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Energy efficient homes: implementation of renewable energies in retrofitted buildings.

HERRERA, D. and BENNADJI, A.

2013

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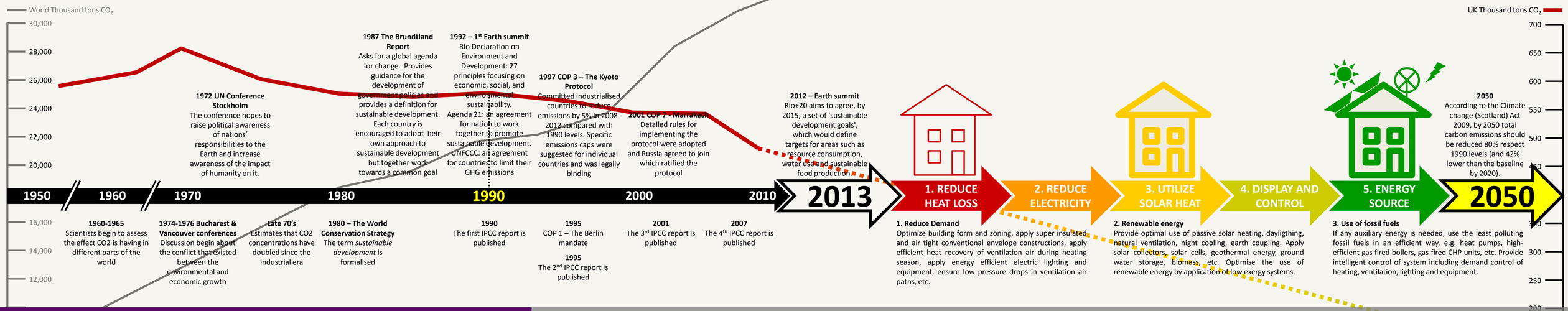
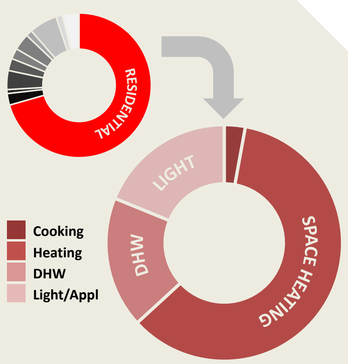


ROBERT GORDON UNIVERSITY ABERDEEN | Daniel Herrera & Dr. Amar Bennadji

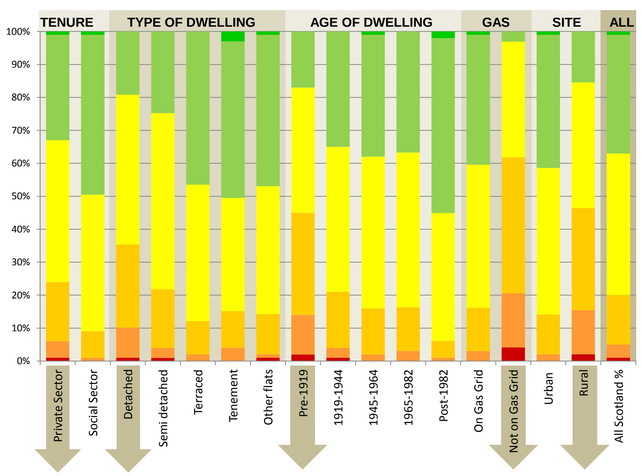
ENERGY EFFICIENT HOMES: IMPLEMENTATION OF RENEWABLE ENERGIES IN RETROFITTED BUILDINGS

1ST BUILDING STOCK ASSESSMENT

Million tonnes of oil eq. consumption by end use 2011. Source: DECC, UK.	Cooking	Space Heating	Cooling Ventilation	Hot Water	Lighting Appliances	Total
Residential	**1.1**	**23.4**	**-**	**7**	**7.3**	**38.8**
Commercial	0.04	0.7	0.2	0.1	0.4	**1.4**
Communication	0.03	0.1	0.03	0.02	0.3	**0.5**
Education	0.2	1.3	0.01	0.3	0.6	**2.3**
Government	0.1	0.9	0.04	0.1	0.3	**1.5**
Health	0.06	0.8	0.01	0.1	0.3	**1.3**
Hotel	0.5	0.6	0.1	0.3	0.4	**2.1**
Other	0.04	0.4	0.02	0.07	0.2	**0.8**
Retail	0.4	1	0.3	0.1	1.6	**3.5**
Sport	0.07	0.3	0.05	0.1	0.3	**0.8**
Warehouses	0.1	1	0.05	0.1	0.7	**2.0**
Total	**2.8**	**30.7**	**0.75**	**8.4**	**12.4**	**55.0**



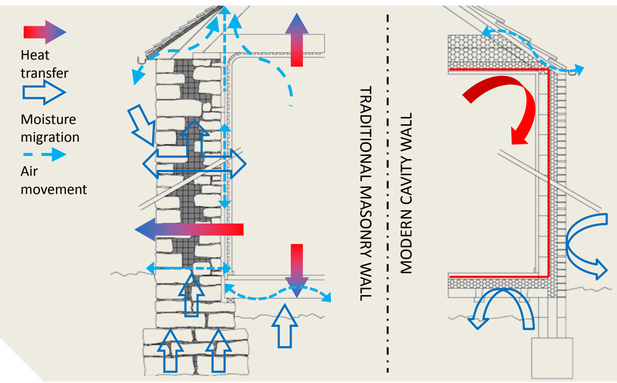
Energy Efficiency
Source: SHCS, 2011
Energy Performance Certificates (EPCs) were introduced for existing buildings from December 2008 to promote improvements to the energy efficiency of buildings. Every dwelling built, sold or re-let must now have an EPC. As part of this initiative, dwellings are given an energy efficiency rating on a scale from 'A' to 'G', with 'A' being the most and 'G' being the least energy efficient.



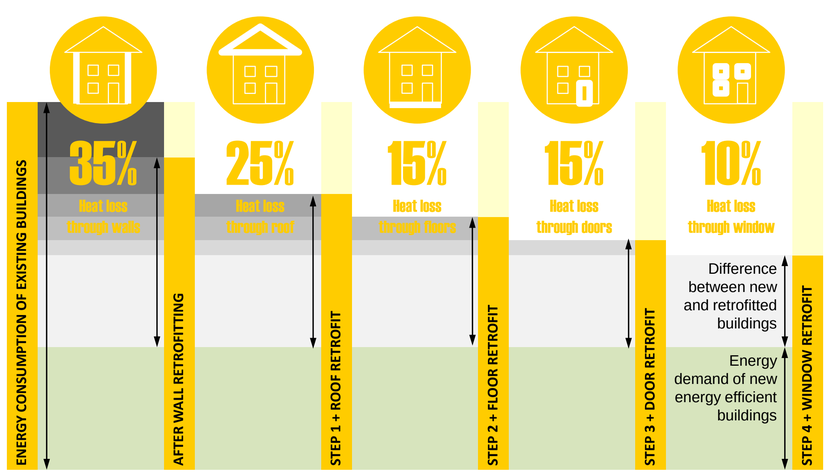
BUILDING STOCK CHARACTERISTICS

According to the Climate change (Scotland) Act 2009, by 2020 total carbon emissions should be reduced 42% respect 1990 levels (and 80% lower than the baseline by 2050).
In this context, it is important to highlight that buildings are responsible of 45% of total CO2 emissions (RAENG 2010) and just residential buildings represent 26% of UK CO2 emissions (Moran, Nikolopoulou and Natarajan 2012). Moreover, due to the low average renovation rate in Europe, 1.2-1.4% per year (Dyrbøl, Thomsen, et al. 2010), it is estimated that between 80% (RAENG 2010) and 85% (Palmer et al. 2006) of the buildings we will occupy by 2050 are already built.

2ND REDUCING ENERGY DEMAND



Heat loss
Existing buildings perform in a completely different way that new low energy buildings. Solid masonry and non insulated cavity walls have a poor thermal performance compared to current insulation materials. Moreover, these buildings have high rates of air leakage that affects the final energy demand.



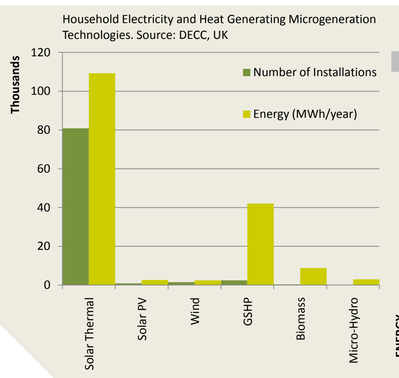
ENERGY DEMAND AND CONSUMPTION IN UK HOUSING

Energy consumption could be expressed as the result of the following equation:

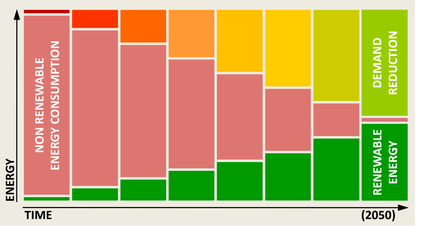
Energy consumption = Energy demand / System performance

Consequently, energy efficiency could be achieved working on the equipments substitution and improving the factors that affect the demand.
To achieve the low energy demand rates of new buildings in retrofitted properties is almost impossible. However, combination of energy demand reduction measures and use of renewable energies could lead to a high efficient homes with low rates of fuel consumption and thus low greenhouse gases emissions.

3RD ENHANCING ENERGY PRODUCTION



Energy generation
Housing can benefit from renewable technologies that provide heat or electricity directly to the house. In both cases, there can be major advantages in generating energy close to the place it is used, at smaller scale than traditional power stations.



RENEWABLE TECHNOLOGIES FOR RESIDENTIAL BUILDINGS

	THERMO SOLAR	SOLAR PV	WIND MILLS	HEAT PUMPS	BIOMASS	HYDRO POWER
Space heating	☀	☀☀ *	☀☀ *	☀☀☀	☀☀☀	☀☀ *
Domestic Hot Water	☀☀☀	☀☀ *	☀☀ *	☀☀☀	☀☀☀	☀☀ *
Lighting / Appliances		☀☀☀	☀☀☀			☀☀☀
Predictability	☀	☀		☀☀☀	☀☀☀	☀☀
Correlation with heating demand	☀		☀☀	☀☀	☀☀	☀☀
Ease of integration	☀☀☀	☀☀☀	☀☀	☀	☀☀	☀
Lifespan	25 years	25 years	20 years	20 years	15 years	50 years
Observations	Not permitted in the main facades of protected areas	Not permitted in the main facades of protected areas	Turbines are usually best suited to rural areas.	Choice of system is dependent on site conditions.	Warrant needed for flue or storage installation.	Requires a nearby source of running water.

*Only where space heating and domestic hot water systems are electric

IMPLEMENTATION OF RENEWABLE ENERGIES

"The keys to successful inclusion of microgeneration systems in historic properties are **a good understanding both of the buildings and the technologies, a sensitive approach, and flexibility on all sides. Planning authorities** and developers will both need to be flexible in considering locations so as to **ensure an adequate balance is struck between maximising energy production and minimising unwelcome visual impacts"**
Planning Advice Note 45 Annex: planning for micro renewable (Scottish Executive, 2006)