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Reflection on the current debate on how to link flood insurance and disaster risk reduction in the European Union

**Swenja Surminski, Jeroen Aerts, Wouter Botzen,
Paul Hudson, Jaroslav Mysiak and Carlos Dionisio
Pérez-Blanco**

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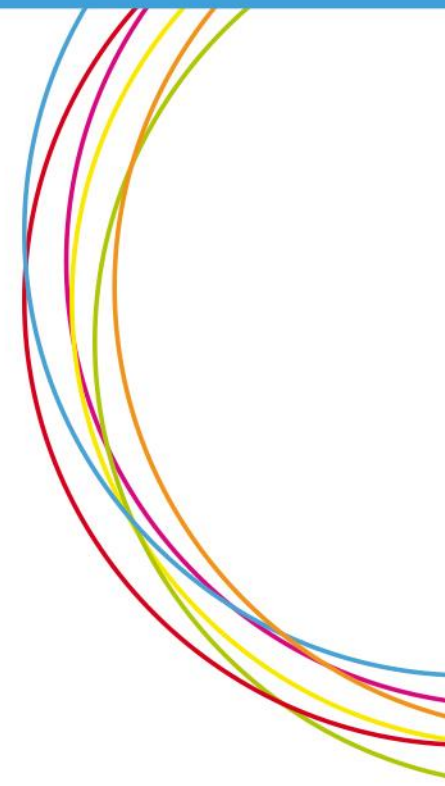
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Authors: S. Surminski (The Grantham Research Institute on Climate Change and the Environment, London School of Economics), J.C.J.H. Aerts (VU University Amsterdam), W.J.W. Botzen (VU University Amsterdam), P. Hudson (VU University Amsterdam), J. Mysiak (Fondazione Eni Enrico Mattei), C.D. Pérez-Blanco (Fondazione Eni Enrico Mattei)





Title	Reflection on the current debate on how to link flood insurance and disaster risk reduction in the European Union
Author(s)	S. Surminski (The Grantham Research Institute on Climate Change and the Environment, London School of Economics), J.C.J.H. Aerts (VU University Amsterdam), W.J.W. Botzen (VU University Amsterdam), P. Hudson (VU University Amsterdam), J. Mysiak (Fondazione Eni Enrico Mattei), C.D. Pérez-Blanco (Fondazione Eni Enrico Mattei)
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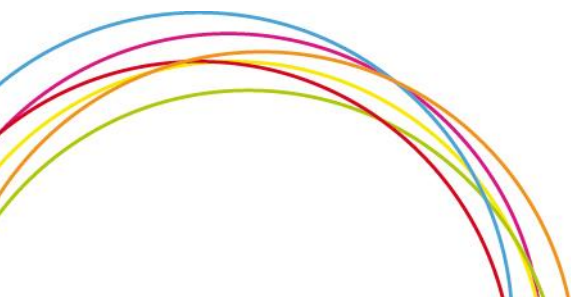
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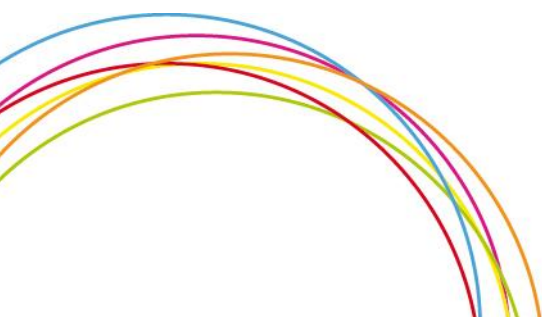
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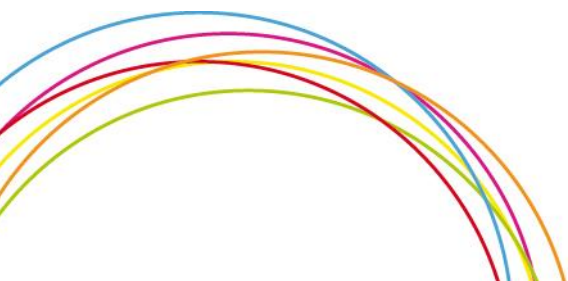


Executive summary



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1 Introduction

Recent flood events across Europe have resulted in human tragedy and disruption to homes, communities and business processes. Over the period of 2000 – 2012 average annual losses were €4.2 billion (Jongman et al. 2014). How these flood losses are financed differs hugely across the EU – insurance, state compensation schemes and liability are the most common approaches. These mechanisms follow different principles, ranging from ex-ante to ex-post funding, applying a solidarity based or market driven approach, and are based on varying degrees of public-private partnership¹ (Bouwer et al. 2007).

This existing patchwork has arisen for historic and cultural reasons, with different perceptions and customs when it comes to dealing with flood risk (von Ungern-Sternberg 2004). Public awareness in their operation is usually highest after a significant flood event (Cowan 2014), when those affected are looking for compensation. Beyond these reactive responses to financial flood losses there is also a more forward looking dimension emerging, triggering growing concerns about future risk levels in the wake of improved probabilistic forecasting and flood risk mapping tools (for example awareness raised with the UK's Flood Maps; Wheeler 2006). Latest projections show that flood risk is likely to increase – due to socio-economic factors and to climate change: Jongman et al. (2014) produce probabilistic estimates of future flood risk in Europe and show that by 2050 the predicted annual damage will have increased to €23.5 billion (from around €4 billion predicted annual damage in 2010).

These trends are likely to pose a significant challenge for the financial compensation mechanisms, unless more preventative measures such as flood defence investment and stricter building codes are applied. Effective prevention is expected to play a significant role for affordability and availability of compensation mechanisms, but it is far from clear how these two approaches interact, and where the scope for future reform is. We argue that until today efforts to reform flood compensation mechanisms in Europe are exclusively focused on dealing with the financial losses, without considering the implications for managing the underlying flood risks.

Amending existing compensation mechanisms or developing new tools requires political will and stakeholder buy-in at different levels and over varying time-scales. The ad-hoc payments after a flood are usually decided very quickly, often nationally, while changes to the legal system are far more complex and require detailed preparation and elaboration. Reforming insurance systems sits somewhere in the middle - but as recent national experiences in the Netherlands and the UK show this process can also take very long, with unclear outcome. Taking the 2014 UK floods as an example, within one month the government had promised £20 million for extra flood defences, an ad-hoc continuation of the

¹ Public-private partnerships (PPP) are schemes that are undertaken with a contractual agreement between a public body and a private sector company. The private sector company then assumes a specific role to achieve a particular outcome while the public body offers the degree of support as defined in the contract.

current approach (BBC 2014), while the discussions for Flood Re (system reform) started in 2010 (Defra, 2011) with Flood Re's expected launch date set for 2015 (Financial Times 2014).

The case of insurance illustrates the complexities of existing governance arrangements: Technical design of insurance products and demand and supply are amongst the factors that determine how flood insurance works. Jurisdiction for this rests with Member States (MS), and even at sub-national level, for example in Germany, where the Länder² play a key role (Schwarze and Wagner 2007). At the same time many policies relevant to insurability of flood risk are guided by EU Directives – ranging from risk information and mapping, prevention measures and compensation arrangements. This political and regulatory infrastructure does have implications on the feasibility of flood insurance by potentially reducing the underlying flood risk and making flood insurance more viable.

In this paper we investigate how the questions of compensation and prevention are linked, and how this can be supported or hampered by public policy. We analyze this for flood insurance, where the EU has instigated a debate on what the role of the EU should be in the context of flood insurance and other disasters in Europe. The EU Green Paper on disaster insurance, published in summer 2013 (EC 2013a), builds upon existent evidence to produce insights that can guide potential actions at a European level to increase market penetration. These include mandatory insurance, product bundling, public reinsurance or disaster pools. There is ample evidence that insurance, or risk transfer in general, can boost resilience to natural hazards more (effectively) than ex-post disaster aid (e.g. Ranger et al. 2011). Insurance can reduce financial burdens and uncertainty (Ghesquiere and Mahul 2007; Melecky and Raddatz 2011), and assists economies in dealing with the negative long run impacts of natural hazards such as flooding (von Peter et al. 2012). Risk pricing may encourage reduction of exposure and lead to lower damage costs (Bozzola 2014). Yet on the other hand poorly designed insurance products and ill-structured insurance markets can drive economic inefficiency and maladaptation to future risks (Surminski 2013). Hence the focus on flood insurance is not simply a question of penetration rates, it also touches on design and operational issues.

The EU Green Paper reflects on the concerns about rising risk levels and how this can be accommodated through new and existing flood insurance schemes. The consultation document frames insurance in two ways: the question of availability and affordability, and the potential to use flood insurance as a lever for flood prevention and flood damage mitigation.

We investigate if and how current EU policies interplay with these two dimensions and reflect on the national policy level, by illustrating the cases of flood insurance in the UK and the Netherlands. While at first these two dimensions appear separate, at least in terms of their governance structure, we argue that they are interwoven: flood prevention impacts the costs of an insurance policy, while at least in theory flood insurance could send signals leading to more preventative or mitigative actions by those insured or the government (see, for example, Kunreuther 1996, Botzen et al. 2009; Botzen and van den Bergh 2008; Shilling et al. 1989; Treby et al. 2006). However, recent studies highlight a lack of integration of

² Länder refers to the 16 federal states in Germany.

prevention and risk transfer, and despite some positive examples there appears to be lack of progress in terms of innovation and political decision-making (e.g. Surminski and Eldridge 2014).

Taking the EU Green Paper as a starting point, we explore these two dimensions of flood insurance. We first consider affordability and availability, and risk reduction linkages in an EU context (section 2 and 3), and then gather insights from two very different cases of insurance reform efforts at national level in the Netherlands and the UK (section 4). This is followed by an analysis of how EU policy could help address the challenges at member state level (section 5). We conclude by outlining the need for further research in section 6. Our investigation is based on analysis of written and oral evidence, gathered through detailed assessment of responses to the EU Green Paper on disaster insurance as well as discussions with stakeholders at a recent workshop hosted by the authors, which reflected on successes, gaps and action needed for flood insurance in Europe.

2 Current flood insurance arrangements in the European Union

Flood insurance is one option within the toolbox of flood risk management instruments. It allows risk to be transferred financially, with a premium paid by the policyholder to the insurer, effectively allowing those in at risk areas to continue to live and work with low financial impact after a flood event. Public liability policies and compensation programs co-design the regulatory environment for damage compensation in which insurance is to operate (Bozzola 2014; Crichton 2008; Paudel et al. 2012). Flood insurance is deemed most effective as part of a comprehensive Disaster Risk Reduction (DRR) strategy that includes risk assessment and awareness, prevention policies and other damage compensation instruments among others (Warner et al. 2009). The interplay of the above instruments varies within and across countries, often as a result of multiple and conflicting views as to what extent the public responses to flood risk should draw on principles of affordability, equity and solidarity (Sugarman 2006). Local customs and traditions, as well as risk perception and attitudes (e.g. Schwarze and Wagner 2007) also play an important role in determining the extent of the underwriting of flood insurance products.

It is not surprising hence that the existing flood insurance products across Europe differ widely in scope and reach (Bouwer et al. 2007; Schwarze et al. 2011). In France, the state-managed CatNat system (Maccaferri et al. 2012) covers flood risk, offers low-priced reinsurance and channels part of the resources into a state-managed fund for natural risk prevention. The CatNat scheme is offered through private intermediaries and funded through a flat rate surcharge (between 6% and 12%) over existent policies against property damages (Botzen and van den Bergh 2008; Poussin et al. 2013). The scheme increases affordability and reduces adverse selection, but does not encourage risk-reducing behaviour and does not guarantee equity as rates are independent of agent's income (Crichton 2008).

Alternatives to develop flood insurance in a solidarity context are in practice. For example, the Spanish Insurance Compensation Consortium (CCS) scheme provides flood insurance on a subsidiary basis if flood damages are not covered by private insurance. Similarly to CatNat the CCS is funded via a flat rate surcharge. In order to promote private insurance, a deductible over public compensations applies and private insurance is offered in a bundle system (ICC 2014). Bundling makes flood insurance compulsory if you are insuring against some selected risks (e.g., earthquake, storms), and vice versa. This system increases market penetration, reduces adverse selection and encourages DRR through risk based pricing. Yet, it may result in inequitable and even unaffordable premiums that increase the burden on the public CCS (Sugarman 2006). This raises further consideration in regards to deductibles, co-insurance and caps (Sugarman 2006).

In Sweden, Portugal and Ireland flood insurance is voluntary and policies are issued and managed by private companies. The State does not offer insurance itself nor financially back the insurers. Portugal and Ireland apply risk-based pricing, with a certain degree of cross-subsidization in Ireland. On the other hand, the location of the asset does not influence the premium to be paid in Sweden (Maccaferri et al. 2012). However, penetration rates appear to be mostly driven by factors other than pricing. In Sweden and Ireland, mortgage lenders require borrowers to insure buildings, resulting in penetration rates above 90% (Maccaferri et al. 2012). In Portugal, where this condition does not apply, penetration rates are much lower (50%) and insurers are required to constitute a (tax-exempt) equalisation reserve to prevent cash-flow depletion in the event of a significant unforeseen catastrophe. In the UK flood insurance is provided by private insurers on a bundled basis, reaching high penetration

rates due to mortgage requirements, while the roles and responsibilities of public and private players is currently being reviewed as part of the proposed introduction of Flood Re (section 4). In the Netherlands no flood insurance is available beyond some commercial policies.

How the roles of public and private agents are split differs also widely across the spectrum.

In the case of genuine private insurance markets, the role of the state can be limited to preserving fair competition and financial viability of the insurer. When the pre-conditions for private markets are not fulfilled, or the potential positive externalities of insurance are not internalised, state interventions may boost insurance markets either by backing up the private insurers, e.g. government lead reinsurance or investing in preventative measures or by compelling insurance, and by doing so expanding the market. Balancing the trade-off between insurance affordability and the solvency of an insurer may in some situations demand public support. By imposing mandatory flood insurance governments resort to solidarity which, in justified cases, may create conditions of equitable sharing of the burden. In addition there is the aspect of flood risk management – which is widely regarded as a public function, although budgetary constraints may change this approach, as seen in the UK, where there is a quest for private flood investment and individual risk management action. Under the UK's Statement of Principles approach to flood insurance, the public investment in flood defences was spelled out as a government commitment, but with the newly proposed Flood Re there appears to be less focus on the public risk management role (Surminski and Eldridge, 2014 – see also section 4). Strengthening the observation that, seemingly, the most prominent element of the system is to share the financial burden of flooding rather than reducing expected losses.

3 The current EU flood policy context and the interplay with flood insurance

The decision if and how flood insurance is designed reflects country specific risk features in addition to loss experience, which plays a key role. EU policies can influence this to some extent – in table 1 we summarize how the existing EU policy instruments interact with the provision of insurance. These policy tools can be grouped into three large categories: those explicitly aimed at the regulation of insurance market (Solvency I and II and other insurance market regulations); those implicitly affecting insurance provision through flood risk assessment and management; and those implicitly affecting insurance provision through compensation arrangements outside insurance.

Table 1: EU legislative instruments and their relationship to insurance provision

Policy	Relevance for flood insurance	Impact on flood insurance
Solvency I (Directive 73/239/EEC and others) and Solvency II (Directive 2009/138/EC)	Explicit	Insurance systems will have to accommodate the remit of Solvency II ensuring that schemes are economically risk secure. Solvency II determines the risk appetite as well as the internal risk portfolio decisions of insurance companies. It demands a structured risk-based approach to assess the solvency risks faced by insurance and reinsurance companies, including flood insurance (EC 2009). It also regulates the assessment and validation of the methods being used to do so. If validated, evidence that these methods are actually followed should be provided (EC 2009). Finally, it imposes an upper limit on the probability that the annual losses exceed company's operating capital (EC 2009).
Competition rules, state aid	Implicit	Competition law can influence how public and private sectors may collaborate through <i>public-private</i> partnerships (PPP). State aid regulation controls public recovery aid to economic undertakings without distorting the internal market. Recently, Commission Regulation 651/2014 exempted aid to make good damage caused by natural disasters from the obligation to notify the state aid, pursuant to the specific conditions.
Environmental liability directive (ELD, Directive 2004/35/EC)	Implicit	ELD imposes an obligation of preventing or remedying of environmental damage at source and by the polluter, in accordance with the Article 191(2) TFEU. It distinguishes strict and fault-based liability but stops short of imposing financial guarantees in case of insolvency; rather it leaves it for the discretion to the MS to develop financial security instruments and markets.



Water Framework Directive (Directive 2000/60/EC)	Implicit	Establishes River Basin Management Plans (RBMPs) based on a better understanding of pressures, impacts and economic analysis. The WFD stressed the role of economic instruments in achieving a 'good ecological status' (EC, 2000). Although it specifically referred to water pricing, this has resulted in practice in a much wider diversity of economic instruments, including insurance. The 'good ecological status' should contribute to 'mitigating the effects of floods' (EC 2000).
Floods Directive (Directive 2007/60/EC)	Implicit	Flooding risk maps (EC, 2007, chap. III) and assessments are instrumental for a sound determination of risk premiums. The FD is expected to contribute to reduce exposure and vulnerability, and increase risk awareness. The flood risk management plans will specify and prioritise interventions for flood risk reduction.
European Union Solidarity Fund (EUSF)	Implicit	EUSF provides assistance to MS for coping with major natural and/or extraordinary regional disasters ³ . Solidarity Fund aid can be mobilized up to a maximum annual total of 500 million EUR (in 2011 prices). The EUSF contributions are meant for essential public emergency and recovery operations only but may unbound public resources for recovery aid to households and private enterprises. The 2014 EUSF reform places emphasis on the MS's compliance with the Union legislation on disaster risk prevention and management, and prevention policies to avoid similar disasters in the future.
EU legislation on disaster risk prevention and management	Implicit	The Union Civil Protection Mechanism facilitates cooperation and coordination in the field of civil protection, through systematic risk assessments and risk management planning among others. The proposed Council Decision on the implementation of the Solidarity clause (Article 222 of the Lisbon Treaty) foresees, starting from 2015, an annual integrated threat and risk assessment report at Union level.

³ The Council Regulation (EC) No 2012/2002, amended in 2014, specifies major natural disasters as those having caused direct damage above 3 billion EUR (in 2011 prices) or 0.6 per cent of Gross National Income (GNI) of the country affected. Extraordinary regional disasters are those having caused damage above 1.5 per cent of the GDP at regional (NUTS2) level.

Table 1 indicates that there are various ways through which the EU policies influence coverage and uptake of insurance; mainly through an implicit, indirect channel rather than through explicit regulatory measures.

The objectives of the EU regulation on insurance and reinsurance is to impose an upper limit on the probability that the annual losses exceed company's operating capital (EC 2009). This is aimed at enforcing insurance contracts and ensuring that insurers are solvent and pay what they owe. In addition there are EU policies on competition and market operations, which drive private sector operations. Beyond this most rules are set nationally - such as insurance scheme licensing and taxation, as the UK and the Netherlands examples show (see section 3). In addition, states typically create guaranty funds through which solvent insurers step up and provide at least limited benefits for claimants whose insurers have financially collapsed, either through public (e.g., Spain, France) or private (e.g., UK) reinsurance. This regulatory framework reduces uncertainty and provides a sound background for higher market penetration. Noteworthy, though, demanding legal frameworks may make the insurance against infrequent disasters with long accumulation processes non attractive to insurers and reinsurers (Sugarman 2006). This may be aggravated by some national tax law rules that discourage premium collection without pay-outs (Paudel et al. 2012). Finally, even if insurable (e.g., solvency laws are properly balanced and tax exemptions are provided), premiums may be unaffordable or inequitable.

Policies in support of flood risk prevention can indirectly influence flood insurance, particularly those measures that succeed in reducing risk levels, improving data quality/availability and clarifying roles and responsibilities of stakeholders. The Water Framework Directive (WFD) and the Floods Directive (FD) are examples, credited with improved mapping of all water related risks, and holistic water management at the river basin (district) level. The WFD and FD contribute to a better appreciation of multiple risks, and a more effective coordination and management. Traditionally, flood risk management placed an emphasis on structural protection, although there is a growing awareness that this (alone) is not enough. Investing in water retention infrastructure shows positive and increasing marginal costs, since more exposed areas are increasingly expensive to protect (Crichton 2008). In spite of this, engineering works have been previously implemented on the grounds of their significantly lower transaction costs, i.e. the costs of reaching an agreement, even in the cases where the investment costs were higher (Garrick et al. 2013). However, recent climate projections indicate that flood hazard is on the rise in some regions (IPCC 2012; UNISDR 2012) at a moment when budgetary constraints have increased the opportunity costs (i.e., foregone benefits) of hard engineering in some countries. In addition, water retention infrastructure can twist risk perception and has resulted in a number of cases with concentrated populations, wealth and property values in highly exposed areas (EC, 2007), which often hold some comparative advantages (e.g., aesthetic values, better soils, strategic locations near ports). The EU Floods Directive is cautious about the negative downstream impacts that may arise in highly engineered rivers and encourages long term developments based on soft engineering, such as sustainable land use practices (EC, 2007) taking into account the entire river basin.

As a part of the *State Aid Modernisation* initiative (EC 2012), the Commission has revised and simplified both *de minimis aid* regulation and the *general block exemption regulation* (GBER). The reform of *de minimis aid* (EC 2013b) maintained the ceiling of 200.000 EUR for

each single undertaking over a period of three fiscal years⁴ irrespective of the form of aid and expressed as *net present value* if granted through periodic instalments. If granted in other than direct grant, such as soft loan or guarantee, the gross grant equivalent of the aid needs to be estimated. A subsidised loan up to 1.000.000 EUR over a period of 5 years is possible under the revised de minimis aid rules if the loan is secured by collateral covering to the level of at least 50 percent of the loan. The Commission Regulation 651/2014 (EC 2014) exempted aid to make good damage caused by natural disasters from the obligation to notify the state aid, pursuant to the following conditions: *First*, the regulation declared 'earthquakes, landslides, floods (in particular floods brought about by waters overflowing river banks or lake shores), avalanches, tornadoes, hurricanes, volcanic eruptions and wildfires of natural origin' (*ibid*, recital 69 and Article 50(1)) as events constituting a natural disaster, while excluding damage arising from adverse weather conditions (frost, hail, ice, rain or drought). *Second*, the damaging event has to be recognized by competent authorities as a natural disaster, and a clear causal link needs to be established between the disaster and damage suffered. The total payments for making good the damage, including the payments under insurance policy, may not exceed 100 per cent of eligible damage costs. *Third*, the aid scheme has to be introduced within three years, and any aid granted within four years after the disaster. Fourth, the eligible damage costs include material damage incurred as a result of disaster and loss of income resulting from suspension of activity for a period of six months after the disaster event occurred. The damage assessment based on repair cost or economic value of the affected asset before the disaster should be certified by accredited experts or insurance undertaking.

Public compensation funds can create disincentives for risk reduction and transfer, as we show in example of the Netherlands (see section 4). The provision of State Aid as a tool to compensate for flood losses can play a key role in terms of expectation by those at flood risk and willingness to buy of insurance. In the UK there is no direct ex-post aid and reliance on insurance is important to minimise damage and loss. In a historical context the possibility of the Government introducing a 'National Disaster Fund' in the early 1960s spurred on the industry to provide a private industry solution, a response to the worry that it would lead to a reduction in demand for catastrophe cover on the private market (Bek 2013). In principle, State Aid to economic undertakings should be limited to the residual uncertainty (i.e., the flood risk with a very small though unpredictable likelihood and a potentially high though unpredictable damage) that cannot be possibly addressed in an efficient, equitable and affordable way with the previous barriers. Given the low probability of these events, insurance provision and DRR would not be affected by State Aid. State Aid is better funded via *ex-ante* flood emergency funds (e.g., via a surcharge on existing premiums) and better allotted through grants and loans (Sugarman 2006). In reality, though, the barriers to State Aid tend to fade after a crisis. Quoting insufficient prevention, deficient insurance regulation and market penetration and even flaws in tort law design become altogether evident and the State assumes the costs, sometimes using allotment mechanisms that may hinder competency (e.g., tax exemptions, debit write-offs, reduction of social security contributions) (OJ 2012). Since 2007, 34 ad hoc compensation schemes for flood damage were notified and approved by the EC for a total value amounting to 1,700 million Euros (EC 2014). Although aiding overwhelmed communities can be morally laudable on the grounds of altruism and solidarity, this is neither equitable (only a relatively small share of the EU is truly at risk), nor

⁴ Except the road freight transport sector for which the ceiling is 100.000 EUR

sustainable: discouraged DRR coupled with climate change will likely increase in the future the already large impacts over the public budget.

Finally, competition law also shapes flood insurance. The proposed new Flood Re scheme is subject to EU rules as the proposed levy on insurance customers is seen as a de-facto tax, which is passed into the Flood-Re Pool (Defra, 2013). A decision by the EC and the conclusion of the EU clearance process is expected by April 2015 (Thoresen and Evans 2014). The EU rules on competition state that 'aid to make good the damage caused by natural disasters' are compatible with the requirements of the internal market (EC 2008) and as such State Aid designation for Flood Re can be expected to be reviewed by the EC on this basis.

What remains unclear is if and how these policies influence design and implementation of flood insurance and how this in turn could drive a linkage of compensation and prevention.

4 The national context: the examples of the Netherlands and the UK

The above policy framework indicates how existing EU policies can send signals to influence national flood insurance provision. If and how this shapes the coverage and take-up, as well as the design of insurance is described through the cases of the Netherlands and the UK, both at opposing ends of the spectrum of flood insurance penetration in the EU.

4.1 The Netherlands

Flood risk management in the Netherlands relies strongly on hard engineering which is focused on flood protection infrastructure. This is a historically created situation in which water managers have developed highly qualified flood protection systems with the highest safety standards in the world. A major storm surge in 1953, which flooded large coastal areas in the Southwest of the Netherlands (about 200,000 hectares), initiated a boost in technical innovations in flood protection measures. The Dutch government stated that a large storm surge flood may happen again and, therefore, initiated the 'Delta Plan'. This plan led to the construction of the 'Deltaworks', which are comprehensive systems of dams, sluices, dikes, and storm surge barriers constructed between 1958 and 1997. As a result, low-lying flood-prone parts of the Netherlands are divided in 53 areas which have their own closed system of flood protection (so called "dyke-ring areas"). These flood defences are built high enough to prevent overtopping by extreme flood waters that occur on average between 1/10,000 and 1/1,250 years, although several areas near rivers remain unprotected or have lower protection standards.

The current safety standards in the Netherlands have been under discussion because of an increase in properties exposed to floods during the past several decades, which substantially increased potential flood damage (de Moel et al. 2011). Moreover, the projected increase in flood risk as a result of climate change could justify higher safety standards in some areas, or additional measures that limit potential flood damage (Kind, 2013). Although the prevention of floods will always remain the dominant strategy in Dutch water management policy, other measures have received increasing attention since high river discharges in 1993 and 1995 almost resulted in large-scale flooding in the Netherlands. Alternative strategies that are receiving increasing attention are the development of flood insurance, the flood-proofing of houses to limit damage during floods as well as soft engineering and spatial planning measures that limit potential flood damage.

Standard home and home contents insurance policies in the Netherlands exclude coverage for damage caused by flooding. Flood damage can be partly compensated by the government via the Calamities and Compensation Act (WTS – *Wet Tegmoetkoming Schade bij Rampen en Zware Ongevallen* in Dutch), which has been in force since 1998. The WTS is an ad hoc compensation arrangement for which no funds have been established and, there are no clearly predefined rules about the criteria for which cases, and by how much, flood damage will be compensated. The cabinet needs to give separate approval to compensate damage of saltwater floods which are explicitly excluded from the WTS (Botzen et al. 2010). There is no legal obligation for the government to compensate flood damage, meaning that the government is not officially liable. Thus, it is uncertain whether households in the Netherlands will receive compensation for damage caused by flooding.

Over the last several years there has been debate about the desirability of the introduction of flood insurance. This debate has been motivated by a desire of the government to limit

the financing of compensation for natural disaster damage from general taxes (Botzen et al. 2010), consumer demand for more certainty of flood coverage (Botzen and van den Bergh, 2012a,b), potential financial efficiencies of private instead of public compensation schemes (Jongejan and Barrieu 2008), and possibilities to use insurance with risk-based premiums to stimulate policyholders to invest in flood damage mitigation measures (Botzen et al. 2009). The extreme character of flood risk in the Netherlands with the uncertain potential for catastrophically high damages, implies that private flood coverage would be expensive relative to the expected value of flood damage (Paudel et al. 2013). Therefore, flood insurance may be best offered in the form of a public-private partnership in which the government provides coverage for extreme flood risks, while insurance companies provide coverage for flood damage up to a certain maximum amount (Botzen and van den Bergh 2008; Paudel et al. 2014). The government can provide such coverage as State Aid, or act as a reinsurer meaning that the government receives compensation for this coverage by means of a premium that equals the expected value of flood losses covered. Discussions were ongoing between 2006 and 2010 amongst Dutch insurers and the government about introducing such public-private flood insurance, which were ended by the government. The official reason for this was that levying the premium for this compulsory insurance was regarded as undesirable during times of economic crisis.

In September 2012, a coverholder of Lloyd's introduced a catastrophe insurance policy in the Netherlands, which allows homeowners to purchase insurance coverage for flood damage bundled with earthquake and terrorism risks. From a DRR perspective, interesting features of this insurance are that it aims to raise risk awareness and charges risk based insurance premiums on which policyholders receive premium discounts if they take measure to "flood-proof" their home. Flood risk information is provided on the insurer's website on which individuals can enter their zip code level to access location specific information about flood probabilities, quality of flood defences, potential water levels, and the risk based insurance premium. Four different measures are eligible for a premium discount of 5% each: namely, installing electrical equipment and the central heating installation above the ground floor level, having flood shields available, and having a water-resistant floor on the ground floor level, such as tiles. However, this insurance is unlikely to result in broad insurance coverage of flood risks in the Netherlands, because it is only available for homeowners and not for tenants, its availability per dike ring area is limited, coverage is limited to €75,000 per policy, while the premium is relatively high compared with estimates of homeowner's willingness-to-pay (WTP) for flood insurance (Botzen and van den Bergh 2012a, b). For example, according to the Dutch Consumer Association (2012) the premium of the catastrophe insurance in flood-prone areas is about €200 per month, although the premium varies widely depending on the actual flood risk that the homeowner faces. Estimated demand curves based on the WTP derived from a choice experiment show that only a very small percentage of the households in flood-prone areas who own a house with a ground floor would be interested to purchase the policy for this premium (Botzen and van den Bergh, 2012b). However, this demand could be up to 50% if flood insurance premiums would be priced to the expected value of flood losses.

A broad flood insurance coverage could have been established by a proposal by the Dutch insurance union made in 2013 to introduce a flood insurance pool. All Dutch property insurers would compulsory contribute to this pool and offer flood coverage as part of regular property insurance policies of €250,000 and €25,000, respectively, for property and contents damages. This pool would cover up to a maximum of €5 billion of flood damages, meaning that the government could compensate damages exceeding this amount through the WTS, resulting indirectly in a public-private flood insurance arrangement. This proposal was rejected in June 2013 by the Dutch Authority for Consumer and Market because the

compulsory character of the pool could limit competition in the Dutch insurance market (ACM 2013).

In summary, the characteristics of the Dutch flood damage compensation system have been very much influenced by local risk and economic characteristics, meaning that these local challenges are unlikely to be resolved by a European “one size fits all” natural disaster insurance solution. The government focus on flood prevention after the catastrophic 1953 North Sea flood has substantially lowered flood probabilities, and created a situation in which the government is regarded as being liable for the compensation of flood damage once flood protection infrastructure fails. Over the last decade the increased interest in introducing flood insurance has been partly complicated by the extreme low-probability/high-impact nature of flood risks in the Netherlands which results in relatively high premiums for limited commercial flood insurance coverage. Proposed solutions for compulsory (public-) private flood insurance have been obstructed by concerns about limited competition in the Dutch insurance market. European regulations that foster knowledge on flood risks could reduce uncertainty of flood insurance premium estimation and facilitate the creation of a flood insurance market. Moreover, improved insights on potential damage saving from flood damage mitigation measures and the effectiveness of insurance incentives for implementing such measures could help the design of a flood insurance system that integrates disaster risk reduction.

4.2 Flood risk management and insurance in the UK

Flood insurance in the UK is provided by private insurers as part of the home-insurance bundle. This has led to high insurance penetration rates: 91% for buildings (Defra 2013) and 74.9% for contents (ABI 2012), principally due to the need to have insurance when taking out a mortgage. However there remains a disparity amongst low income households, where only 29% have buildings insurance (Defra 2013). The role of mortgage providers in requiring owner occupiers to hold buildings insurance as part of their mortgage arrangement is another key factor for maintaining this high penetration rate and forms an important element in within the arena of insurance provision.

The current UK flood insurance arrangement, an agreement termed the Statement of Principles (SoP), is based on a partnership approach to address flood risk (evolution of this approach can be seen in Appendix 3). It sets the foundations for flood risk management from government, as well as maintaining wide financial protection and risk transfer from the insurance industry. Despite its innovative nature, this approach was always considered as a temporary solution by the private insurers, as it was seen to distort the market and preventing specialist flood insurance providers to emerge (ABI 2008).

Under the SoP, Government agreed to invest in flood defences, enhance planning regulation to prevent uncontrolled development in high flood risk areas, and increase transparency through improved flood risk data provision. In exchange the insurance industry committed to offer flood insurance to all homes up to a 1 in 75 year risk level. Pricing and conditions of cover were left to the private sector, which led to growing concerns about affordability of cover within government. Insurers on the other hand were increasingly unconvinced that government was doing enough to reduce flood risk. Particularly in times of public spending cuts, a heated debate about investment in flood risk management arose - insurers expressed their disappointment to an announcement that government investment in defences was cut

when taking into account inflation⁵ (ABI 2010). This remains an extremely political issue: the lack of flood defence spending has been highlighted as a concern in the most recent flood event [December 2013- January 2014] (HM Parliament 2014). In addition it is unclear how effective efforts to reform the planning system have been. Some experts state that over the last 10 years still 13% of all new development (21,000 homes and businesses) has been built on floodplain (ASC 2012).

Between 2011 and 2013 industry and government investigated a new approach to the provision of flood insurance. At the outset the Government and the Association of British Insurers (ABI) listed guiding principles for a new insurance solution:

Table 2: Principles guiding flood insurance provision in the UK (Source: Defra 2011).

Principles
1. Insurance cover for flooding should be widely available.
2. Flood insurance premiums and excesses should reflect the risk of flood damage to the property insured, taking into account any resistance or resilience measures.
3. The provision of flood insurance should be equitable.
4. The model should not distort competition between insurance firms.
5. Any new model should be practical and deliverable.
6. Any new model should encourage the take up of flood insurance, especially by low-income households.
7. Where economically viable, affordable and technically possible, investment in flood risk management activity, including resilience and other measures to reduce flood risk, should be encouraged. This includes, but is not limited to, direct Government investment.
8. Any new model should be sustainable in the long run, affordable to the public purse and offer value for money to the taxpayer.

What reads as a wish list, based on expectations that stakeholders have towards flood insurance, it also shows that there are several trade-offs at play. Achieving all of those principles simultaneously appears almost impossible.

After more than two years of negotiations both sides have agreed to create a new flood insurance pool – termed Flood Re (Defra and ABI 2013), due to commence in summer 2015. Flood Re is based on households under low to normal risk issued with standard insurance provision with the free market, and high risk properties under the Flood Re pool. The subsidy

⁵ Over the previous four year spending review period (2007/8- 2010/11) the government allocated £2.562bn to flood and coastal defence and in the current spending period (2011/12-2014/15) the government have allocated £2.315bn. These figures are priced in real terms at based on 2012/13 prices.

for the latter is claimed from a levy taken from all policyholders and is approximately £10.50 per policy. The premiums offered for high risk households are fixed based on council tax banding and cover is offered at a set price, this is based on a particular threshold level for defining high risk, yet to be determined. The government proposal envisages that small business would not be covered by the Pool with several other exclusions including leasehold properties over a certain size and Band H properties. However this latter is now subject to debate and several other technical aspects remain unclear, including the handling of flood losses beyond a suggested cap of 1 in 200 loss event. As such there remain several key points to operation and delivery of the new scheme that will be subject to agreement between insurers and government.

With regards to risk prevention the industry itself has pointed to the need for policies in support of insurance and risk reduction. This has been highlighted by the ABI's adaptation manifesto - Appendix 2, a call for public policies that aim at reducing climate risks (ABI 2007). This refers to the 'two-way-relationship' of insurance and prevention: Availability of cover, affordability and the role of private and public players and how they could be influenced by rising flood risk. While at the same time insurance could also steer prevention and flood risk reduction efforts by sending risk price signals. Risk reduction is not explicitly considered in the Flood Re scheme – an aspect that has triggered some criticism (Surminski and Eldridge 2014).

It is important to recognize that there may be scope for regional differences: Crichton (2012) exemplifies an approach in Scotland to involving insurers in Flood Liaison and Advice Groups (FLAGs). Insurers sit on these groups alongside several other key stakeholders in the planning, development and water management arena. They aim to resolve flooding issues on an informal basis but also importantly ensure flood insurance will be available – providing essential knowledge from the insurance side but also establishing a link between planning authorities and the insurance industry (Crichton 2012).

Within the UK the devolved regions have developed their own approaches to transposing EU Directives into UK legislation: examples are the Flood Risk Regulations 2009 and Flood and Water Management Act 2010. This has resulted in the driving forward of risk mapping from all sources and is a particularly important influence in the recent publication of a national (and locally detailed) surface water flooding maps. The lack of which was initially highlighted by the 2007 flooding- of which two thirds was a result of surface water (Pitt 2008). As flood mapping and modelling is becoming increasingly accurate and detailed to the property level, risk differentiation can be made to ensure better understanding of exactly which properties are at risk. This can be expected to continue to progress with an increased availability of data, particularly with a national database of property level risk being made available from the ABI to the government under the proposed new system (Defra and ABI 2013). This is also interesting as national flood policy measures are usually considered somewhat reactive and often legislation is brought into play after large flood events, as in the case of the Flood and Water Management Act in 2010 as a response to the 2007 flooding and the question of responsibilities at the time (EFRA 2009).

5 Perspectives on the way forward for flood insurance in Europe

Against the backdrop of the above policy framework and the national – EU interplay there is an ongoing discussion about how to address existing lack of coverage and low uptake of insurance as well as the design aspects of insurance schemes, particularly for risk reduction. This has been at the core of the EU Green Paper (GP), and the responses that it triggered. We reflect on positions expressed as part of the Green Paper consultation and as part of a recent workshop hosted by the authors on this topic.

5.1 Reflections at the EU level

Contemplations about flood insurance by EU institutions can be inferred from two documents: the EC's GP and the European Parliament's response. The GP sparked the initial discussion by asking if the EU led action on disaster insurance around a system concerned with balancing affordability, DRR incentives, and internalizing possible public good externalities for high insurance penetration rates was warranted or desired. The GP placed an emphasis on systems that promote high insurance penetration rates as the GP states that a lack of insurance is a sign of vulnerability, emphasising insurance as a tool to minimize recovery time and to smooth income interruptions due to flood events. Examples of possible EU-lead systems in the GP are mandatory insurance purchasing or risk bundling. The affordability of insurance is also a key concern in the GP – with a reference to the potential trade-off arising from risk pricing: while risk pricing creates strong DRR incentives it can produce very high premiums that can prevent low income groups from buying insurance.

Responding to the GP and reflecting on the results of the public consultation exercise the European Parliament's response differed from the GP by stating that insurance should remain voluntary and the market should remain as flexible as possible so that products can be tailored to local requirements. Therefore, the Parliament's view is that it is not prudent to harmonize disaster insurance. The European Parliament (EP, 2014) took a critical view on the state-mandated insurance scheme hinted at in the GP. It declined the existence of a market distortion that could be rectified only through EU wide intervention and rejected a 'one-size-fits-all' solution to low market penetration of flood insurance schemes across Europe. Instead, tailor-made insurance products designed according to the type of risk; the country specific prevention and preparedness policies as well as capacity to respond to unfolding hazards should be favoured. Flexible insurance markets and voluntary underwriting are in the view of the EP more suited for insurance companies to develop appropriate products.

A recent opinion of the Advocate General Niilo Jääskinen in a similar although unrelated case (C-525/12, European Commission against Germany) suggests that the European Court of Justice (ECJ), in case of doubt, is more inclined to sustain the discretion of the Member States in choosing an (economic) policy instrument to meet collectively adopted policy targets. In this case, the European Commission referred Germany to the ECJ for a 'too narrow interpretation' of water services under the Water Framework Directive (WFD, 2000/60/EC). In the Commission's view, although the WFD makes it possible for the Member States to choose on which water services to impose the cost recovery requirement and to what degree, Germany has used this discretion to exclude all but two water services from the mandatory cost recovery regime. The Advocate General (Jääskinen 2014) described the Commission complaint as ambiguous but underscored the Member States' discretion of choosing an economic or other instrument best suitable for the given purpose.

A further concern at the EU level, as noted in the European Parliament's response, is the possibility of charity hazard whereby government-sponsored prevention (or compensation) lowers a citizen's incentive to protect themselves (see e.g., Hung 2009). This view is very similar to results of the public consultation in calling for little harmonization and placing a central role on DRR in order to manage disaster risk and insurance. The European Parliament's response states that expenditure on prevention is more efficient than recovery expenditure, while the GP argues that DRR in addition to lowering risk also lowers insurance premiums. Therefore, member states are called upon to invest in DRR in the European Parliament's response while at the same time combining DRR investment with strategies promoting individual responsibility.

In the public consultation, the UK treasury responded that disaster insurance harmonisation is unwarranted; echoed by the Dutch, Finnish, Estonian, Czech and Spanish governments or governmental bodies (the majority of responses are from governmental bodies). Moreover, these responses acknowledged the role of insurance as an indirect incentive for DRR. The Spanish view differed slightly in saying that as the Spanish catastrophe insurance is solidarity based as to provide an affordable compensation mechanism, DRR is the province of the state and not policyholders. Participants in European insurance market also provided responses to the GP in a similar tone in calling for the minimum of harmonization. Both groups take this view as the GP posits several possible ideas of how to structure insurance products, such as compulsory insurance purchasing or risk bundling, because they may stifle innovation in insurance products or not fit the tastes of consumers in specific markets. This stance is because the risk profiles of member states are different and require the free choice of market agents and market incentives to tailor insurance products and coverage to local needs. Not only are the risk profiles different between countries but so are attitudes towards risk and insurance. For instance, the UK follows a risk based approach while Spain takes a solidarity based approach; moving from one approach to the other might not be politically acceptable within the local risk culture; for instance in Germany compulsory disaster insurance may be illegal. Therefore, the industry and national body responses indicate that the insurance market should have minimal EU interference, so that markets can offer what local customers want. This line of reasoning shows that there is no one size fits all solution that could be imposed by the EU because the current arrangements have evolved in response to local needs and attitudes.

Taken as a whole the submitted responses to the GP indicate that there is little appetite for the EU to take a top-down approach regarding the provision of insurance because regional risk profiles and cultures are too different. Therefore, the responses indicate that the provision of insurance should remain in the hands of the member states. At the same time a stronger EU role in terms of flood risk management maybe feasible, with the EU facilitating flood risk management across different countries. Within the European Parliament's response, for example, it is stated that the best role for the EU is as a facilitator for spreading knowledge and providing better, international comparable and freely accessible data.

5.2 Reflections from the Munich Workshop

The workshop organized by the authors consisted of mainly representatives from the insurance industry and academia (Appendix 1) and the overall view expressed echoed the perception that there is no one size fits all solution regarding insurance provision. Regional differences and cultures means that a single style of insurance provision that is suitable across all regions of Europe may be impossible to find. Therefore, the responsibility should

be left to national regulators and/or competitive forces to tailor insurance provision to local needs, in this view. Furthermore, the representatives present at the workshop agreed that DRR is key and should play a central role regarding both insurance and risk management. Keeping this in mind, the discussions during the workshop identified several barriers to connecting DRR and insurance or other structures that may strengthen insurance provision; some of which may be removed with action from the EU.

The first observation from the workshop's discussion was that it appears that it is hard for different insurance or DRR stakeholders to work together. Which when combined with the time that it takes to change behaviours creates a degree of institutional deadlock that prevents countries from altering their disaster insurance systems. The workshop also perceived that the problems which impede the creation of new partnerships, such as public-private partnership insurance provision, are often compounded by the observation that no one "owns" flood risk, creating coordination problems that strengthen the inertia behind current systems. There is generally not one governmental office that has responsibility for disaster risk management (or its aftermath) and so different aspects of risk management are allocated between different offices. The lack of a central coordinator for the various stakeholders involved in flood risk management strengthens the various barriers currently preventing better management of the problem. Moreover, the instability of political preferences about forming flood insurance partnerships also adds to deadlock. For example, in the Netherlands it was initially the government who took the initiative for discussions with the insurance sector to promote the insurability of flood risks (Botzen et al. 2010). However, later this was reversed with the government blocking public-private flood insurance. While there may be little appetite for the EU to aid directly in the creation of partnerships there may be room for the EU to assist indirectly. For example, if governmental responsibility for natural disaster risk was transferred to a single government office there would be a natural locus for the various stakeholders to converge upon. Furthermore, the European Parliament's preferred role of the EU as a facilitator for information dissemination could also be useful by sharing information regarding best practice on how to bring together stakeholders and to prevent discussions from stagnating or by providing a neutral arbitrator.

The second perception that the workshop identified as holding backing insurance and DRR is the information available. The insurers present stated that they had a good and improving technical understanding of risk but they were missing information on the socio-economic drivers of disaster risk. Accessible risk information might also differ across regions making it harder to integrate or may not be available at an appropriate scale. There is also a strand of information missing about how effective various DRR measures are, so that insurance premiums could be correctly tailored. The information the insurers, governments and other stakeholders require is an area where the EU could facilitate. For instance, the EU could promote a common way of investigating or mapping risk so that the information provided by the various member state bodies can be integrated together. For example, the EU Floods Directive aims, in part, to produce such information, and the view of the workshop was that such projects are very useful. Not only for providing information but for also forcing various stakeholders to work together helping to overcome institutional deadlock.

The third observation is that the insurers present at the workshop stated that while insurance can promote DRR indirectly via risk based premiums, DRR is mainly the role of the state. The provision of large scale DRR projects lowers risk and allows insurance to be affordable; potentially creating a virtuous-circle for DRR. During the workshop it was argued that the state should provide large scale DRR projects because the state can take into account the whole area at risk, the relevant planning rules, access to finance, etc. The EU may be able to facilitate member states with investing in DRR by helping to share

information between member states regarding best practice and the relative merits of different DRR projects. A further way that the EU could facilitate DRR investment was discussed during the workshop and involved changing the role of the European Solidarity Fund (EUSF). Currently the EUSF can dispense aid if a country is affected by a disaster causing 0.6% of Gross National Income or €3 billion in damage. It was expressed that EUSF funding reduces the financial pressure that disasters place on governments, which in turn can reduce the incentive of governments to invest in DRR projects. The workshop argued that if the EUSF was converted to a mechanism for subsidizing investment in DRR activities it would provide an incentive for states to invest in DRR thanks to a movement away from an ex-post mechanism towards and ex-ante mechanism.

The final perceived barrier that the workshop discussed was the use of risk based pricing. The workshop participants agreed that the use of risk based pricing is required, but not a sufficient, condition for preventing moral hazard and incentivizing DRR. However, the participants noted that different European countries have different approaches towards risk based pricing and as such trade off affordability against risk based pricing to differing national degrees of acceptability. However, there seems little appetite for EU harmonisation of risk based pricing across Europe due to regional differences. However, facilitating the spread of information regarding the benefits or weaknesses of insurance systems, based on different degrees of risk pricing, can offer member states more information about different insurance systems.

6 Conclusion and reflection on next steps needed

Flood insurance differs widely in scope and form across Europe (see for example CEA 2009, p.18 Table 2). The current patchwork of public and private schemes is influenced by public policy – directly through regulation such as mandating cover or instigating the development of new schemes. And indirectly by providing the enabling infrastructure and environment, for example through a broad risk reduction framework, including building codes and better flood risk data provisions. The policy signals come from EU, national and in some cases regional level – usually aimed at demand and supply of flood insurance, with affordability and the question of insurability as the key pillars of the debate.

Recent flood losses and the publication of the GP in 2013 have revived the debate about the future of flood insurance in Europe. While the question of supply and demand is at the core of the public discourse, we argue that another key dimension is often overlooked: how to use insurance as a lever for risk reduction and flood prevention efforts.

In this paper we explored if and how current EU policies influence flood insurance. We notice a degree of direct impact through regulation and competition rules, determining the way private insurers can offer flood insurance (and other products) across the EU, as well as indirect influence through measures aimed at flood risk management and state aid to make good the damage caused by natural disasters. However, the design and implementation of insurance schemes remains a national concern. Reflecting on the current debate about the future of flood insurance in the EU we find little appetite for harmonization of flood insurance arrangements across the EU. The wide variety of existing insurance schemes, as well as different supply and demand patterns, show that there is no 'one size fits all' solution as is clear from the Netherlands and UK cases.

However, there appears to be a need for enhancing the indirect influence that EU policy can have, for example through policies to enhance flood risk information sharing and improve flood risk assessment. This could in turn play a role in the design of new or reformed schemes. Currently, concerns about affordability and availability of cover are the key factors driving the debate about flood insurance. The scale of flood risk and expected future risk trends are referenced, but do not seem to influence the design of schemes.

Through which instruments this could be achieved and how this could be interwoven with efforts to maintain affordability and availability is less clear, as our investigation shows.

The UK and the Netherlands cases both show that risk reduction and insurance are not closely integrated - neither the unsuccessful insurance plans in the Netherlands nor the proposed Flood Re scheme in the UK feature strong risk reduction elements. Reflecting on evidence emerging from other European and indeed international flood insurance schemes, we notice that this is not an exception, but rather the norm. The potential to use flood insurance as a lever for flood prevention is far from being exhausted. This is surprising, as flood prevention is likely to play a much stronger part in securing insurability and affordability of cover. Risk transfer alone, without consideration of risk reduction efforts, is not a sustainable solution going forward, particularly in the context of a changing climate. Moral hazard is a key challenge for any insurance product, but is a very acute problem in the field of flood insurance because it can undermine the economic benefits of risk transfer and the wider efforts to reduce risks.

While our investigation focused on the rather narrow field of flood insurance, we believe that there are a range of parallels to other disaster risks, particularly in the context of climate change. The debate about flood insurance in Europe highlights the key challenges of managing current and preparing for future climate risks: At the core lies the issue of collective versus individual responsibility, and solidarity versus market based approaches. At EU level there is also the question of subsidiarity versus harmonization – is EU intervention needed to change the way flood insurance is provided across Europe?

We argue that there is clear scope for the EU to play a greater role in linking risk transfer and flood risk management and prevention, beyond existing channels, to ensure an integrated approach to flood risk management across the EU, without resorting to a one-size fits all solution being imposed. Rather the EU can act in a way that promotes an overarching objective but allows for a decentralised approach.

Progress in this area will depend on a mix of increased evidence and understanding of underlying risk issues, better collaboration of stakeholders and openness about limitations and costs. The issue spans many dimensions, which makes innovation and reform challenging for political decision makers and private companies. In order to improve the link with flood insurance and disaster risk reduction in the EU, future research should provide insight into several issues. Namely: local flood risk estimations and their implications for the differentiation of premiums according to local risks, the costs and benefits (avoided flood damage) of flood risk mitigation measures that can be implemented by policyholders and the performance of such measures under a variety of flooding conditions. In addition the effectiveness of insurance incentives, such as premium discounts, in stimulating policyholders to adopt flood risk mitigation measures including possible moral hazard effects of insurance coverage, and barriers for insurance companies to proactively stimulate policyholders to limit risks. For incentives to be successful they need to target those who can take action: While stakeholders have only limited direct control over the occurrence of a natural disaster, their actions determine the extent of losses during and after the event. Therefore moral hazard can occur at government level, where the existence of an insurance scheme may reduce the urgency to prevent and reduce risks, or at the insured level, where the purchase of insurance may lead to a false sense of security. In theory, risk-based pricing should help prevent moral hazard and promote risk reduction behaviour. Evidence of how this works in practice is limited. Due to affordability concerns this may have to be linked to public financial support measures at least on a temporary basis.

Here the message from our workshop indicates a clear preference for public funding of flood risk management, in the form of prevention measures, rather than insurance subsidies.

The workshop discussion also highlights that there are several cases where information on the costs and benefits of flood risk management is missing. Therefore, there is scope for continued research, academic or otherwise, into the cost effectiveness of different flood risk management strategies, including an investigation of how responsive the various stakeholders are to incentives. Once this research is carried out the findings should be presented in such a way that it is easily accessible.

Our stakeholder discussions show that there is evidence of a range of further activities conducted by the insurance industry to foster flood risk management efforts, but it remains unclear to what extent this is effective at household level and to what extent they could be scaled up if deemed a success. Other stakeholders may be needed to reflect on the risk reduction potential, such as property developers, home-builders and mortgage providers in the context of property insurance.

One other aspect deserving further consideration is the suitability of insurance as opposed to other mechanisms. It is important to recognise that insurance is not a solution for all flood risks, and it should always be considered in conjunction with other mechanisms. For instance the tax system would offer a route to address some of these aspects, but this is often not deemed politically acceptable. Until today we know very little about the interplay between different compensation mechanisms and economic instruments.

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9 Appendix 1

Policy

Alexander Ferstel	EU-DG CLIMA
Marco Gemmer	EU-DG Research
Stefanie Dannenmann-Di Palma	United Nations Office for Disaster Risk Reduction (UNISDR)

Industry

Benno Keller	Zurich Insurance Company, Switzerland
Markus Aichinger	Allianz
Thomas Hlatky	Austrian Insurance Association / Insurance Europe
Roland Nussbaum	French Insurance Association (Mission Risques Naturels)
Oliver Hauner	German Insurance Association
Delima Oramas-Dorta	Guy Carpenter
Carmen Bell	Insurance Europe
Eberhart Faust	Munich Re
Jan Eichner	Munich Re
Michael Roth	Munich Re
Peter Hoeppe	Munich Re
Wolfgang Kron	Munich Re
Katherine Today	ClimateWise
Timothy Fewtrell	Willis
Carlos Amaral Netto	Metacortex

Academia

Diane Horn	Birkbeck, University of London UK
Franz Prettenthaler	Joanneum Research, Austria
Gijs Kloek	Achmea, Netherlands
Swenja Surminski	LSE
Jim Hall	University of Oxford
Reinhard Mechler	IIASA
Dionisto Perez	FEEM
Jeroen Aerts	VU University Amsterdam
Wouter Botzen	VU University Amsterdam
Brenden Jongman	VU University Amsterdam
Paul Hudson	VU University Amsterdam
Joanne Linneroth-Bayer	IIASA
Anna Lorant	IIASA
Wang Run	Chinese Academy of Sciences
Jiang Tong	National Climate Centre of China Meteorological

10 Appendix 2

Table A2: Table of business needs in response to climate threats with solutions, actions and responsibilities.

BUSINESS NEED	CLIMATE THREAT	STRATEGIC SOLUTIONS	IMMEDIATE ACTION REQUIRED	RESPONSIBILITY
HABITABLE HOUSING AND FLEXIBLE COMMERCIAL BUILDINGS	Increasing frequency and severity of storms and floods will lead to more frequent and costly repairs, higher housing and insurance costs and declining housing quality in difficult locations. High night-time temperatures will result in health problems, made worse by disturbed sleep patterns.	<p>AVOID with building codes fit for 2050s severe weather and</p> <p>summer heat</p> <p>REDUCE through better housing for groups with poor health profiles</p> <p>MANAGE with building standards that reduce leaseholders' risks</p>	<ul style="list-style-type: none"> Greater investment in flood defences Strengthening the Code for Sustainable Homes, requiring adaptation measures Higher standards for social housing and housing for vulnerable groups Rigorous implementation of PPS25, including the Growth Areas 	<p>Defra</p> <p>CLG</p> <p>Local authorities</p> <p>HMT</p>
RISK BASED DEVELOPMENT POLICIES	Coastal regions and low-lying urban centres will be increasingly affected by flooding, intense rainfall and storms. Coastal erosion will accelerate. High density development will exacerbate drainage and heat island effects.	<p>AVOID by only developing low risk areas using site and building designs fit for 2050s climate</p> <p>REDUCE by risk reduction in existing properties in medium/high risk areas</p> <p>MANAGE by improving flood and coastal defences and emergency</p> <p>support services</p>	<ul style="list-style-type: none"> Greater investment in flood and coastal defences Rigorous implementation of PPS25 based on improved mapping Regeneration projects assess and fund management of climate risks Home Information Packs to include 2050s climate risk information 	<p>Defra</p> <p>CLG</p> <p>DTI</p> <p>HMT</p>
RELIABLE TRANSPORTATION	High winds, floods, landslips and coastal storms and erosion will increasingly interrupt vulnerable road and rail routes, including strategic links to ports and docks	<p>REDUCE through risk-based preventive management for main transport links</p> <p>MANAGE vulnerable coastal routes and ports through protection or re-routing</p>	<ul style="list-style-type: none"> Greater investment in coastal protection Creation of a national risk register of key transport routes Better risk management of key routes and facilities 	<p>DfT</p> <p>Defra</p> <p>HMT</p>

SECURE ENERGY SUPPLIES	Increasing frequency and severity of storms and floods will result in more frequent interruption of supply and business activity. Coastal generating capacity is particularly vulnerable. Foreign supplies may be unreliable during crises. Hotter summers will change demand patterns and reduce power station cooling capacity.	<p>AVOID by ensuring energy security by diversifying sources,</p> <p>including micro-generation</p> <p>AVOID by contractual guarantees on continuity of foreign supplies</p> <p>REDUCE by increasing resilience of local distribution networks</p> <p>MANAGE by promoting energy efficiency</p>	<ul style="list-style-type: none"> • Energy Review increases diversity of supplies and support for local resilience measures • Strategic assessment of coastal protection needs of key facilities 	DTI Ofgem
SAFE AND SECURE WATER SUPPLIES	Reduced summer rainfall and more frequent droughts threaten the volume and quality of supplies in the regions with the fastest growing populations.	<p>AVOID by using 2050s climate scenarios for future investment plans</p> <p>REDUCE through demand management in existing housing</p> <p>MANAGE through business-friendly restrictions of supply</p>	<ul style="list-style-type: none"> • Ofwat incorporate climate scenario planning into 2010 price review • Incentives for householders to adopt water saving measures 	Ofwat Defra HMT
WORLD BEATING SCIENCE AND TECHNOLOGICAL INNOVATION	Uncertainties in climate modelling lead to under-estimation of threats affecting critical infrastructure. New risks overwhelm current technologies.	<p>AVOID by mainstreaming climate threats and through multidisciplinary research</p> <p>REDUCE through further strengthening centres of excellence in climate science</p> <p>MANAGE by strengthening academic research links with business</p>	<ul style="list-style-type: none"> • Increased funding of climate-related research and studentships • Greater business access to publicly funded climate and geographic data • Wider stakeholder involvement and partnership working 	DTI HMT
WELL EDUCATED WORKFORCE	Current school buildings and timetables are unsuited to high summer temperatures and vulnerable to storms and floods, risking poor learning conditions and increasingly interrupted education.	<p>AVOID by strengthening building standards for new build</p> <p>REDUCE through planned refurbishment of existing schools</p> <p>MANAGE by remodelling school year/day where buildings</p>	<ul style="list-style-type: none"> • Revised specifications for new build and refurbishments, with additional funding • Review of school year planning for 2015 and 2030 conditions 	DfES HMT

		substandard		
HEALTHY PEOPLE	Higher incidence of exotic diseases, allergenic and cardiorespiratory conditions will affect the workforce. Vulnerable dependents (children and the elderly) will require more care.	<p>AVOID by improving urban air quality</p> <p>REDUCE with more effective cardio-respiratory treatments</p> <p>MANAGE with strengthened primary care and public health provisions, including heatwave planning</p>	<ul style="list-style-type: none"> Strengthened air quality monitoring and risk based improvements Greater preventive healthcare education Regular updating of heatwave plans 	<p>DH</p> <p>Defra</p> <p>HMT</p>
RESILIENT TRADING PARTNERS	Climate change impacts vary but will be earlier and stronger in coastal regions and on inland waterways, areas of economic concentration. Millennium Development Goals will be frustrated where drought, storms and flooding devastate subsistence agriculture and fledgling industries with increasing frequency.	<p>AVOID through revision of EU legislation to respond to climate change</p> <p>REDUCE through strengthened international cooperation on increasing resilience</p> <p>MANAGE through international aid taking climate risks into account</p>	<ul style="list-style-type: none"> EU Green Paper on climate change reviews all EU-wide measures Gleneagles (G8) process incorporates resilience Aid projects incorporate climate risks and adaptation 	<p>Whitehall-wide,</p> <p>especially DfID, CO and FCO</p>

BUSINESS NEED	CLIMATE THREAT	STRATEGIC SOLUTIONS	IMMEDIATE ACTION REQUIRED	RESPONSIBILITY
HABITABLE HOUSING AND FLEXIBLE COMMERCIAL BUILDINGS	Increasing frequency and severity of storms and floods will lead to more frequent and costly repairs, higher housing and insurance costs and declining housing quality in difficult locations. High night-time temperatures will result in health problems, made worse by disturbed sleep patterns.	AVOID with building codes fit for 2050s severe weather and summer heat REDUCE through better housing for groups with poor health profiles MANAGE with building standards that reduce leaseholders' risks	<ul style="list-style-type: none"> Greater investment in flood defences Strengthening the Code for Sustainable Homes, requiring adaptation measures Higher standards for social housing and housing for vulnerable groups Rigorous implementation of PPS25, including the Growth Areas 	Defra CLG Local authorities HMT
RISK BASED DEVELOPMENT POLICIES	Coastal regions and low-lying urban centres will be increasingly affected by flooding, intense rainfall and storms. Coastal erosion will accelerate. High density development will exacerbate drainage and heat island effects.	AVOID by only developing low risk areas using site and building designs fit for 2050s climate REDUCE by risk reduction in existing properties in medium/high risk areas MANAGE by improving flood and coastal defences and emergency support services	<ul style="list-style-type: none"> Greater investment in flood and coastal defences Rigorous implementation of PPS25 based on improved mapping Regeneration projects assess and fund management of climate risks Home Information Packs to include 2050s climate risk information 	Defra CLG DTI HMT
RELIABLE TRANSPORTATION	High winds, floods, landslips and coastal storms and erosion will increasingly interrupt vulnerable road and rail routes, including strategic links to ports and docks	REDUCE through risk-based preventive management for main transport links MANAGE vulnerable coastal routes and ports through protection or re-routing	<ul style="list-style-type: none"> Greater investment in coastal protection Creation of a national risk register of key transport routes Better risk management of key routes and facilities 	DfT Defra HMT
SECURE ENERGY SUPPLIES	Increasing frequency and severity of storms and floods will result in more frequent interruption of supply and business activity. Coastal generating capacity is particularly vulnerable. Foreign supplies may be unreliable during crises. Hotter summers will change demand patterns and reduce power station cooling capacity.	AVOID by ensuring energy security by diversifying sources, including micro-generation AVOID by contractual guarantees on continuity of foreign supplies REDUCE by increasing resilience of local distribution networks MANAGE by promoting energy efficiency	<ul style="list-style-type: none"> Energy Review increases diversity of supplies and support for local resilience measures Strategic assessment of coastal protection needs of key facilities 	DTI Ofgem
SAFE AND SECURE WATER SUPPLIES	Reduced summer rainfall and more frequent droughts threaten the volume and quality of supplies in the regions with the fastest growing populations.	AVOID by using 2050s climate scenarios for future investment plans REDUCE through demand management in existing housing MANAGE through business-friendly restrictions of supply	<ul style="list-style-type: none"> Ofwat incorporate climate scenario planning into 2010 price review Incentives for householders to adopt water saving measures 	Ofwat Defra HMT
WORLD BEATING SCIENCE AND TECHNOLOGICAL INNOVATION	Uncertainties in climate modelling lead to under-estimation of threats affecting critical infrastructure. New risks overwhelm current technologies.	AVOID by mainstreaming climate threats and through multidisciplinary research REDUCE through further strengthening centres of excellence in climate science MANAGE by strengthening academic research links with business	<ul style="list-style-type: none"> Increased funding of climate-related research and studentships Greater business access to publicly funded climate and geographic data Wider stakeholder involvement and partnership working 	DTI HMT

WELL EDUCATED WORKFORCE	Current school buildings and timetables are unsuited to high summer temperatures and vulnerable to storms and floods, risking poor learning conditions and increasingly interrupted education.	<p>AVOID by strengthening building standards for new build</p> <p>REDUCE through planned refurbishment of existing schools</p> <p>MANAGE by remodelling school year/day where buildings substandard</p>	<ul style="list-style-type: none"> Revised specifications for new build and refurbishments, with additional funding Review of school year planning for 2015 and 2030 conditions 	DfES HMT
HEALTHY PEOPLE	Higher incidence of exotic diseases, allergenic and cardiorespiratory conditions will affect the workforce. Vulnerable dependents (children and the elderly) will require more care.	<p>AVOID by improving urban air quality</p> <p>REDUCE with more effective cardio-respiratory treatments</p> <p>MANAGE with strengthened primary care and public health provisions, including heatwave planning</p>	<ul style="list-style-type: none"> Strengthened air quality monitoring and risk based improvements Greater preventive healthcare education Regular updating of heatwave plans 	DH Defra HMT
RESILIENT TRADING PARTNERS	Climate change impacts vary but will be earlier and stronger in coastal regions and on inland waterways, areas of economic concentration. Millennium Development Goals will be frustrated where drought, storms and flooding devastate subsistence agriculture and fledgling industries with increasing frequency.	<p>AVOID through revision of EU legislation to respond to climate change</p> <p>REDUCE through strengthened international cooperation on increasing resilience</p> <p>MANAGE through international aid taking climate risks into account</p>	<ul style="list-style-type: none"> EU Green Paper on climate change reviews all EU-wide measures Gleneagles (G8) process incorporates resilience Aid projects incorporate climate risks and adaptation 	Whitehall-wide, especially DfID, CO and FCO especially DfID, CO and FCO

BUSINESS NEED	CLIMATE THREAT	STRATEGIC SOLUTIONS	IMMEDIATE ACTION REQUIRED	RESPONSIBILITY
HABITABLE HOUSING AND FLEXIBLE COMMERCIAL BUILDINGS	Increasing frequency and severity of storms and floods will lead to more frequent and costly repairs, higher housing and insurance costs and declining housing quality in difficult locations. High night-time temperatures will result in health problems, made worse by disturbed sleep patterns.	AVOID with building codes fit for 2050s severe weather and summer heat REDUCE through better housing for groups with poor health profiles MANAGE with building standards that reduce leaseholders' risks	<ul style="list-style-type: none"> Greater investment in flood defences Strengthening the Code for Sustainable Homes, requiring adaptation measures Higher standards for social housing and housing for vulnerable groups Rigorous implementation of PPS25, including the Growth Areas 	Defra CLG Local authorities HMT
RISK BASED DEVELOPMENT POLICIES	Coastal regions and low-lying urban centres will be increasingly affected by flooding, intense rainfall and storms. Coastal erosion will accelerate. High density development will exacerbate drainage and heat island effects.	AVOID by only developing low risk areas using site and building designs fit for 2050s climate REDUCE by risk reduction in existing properties in medium/high risk areas MANAGE by improving flood and coastal defences and emergency support services	<ul style="list-style-type: none"> Greater investment in flood and coastal defences Rigorous implementation of PPS25 based on improved mapping Regeneration projects assess and fund management of climate risks Home Information Packs to include 2050s climate risk information 	Defra CLG DTI HMT
RELIABLE TRANSPORTATION	High winds, floods, landslips and coastal storms and erosion will increasingly interrupt vulnerable road and rail routes, including strategic links to ports and docks	REDUCE through risk-based preventive management for main transport links MANAGE vulnerable coastal routes and ports through protection or re-routing	<ul style="list-style-type: none"> Greater investment in coastal protection Creation of a national risk register of key transport routes Better risk management of key routes and facilities 	DfT Defra HMT
SECURE ENERGY SUPPLIES	Increasing frequency and severity of storms and floods will result in more frequent interruption of supply and business activity. Coastal generating capacity is particularly vulnerable. Foreign supplies may be unreliable during crises. Hotter summers will change demand patterns and reduce power station cooling capacity.	AVOID by ensuring energy security by diversifying sources, including micro-generation AVOID by contractual guarantees on continuity of foreign supplies REDUCE by increasing resilience of local distribution networks MANAGE by promoting energy efficiency	<ul style="list-style-type: none"> Energy Review increases diversity of supplies and support for local resilience measures Strategic assessment of coastal protection needs of key facilities 	DTI Ofgem
SAFE AND SECURE WATER SUPPLIES	Reduced summer rainfall and more frequent droughts threaten the volume and quality of supplies in the regions with the fastest growing populations.	AVOID by using 2050s climate scenarios for future investment plans REDUCE through demand management in existing housing MANAGE through business-friendly restrictions of supply	<ul style="list-style-type: none"> Ofwat incorporate climate scenario planning into 2010 price review Incentives for householders to adopt water saving measures 	Ofwat Defra HMT
WORLD BEATING SCIENCE AND TECHNOLOGICAL INNOVATION	Uncertainties in climate modelling lead to under-estimation of threats affecting critical infrastructure. New risks overwhelm current technologies.	AVOID by mainstreaming climate threats and through multidisciplinary research REDUCE through further strengthening centres of excellence in climate science MANAGE by strengthening academic research links with business	<ul style="list-style-type: none"> Increased funding of climate-related research and studentships Greater business access to publicly funded climate and geographic data Wider stakeholder involvement and partnership working 	DTI HMT

WELL EDUCATED WORKFORCE	Current school buildings and timetables are unsuited to high summer temperatures and vulnerable to storms and floods, risking poor learning conditions and increasingly interrupted education.	<p>AVOID by strengthening building standards for new build</p> <p>REDUCE through planned refurbishment of existing schools</p> <p>MANAGE by remodelling school year/day where buildings substandard</p>	<ul style="list-style-type: none"> Revised specifications for new build and refurbishments, with additional funding Review of school year planning for 2015 and 2030 conditions 	DfES HMT
HEALTHY PEOPLE	Higher incidence of exotic diseases, allergenic and cardiorespiratory conditions will affect the workforce. Vulnerable dependents (children and the elderly) will require more care.	<p>AVOID by improving urban air quality</p> <p>REDUCE with more effective cardio-respiratory treatments</p> <p>MANAGE with strengthened primary care and public health provisions, including heatwave planning</p>	<ul style="list-style-type: none"> Strengthened air quality monitoring and risk based improvements Greater preventive healthcare education Regular updating of heatwave plans 	DH Defra HMT
RESILIENT TRADING PARTNERS	Climate change impacts vary but will be earlier and stronger in coastal regions and on inland waterways, areas of economic concentration. Millennium Development Goals will be frustrated where drought, storms and flooding devastate subsistence agriculture and fledgling industries with increasing frequency.	<p>AVOID through revision of EU legislation to respond to climate change</p> <p>REDUCE through strengthened international cooperation on increasing resilience</p> <p>MANAGE through international aid taking climate risks into account</p>	<ul style="list-style-type: none"> EU Green Paper on climate change reviews all EU-wide measures Gleneagles (G8) process incorporates resilience Aid projects incorporate climate risks and adaptation 	Whitehall-wide, especially DfID, CO and FCO especially DfID, CO and FCO

11 Appendix 3

Table A3 documents the changes over time of the SoP and the driving factors behind the change.

*Table A3: Detail of the evolution of flood insurance in the United Kingdom. *This requirement although in the Statement of Principles was never fully realised as 5 year defence plan was not available (Kerr, 2013). (Detail for table taken from: Arnell et al., 1984; Bek et al., 2013)*

Date	Agreement	Main principals	Driving factors	Developments
1961	'Gentleman's Agreement'	<ul style="list-style-type: none"> Agreement between government, British Insurance Association (BIA) and Lloyd's of London Flood cover available as part of a comprehensive household policy made more available Right not to grant insurance cover if area had a greater than normal flood risk Terms and conditions of policy vary depending on individual circumstance 	<p>Large floods in 1952/1953</p> <p>Large uninsured losses</p> <p>Government pressure on industry for solution</p> <p>Threat of national disaster fund</p> <p>Widely available by the late 1970s</p>	<p>Initiation of flood insurance for all</p> <p>Increasing penetration rate</p>
2000	'Gentleman's Agreement'	<ul style="list-style-type: none"> Agreement between government and industry Flood insurance included in standard policy for household and standard businesses up to a risk level of 	<p>Increasing flood loss</p> <p>Lack of investment in flood defences</p>	<p>Change to more comprehensive updated system</p>



		<p>1:75 return period (1.3%)</p> <ul style="list-style-type: none"> Covers both buildings and contents Government commits to investment in flood defence, improved risk data and strengthened planning system Higher risk properties considered for insurance if EA improves defences in the area in the next 5 years* Pricing and terms not affected by SoP Cross subsidization between households (low and high risk) 		
2002	'Gentleman's Agreement'	All policies would be renewed in line with the above commitments except in 'exceptional circumstances'.	<p>Increasing flood loss</p> <p>Lack of investment in flood defences</p>	
2005	Statement of Principles		Flood losses	
2008	Statement of Principles	<p>Continued cover for properties at significant flood risk</p> <p>Statement of Principles does not apply to property built after 1 January 2009.</p>	Flood losses, increasing excesses seen in risk areas	
2015	Flood Re	<ul style="list-style-type: none"> A pooled system for high risk properties Other properties 	<p>Flood losses</p> <p>Affordability</p>	



		<p>enter the free market</p> <ul style="list-style-type: none"> • Safeguards affordability and availability of insurance to high risk households • Small businesses, Band H properties and ‘genuinely uninsurable properties’ excluded from the scheme • Levy paid from insurers to the pool and topped up (if required) through ‘<i>ad hoc</i>’ payments 	<p>‘Cherry picking’ customers when new firms enter the market</p>	<p>Officially termed the SoP in 2005</p> <p>Increase in potential for large excesses and premiums</p> <p>End of SoP June 2013</p> <p>Change to Flood Re in summer 2015</p>
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