num fans/passive vents			Natural Ventilation with 3 extract fans, No Chimney, Draught Lobby included, 2 sides sheltered			Natural Ventilation with 3 extract fans, No Chimney, Draught Lobby included, 2 sides sheltered			As for Semi-detached	Natural Ventilation with 2 extract fans, No Chimney,No draught Lobby, 2 sides sheltered	
	Result of pressurisation test m3/hr			5m3/hr/m2			5m3/hr/m2			5m3/hr/m2	5m3/hr/m2	
Fabric	Door		Area	1.85			1.85			1.85	1.85	1.85
			U	1.5			1.5			1.5	1.5	1.5
	Ground floor		Area	114.4	69.3	154	52.8	63	88	38.5		
		eg. 110mm PIR under slab	U	0.15			0.15			0.15		
	Wall		Area	84.88	148.02	199.28	88.2	85.8	105.86	59.55	26.1	46.32
		eg. 150mm block cavity wall with 140mm EPS or 100mm PIR and 50mm PIR internal lining	U	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
	Roof		Area	114.4	69.3	154	52.8	63	88	38.5		46.2
		eg. 340mm mineral wool between and over joists or 150mm PIR between rafters and 60mm PIR under rafters	U	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Windows	E/W		Area	24.15	29.65	68.15	22.15	29.65	38.15	24.4	11.65	19.15
			U	1.1(Triple Glazed)	1.3 (Double Glazed	.9(Triple)	1.2(double)	1.3(double)	1.2 (double)	1.1(triple)	0.9	.9 (triple)
			Window type ID	4	4	4	4	4	4	4	4	4
	Thermal bridging parameter[1]			0.06	0.05	0.08	0.05	0.05	0.06	0.06	0.05	0.05
	Area of solar collector, m2/cyl size	collector efficiency=.6, heat loss coeff=.3,		4.3m2, 300l cyl, 100mm insul	5.5m2, 320 l cyl 100mm insul	6.5m2, 450 l cyl, 100mm insul	4.3m2, 300 l cyl, 100mm insul	5.5m2, 320l cyl, 100mm insul	6.5m2, 360l cyl, 100mm insul	4.3m2, 300l cyl, 100mm insul	3m2, 200 cyl 100mminsul	4.0m2, 300l cyl, 100mm insul
	Solar Fraction %			55	57	50	56	57	57	54	53	57
	kWh/m2 from solar			12	12	7	13	12	11	12	15	14
	Primary circuit loss			360	360	360	360	360	360	360	360	360
Light	Low-energy light proportion %			100	100	100	100	100	100	100	100	100
HtUse	Living area fraction			0.25	0.25	0.20	0.31	0.25	0.24	0.29	0.43	0.33
SH	Control category			3	3	3	3	3	3	3	3	3
	Responsiveness category			1	1	1	1	1	1	1	1	1
	Central heating pump[2]			1	1	1	1	1	1	1	1	1
	Oil boiler - pump or Gas Boiler flue fan			1	1	1	1	1	1	1		
ER1	Efficiency of main htg system			91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.3
	Fraction from sec htg system			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Efficiency of sec htg system			80	80	80	80	80	80	80	80	80
	Fuel		Main htg s	mains gas	mains gas	mains gas	mains gas	mains gas	mains gas	mains gas	mains gas	mains gas
			Sec htg sy	mains gas	mains gas	Wood Pellets in Bags	mains gas	mains gas	mains gas	mains gas	mains gas	mains gas
Compliance when gas fired boiler used												
Compliance	EPC			0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
CPC	CPC			0.37	0.37	0.35	0.38	0.38	0.38	0.38	0.39	0.38
Compliance when oil fired(91.3% efficient gas boiler replaced with 94% efficient oil boiler)												
	EPC			0.4	0.39	0.39	0.4	0.4	0.4	0.4	0.4	0.39
	CPC			0.46	0.45	0.42	0.46	0.46	0.46	0.46	0.46	0.45

Part L the challenge

Wall U - Value	Insulation	Wall thickness
0.21	80 mm in the cavity	325 mm
0.12	100 mm in the cavity and 62.5mm laminate board	410 mm

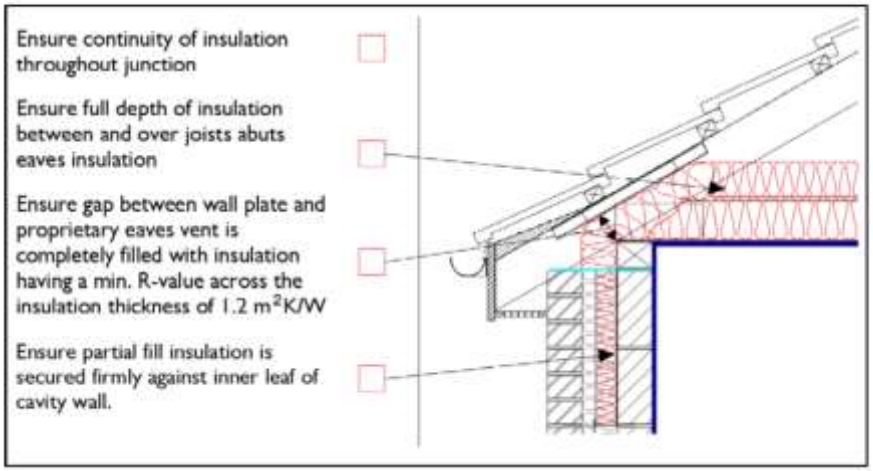
- 120 m2 house results in
  - 5.48 m2 loss in total floor area
  - 2.7 m2 loss in plot area.
  - For every 44 houses built a house is lost

Part L the challenge – Thermal Bridging

Table D1	Section 1 - Cavity Wall Insulation	Target U-values		
Junction detail Identifier 2011 Edition	Junction detail	U-value = 0.21 W/m²K, 150mm full-fill or partial fill cavity[1, 3] (roof U = 0.16) (floor U = 0.21)	U-value = 0.15 W/m²K, 150mm full-fill or partial fill cavity and internal insulation[2, 3] (roof U = 0.14) (floor U = 0.15)	U-value = 0.15 W/m²K, 200mm full-fill or partial fill cavity[2, 3] (roof U = 0.14) (floor U = 0.15)
		ψ-value (W/mK)	ψ-value (W/mK)	ψ-value (W/mK)
Section 1	Details			
1.01a	Ground Floor - Insulation above slab	0.170	0.072	0.196
1.01b	Ground Floor - Insulation above slab plus lightweight block	0.080	0.042	0.093
1.02a	Ground Floor - Insulation below slab	0.163		
1.02b	Ground Floor - Insulation below slab plus lightweight block	0.070		
1.03	Timber Suspended Ground Floor	0.219		
1.04	Concrete Intermediate Floor within a dwelling	0.000		
1.04a	Concrete Separating Floor between dwellings	0.064		
1.05	Timber Intermediate Floor within a dwelling	-0.001		
1.05a	Timber Separating Floor between dwellings	0.041		
1.06.1	Masonry Solid Separating Wall (plan)	0.045		
1.06.2	Masonry Cavity Separating Wall (plan)	0.051		
1.07	Masonry Partition Wall	0.000		
1.08	Stud Partition Wall	0.000		
1.09/1.10	Eaves – Unventilated/Ventilated attic	0.049		
1.11.1/ 1.12.1	Eaves – Unventilated/Ventilated - Insulated at ceiling	0.028		
1.11.2/ 1.12.2	Eaves – Unventilated/Ventilated – Insulation between and under rafters – Dormer	0.014		

- Thermal bridging
- Psi (Ψ) value in units of (W/mK).

Diagram 9 - Eaves Detail for masonry cavity wall with slate Cavity closer Ψ=0.14



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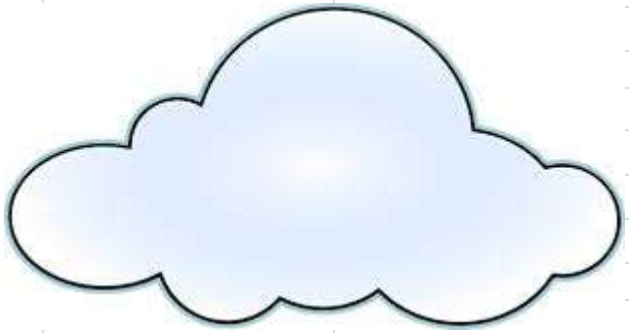
Does fabric make sense

U Value	0.21	0.21	0.21	0.15	0.14
Insulation Type	PIR	Penolic	Full Fill Board	Penolic	Full Fill Board
Cavity width	130	120	100	150	150
Insulation thickness	90	80	90	110	140
Cost / m2	€ 10.27	€ 18.70	€ 21.45	€ 24.78	€ 29.70

A box of Grapes from Egypt = 1 kg

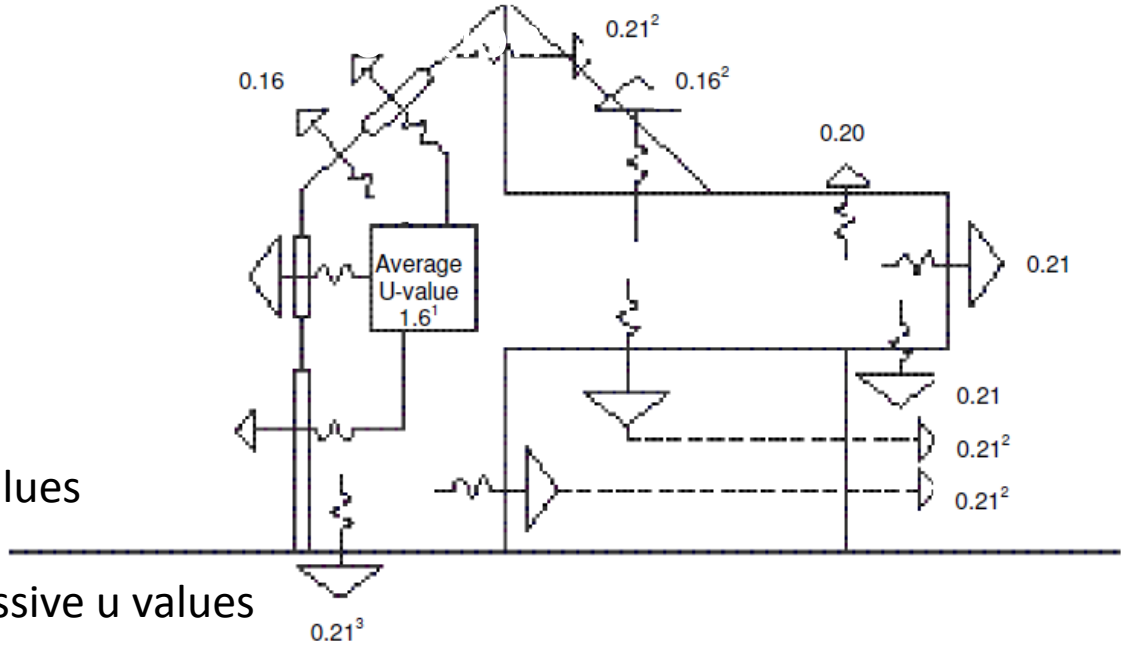


	0.21 wall solution	0.15 wall solution	Saving	Payback on Insulation
Total building heat loss: kW	4.6	4.5	0.1	
Heating annual usage: kWh/yr	9978	9645	333	
DHW annual usage: kWh/yr	3270	3270	0	
Running Cost Gas 90%	€ 961.80	€ 937.63	€ 24.18	74
Running Cost Heat Pump 386% 159%	€ 598.69	€ 584.89	€ 13.80	129

Part L the challenge – Costs

100 m2 house semi			A3 House		A3 House
	Area	Option A U Values	Option A cost	Option B U Values	Option B Additional Cost
wall	122	0.21	n/a	0.15	€ 1,770.22
roof	50	0.16	n/a	0.12	€ 312.50
floor	50	0.21	n/a	0.14	€ 1,100.00
window	€ 27.50	1.60	n/a	1.10	€ 825.00
MVHR					€ 2,500.00
Airtightness		7		5	€ 1,150.00
Boiler					€ 1,000.00
Gas connection					€ 300.00
Cylinder					€ 600.00
Solar PV 4 panel					€ 2,300.00
6 kW Heat Pump and Cylinder			€ 4,200.00		
Solar PV 3 panel			€ 1,800.00		
Total			€ 5,800.00		€ 11,857.72
Running Costs			€ 598.69		€ 937.00

Part L - Alternative



- Maintain the maximum U Values
- No need for approaching passive u values
- Associated costs with materials, labour, compliance and certification
- Don’t change the way we build change the way we heat our houses

Solution 1 – Heat pump

	Option 1	Option 2
Technology 1	6 kW Heat Pump	Oil / Gas Boiler
Technology 2	3 Dimplex PV Panels	4 Dimplex PV Panels
Technology 3		Improved Fabric
Capital Cost	€6000	€11,845

What *is a heat pump?* - Video

Product – Dimplex Air Source heat pumps

- Inverter technology
- High efficiency on HARP 386%
- Easy To plumb – flow and return
- 4 sizes – 16kW – 12kW – 9kW – 6kW
- 50% lower running costs
- Upsell on Underfloor and smartrads
- 3 year warranty

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Designed and made in Ireland For Ireland

Designed for Ireland, made in Ireland

- Optimized for Irish climatic conditions
- Compressor built for use in northern Europe (not global spec!)
- Developed using specific knowledge of the Irish market by Irish engineers based in Co Louth.

Range domestic heat pumps

Range of 5 models:

12kW – single fan

16kW – single fan

8kW – single fan

6kW – single fan

4kW – single fan

All monobloc

Brand new development

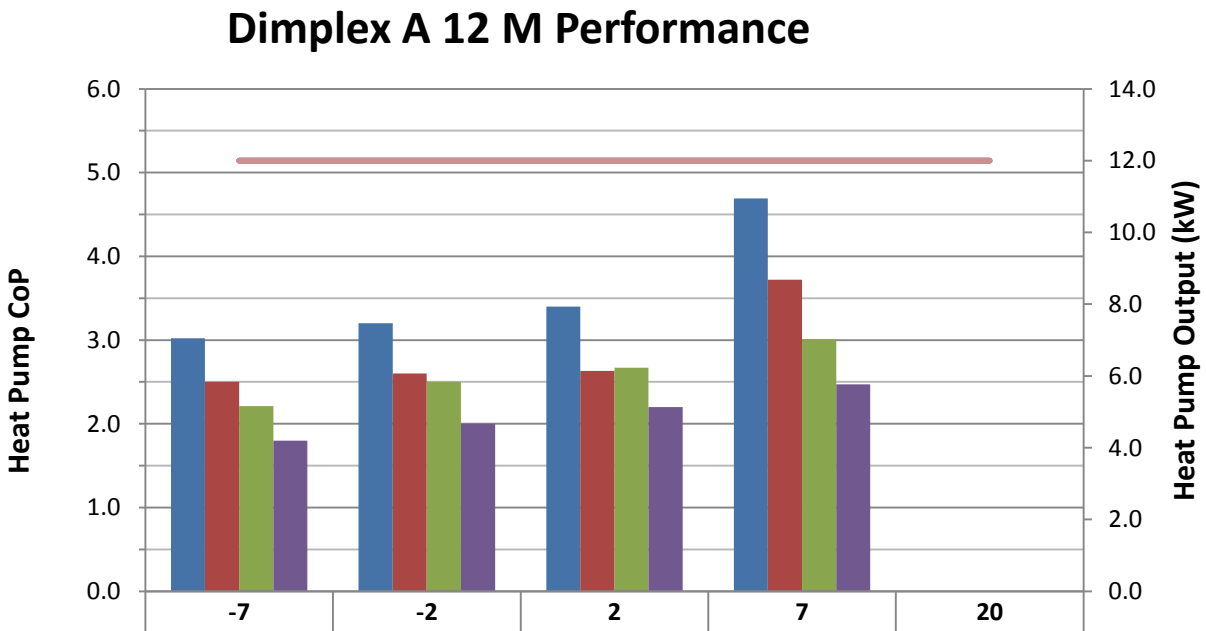
Performance

Outstanding performance and efficiency

- Optimised for the Irish climate
- High CoP's and SPF's
- **4.7** @ A7/W35 **3.4** @ A2 / W35
- **3.0** @ A7 / W55 **2.7** @ A2 / W55

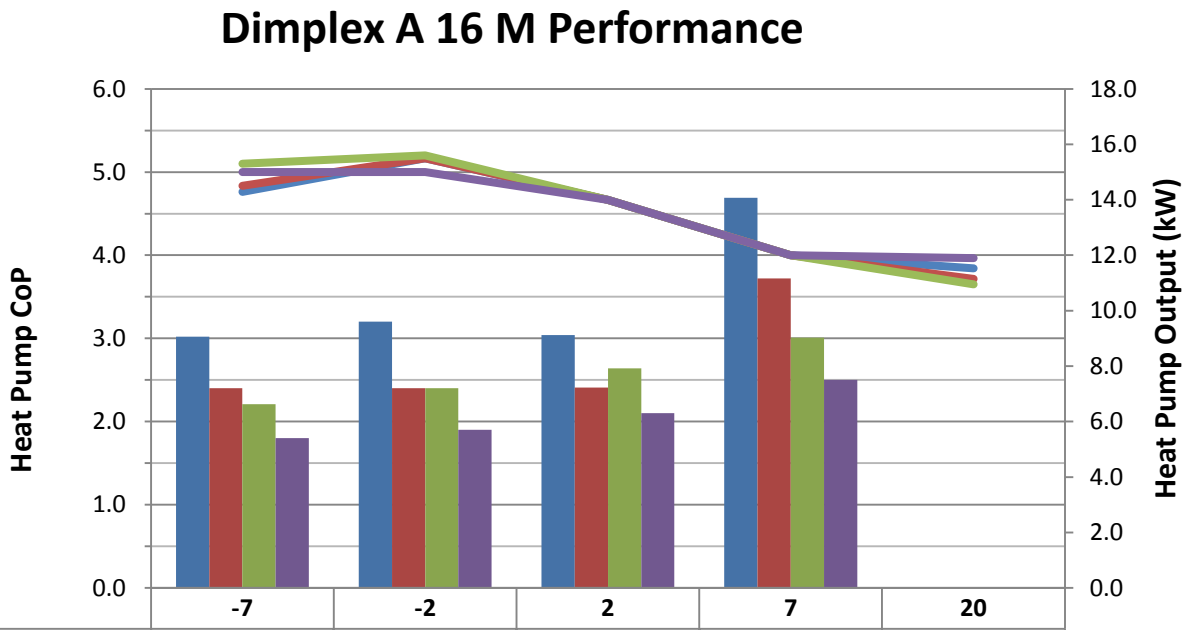
- SPF (floor heating): **3.9**
- SPF (radiators): **3.6**

Performance 12 kW



	-7	-2	2	7	20
COP @ W35	3.0	3.2	3.4	4.7	
COP @ W45	2.5	2.6	2.6	3.7	
COP @ W55	2.2	2.5	2.7	3.0	
COP @ W65	1.8	2.0	2.2	2.5	
Output (kW) @ W35	12.0	12.0	12.0	12.0	12.0
Output (kW) @ W45	12.0	12.0	12.0	12.0	12.0
Output (kW) @ W55	12.0	12.0	12.0	12.0	12.0
Output (kW) @ W65	12.0	12.0	12.0	12.0	12.0

Performance 16 kW



	-7	-2	2	7	20
COP @ W35	3.0	3.2	3.0	4.7	
COP @ W45	2.4	2.4	2.4	3.7	
COP @ W55	2.2	2.4	2.6	3.0	
COP @ W65	1.8	1.9	2.1	2.5	
Output (kW) @ W35	14.3	15.5	14.0	12.0	11.5
Output (kW) @ W45	14.5	15.5	14.0	12.0	11.1
Output (kW) @ W55	15.3	15.6	14.0	12.0	10.9
Output (kW) @ W65	15.0	15.0	14.0	12.0	11.9

Controls

Sophisticated heating, made simple

- Total heating system management / control
- Simple to use graphical user interface
- Advanced control functionality
  - up to 4 heating zones
  - separate DHW control
  - fully weather compensated
- Pre configured
- Commissioning mode

Heating as a system

Complete system packages

- Pre-packaged options
- All new *EC-Eau Smart* cylinders
- All new A Class + Solar PV package
- Smartrad radiators

Hot water

EC-Eau Smart Cylinder

- Complete new range – optimised for Inverter heat pumps
  - Smaller buffer tank (40L)
  - Smaller coil (1.1m^2)
- Max DHW capacity now 250L
  - 150L / 210L / 250L options
- Integrated slave controls
  - Pre wired thermostats, immersions, sensors, pumps and valves

New ECS + 40L buffer models

New ECS HP + ST + buffer model

Warranty and Commissioning

SEAI Approved*

- HARP Approved*
- Triple E Register*

3 year warranty

- When installed by a Dimplex Accredited Installer
- Commissioned by Dimplex

Design Consideration

- **Heat pumps are not being sold on a level playing pitch and are often undersized to "get the sale"**
- Under sizing and over reliance on supplementary immersion heaters evident in poorly performing systems
- **Heat Pump Sizing 100% rule**
- *"provide at least **100%** of the calculated design **space heating power** requirement at the selected internal and external temperatures, the selection being made after taking into consideration the space heating **flow temperature** assumed in the heat emitter circuit and any variation in heat pump performance that may result."*
- Above selected outdoor temperature, no allowance can be made for supplementary electric back up
- Bivalent systems are allowed

Heat pump Sizing

- **Heat Pump Sizing 100% rule**
- Installer must perform a heat loss calculation to EN12831
- Target temperatures
  - Derived from MET Eireann Office data
  - Values at which external temperature exceeded for 99% of the year
- Installer must select a heat pump that can deliver at least 100% of the heat demand at these temperatures
- Must consider flow temperature and heat emitter

Its not just efficiency

- HARP is being used to select heat pumps based on SPF with no regard to sizing
- Consumer are losing out to the benefit of builders due to high bills
- The SPF is not a true reflection of the real performance and running costs
  - **Higher SPF does not equal low running costs**
- SPF is only half of the equation
- The key is to have heat pumps sized to meet the heat requirement of the building
- Rated out put on HARP is at the highest output for one of the two test conditions at Air 7
  - This is completely misleading

Running Costs

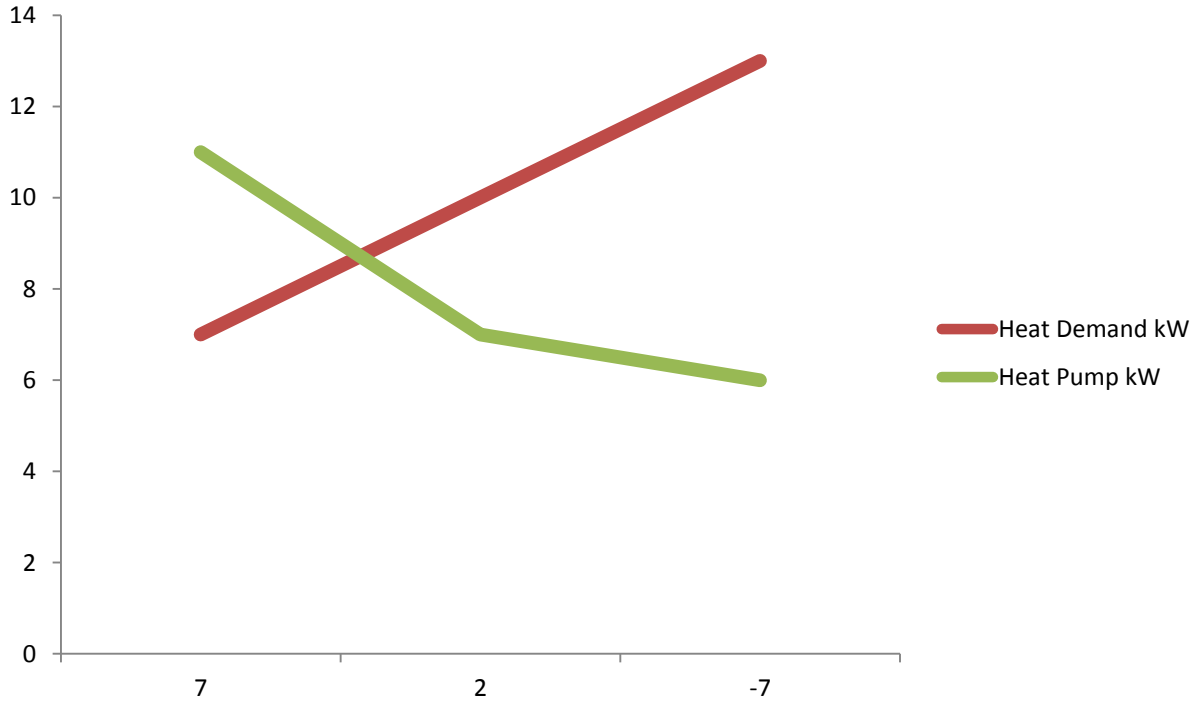
- People buy heat pumps to avail of low running cost – FACT

Heating System Running Costs at Design Temperature			
	Fuel cost per kWh	**Typical Efficiency**	**Cost per useful kWh**
LPG boiler	13.41c	80%	16.67c
Oil boiler	9.69c	80%	12.11c
HP with CoP 2.5	20.16p	250%	8.06c

- There is dissatisfaction in the market with people selecting heat pumps on SPF only

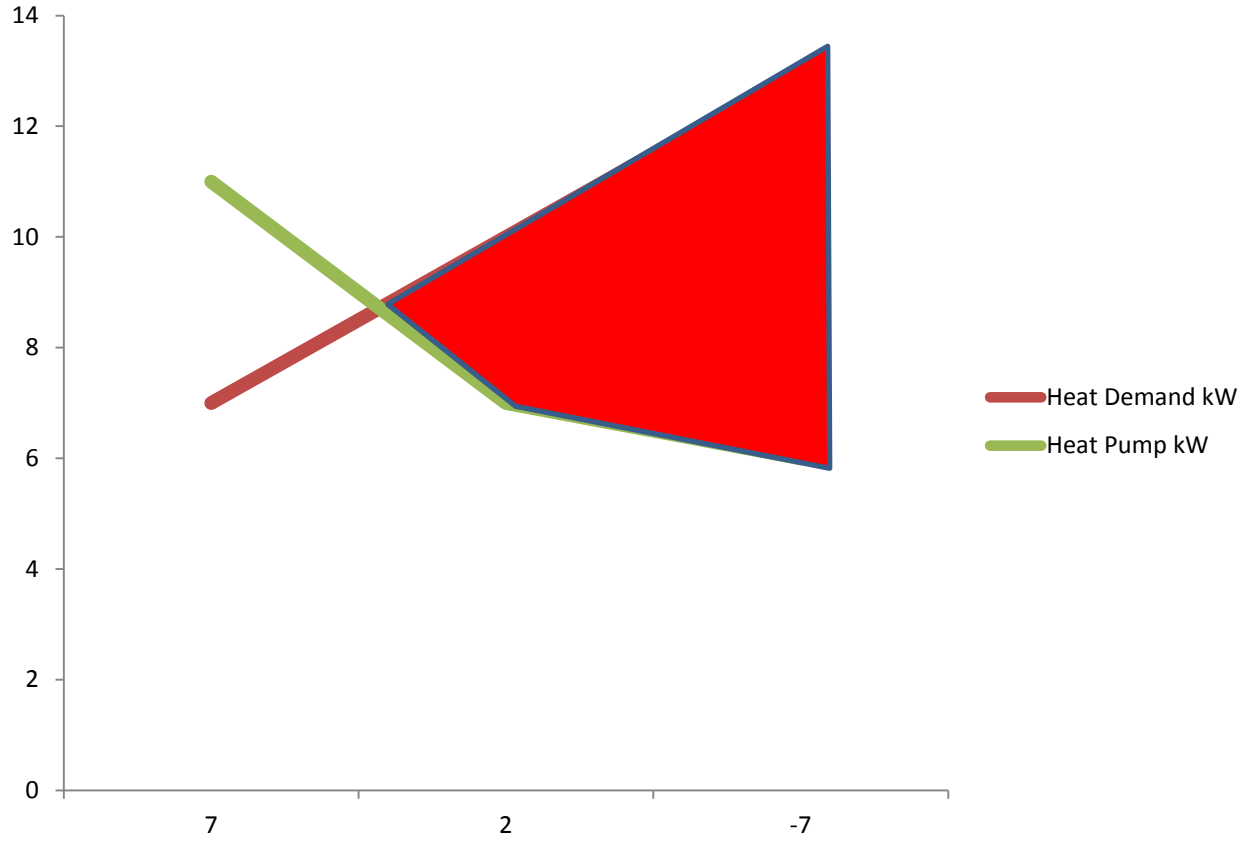
Heat pumps as heating appliances

- When it gets cold a building needs more heat
- When it gets cold a heat pump delivers less heat
- Classic problem with heat pumps
  - they don't deliver the heat when you need it most



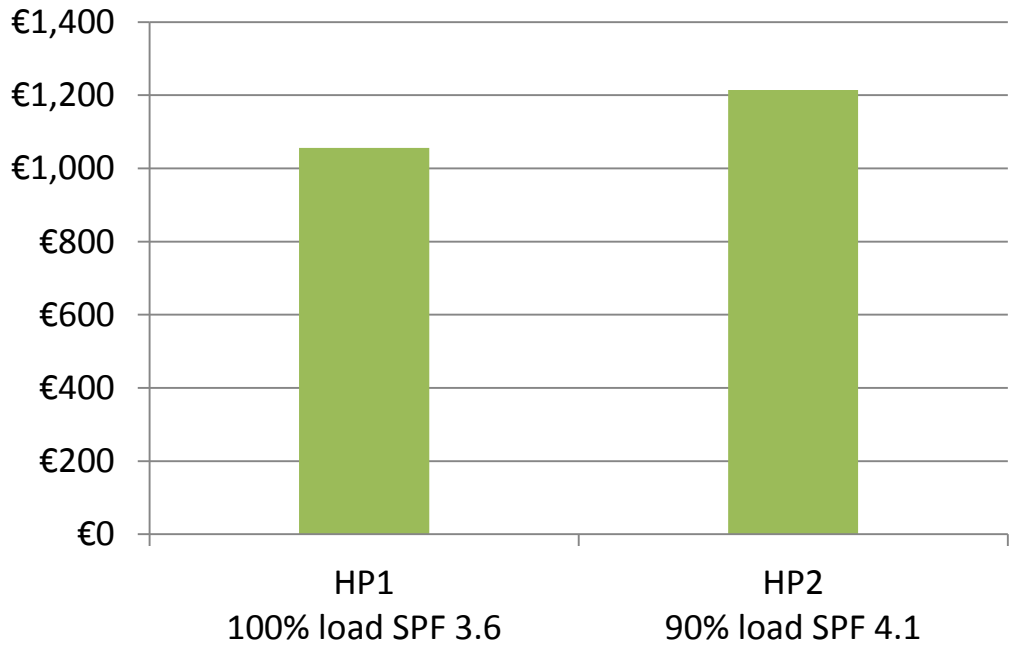
The hidden cost

- Results in direct electricity being used – COP of 1
- Even though it has a very high SPF



The real cost for 20,000kWh

Heat Pump	Heat Pump duty	Heat Load	SPF	Electric Energy	Electric Cost	Cost	Total Cost
1	100%	20000	3.6	5556	€0.19	€1056	€1056
2	90%	18000	4.1	4390	€0.19	€834	€1214
		2000	1	2000	€0.19	€380	



Live system demonstration – Web monitoring

Dimplex A Class

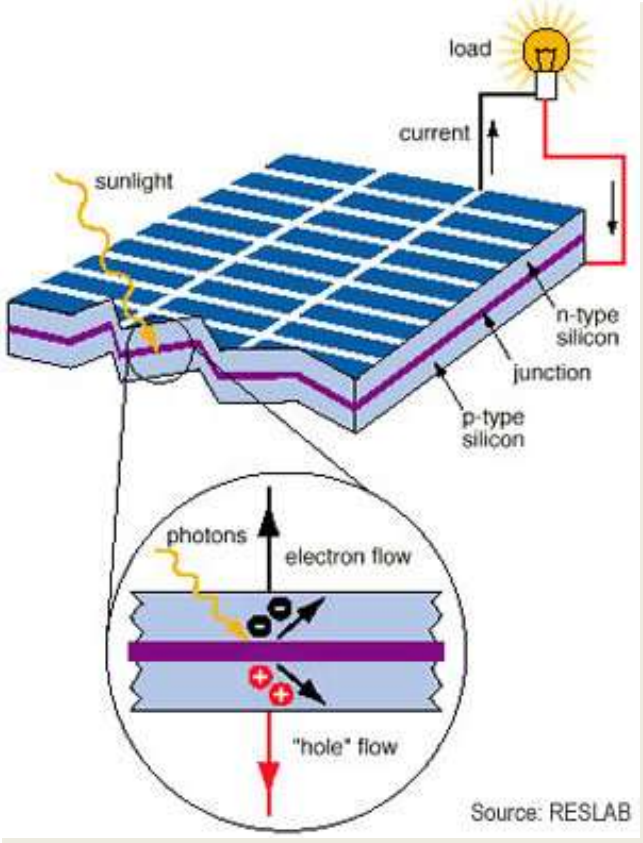
- High Output
- Delivers Full rated output
  even at low air temperatures
- ….and high water temperatures up to to 65°C
- High temperatures allow for retro fit
- Can deliver 100% hot water in DEAP
- No need to “oversize”
- SPF of 3.9 on HARP*
  even though it will deliver 100% of the heat

Solar Photovoltaic Systems

The basics

- Solar PV uses renewable energy from the sun to produce electricity
- Solar PV modules (panels) produce energy from daylight
  - Not direct sunlight
  - Means electricity can be produced even in cloudy weather

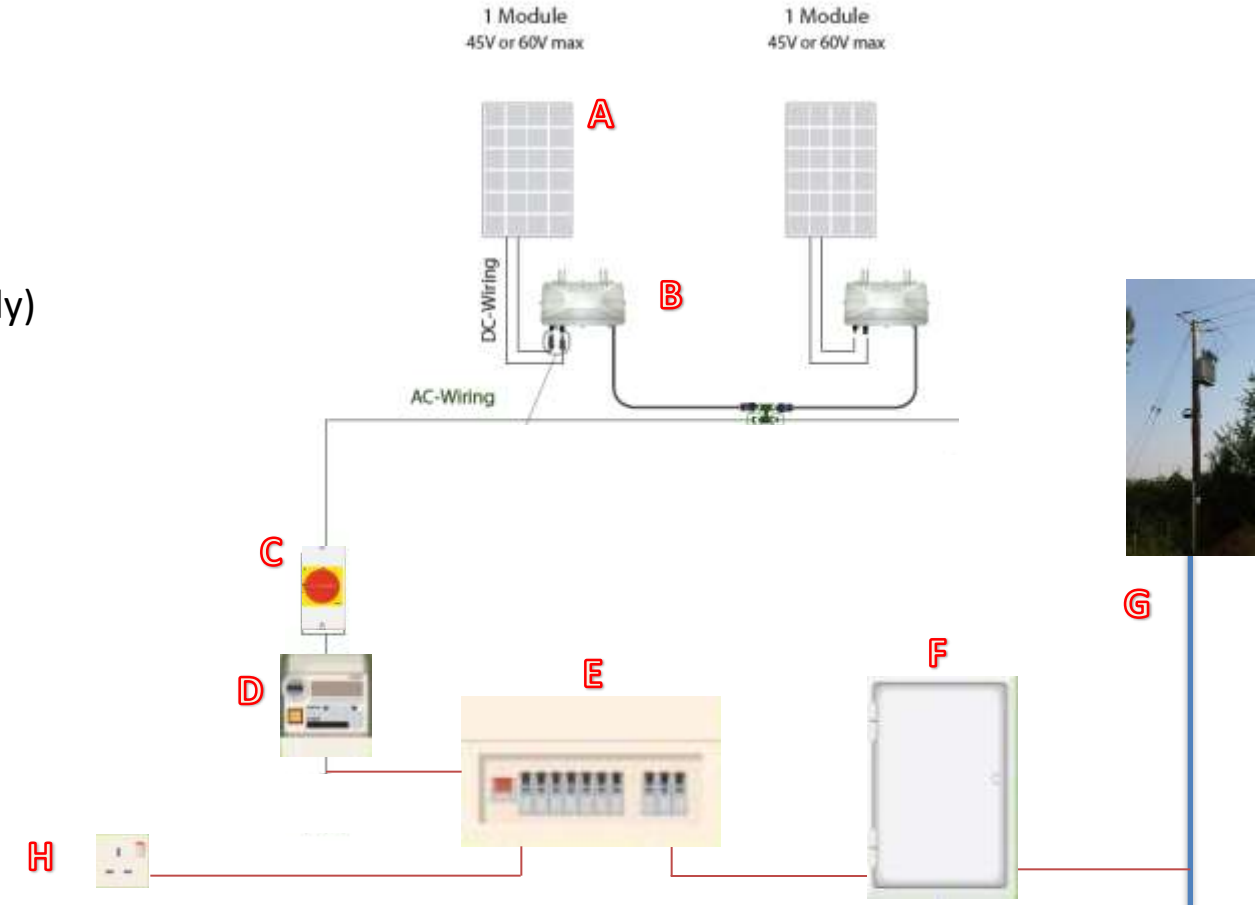
How it works


load
current
sunlight
n-type silicon
junction
p-type silicon
photons
electron flow
"hole" flow
Source: RESLAB

System components

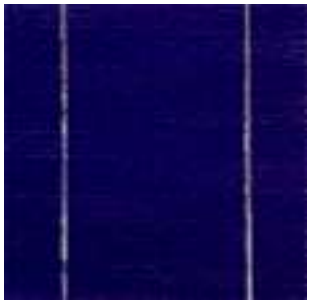
Typical grid connected system

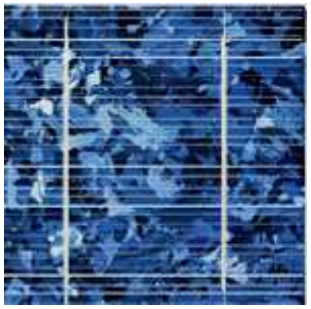
- A: Solar PV module (panel)
- B: Micro inverter
- C: Isolation switch (AC supply)
- D: Energy meter
- E: Consumer unit
- F: Electricity meter
- G: Mains electricity supply
- H: Electrical appliances



Solar PV Cells

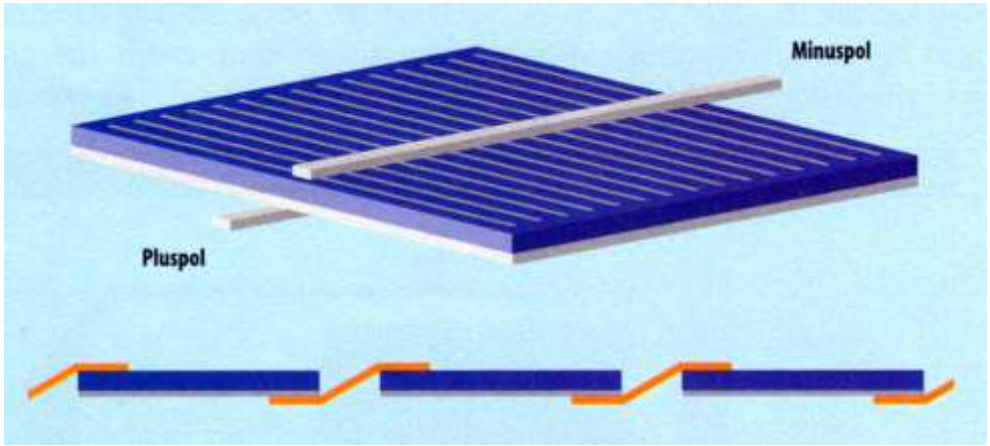
- **Monocrystaline Cells made of high pure Silicon**
  - Max. efficiency (at laboratory): appr. 24%
  - Present efficiency at mass production: 14-17%
  - Present market share: appr. 20%
- **Polycrystaline Cells made of pure Silicon**
  - Max. efficiency (at laboratory): appr. 18%
  - Present efficiency at mass production: 13-17%
  - Present market share: 70%
- **Amorphous Cells**
  - Max. efficiency (at laboratory): appr. 13%
  - Present efficiency at mass production: 5-9%
  - Present market share: 10%

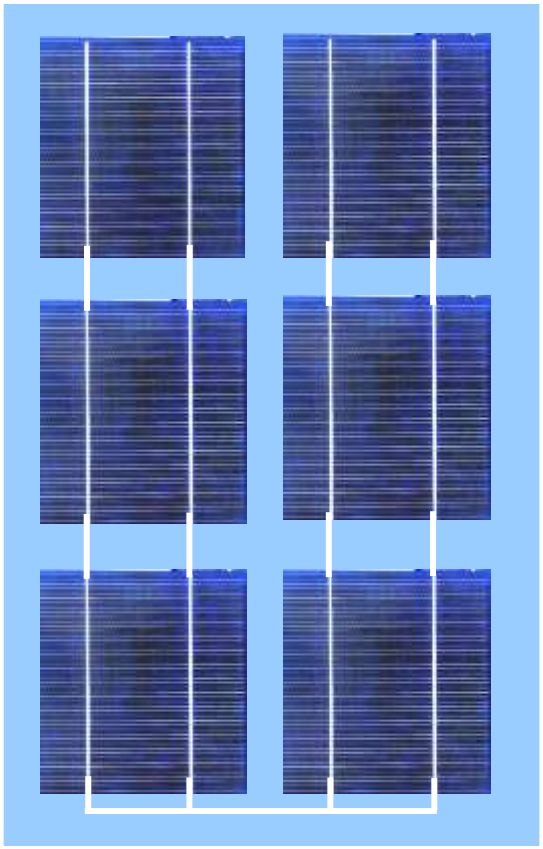




Internal configuration of modules

- Cell string: connection of a number of cells in series





Solar PV Modules - Technical Characteristics

Electrical Characteristics

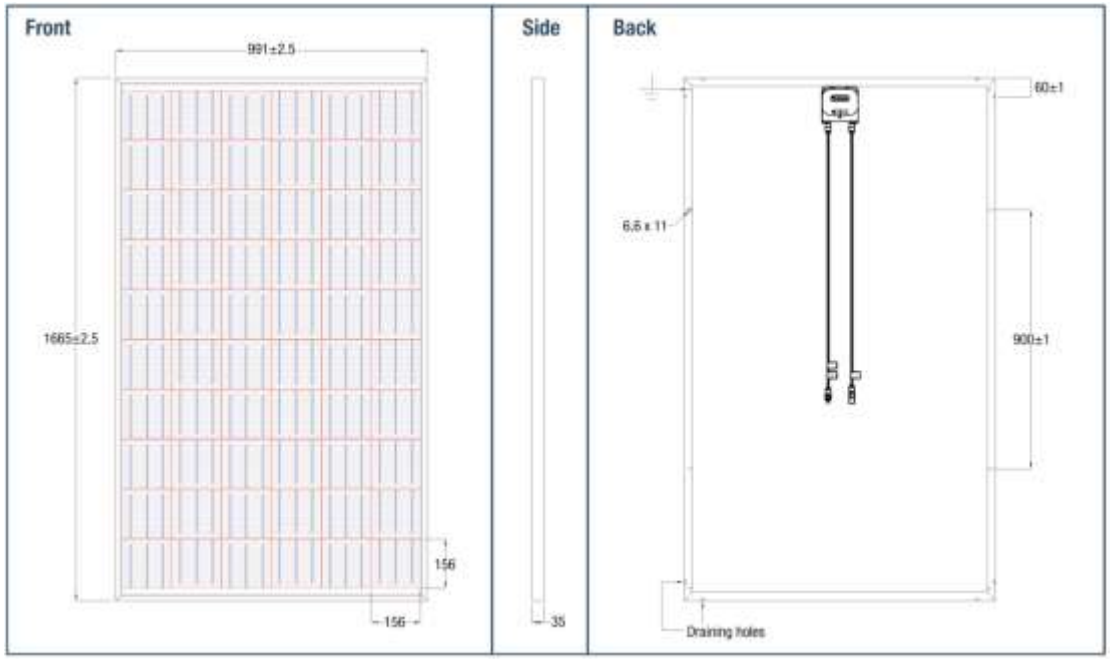
Standard Test Conditions (STC):	DXPVM250P6-30
Maximum power at STC (pmax)	260Wp
Output tolerance	-0% / +10 Wp
Guaranteed minimum power	260Wp
Maximum power operating voltage (Vmp)	31.2V
Maximum power operating current (Imp)	8.49A
Open circuit voltage (Voc)	37.8A
Short circuit voltage (Isc)	8.98A
Module efficiency (ηm)	15.8%
Cell efficiency	16.4%

Standard test conditions measures module output under specific lab conditions, allowing all modules to be compared equally:

Irradiance 1000W/m^2, module temperature 25ºC, spectrum air mass = 1.5

Solar irradiance, orientation and angle will all affect kWp output once installed

Solar PV Modules - Technical Characteristics



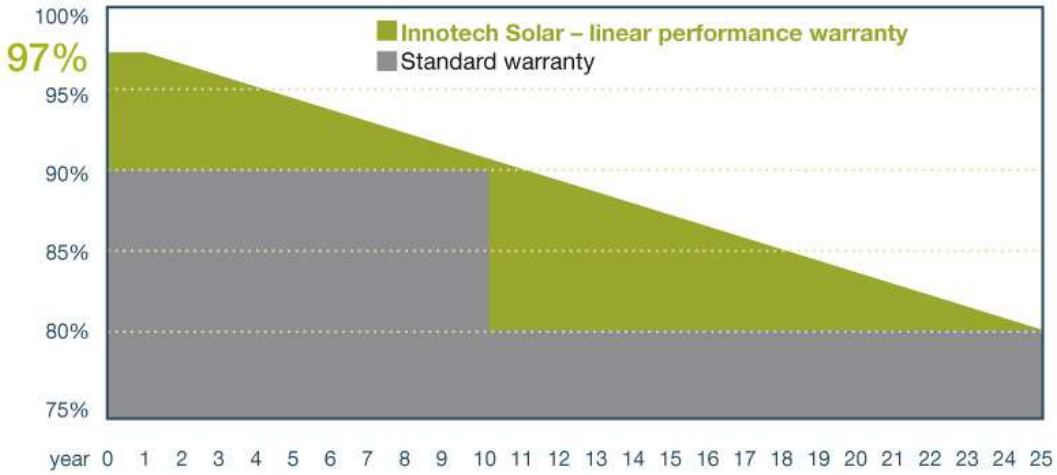
Mechanical Characteristics	
Solar cell	Polycrystalline 156 x 156mm
No of cells	60 (6x10) in series
Dimensions	1665mm x 991mm x 35mm (1.65m^2)
Weight	19kg
Front glass	3.2mm Solar glass with anti reflection
Frame	Black Aluminium Frame
Junction box	IP65 rated
Connection type	2x 1000mm x 4mm^2 cable with MC4 inter-connectors

Made in Sweden – European Quality

Higher yield due to anti reflection glass and positive cell sorting

Lowest Carbon footprint in the market

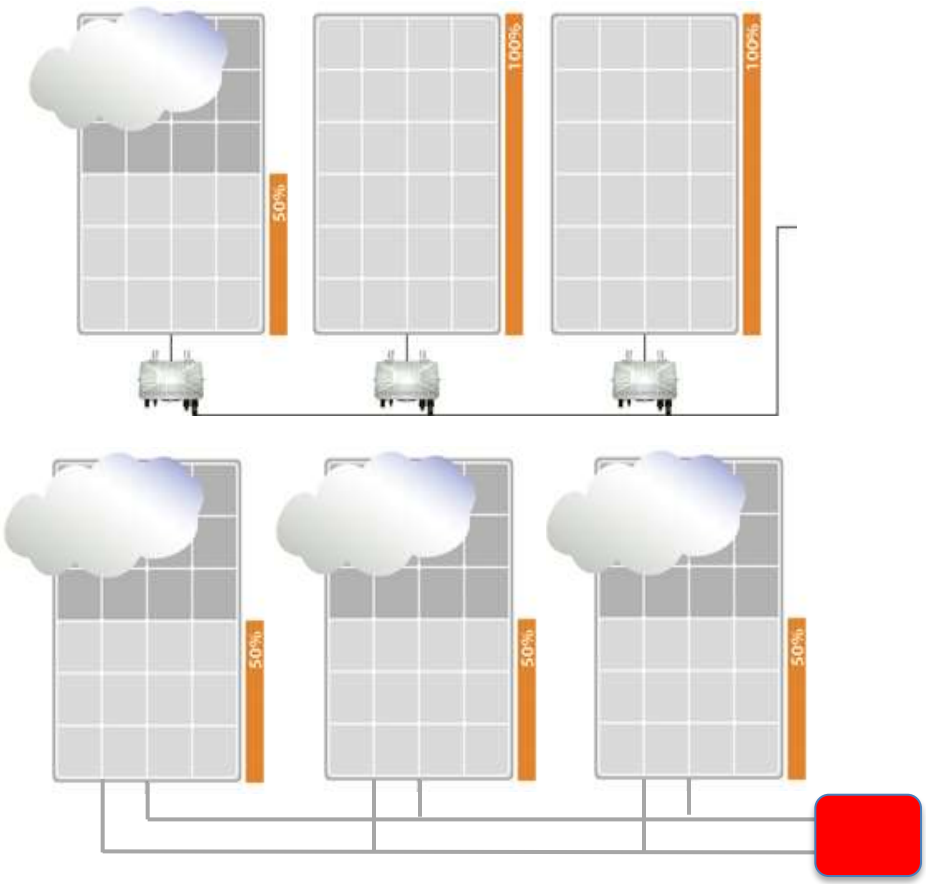
Solar PV Modules - Technical Characteristics



Module output over time

year	Standard warranty	Innotech Solar linear performance warranty	year	Standard warranty	Innotech Solar linear performance warranty
1	90.00%	97.00%	13	80.00%	88.60%
2	90.00%	96.30%	14	80.00%	87.90%
3	90.00%	95.60%	15	80.00%	87.20%
4	90.00%	94.90%	16	80.00%	86.50%
5	90.00%	94.20%	17	80.00%	85.80%
6	90.00%	93.50%	18	80.00%	85.10%
7	90.00%	92.80%	19	80.00%	84.40%
8	90.00%	92.10%	20	80.00%	83.70%
9	90.00%	91.40%	21	80.00%	83.00%
10	90.00%	90.70%	22	80.00%	82.30%
11	80.00%	90.00%	23	80.00%	81.60%
12	80.00%	89.30%	24	80.00%	80.90%

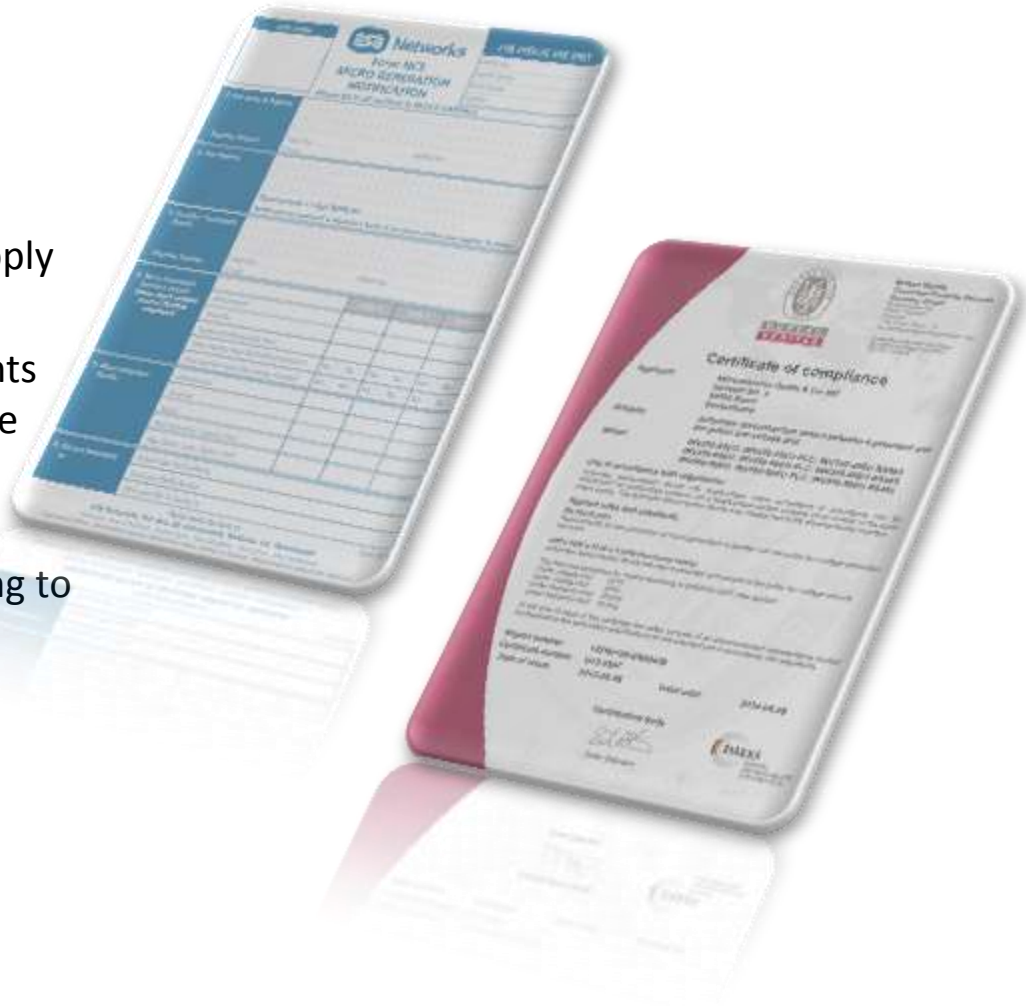
String Vs Micro Inverters



- If one panel is shaded only that panel is affected not the whole array
- Higher system production up to 15%
- Micro inverters allow for smaller systems
  - Smallest systems tend to be 5 panel systems 1.25kWp with string inverters
  - Micro inverters can be as small as a single panel system
  - Optimised part L solutions tend to be 2-4 panel systems
- All AC instalation
- No DC cables required
- All cables are plug and play
- Easier expand the system and add panels at a later date

Connecting to the grid

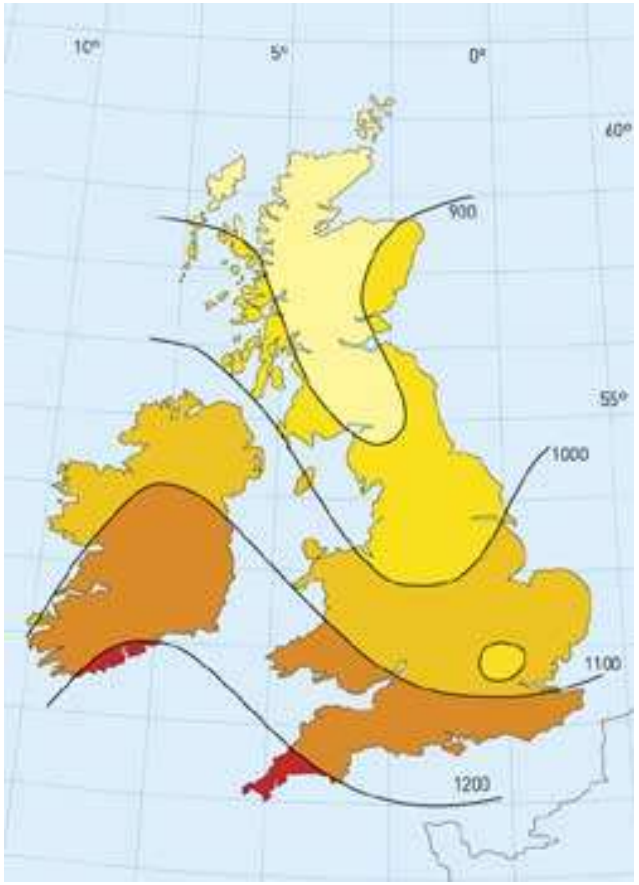
- **Feeding power back to the grid**
  - Need to liaise with ESB Networks must apply with NC6 form
  - Micro Inverter must meet the requirements of ESB Networks Conditions Governing the Connection and Operation of Micro-generation
  - Must meet deviations for Ireland according to EN50438:2007



System Performance
Geographical location

Irish Solar Irradiance

- Solar irradiance varies depending on location
- Map shows total average solar radiation falling on 1m^2 of surface, inclined at 30º



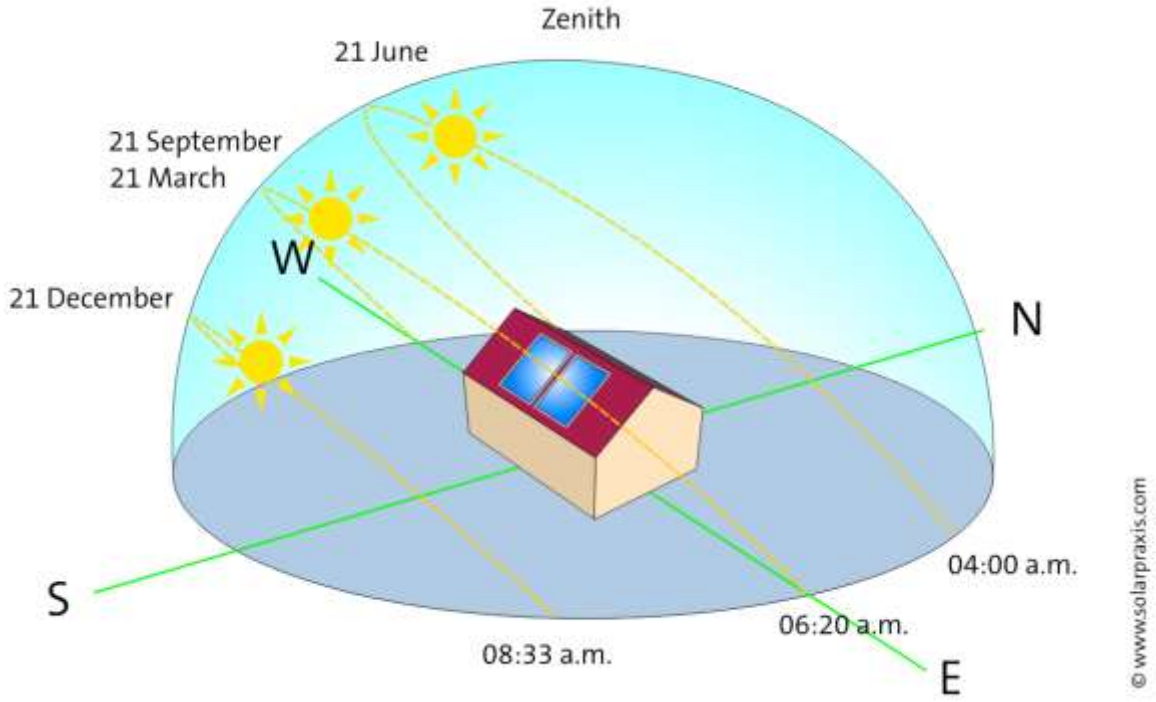
System Performance
Effect of orientation and angle on output

Orientation Chart - Showing % of yearly output available for various orientation tilts (as % of maximum)

Tilt (°) from Horiz.	Orientation - Compass bearing (°) measured from North												
	West 270°	255°	240°	SW 225°	210°	195°	South 180°	165°	150°	SE 135°	120°	105°	EAST 90°
Horiz. 0°	90	90	90	90	90	90	90	90	90	90	90	90	90
10°	89	91	92	94	95	95	96	95	95	94	93	91	90
20°	87	90	93	96	97	98	98	98	97	96	94	91	88
30°	86	89	93	96	98	99	100	100	98	96	94	90	86
40°	82	86	90	95	97	99	100	99	98	96	92	88	84
50°	78	84	88	92	95	96	97	97	96	93	89	85	80
60°	74	79	84	87	90	91	93	93	92	89	86	81	76
70°	69	74	78	82	85	86	87	87	86	84	80	76	70
80°	63	68	72	75	77	79	80	80	79	77	74	69	65
Vert. 90°	56	60	64	67	69	71	71	71	71	69	65	62	58

Note: Near horizontal 0° inclinations are not recommended as the self-cleaning can not be relied on up to about 10°.

System Performance
Effect of orientation and angle on output



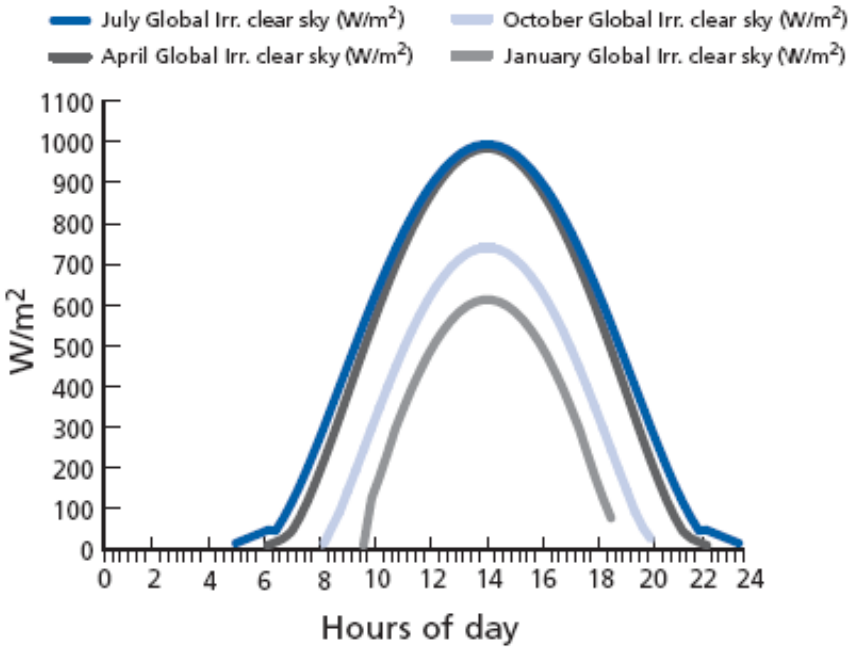
In DEAP the electricity produced by the PV module in kWh/year is calculated as 0.80 x kWp x Solar radiation x overshading factor

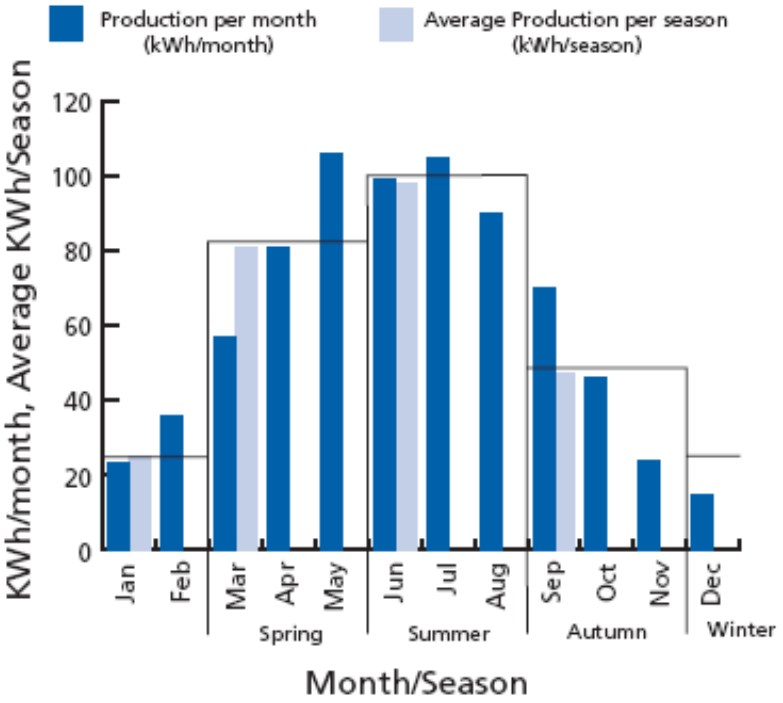
- Example 1. A 1kWp Array
- South Facing @ 30˚
- No shading.
- 0.8 x 1.04 x 1074 x 1 = 893 kWh
- 1kWp array yield = 893kWh

- Example 2. As Above But
- Roof Is Due East
- 0.8 x 1.04 x 886 x 1 = 737 kWh

- Example . As Above But
- Roof Is Due North
- 0.8 x 1.04 x 676 x 1 = 562 kWh

System Performance
Sunpath and seasonal output





System Performance
How much energy will a Part L system generate?

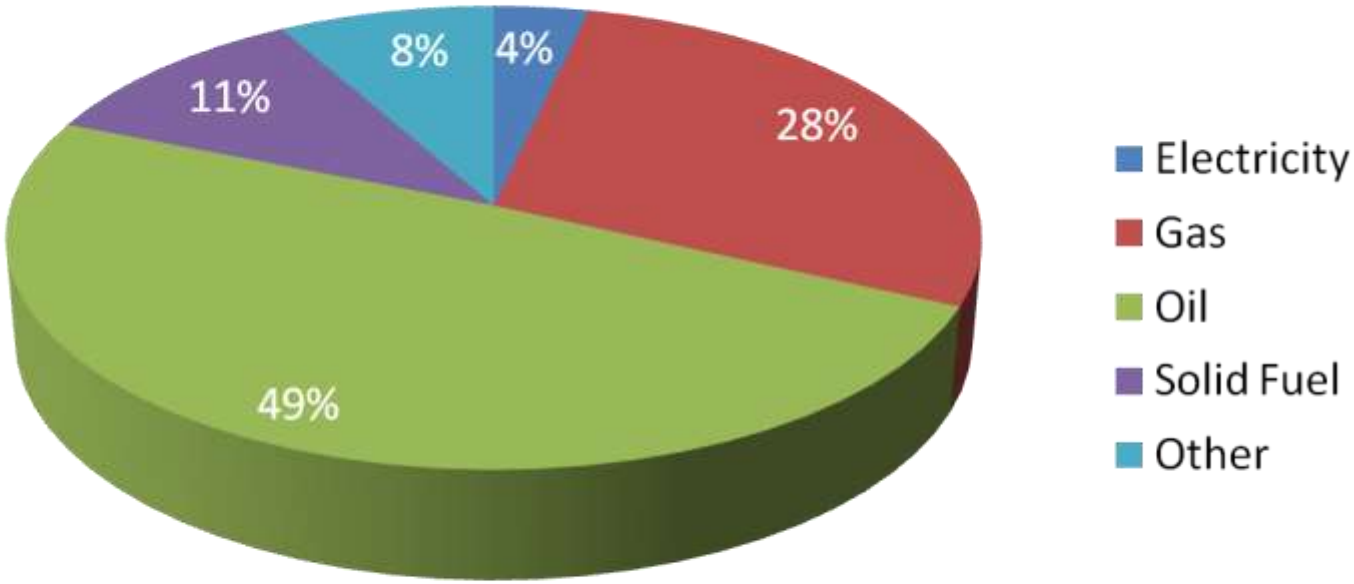
- A typical system in the Ireland will yield 850kWh of electricity every year per kWp installed
- An average 3 bedroom home uses approx 4250kWh of electricity every year
- A typical 1kWp system will yield 850kWh per year
  - 20% of annual electricity requirement
- Energy cost saving >€161.5 year
- Energy savings locked in for next 25 years
- Approx 330 kg CO_2 per year saved

Applications on roof and In roof systems for Tile and slate

Live system demonstration – Web monitoring

SETS – Smart Electric Storage Systems - Quantum

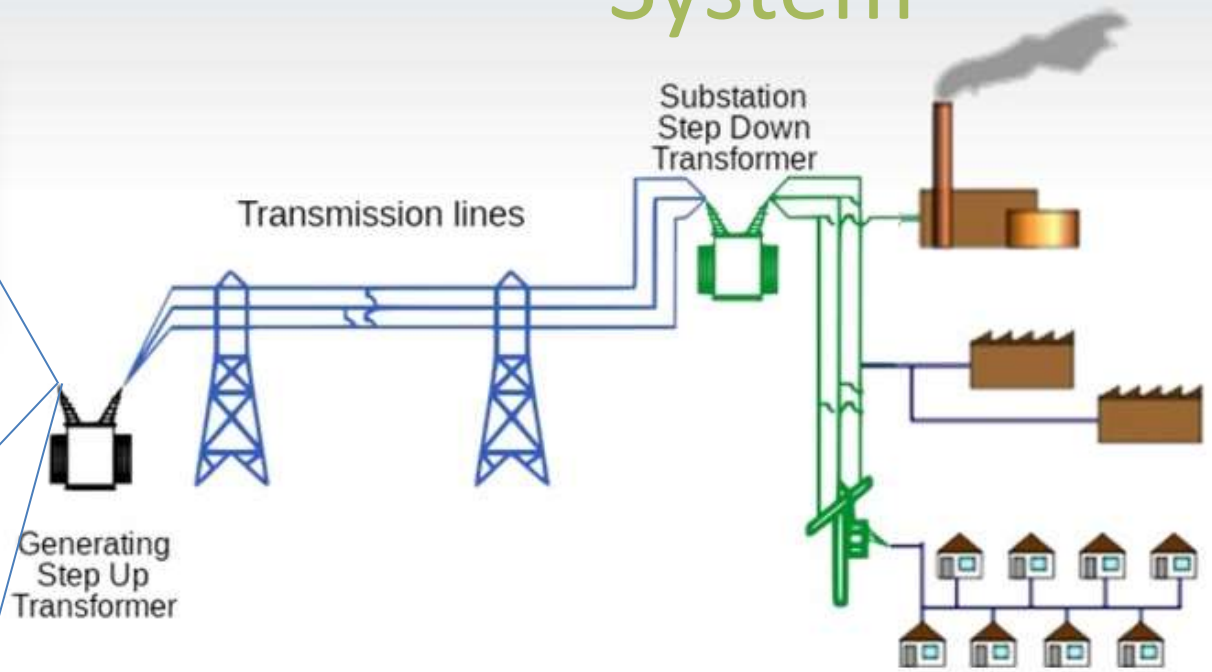
Irish Heating Market



Source; House Hold budget survey (2004/2005)

Today's Electricity System

Centralised Generation



Enormous Inherent Inefficiencies
and Unnecessary Costs

Wind on the Irish grid

15% wind in November 2013

Source: Eirgrid

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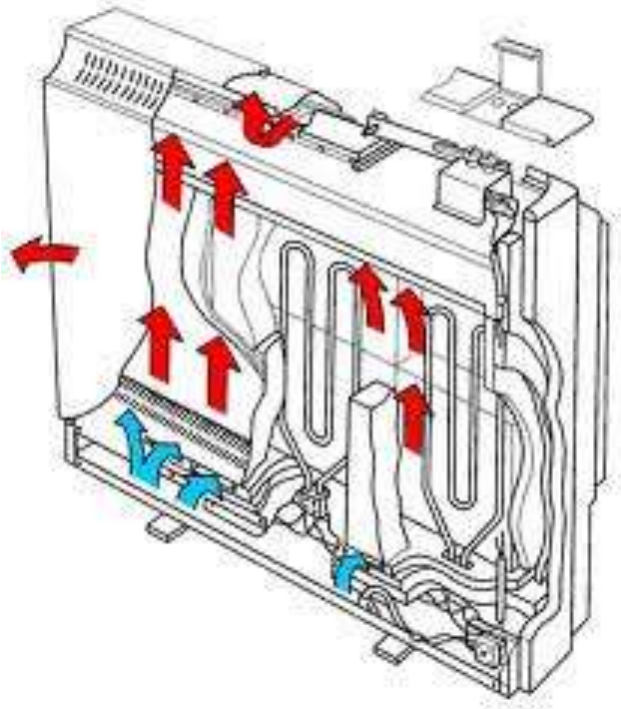
How do we store electricity from Wind?

How do we store electricity from Wind?



Smart Energy Storage

	Electric Car	Smart Water Heating	Smart Space Heating
			
Typical Energy Stored per Day	10kWh (75km per day)	13kWh (210l per day at 65°C)	54kWh (80m² home in winter)

- At a fraction of the capital cost Quantum offers far greater DSM capability than an electric car

Irish installed off peak heating market

Northern Ireland		Connected Load
No. of Electrically heated homes	30k	
Total Installed Heaters	120k	240MW
Total Installed electric DHW cylinders	30k	90MW
Total		**330MW**

Republic of Ireland		Connected Load
No. of Electrically heated homes	80k	
Total Installed Heaters	240k	480MW
Total Installed electric DHW cylinders	80k	240MW
Total		**720MW**

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Changed World of Telecommunications in 25 years

- Simple Copper Wires

- Distributed and Linked to Big Data Systems

Changed World of IT in 25 years

- Centralised Mainframe Computers

- PC Tablet based linked to Big Data Systems

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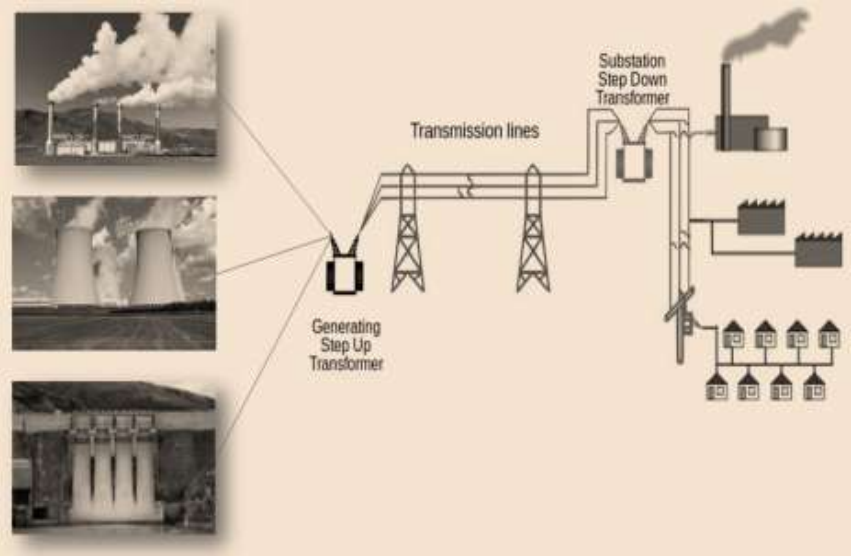
Changing World of Electricity System

- Old Model and Perceptions



- Prosumers

Both Producers and
Self Consumers

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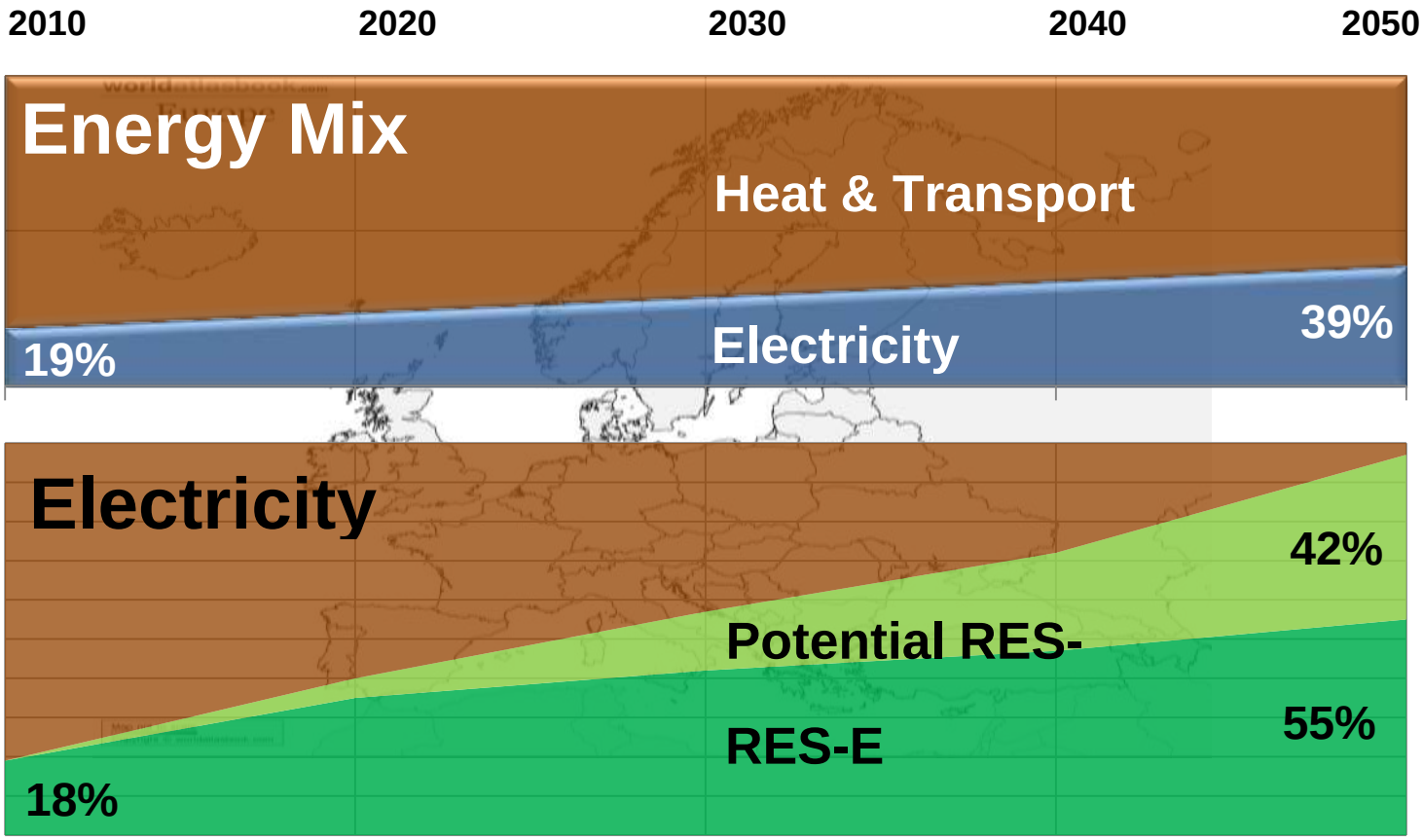
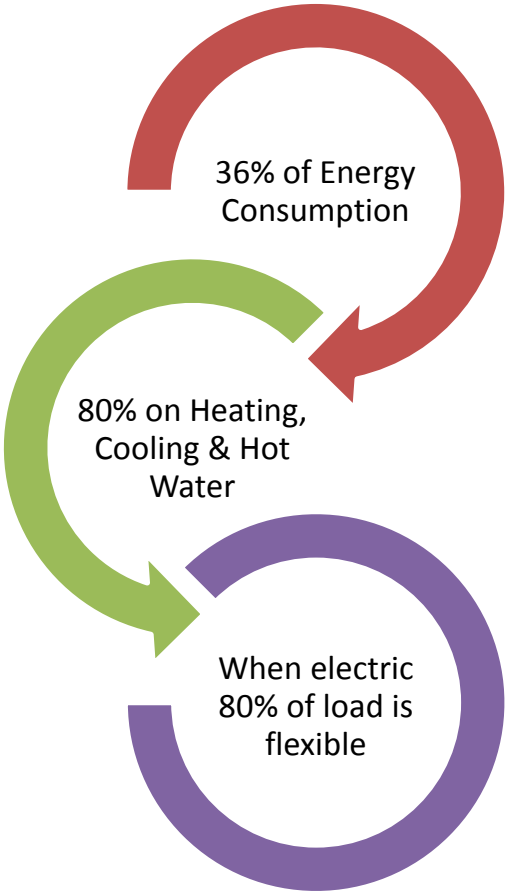
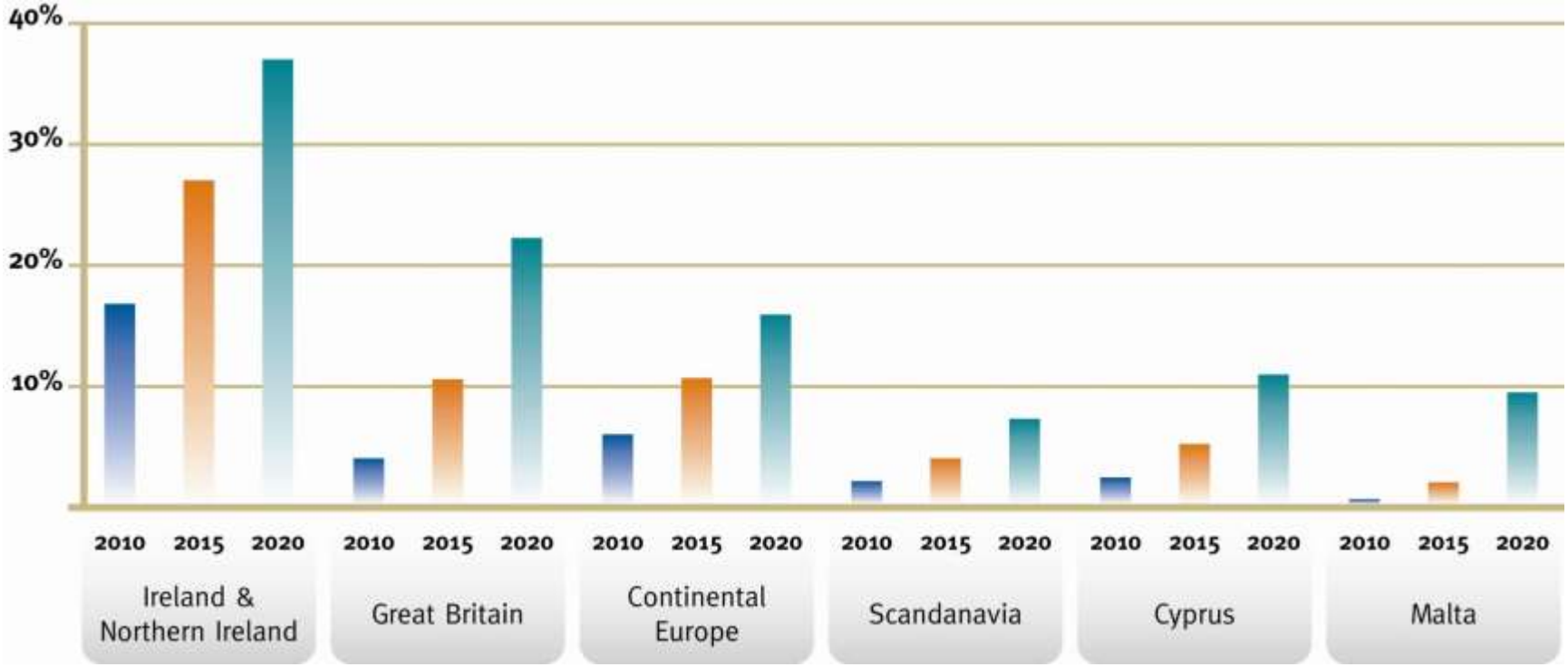
European Energy Roadmap 2050



Significance of Buildings to Demand Management

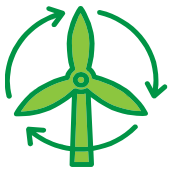


Targets for non-synchronous sources in European Systems



* Based on analysis of National Renewable Action Plans (NREAPs) as submitted by Member States

The Challenge



Increased RES levels

Electrification of new sectors

Increased user participation

Additional system complexity

The Requirement

Smart Grid

Key Enablers

- TOU Meters with Domestic Tariffs
- Fit for purpose Grid
- Appropriate Retail & Wholesale Market Structures
- Increased Interconnection
- Advanced Control Systems
- Intelligent Flexible Devices

- Quantum Smart Electric Thermal Storage System

Quantum – Benefits for the Utility Sector

- Quantum offers the Renewable Generator a real alternative to curtailment
  - 10,000 Quantum homes = 100MW of connected load (30MW water heating + 70MW space heating)
  - Can be connected or disconnected to suit renewable generation capacity
  - Converting existing electric homes reduces fossil fuel power generation when renewables are not available due to 20%+ efficiency improvement

- Quantum provides valuable ancillary services to the Grid Operator & Aggregators
  - Can be remotely switched on or off to facilitate grid balancing at scale with each group of 1,000 homes providing 10MW of switchable load
  - Quantum system have current frequency monitoring capability and can be configured to allow loads to be switched to assist in managing the supply frequency

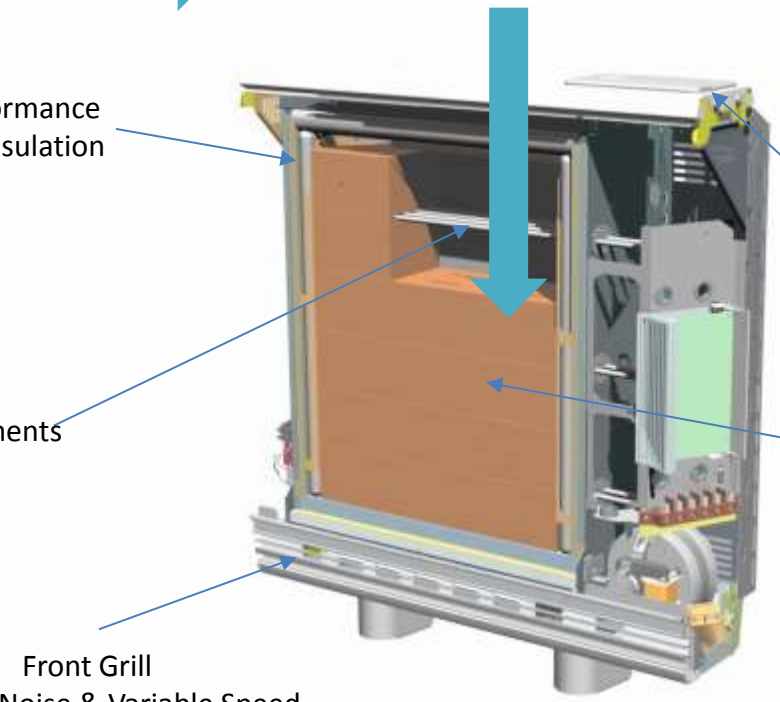
- Quantum provides a market opportunity for the Supply Company
  - Customer retention through added value services
  - Buy electrical energy at optimum times to improve profitability

Quantum Space and Water Heating System

Quantum Water Heating System

Class leading, intuitive, smart energy storage vessel

Electricity In → **Heat Stored** → **Heat Out**



Dimplex Quantum Energy System - Key Features

Consumer

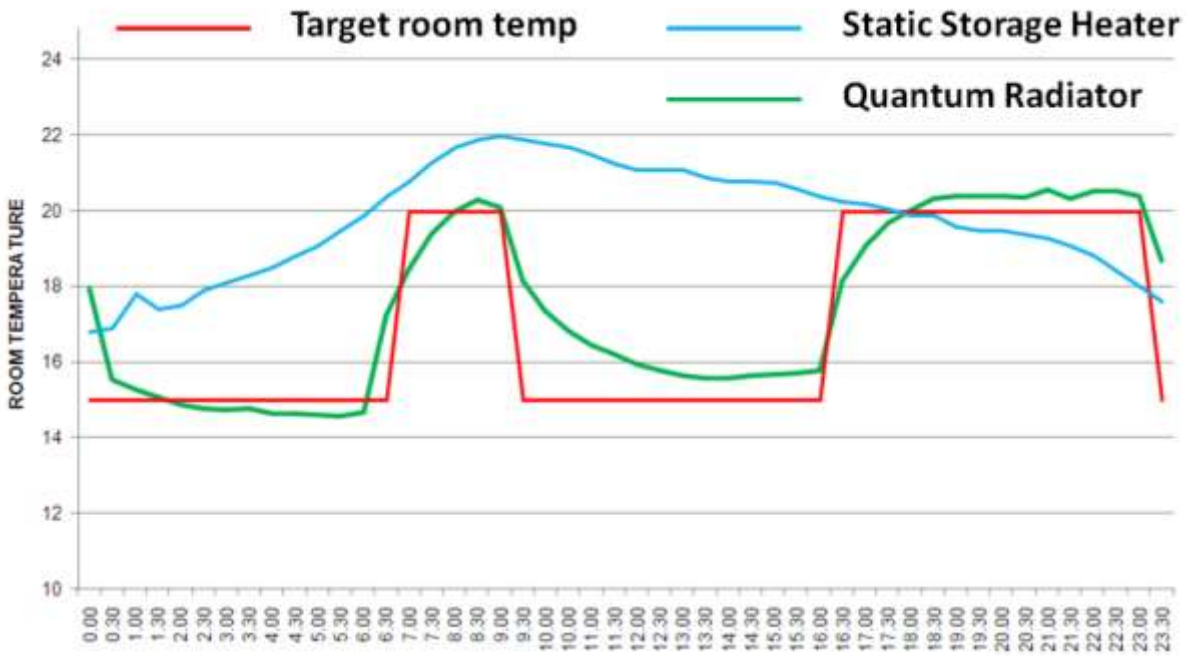
- High efficiency energy store – low losses
- Accurate electronic time and temperature control
- Up to 25% reduction in energy bills
- Advanced apps for user interaction and information

Power System

- Overall Demand Reduction
- Reduction of demand during peak periods
- Increased System Flexibility
- Provision of Ancillary Services
- Facilitation of increased renewable electricity generation

Quantum Storage Heat Profile

- **Matches heat output to user-set room temperature throughout 24 hours.**



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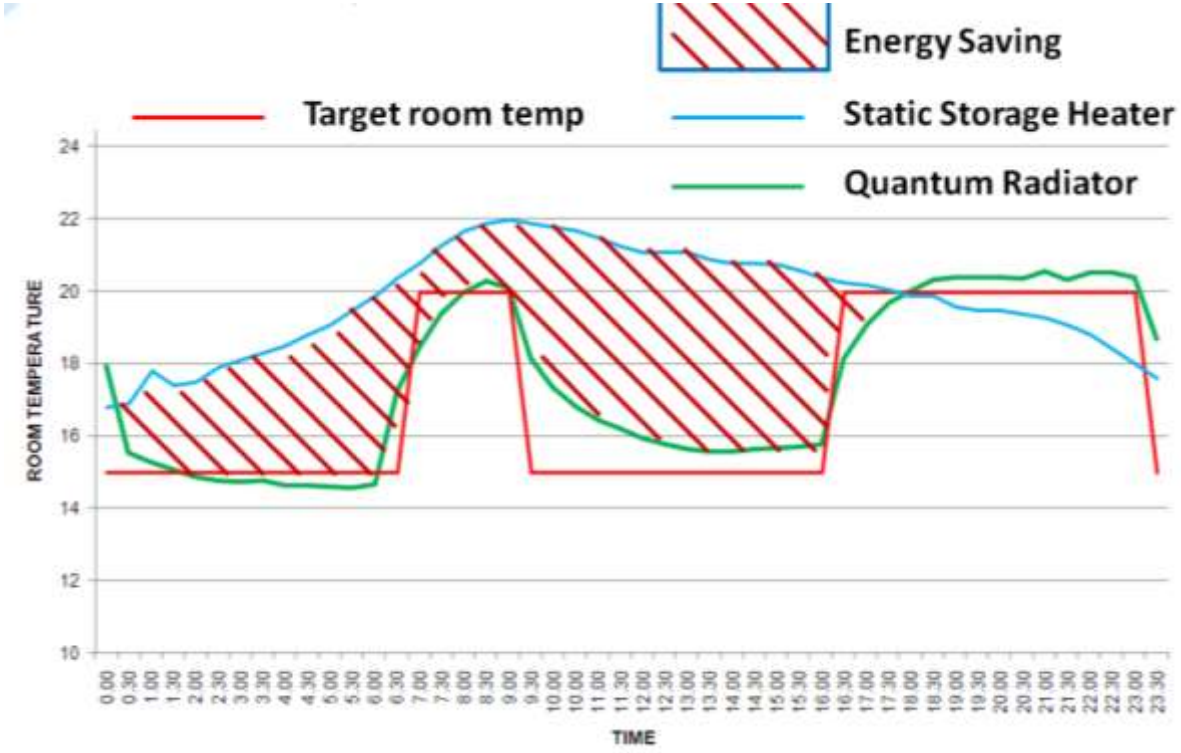
Quantum Savings Comparison Profile

- **Up to 30% reduction in overall running costs***
- ***Independently verified by Strathclyde University**



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What are the Key Differences?

Rating - rated as per direct acting heaters, using the nominal output of the product.

Insulation - the reason the product is capable of such strong running-cost improvements.

Aesthetics - designed to match more modern surroundings, styles and products.

Control - the key benefit that puts this product above anything currently available.

Quantum - Savings Officially Recognised

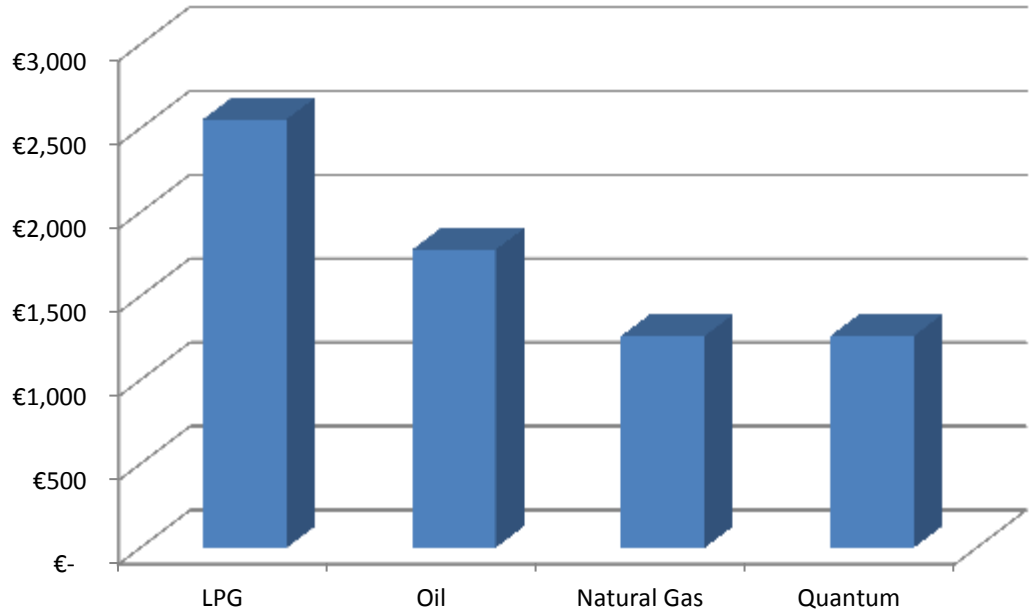
- BRE (Building Research Establishment) and DECC (Department of Energy and Climate Change) have agreed to include Quantum in the next release of SAP (Standard Assessment Procedure)
- SAP will show up to 22% energy saving and up to 27% running cost saving when compared with static storage heaters
- Quantum is eligible for the UK's Green Deal energy efficiency grant scheme

- Irish DEAP review underway
- Qualifies for SEAI Energy Credits

Department of Energy & Climate Change

Running Cost – Average house in Ireland

- 150 m2 House with a heat load of 13,500 kWh
- Based on SEAI fuel price comparison October 2012 with 70% efficient boilers



Quantum Water Cylinder

- The Quantum water cylinder is a direct, vented or unvented cylinder offering between 75 and 250 litres of domestic hot water.
- It features a highly accurate control with the capability of displaying the ‘real-time’ availability of hot water and learning/anticipating hot water requirements.
- Technologically ready to work with demand side management systems and future grid developments.

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Quantum Hub

The Quantum Hub will be hard-wired to the home's electricity meter. It will interact with the heaters and cylinders via an RF signal, and has initially been developed to:

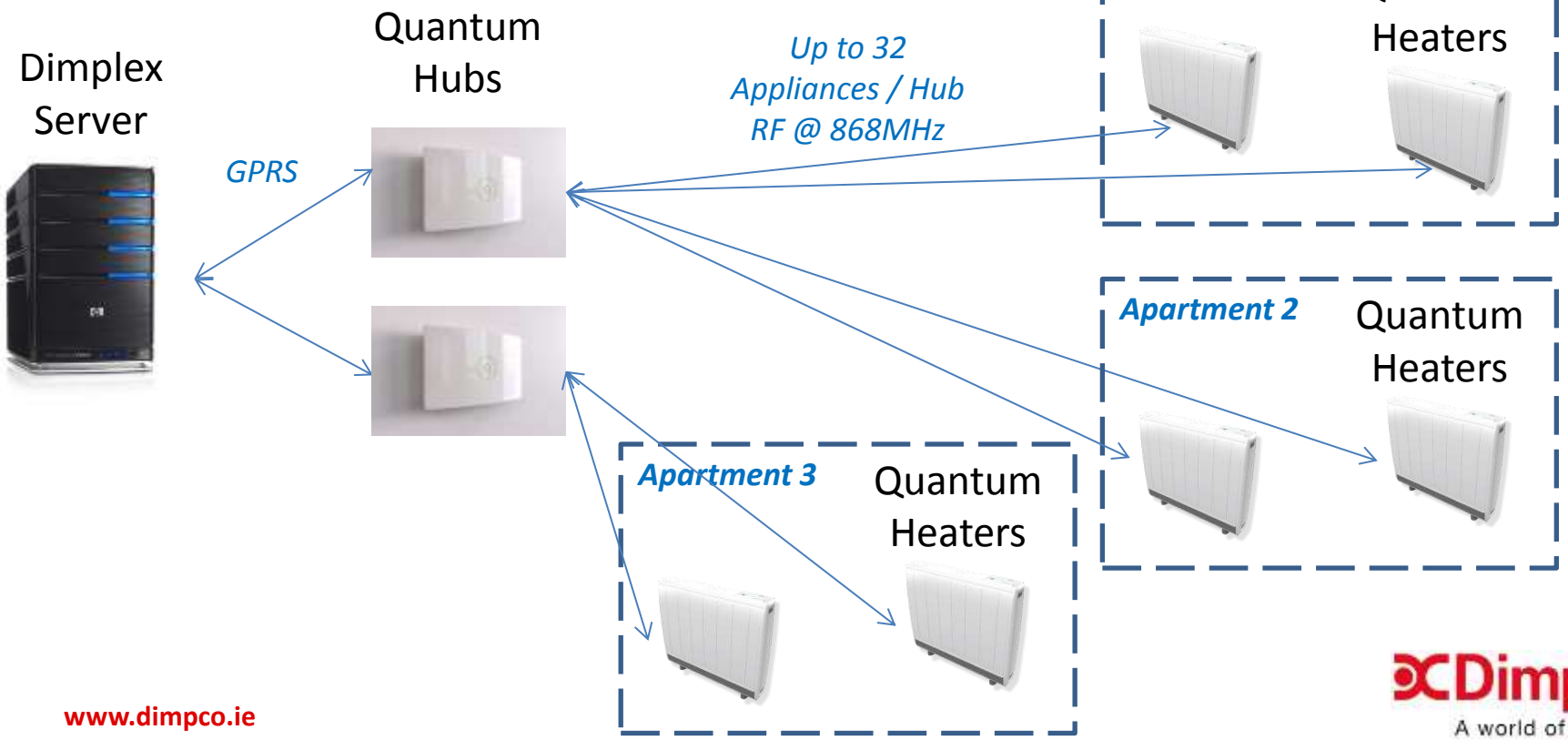
- Switch heaters and cylinders between their on-peak and off-peak states.

In the future, versions of the hub will be able to:

- Tell the supplier the storage potential of the property.
- Give the user feedback on energy management and running costs.
- Allow remote adjustment, from users to service engineers, via their smartphones.
- Interact with HANs/WANs, the 'smart grid' and suppliers.
- Allow for variable tariffs that offer even greater savings as energy suppliers economise with demand-side management.

Greenway – Dublin, Ireland

System Configuration



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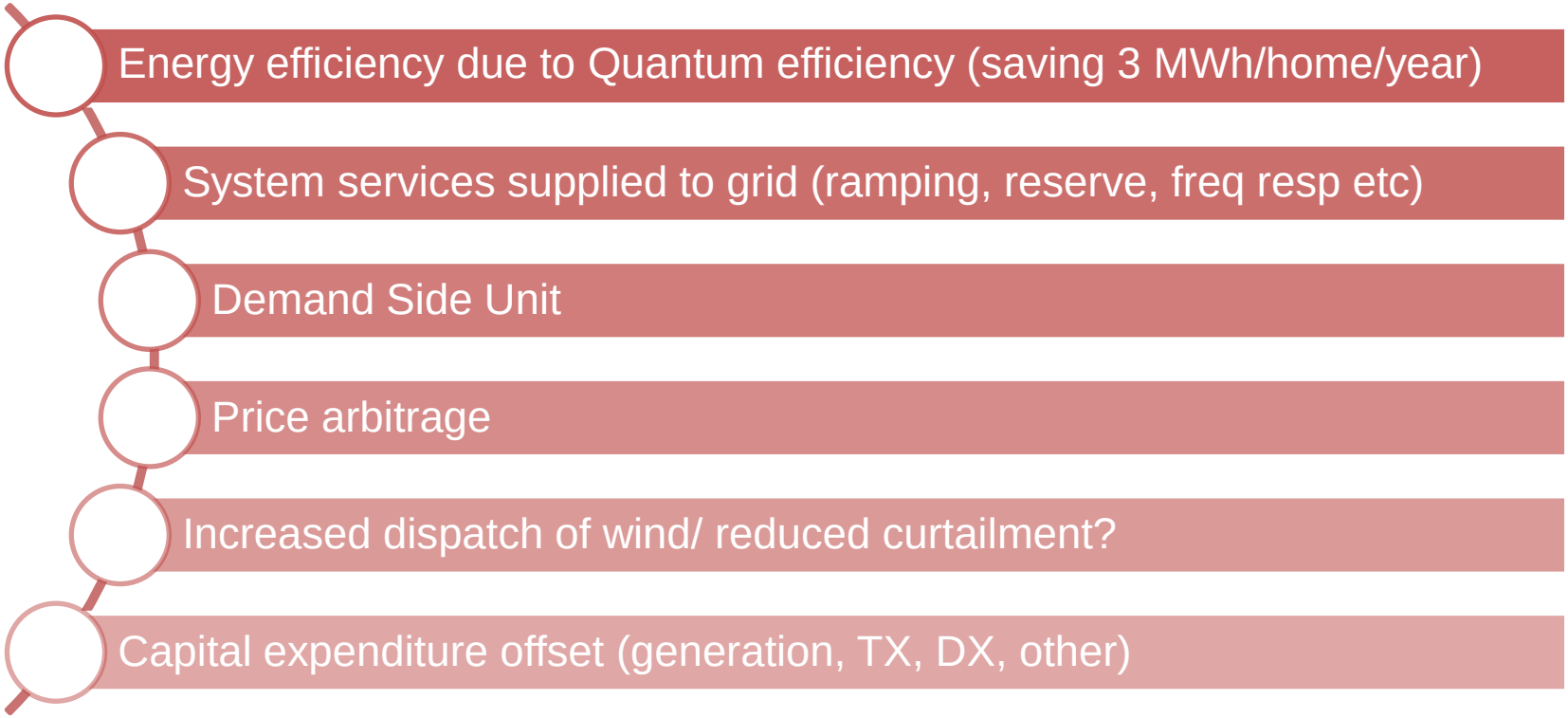
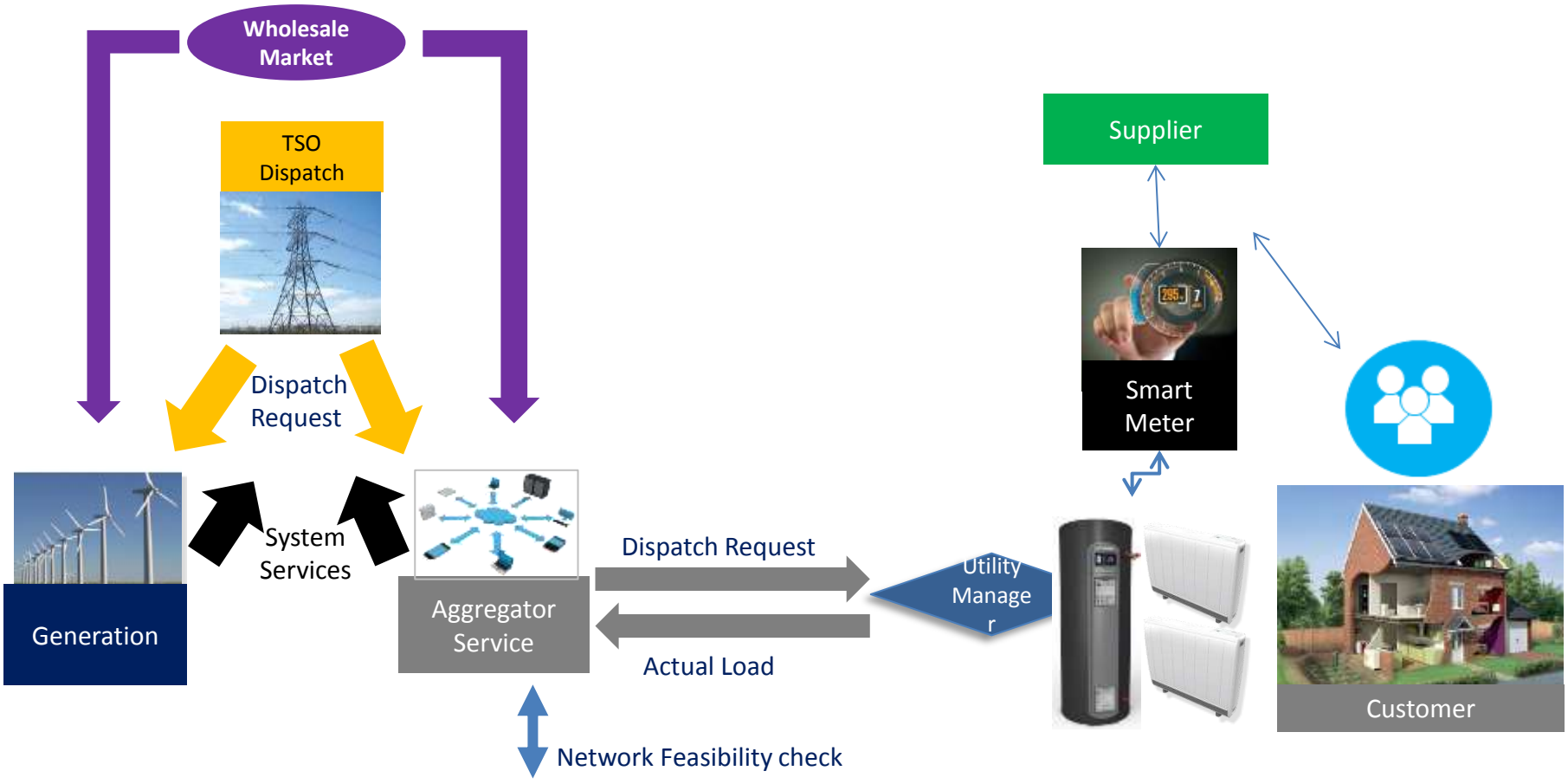
Space and water heating demand side & Response model

What is the value of this controllable asset to the electricity system?

Value Streams:

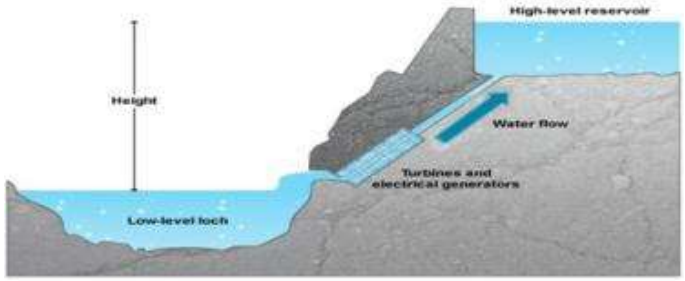


Aggregated Business Model



Energy storage in europe

- Pumped Hydro Storage



100 GWh

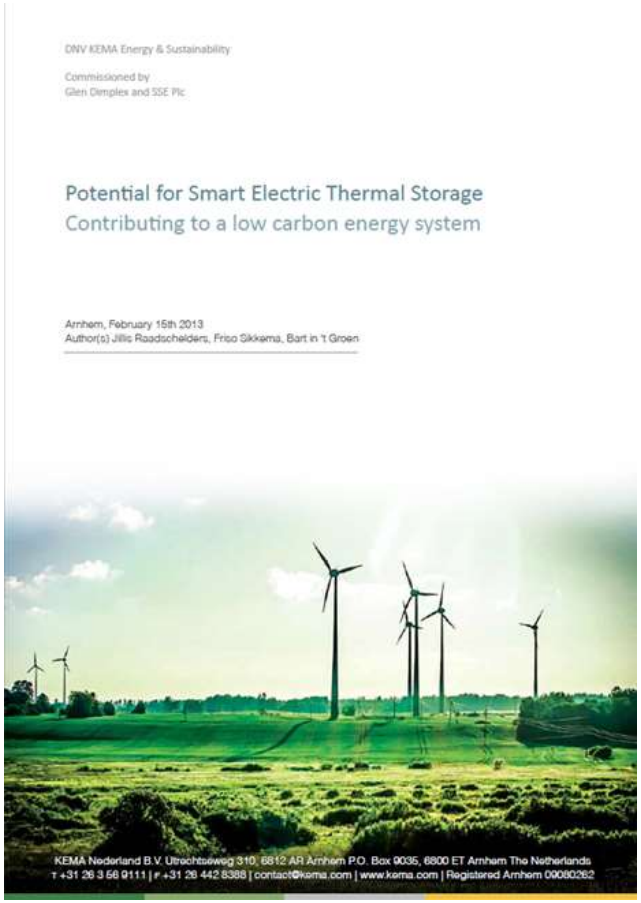
Winter

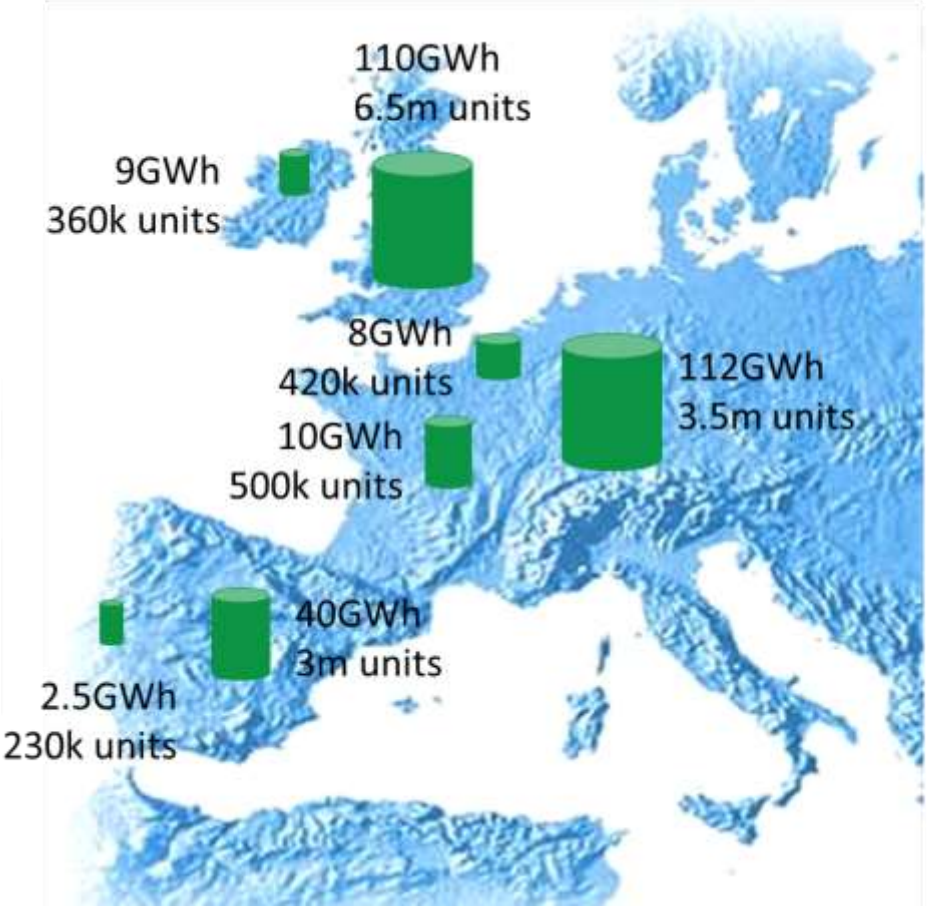
Summer

- Thermal Space and Water Heating Storage

Winter - 400 GWh
Summer - 170 GWh

SMART ELECTRIC THERMAL STORAGE (sets)





www.dimpco.ie

The Green Way
Dublin's Cleantech Cluster

Comhairle Contae Fhine Gall
Fingal County Council
Local Authority of the Year 2010

- 141 properties in mixed use from Green Way members
- Distributed storage in Quantum space heating
- Up to 10MW of connected load proposed
- Aimed at demonstrating Demand Side Management capabilities
- Utility partners to provide communications solutions
- Universities to conduct monitoring and analysis
- Eirgrid / SONI Demonstration Project

Dublin City Council
Comhairle Cathrach Bhaile Átha Cliath

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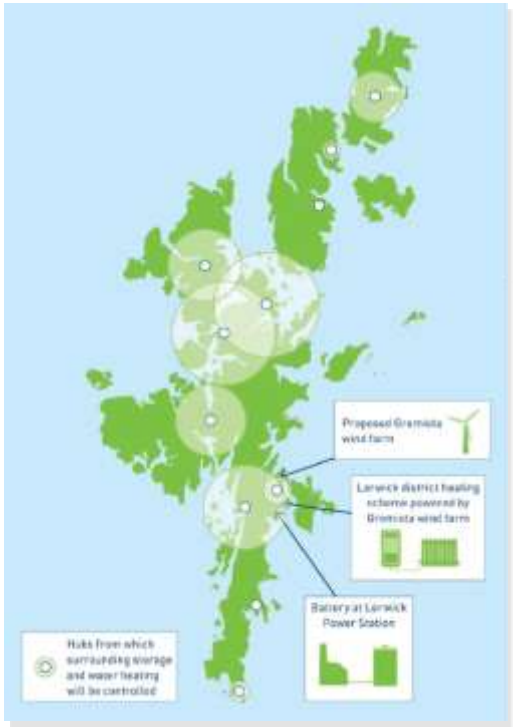
NINES - Shetland

Scottish and Southern Energy plc

Shetland Islands Council

Dimplex

nationalgrid



- 750 homes with smart thermal stores and water cylinders
- 7MW connected load
- 45MWh storage capacity

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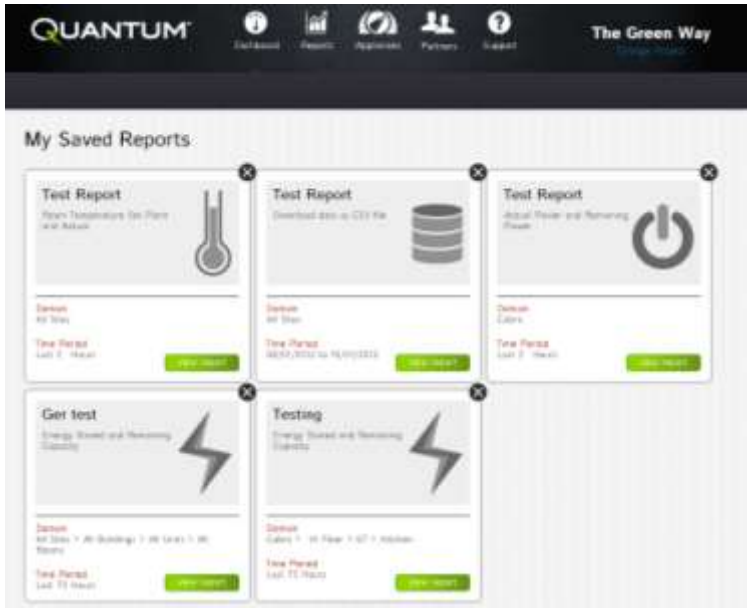
Greenway – Dublin, Ireland

Remote Control & Monitoring www.dimplexquantum.com



Dimplex
A world of expertise

? Airtricity EIRGRID intel GlenDimplex ESB Networks ?

ENERNET International

Project description

- This project is aimed at demonstrating the Demand Side Management (DSM) capabilities of a distributed population of homes with installed Quantum Smart Electric Thermal Storage (SETS) systems.
- The Project has 2 main elements:
  - To develop and test the communications and software technology necessary to remotely manage an aggregated population of homes.
  - To evaluate the business case for deploying such an asset base. This will involve identifying and evaluating all relevant value streams associated with distributed, aggregated SETS systems. These will include:
    - System services
    - Demand side units
    - Energy arbitrage
    - CAPEX avoidance through enhanced grid asset utilisation
- A further outcome from the Project will be the identification of the policy drivers to facilitate aggregated Demand Side Management.

Partners

Airtricity, owned by SSE plc, is Ireland's fastest-growing, greenest and largest independent energy provider, supplying over 625,000 customers across the Republic of Ireland and Northern Ireland.

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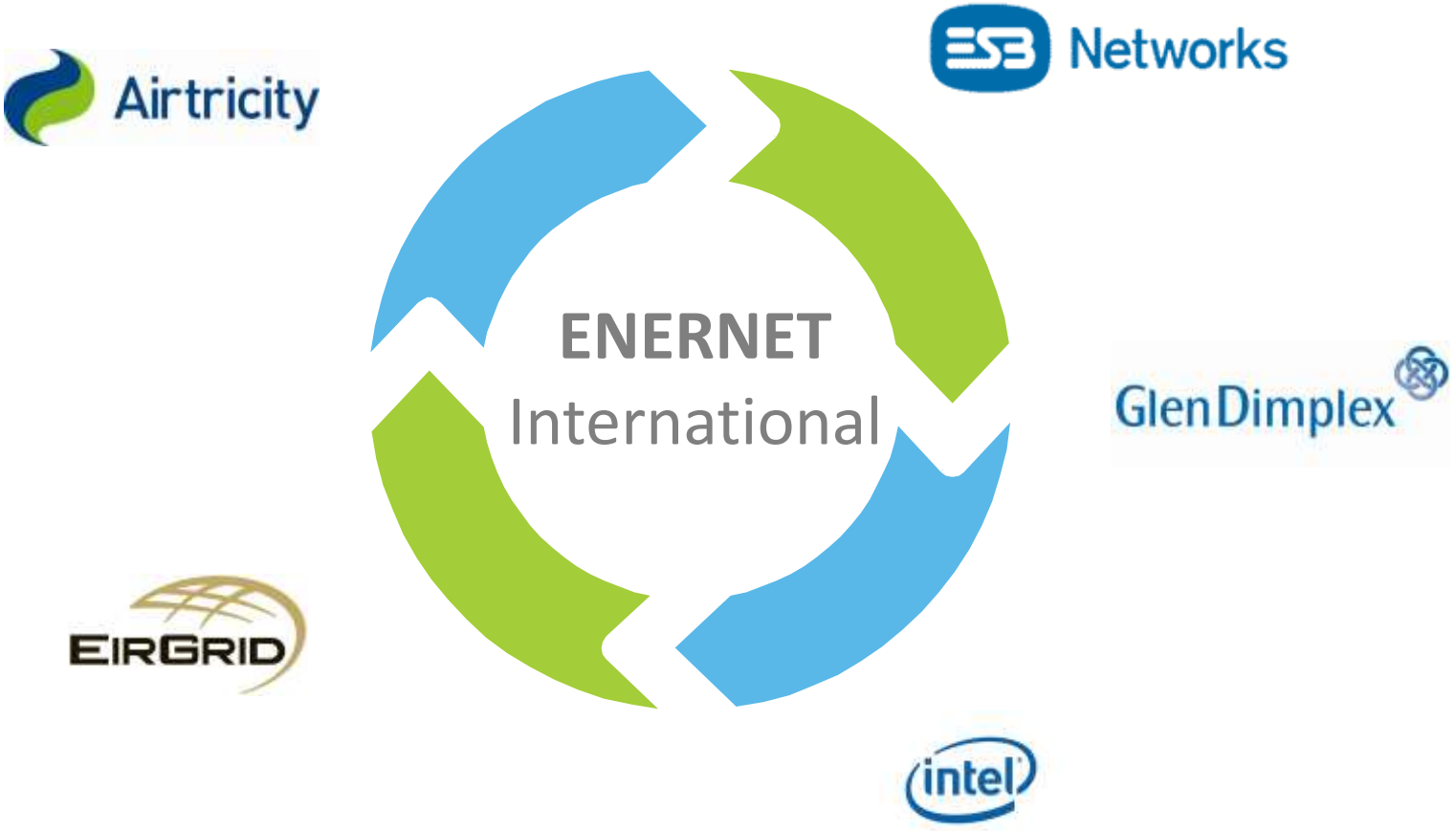
Glen Dimplex is the world's largest manufacturer of electrical heating, and also holds significant global market positions in domestic appliances, cooling, ventilation, and renewable energy solutions.

EirGrid plc is a leading Irish energy business, dedicated to the provision of transmission and market services for the benefit of electricity consumers. It is a state-owned commercial company.

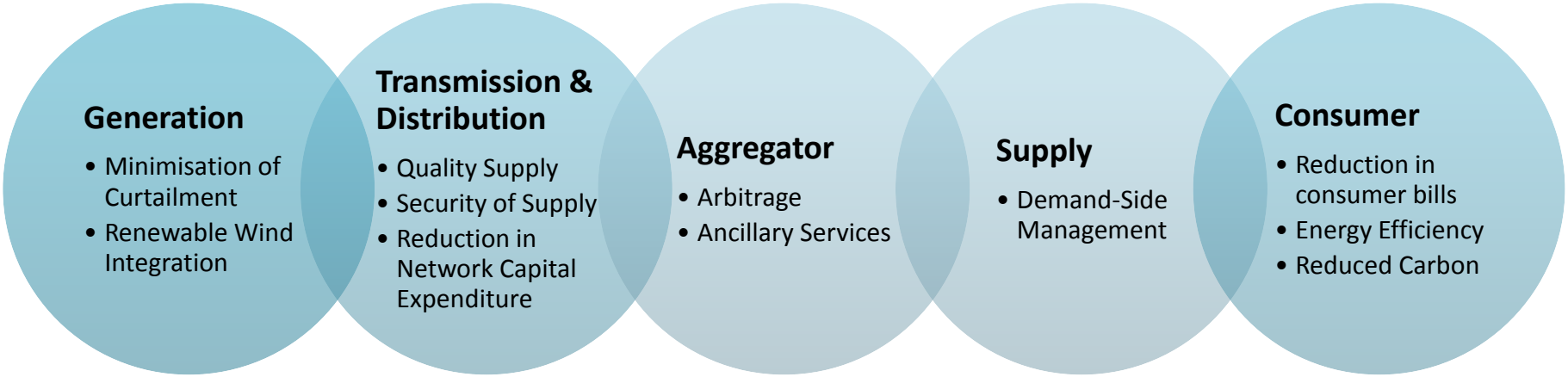
ESB Networks Ltd. is responsible for building, operating, maintaining and developing the electricity network and serving all electricity customers in the Republic of Ireland.

Intel, the world leader in silicon innovation, develops technologies, products, and initiatives to continually advance how people work and live.

Enernet International Project 2014-2017



Expected Benefits



Win – Win solution

- Addresses Fuel Poverty by reducing fuel bills
- Offers real choice in off-gas grid areas and high rise apartments
- Full life Installation, running and maintenance costs lower than fossil fuel alternatives
- Enhances user comfort with advanced controls
- Facilitates Demand Side Management
- Enables more renewables onto the Electricity Grid
- Reduces CO_2 emissions

Quantum was launched on December 2012 in Dublin to much media attention.

The room heater range is available now.

The cylinders and the hub will be available January 2014.

*Winner of the “Product of the Future” award at SEAI Energy Show 2013
*Winner of a new product award at the AECI trade show September 2013

See www.dimpco.ie and www.dimplex.co.uk for product details.

Summary

- Clearly a Part L is driving the market in Ireland
- Photovoltaics are a well proven and reliable technology. Performance in Ireland is well understood and predictable
- Like any technology, care and attention needs to be paid in the design and application of systems in order to maximize efficiency and return on investment
- Micro Inverters offer significant advantages
- PV is a scaleable and versatile technology and has the scope to be applied to buildings in many ways and forms, meaning it is almost always an option