Roadmap Recommendations:
Health

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I. Executive Summary

Vision:

1. Significantly reduce mortality and morbidity from household air pollution, especially among poor and vulnerable households.
2. Attain the global will and commitment necessary to transform clean cookstoves into a worldwide health priority.

Approach:

The overall approach builds a robust evidence base for clean cookstoves through targeted health research and program evaluation; develops program interventions based on this evidence; and communicates key research and programmatic findings to policy makers, public health professionals and advocates, This approach will generate broad support for dissemination of clean cookstoves while building capacity among developing country researchers and practitioners.

Narrative:

Introduction and rationale
There is general agreement that while improved health is not the only major benefit expected from universal access to clean and efficient household energy, it is certainly the most compelling one for governments, NGOs and funders who wish to invest in solving this global issue. Thus, by 2020, the Global Alliance for Clean Cookstoves (Alliance) must be able to demonstrate that the improved stove and/or fuel programs have directly contributed to a substantial impact on reducing deaths and ill-health, and quantify the extent to which this has been the case. In this roadmap, the Health Working Group (WG) has identified a set of core, inter-related requirements that must be addressed if the expected reductions in mortality and morbidity are to be achieved:

1. **Only scale up effective interventions:** We need a higher level of confidence that when implemented at scale, the levels of exposure reduction delivered by stove/fuel interventions will be sufficient to have substantial benefits for deaths and illness, particularly with respect to high burden diseases, including childhood pneumonia (see 4).
2. **Support continuous quality improvement:** We recognize that advancements in cookstoves and fuels to achieve improved health and yet be affordable to those in extreme poverty remains a "work in progress". We hope, however, that research on health benefits will be integrated with the efforts of these industries at all levels such that there is a continuous quality improvement feedback from new research results to inform the stove and fuel implementers to promote progressive improvement in effective and affordable technologies that improve human health.

3. **Learn from thorough and timely evaluation:** We need a cost-efficient, reliable and harmonized approach to evaluating implementation programs as these proceed to scale. Such evaluation can ensure that promising technologies are delivering in practice, and that direct benefits for health can be demonstrated in a scientifically robust manner.
4. **Answer key questions on health risks:** We need to better understand the risks to health from exposure to household air pollution (HAP), including the key issue of "how clean is clean enough" to effect substantial reductions in childhood pneumonia and adverse pregnancy outcomes. In addition, more information is needed on chronic non-communicable diseases, for which links are highly plausible but currently supported by little more than indirect evidence.
5. **Seek to integrate HAP interventions with solutions for other health and social needs:** Women and children suffer the greatest disease burden from exposure to HAP. Providing a safer environment for women and children and improving indoor air quality requires active participation of women to understand needs and to design solutions. Similarly, interventions to reduce HAP should seek where possible integration with other health and poverty-based related interventions to develop sustainable solutions.
6. **Inform and mobilize:** We need to rally the professional, financial and advocacy resources of the international health community which has barely engaged on this issue. It is time to work closely with countries, providing technical support as required to assess needs, plan appropriate policy on interventions and dissemination, and carry out monitoring and evaluation.

In addition to the health-specific requirements noted above, there are several fundamental issues central to all aspects of the household energy access problem in developing countries with very important implications for health. First, women and children suffer the greatest disease burden from exposure to HAP. Providing a safer environment for women and children by improving indoor air quality requires consideration of women and their cultural and traditional roles in all aspects of developing sustainable solutions. Second, it is critical that we recognize the poverty context, and the fundamental relationships between reliance on inefficient, polluting cookstoves and the other major risks to health associated with poverty. These include under-nutrition, inadequate clean water and effective sanitation, infectious disease, etc.

Equity is therefore a key underlying issue, and one which is central to achieving health benefits. An equity perspective should inform all aspects of the Alliance's work, from technology development, through approaches to dissemination and market development, and ensuring that this is included in research and evaluation.

Prioritizing and organizing the recommendations:

Approach

This report from the Health WG sets out priority activities designed to deliver the six requirements described above. These activities have been informed by discussion within the working group and by the recent National Institutes of Health (NIH) workshop for research and evaluation, May 9-11, 2011. A subject as broad and complex as health will inevitably lead to a large and varied set of recommended actions spanning research, program evaluation and public health action. The historically low levels of funding for research and implementation also mean that now, with the topic being given more attention, this

substantial unmet need is being expressed. With nine topic groups and two days of intense work, the NIH meeting produced an extensive agenda of prioritized recommendations.

The Health WG has sought to identify priorities for this report that will best serve the needs of the Alliance. The criteria listed below in Box 1 have helped guide this prioritization. Each of the priority areas submitted in the template lists the key actionable items (as 'activities' in the template) that are recommended if each priority is to be realized. In addition, the full range of priorities for research and programme evaluation put forward by the NIH topic groups in response to the development of the Alliance priorities roadmap requirements is presented in Annex 1 of this report. This has been done to ensure that all of these issues are kept in the dialogue as the Alliance moves forward, and that these are easily accessible to Alliance partners, donors and the research community. The Health WG proposes that these could also be made available through a web link hosted by the Alliance.

The following priorities areas are described in more detail below, under three headings:

A. General communication of the health message
B. Research and program evaluation
C. Public health actions

Box 1: Criteria Used to Guide Prioritization of Health Sector Activities

1. **Transformational in nature in short to medium term**:
   - Research providing answers to critical scientific questions needed to inform technology development and implementation, including exposure-response relationships. Focus on outcomes which are important and change quickly, e.g. pregnancy outcomes, child pneumonia, and indicators of chronic disease process.
   - Public health actions that engage the health professional groups and donors that will lead to a quantum change in priority given to household energy and HAP in public health programs.
   - Support of governmental health agencies to develop health policy and engage in the planning, implementation, and evaluation of national cookstove/cleaner fuel programs.
   - Critical research on other health outcomes such as eye disease and burns which would encourage these communities of interest (professional groups, donors, researchers) to advocate, revise policy, and commit actively to the Alliance.

2. **Supporting effective and efficient evaluation:**
   - Initiatives which will support a coordinated, systematic approach to developing and implementing evaluation which will meet the needs of the Alliance.
   - Health outcomes that can most usefully and feasibly be measured in program evaluation, and methods for their measurement.

3. **Important public health issues:**
   - The burden of disease (BoD) attributable to HAP provides a standardized, comparable indicator of which diseases caused by exposure are most important. The BoD estimates are currently being updated in the new CRA (due late 2011/early 2012).

- Burden should include consideration of ill-health as well as deaths, identifying conditions with high morbidity relative to case-fatality (e.g. blindness, burns), for example through use of disability-adjusted life years (DALYs) and the component of 'years lived with disability'.

4. Investment now for important longer-term outcomes:

- There is growing recognition of the importance of developmental origins of later childhood and adult disease, and the potential role which exposure to combustion pollutants may have during pregnancy and first years of infancy, as well as later in childhood and throughout adult life. Priority should therefore be given to investing in and establishing the longer-term research infrastructure required to study this issue as the epidemic of non-communicable diseases (NCDs) becomes increasingly evident in lower income countries.

Other priorities relevant to health

There are a number of other research, evaluation, information and public health activities that are important for health, but are not elaborated in this report. These are expected to feature strongly in the priorities of other working groups. For example, assessing the situation with regards to traditional fuel use (e.g. through the WHO household energy database), will be important for 'baseline' exposure assessment and monitoring the adoption of improved cookstoves and cleaner fuels, and will be a concern for the Monitoring and Evaluation Working Group (M&E WG). Enhancements to the survey instruments that will be needed to ensure that the information collected is suitable for this task over the next 5-10 years needs consideration. Other examples include the linkages between health and other aspects of evaluation which are discussed under the 'Program evaluation', and the assessment of country disease burden and intervention options, which are discussed under the heading of 'Engaging with nations'. Further emphasis of the relevance to health of these and other activities can be added during preparation of the integrated report(s), and via the working group coordination meeting.

Leveraging existing infrastructure

Many existing centers of excellence, networks, and country-based platforms can greatly facilitate research, evaluation and public health programs. Creating greater awareness about this infrastructure among researchers and encouraging integration of HAP research and programs into these facilities can enhance the "return on investment" for Alliance partners. One approach recommended during the recent NIH workshop proposed development of an interactive, global and web-based map with infrastructure geo-coded with links to information about the site and its potential to facilitate HAP research and programs. Other tools to leverage HAP research and programs through enhanced awareness and communication, and which could be beneficial to the various Alliance working groups, should be considered.

Coordination across working groups

A recurrent theme within this report is the importance of coordination across Working Groups, not only to inform the health-related activities proposed here, but also to ensure that consideration of health risks and benefits informs all other aspects of the work of the Alliance. Accordingly, the group recommends that the Alliance establish an ongoing and robust mechanism to ensure that the highest level of coordination takes place.

A. Communicating the health message: big burden – huge opportunity

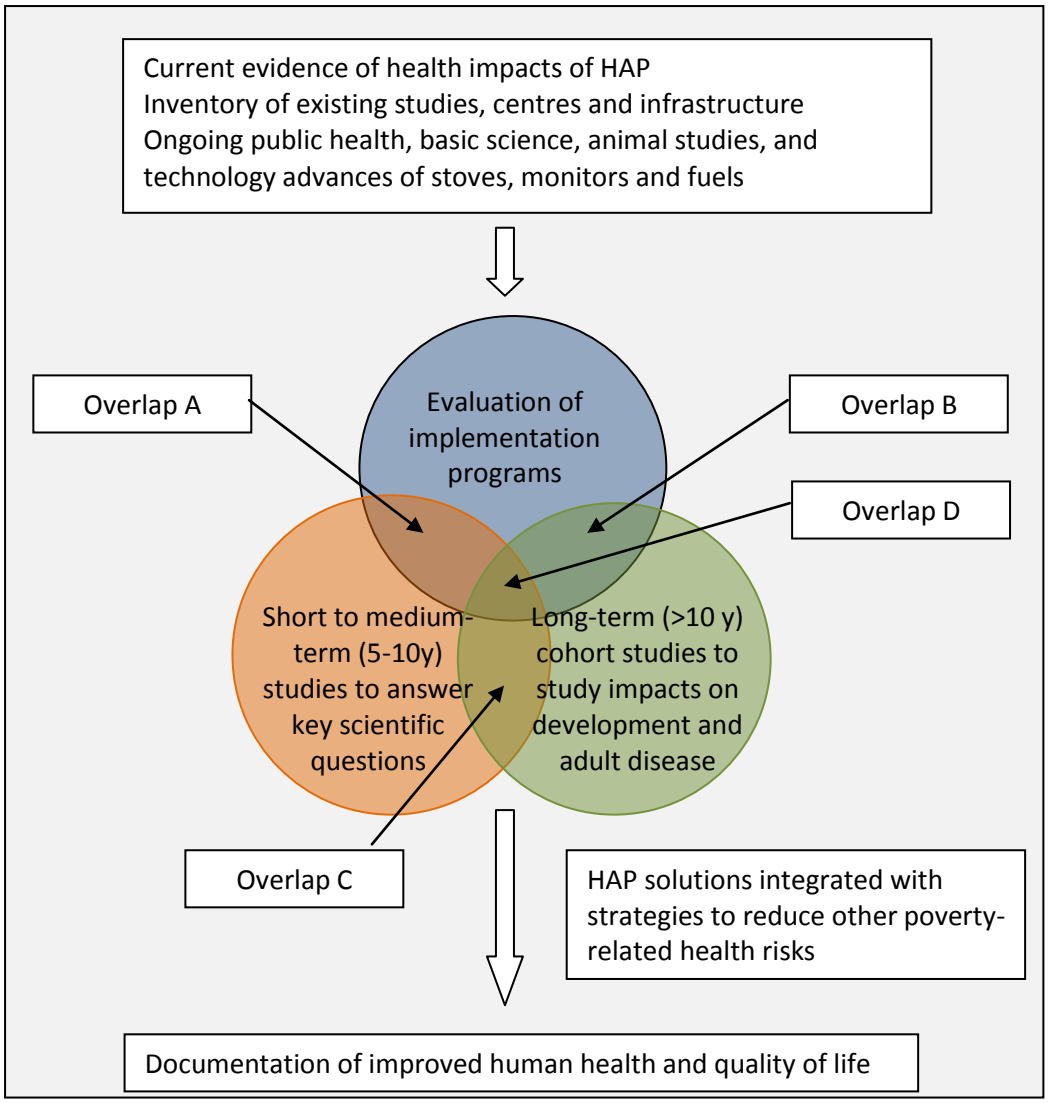
Awareness of the health consequences of traditional cooking remains very low. This is the case in general, as well as among professional organizations, the development community, governments and so on. This roadmap includes specific activities to engage the international health community (health professionals) and also governments (including Ministries of Health). The time has come to raise public and professional awareness about the lives damaged and lost from exposure to toxic smoke. These efforts can and should begin immediately.

B. Research and program evaluation

The NIH workshop on May 9-11, 2011, provided a 'state of the science' of what is known and not known about HAP and human health. A key concern was how research and evaluation could determine the impact of improved cookstoves and fuels on human health. Nine working groups had been preparing draft white papers for months prior to the workshop. These became a forum for discussion at each breakout session with active involvement of the participants. The following topics were included: cancer, cardiovascular, respiratory, infection, pregnancy-neonatal-child, burns, ocular health, women's empowerment and exposure assessment/biomarker development.

As a result of the workshop, three broad, inter-related approaches were identified: (i) short to medium-term research to answer key scientific questions; (ii) program evaluation; and (iii) establishment of long-term cohort studies. These three approaches are illustrated in Figure 1. Using this template, each working group identified priorities necessary for research and evaluation to document improved human health. Tables 1-9 in ANNEX 1 show color-coded priorities related to this diagram.

Figure 1: Three interrelated areas of research and program evaluation, with important overlaps labelled A – D (see text for further explanation)



Short to medium-term research (<10 years)
This research will use RCT and other study designs to provide the robust scientific evidence that is needed to (i) inform the planning, development and implementation of clean stove and fuel options for households over the next 5-10 years, and (ii) to maintain and increase donor, government, professional and societal commitments. The research will include studies to define the 'exposure-response' relationship for critical acute health outcomes (such as child pneumonia, low birth weight/pre-term birth, etc.) and markers of chronic disease process (e.g. COPD, IHD, possibly also for cataracts, etc.), and to remove uncertainty about the levels of exposure needed to ensure substantial health gains. These studies will be designed and implemented to provide high quality scientific evidence. They need to be planned and started as soon as possible. Harmonized methods (e.g. for exposure and outcome assessment) are vital to ensure that results from different settings can be compared and combined.

The development of concentration-response functions which incorporate the broader group of combustion sources of pollution, including indoor/household, ambient, and cigarette smoke (active and second-hand smoke) will enable a fuller quantification of the health effects of household air pollution. While historically there has been a somewhat artificial divide between 'indoor' and 'outdoor' pollution, use of solid household fuel is a major contributor to ambient air pollution in many areas of the world - and (in some settings at least) a heavily regulated and monitored arena. We should consider how best to maximize this additional policy lever.

Program evaluation
Evaluation will be critical to the Alliance, enabling continuous quality improvement and addressing multiple aspects, including impacts of interventions and program effectiveness and efficiency. While demonstration of direct effects on health outcomes will be important for intervention impacts, evaluation will also examine impacts on air pollution and exposure levels, fuel efficiency, stove acceptability and sustainable use, climate, time, opportunities for women, costs, etc. The health outcome component is not separate from these aspects of evaluation, indeed it is inextricably linked, for two main reasons. First, generally speaking, the measurement of health outcomes (both acute such as acute lower respiratory infections (ALRIs), and more chronic disease) is expensive, time intensive and complex. It is therefore important that more complex studies of health impacts related to HAP are not carried out until the programs being evaluated have clearly shown potential for substantial exposure reductions, good acceptability, and scaling up.[1] Second, key indicators of intervention performance, (e.g. HAP levels), can serve as proxies for health impacts earlier in the process, and in programs where it is not feasible, affordable or necessary to include direct measurement of health outcomes. As scientific evidence on the exposure-response relationship becomes more firmly defined and available for multiple health outcomes, it will be possible to state with greater confidence the expected health benefits of a program based on measured exposure levels. This should not be seen as complete substitute for direct assessment of impacts on health outcomes, but a complementary approach.

To address these points, the Health WG proposed that a priority activity for program evaluation should be a systematic approach to planning and implementation, covering:

[1] Note that other health outcomes such as burns can and should be assessed earlier in the process of intervention development and scaling up.

- A phased framework for carrying out program evaluation studies in a range of settings, coordinated with groups responsible for the other aspects of evaluation (HAP, fuel efficiency, acceptability, etc.)
- Development of evaluation study designs and methods, with harmonization to ensure comparability of results
- Rapid synthesis and communication of results and experience.
- Integration and coordination of evaluation with short-term and longer-term research to ensure efficiency of effort.

Longer-term cohort studies (>10 years)

Emerging basic science and epidemiological evidence on the effects of air pollution exposure (from solid fuel and or other sources) during pregnancy and childhood (and continuing into adulthood) suggests that there are likely to be very important consequences for a range of development and health outcomes through childhood and into adult life. In childhood, these include outcomes such as growth, cognitive development and respiratory health (e.g. asthma) and lung growth. In adults, the developmental origins of chronic NCDs such as cardiovascular disease, COPD and cancer are the focus of concern. Given the importance of these outcomes, priority should be given to establishing, as soon as practical, the research infrastructure that will allow investigation of these longer-term health effects. There are likely to be multiple opportunities to build such investigations onto existing long-term cohort studies, while some new cohorts should also be established.

Overlaps and synergies between priorities

In Figure 1, the priorities (circles) have areas of overlap. These areas are important features and are critical to how this work will be implemented in practice. The overlaps have been labelled A - D:

- **Overlap A:** in this area are included shorter-term studies including RCTs of the impact on health outcomes of interventions that are delivered (or accessible) via health or other government systems, for example the ante-natal care system, or conditional cash-transfer programs.
- **Overlap B:** in this area, long-term cohort studies may be developed from evaluation studies of programs being brought to scale.
- **Overlap C:** in this area, long-term cohort studies may be developed from RCTs, or by extension of shorter-term cohort studies that were established for more rapid investigation of outcomes such as birth weight, pre-term birth, congenital anomalies, and neonatal sepsis/pneumonia.
- **Overlap D:** a fourth area of overlap, where all of three of the circles meet, addresses cross-cutting issues, including harmonization of studies and programs, exposure and biomarkers, fundamental science on mechanisms, gender and women's empowerment, and links to other critical poverty-related health risks.

Exposure assessment

A critical aspect for health, exposure assessment in particular will require much greater effort and investment in almost all of the research and evaluation areas discussed above, including for studies seeking to define exposure-response relationships and in many program evaluations where exposure may act as a proxy for actual health outcomes.

Linking household energy to other improvements in the home environment

It is essential that as improvements in household energy use are documented to cause significant reductions in HAP and to improve human health that these approaches are integrated with similar strategies to address water, sanitation and hygiene (WASH), nutrition and other poverty-related health risks (Figure 1). As an example, it is critical that women and girls living in poverty be empowered to develop new economic and educational opportunities, factors required to build sustainable solutions for hundreds of millions of families living in middle and lower income countries. Peru's former First Lady Pilar Nores Bodereau, who presented the keynote address on the first evening of the NIH workshop, emphasized that in the national cookstove program in Peru, families receive new cookstoves at the same time other issues of WASH, nutrition and poverty are addressed. The Health WG seeks to use research, evaluation and public health as tools to ensure successful implementation programs that not only improve human health by improving indoor air quality but to seek novel approaches that integrate these interventions into parallel strategies being used to improve the health and quality of life of those living in extreme poverty around the world.

C. Public health actions

While research to inform policy and evaluation will provide the feedback on what is working and why (or not, as the case may be), this research must be complemented by a set of public health actions to accord the goals of the Alliance the full weight and influence of health professionals, donors, health systems and the health concerns of civil society. For most of these groups, levels of knowledge and engagement are negligible, or at best restrained, with a palpable sense of hesitation and uncertainty about whether clean household energy will deliver any health benefits, never mind how much. A key priority is to make access to clean, safe household energy an important public health program goal for professional groups, countries, donors and civil society, within the next 5 years. In order to achieve this goal, and complement the research and evaluation agenda, the Health WG identified the following priority areas for public health action:

A global public health imperative

Currently, access to clean, safe and efficient household energy and reducing HAP exposure is not a public health priority. To address this, we need to identify the key opinion leaders in the various sectors that develop, fund and implement public health policy. We need to advocate, making the most of the evidence we have available on the expected health benefits of clean cookstoves and fuels, while working to strengthen this evidence base as quickly as possible. This will require development of information resources for policy statements, and working with researchers and professional groups on tools (e.g. disease burden, Lives Saved Tool –LiST, etc.) that can raise the topic up the policy agenda. Within the 'umbrella' of the Alliance, we should develop a global network of organizations that will advance the global health agenda for clean and safe cookstoves.

Engaging nations to protect and improve health

Public health can serve as a catalyst for transition from the traditional three-stone fire to cleaner cooking solutions. Broad adoption of improved cookstoves and fuels depends on Ministries of Health (MOH) integrating these into ongoing public health functions, building evidence-based programs and learning from others' experiences. Integration of cookstove programs with water and sanitation programs has shown promise, as have linkages with maternal and child health programs.

Engaging and supporting MOH is critical to our understanding of the health impacts of country implementation of clean and safe cookstove programs. Public health involvement should focus on five core public health functions: 1) surveillance of community health; 2) policy development; 3) program planning and implementation; 4) community education and mobilization, and 5) program monitoring and evaluation. Directed cookstove health intervention programs conducted with the support of MOH, public health agencies, and non-governmental organizations will ensure health sector leadership and hasten recognition of clean and safe cooking as a public health priority.

Raising the profile of health within UN Agency efforts on energy access

It is important to recognize and collaborate with the Alliance to coordinate (e.g. as planned for Vienna, June 2011), UN Energy and the AGECC universal energy access agenda[2], International Year of Sustainable Energy for All (2012), and similar initiatives. While the health benefits of energy access are recognized, they tend to remain in the background. Our goal is to bring health to the forefront, alongside the other compelling arguments for economic development, poverty reduction and mitigating climate change; and to influence policy to maximize health benefits and minimize health risks. We see a lead role for the WHO in this effort, including raising awareness of the purpose, proposed content and application of the new WHO Indoor Air Quality Guidelines, due in 2012.

Improving health through innovative technology

Investment in cookstoves, fuels, testing, and marketing new technologies has been lacking. A program supported by all sectors of the Alliance focused on design, development, and testing of innovative technology could provide dramatic advancements that would transform the field. Innovative approaches to stove design and manufacturing that protect health and safety are vital. Stove designs have evolved in response to changing demand, initially responding to the need to conserve biomass fuels and later to minimize toxic emissions and safeguard health. Design and production of very low-cost, very clean-burning cookstoves depends on continued innovation and discovery. Achieving significant health impacts from clean cookstoves will be realized only if millions of households can adopt inexpensive, clean-burning cookstoves. Resources are essential to encourage and support investigation and testing. Research and development is an exploratory process, with uncertain outcomes and failures as well as successes. External support will make it possible for laboratories, universities and researchers to continue to investigate, experiment and ultimately find solutions.

Ensuring safety is a priority

As new cookstove technology and implementation programs are initiated, the issue of stove and fuel safety will surface as an important public health issue. A primary health outcome of safety concerns burns, including the risk of explosions from the use of faulty gas equipment. The concept of safe cookstoves and fuels should be incorporated into all aspects of the cookstove efforts including 1) understanding the scope of the problem, 2) designing clean, efficient, and safe cooking solutions, 3) testing stove effectiveness, 4) implementing wide-scale installation programs, and 5) refining efforts based on field evaluations. Key to these

[2] The UN Secretary General's Advisory Group on Energy and Climate Change (AGECC) has proposed the following targets for Universal Access to modern energy by 2030: provide universally a basic minimal threshold of 100 kgoe (kg of oil equivalent) of modern fuels per person per year by 2030; provide universal access to electricity of at least 100 kWh per person per year by 2030. AGECC also includes targets for energy efficiency (40% improvement in global energy intensity), and percentage from renewable sources (30%) by 2030.

efforts is development of efficient surveillance systems and evaluation designs that allow for collection of burn data.

Global partners, such as the WHO and the International Society for Burn Injuries, and academic centers with specific expertise in global injury research, should be engaged in this process to ensure a widely accepted injury prevention agenda that spans basic prevention to long-term care. Short-term steps are needed to design safety guidelines that address burn prevention and to include injury questions in surveillance, testing, and evaluation efforts. Long-term goals would include incorporating safety features into cookstove solutions and examining associated impacts on burn and other injuries.

Conclusions

The Health WG recognizes the importance of other WGs and the need to integrate all the plans into an overall strategic plan. The interdependence of these plans is clear. Going forward, we believe that collaboration must be facilitated by mechanisms of ongoing communication across WGs to ensure sharing of information and modification of plans as opportunities arise. We encourage that all these plans be viewed as "living documents" on the Alliance website and be accessible to the public and to potential donors and partners. We are hopeful that a fully integrated strategic plan that permits donors and partners to see the overall strategy as well as the individual components that reflect their own mission-specific interests is the ideal path to facilitate funding and timely achievement of the health-related goals in this report. The Health WG believes that if we do not protect health, nothing else matters. We must document that the planned stove and fuel programs of 100 by '20 do actually improve human health.

There are critical components noted in the report that are necessary for health-related goals to be achieved in concert with the Alliance's implementation goal of 100 by '20. First, it is important that the Alliance encourage harmonization of studies and programs, and develop a system-wide standard for studies and programs including those that are not supported by the Alliance. This is an important service to the global stove/fuel community. If successful, it will permit more effective evaluation of studies and programs to determine impact on human health. Second, the health consequences of HAP are disproportionately borne by women and children in the care of women. To be sustainable, any proposed solutions for these health consequences must involve women and the empowerment of women and girls. Finally, as research, evaluation and public health programs indicate that workable solutions are available and can be successfully implemented on a large scale, this information must be communicated effectively across the global stove and fuel community. These solutions must also be integrated into other successful programmatic interventions dealing with WASH, nutrition and other poverty-related health risks to provide the best chance for future investments and future policies to reduce global poverty and increase global quality of life.

II. Priorities and Activities

Priority 1: Short- to Medium-Term Health Research (<10 years)

Title: Short- To Medium-Term Health Research (<10 Years)	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* Very high
Narrative description: The process for identifying this Priority Area ('Short to medium term health research') from the work of the May 2011 NIH meeting is described in detail in the main narrative, together with how these research activities relate (and inter-relate) with the other two research-based topics: 'Program Evaluation' and 'Longer-Term Research Studies'. Multidisciplinary groups identified and prioritised specific research activities at the workshop. These have been further prioritised during preparation of this report. All of the topics reviewed at the NIH meeting are deemed important, although for differing reasons. An overview of priorities for each topic is provided in the 'Activities' section of the template, with a brief rationale of why these issues are important to the goals of the Alliance, duration of the work, and approximate costs. Actual costs for research are very difficult to estimate without moving to a more detailed planning stage, and therefore these estimates are very general in nature. All of these priorities are described in more detail for each topic in Annex 1.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: This Priority Area is ranked as having very high transformational potential, for two key reasons. First, evidence of substantial impact on many of these outcomes either in terms of risk (from observational studies) and/or as a result of reducing HAP exposure (in intervention trials) will remove much of the uncertainty about the ability to prevent a set of conditions with high disease burden, including during the most critical periods for child survival and development, and for several of the most important NCDs. The value of this research in terms of maintaining the attention of governments, donors, the research community, and society will be high. Second, high-quality, well-resourced studies will provide much needed information about the exposure-response relationships for a range of high priority health outcomes, with critical implications for the whole Alliance strategy with respect to the technologies promoted, performance standards, and what health benefits can be expected given the time frame, resources and policies, etc., required to achieve the necessary exposure levels.	
Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries)	

Timeline: Up to 10 years
Geography: Global – it is important that the work described is carried out in multiple settings, across all of the regions of the world where HAP and other risks associated with traditional household energy use (e.g. burns, injuries & violence in fuel collection, etc) are common.

- Cost (1 = most costly, 5 = least costly): 1 (high but value for money)
- Timeline (1 = long-time, 5 = immediate): 3 (start immediate, will take mostly 3-10 years for results)
- Funding Potential (1 = low likelihood, 5 = high likelihood): 5 (many of these outcomes should attract funding rapidly)
- Success (1 = low, 5 = high): 5
- Breadth (1 = just one Working Group, 5 = many Working Groups): 5 (wide range of issues covered)
- Added Value (1 =modest , 5 = extremely high): 5

Activity to Deliver Priority	*Estimated Duration*	*Rationale*
1. Short to medium-term health research for MATERNAL, NEONATAL AND CHILD HEALTH. Studies to establish risk associated with exposure, the impact of interventions, and where feasible, exposure-response relationships. A mix of observational (case-control and cohort) and intervention (randomised trial) study designs would be used.	Up to 10 years; most outcomes can be investigated in studies of relatively short duration, e.g. 2-3 years, up to 5 years with longer follow-up of young children	The main outcomes identified for these studies were: 1. Fetal growth restriction and pre-term birth 2. Stillbirth 3. Neonatal deaths (early and late) 4. Neonatal sepsis and pneumonia 5. Maternal pregnancy complications (haemorrhage sepsis, hypertension/pre-eclampsia) 6. Early pregnancy failure 7. Brain injury (leading to impaired cognitive development) 8. Breastfeeding and nutrition (impaired and or contaminated milk) Rationale: these outcomes have weak direct and/or indirect evidence that needs strengthening; most are major contributors to disease burden; all have very important consequences for maternal and child health; outcomes can be studied over

Wherever possible, studies will investigate multiple outcomes, through pregnancy into early childhood.		a relatively short time-scale as these relate to pregnancy and the neonatal period (4 weeks from birth). Follow up to at least 2 years of age will bring further valuable evidence.
2. Short to medium-term health research for INFECTIONS	Up to 10 years, from immediate	1. Childhood pneumonia accounts for 50% of known HAP related deaths 2. Adult pneumonia risks unknown, but tobacco and other exposure risks supportive 3. TB a probable risk from HAP, may represent major under-recognized factor with or without HIV 4. HIV: risk of opportunistic infections from smoke. HAP not yet studied. 5. Vaginal infections: inadequate data but suggestive from other exposures 6. Otitis Media: suggestive from OM studies from HAP but inadequate data Rationale: There is abundant evidence that environmental exposures such as tobacco smoke and other toxic inhalants can predispose to infections, especially in the respiratory system. Several studies have shown an association between HAP and risk for acute pneumonia and death in children under age five. As acute pneumonia accounts for almost half (900,000) of the estimated deaths every year from HAP, it is critically important to reduce pneumonia and death in children. Preliminary results from the RESPIRE study in Guatemala suggest that a reduction in HAP by use of an improved stove can significantly reduce acute pneumonia and death in children under 5. However, further studies are necessary to confirm these results and to determine what level of reduction in HAP is necessary to reduce the risk of pneumonia and other infections.
3. Short to medium-term health research for CHRONIC RESPIRATORY DISEASE	Up to 10 years, from immediate	1. Current estimate of COPD mortality in non-smokers is 700,000-900,000 deaths per year from HAP, mostly in women 2. Treatment of COPD from HAP is a major knowledge gap 3. 300 million people suffer from asthma worldwide and 250,000 die annually.

		Role of HAP uncertain Rationale: Long term exposure to HAP is associated with development of COPD in non-smoking women. As COPD develops over decades of exposure, it is necessary to determine if an intervention with improved cookstove or fuels can reduce exacerbations or progression. Additional long-term cohort studies may indicate whether improved cookstoves or fuels reduce prevalence of COPD. Asthma, a common childhood disease that often extends into adulthood, is associated with maternal smoking or exposure to second hand smoke during childhood. Relationship to HAP is uncertain but deserves further study as the prevalence is increasing in developing countries without a clear explanation.
4. Short to medium-term health research for CANCER. Given long latency, use of case-control designs for suggested for short-term research and cohort for medium term.	Variable from 3-4 years for case-control to 10 years for cohort	1. Coal exposure and cancers other than lung, in China 2. Cancer risk from biomass exposure 3. Investigation of whether there are susceptible genotypes that modify risk of cancer Rationale: Coal is a Group 1 carcinogen, but it is not known if household exposure causes cancers other than lung. Biomass is a Group 2A, carcinogen and risk needs to be better defined, given that exposure is so widespread (noted that review in process for the GBD/CRA project update, but further studies will be needed). No evidence available yet on susceptible genotypes, although tobacco research supports this.
5. Short to medium-term health research for CARDIOVASCULAR DISEASE.	Start immediately with durations from 2-3 to 10 years	1. Surveillance studies (e.g. interrupted time-series) of hard CV end points and surrogates (e.g. blood pressure) 2. RCTs of surrogates (e.g. BP) and if possible hard CV end points 3. Studies of exposure level and CV risk and outcomes in cohort studies 4. Impact of exposure on clinical outcomes including CVD death, using case-control design Rationale: CVD has very large global disease burden. There is a strong evidence base for effects of combustion pollution in developed countries from SHS and

		smoking, but no direct evidence for HAP in developing countries.
6. Short to medium-term health research for BURN INJURIES	Up to 10 years	1. Guidelines and testing 2. Qualitative studies of surveys, focus groups to improve stove design 3. Establish burn registry 4. Global risk assessment by epidemiologic studies Rationale: Burn injuries from cooking fires represent a hazard for both women and children in developing countries. Burns and complicating infections are rarely treated adequately and are associated with excessive morbidity and mortality when severe. It is critical that new cookstoves and fuels are safer and reduce risk of burn injuries.
7. Short to medium-term research for OCULAR HEALTH	Up to 10 years,	1. Cataracts are responsible for 50% of blindness worldwide. HAP is probable cause of a large proportion of cataracts. 2. Trachoma is epidemic in 55 countries and accounts for 7% of blindness. HAP is suggestive risk. 3. Dry Eye & Ocular Surface Disease/RESPIRE shows an 80% decrease with improved cookstoves Rationale: 285 million people worldwide have visual impairment. However, it not known if improved cookstoves or fuels will reduce the prevalence of cataracts or reduce the progression of visual impairment. The relationship of Trachoma to HAP is uncertain but is plausible as a contributory factor. Dry eye & ocular surface disease are extremely prevalent with 20 to 50 % of adults in certain populations. The RESPIRE study showed >80% decrease in eye soreness after the introduction of cleaner cookstoves. These studies need to be replicated and impact on eye disease and blindness verified as HAP is reduced.
8. Short to medium-term health research for	Start immediate, duration 2-3	1. Gender and decision-making, gender roles, cost issues, etc., using descriptive research methods

WOMEN'S EMPOWERMENT	years, and longer	2. Time use studies with new cookstoves, can be included in RCTs and other projects. Rationale: Gender constructs inform household decision-making, which is central to household energy procurement and use. Time-savings seen as important (potential) benefit of improved cookstoves and fuels, but relatively little direct evidence on changes, and how women spend any time saved.
9. Short to medium-term health research for EXPOSURE AND BIOMARKERS	Start immediate, duration from 2-3 years, up to 5-10 years	1. Improve measurement and understanding of intra- and inter-individual exposure, covering key pollutants (PM, BC, CO, PAHs, ultrafines), validating new technologies in field, studies drivers of variability, and developing new modelling approaches. 2. Study mixtures from traditional and improved cookstoves, and toxicity in vitro and in vivo. 3. Improve understanding of existing known biomarkers, and develop/assess new, more informative and source specific biomarkers. Rationale: Existing literature and knowledge is constrained by generally weak exposure measurement and lack of suitably robust methods (including technologies), and lack of information on cost-effective, specific biomarkers of exposure. There are also major gaps in understanding toxicity of pollutant mixtures. This is a critical priority because exposure assessment is central to both health studies and program evaluation.

Priority 2: Program Evaluation

Title: Program Evaluation	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* Very high
Narrative description: This vital and challenging area of work for the Alliance is discussed in more detail in the main narrative. The activities reported here and in the summary tables of Annex 1 were derived from the NIH workshop using the same process as for the shorter and longer-term research priorities. Please refer also to Priority Area 4: Research and Evaluation Development and Support. The main narrative also describes work on developing a strategic, integrated evaluation plan. This plan will be required to carry out more concrete assessment regarding which health outcomes can and should be included in program evaluation, how these evaluation studies relate to research studies in programmatic settings, costs, timeframes, and other such details. Given the many issues to be considered in developing program evaluation priorities at this stage, the activities reported here should be seen as provisional, an initial step contributing to the planning process described in Priority Area 4. One critical aspect of program evaluation is that it must represent the interface between implementers and health investigators such that the research and the implementation are integrated at the beginning. Research results must be communicated quickly back to the stove and fuel industries to ensure continuous quality improvement in stove design and fuel ultimately achieving documented improvement in human health as a result of large scale implementation.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: This Priority Area has very high transformational potential. It is the primary means of demonstrating whether intervention programs in routine use and at scale are saving lives and preventing ill-health, and to what extent. Research studies (especially RCTs) will contribute vital information as well, but these by their very nature will tend to be in more scientifically 'controlled' situations and therefore less reliable indicators of the impacts in everyday use, adopted at scale through sustainable mechanisms.	
Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries) Timeline: 9 years (to 2020) and beyond	

Geography: Global – Program evaluation health impact must be carried out in multiple settings, in all regions where HAP and other risks associated with traditional household energy use (e.g. burns, injuries & violence in fuel collection, etc.) are common.

- *Cost (1 = most costly, 5 = least costly): 3*
- *Timeline (1 = long-time, 5 = immediate):3*
- *Funding Potential (1 = low likelihood, 5 = high likelihood):3*
- *Success(1 = low, 5 = high):4*
- *Breadth (1 = just one Working Group, 5 = many Working Groups):5*
- *Added Value (1 =modest , 5 = extremely high):5*

Activity to Deliver Priority	*Estimated Duration of the Project*	*Rationale*
1. Program evaluation for MATERNAL, NEONATAL AND CHILD HEALTH	Several years will be required to establish suitable settings, methods, and capacity. Variable evaluation period, may be long term Goal is to have results on lives saved by 2020	The following outcomes are recommended for inclusion in selected program evaluation studies: 1. Stillbirths 2. Neonatal deaths (early and late) 3. Neonatal sepsis and pneumonia 4. Birth weight and prematurity Rationale: Stillbirths and neonatal deaths are unambiguous outcomes, and will contribute to demonstrating lives saved (although recognized these may be difficult to assess). Of conditions included in this group, neonatal sepsis/pneumonia has the highest risk of death, and represents a high disease burden. Birth weight (fetal growth restriction) and prematurity may also be included where data collection/surveillance is feasible. These outcomes are very important for child survival and longer-term health and developmental outcomes.

2. Program evaluation for INFECTIONS	2-5 years	Malaria and other vector-borne diseases have potentially increased risk with reduced HAP from new stoves or fuels Rationale: Concerns exist that a reduction in HAP with its reduction in smoke will permit more mosquito bites and place families at higher risk for vector-borne diseases.
3. Program evaluation for CHRONIC RESPIRATORY ILLNESS	2-5 years 0-5 years	Assessment of COPD outcomes from time of onset to include exacerbations, progression, symptoms, quality of life and mortality. Integrate tobacco control with HAP Rationale: Current estimate of COPD mortality in non-smokers is 700,000-900,000 deaths per year from HAP, mostly in women. Integration of tobacco control with HAP control might have highest chance to success. Large numbers needed to conduct above studies and if sufficient may reflect impact of HAP intervention over years.
4. Program evaluation for CANCER	Up to 5 years	1. Economic analysis and time-series of existing data 2. Development of risk prediction models of exposure to solid fuel HAP and other cancer risk factors Rationale: Proposed studies require large numbers with variable exposure levels to assess risk and economic analyses across populations.
5. Program evaluation for CARDIOVASCULAR DISEASE		None specified by CVD topic group
6. Program evaluation for BURNS INJURIES	3-5 years 5-10 years	1. Determine burn injury risk factors and rates 2. Establish surveillance, data systems and local capacity

		Rationale: Risk assessment for burn injuries and the type of injuries requires large numbers and in variable conditions. These data could be obtained through prospective data collection or if to assess specific interventions by nested RCTs.
7. Program evaluation for OCULAR HEALTH		None specified by Ocular health topic group
8. Program evaluation for WOMEN'S EMPOWERMENT	Variable	Extent of gender based violence during fuel collection (rape and assault) Rationale: Mainly anecdotal information indicates this is a serious and common problem, and it is important to document frequency and associated factors.
9. Program evaluation for EXPOSURE AND BIOMARKERS		All major implementation programs should include exposure assessment and use of appropriate biomarkers if possible. These indicators are critical for program evaluation and feedback for ongoing technological improvement. This is assumed for the above health outcome studies. The projected costs are embedded in program evaluations above.

Priority 3: Longer Term Research/Cohort Studies (>10 Years)

Title: Longer Term Research/Cohort Studies (>10 Years)	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:*
Narrative description: As with Priority Areas 1 and 2, this area was identified through an analysis of the NIH workshop recommendations. Given that there is direct and indirect evidence of links between HAP exposure, (especially during pregnancy/development and early childhood), later childhood disease, and adult NCDs, this area is considered a very important opportunity that should not be missed. Building HAP assessment (and additional outcome measurement if needed) into existing long-term cohort studies provides a potentially highly cost-efficient opportunity. In addition, new cohorts can be established, developing from short to medium term research studies (cohort studies, RCTs) which may also be built around large scale implementation programs. Such new cohort studies can be seen as "stove observatories", providing wide-ranging opportunities to study the impacts of improved cookstoves and cleaner fuels on health and many other aspects of people's lives, socio-economic conditions, climate, etc. Given that these long-term studies will extend over 30 or more years, it is important that these be established as soon as practical.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: This priority is ranked high in transformational potential because, despite the long timeline (at least 10 years), the impact of these studies – if positive – would be far-reaching and radical. The issues under study are the extent to which exposure to HAP in pregnancy and early childhood (and also at later stages in life, depending on the age of enrolment into the studies) leads to a wide range of health and developmental outcomes which are among the most important issues over the life course, namely growth, cognitive development, chronic diseases of childhood such as asthma, and the main chronic non-communicable diseases of adulthood (CVD, cancer, COPD, etc). Such studies will allow investigation of the effects of early life exposure, and the interactions with subsequent childhood and adult environmental, social/economic, lifestyle and other factors. These studies will also permit the investigation of important, newly emerging epigenetic mechanisms through which environmental exposures such as HAP may impact health throughout life.	
Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries)	

Timeline: Starting as soon as practical, the duration of these studies will be in excess of 10 years, extending to 30 or more years.

Geography: To obtain results with wide relevance, the studies should be established in all regions with high levels of HAP. Given the investment of research infrastructure and long-term commitment, it is not expected that more than 1 or 2 at most per region would be continued for as much as 30 (or more) years, although a larger number of intermediate duration studies may be developed.

- *Cost (1 = most costly, 5 = least costly):* 1
- *Timeline (1 = long-time, 5 = immediate):* 1
- *Funding Potential (1 = low likelihood, 5 = high likelihood):* 3-5 depending on outcomes being proposed
- *Success (1 = low, 5 = high):* 3-5, as some risks involved in maintaining such long-term studies
- *Breadth (1 = just one Working Group, 5 = many Working Groups):* 5 as have potential for very wide-ranging scope
- *Added Value (1 =modest , 5 = extremely high):* 5 potentially, especially given the growing focus on NCDs, etc., but this may require skilful conveying of the value of these long- term investments

Activity to Deliver Priority	*Estimated Duration*	*Outcomes and Rationale*
1. Longer term research for MATERNAL, NEONATAL AND CHILD HEALTH.	5-30+ years	Outcomes to be included in longer-term studies: Health and disease outcomes potentially linked to exposure during pregnancy and early childhood, including asthma, growth and obesity, IHD, COPD, cancer, cognitive development; educational and employment attainment, fertility, etc Rationale: There is a strong case for high HAP exposures during pregnancy and in early childhood to have long-term impacts, but no direct evidence is available. Given the importance of later childhood and adult NCD outcomes, early establishment of long-term cohort studies would be very valuable.
2. Longer term research for INFECTIONS	5-20 years	To determine the long-term impact on HIV infection and CV diseases, etc. Complications associated with HIV medications.

		Rationale: Complications of chronic diseases such as HIV and CV in the presence of environmental risks such as HAP with or without an intervention require large numbers and variable exposure levels to assess risk and benefits from interventions.
3. Longer term research for CHRONIC RESPIRATORY ILLNESS	5-20 years	Asthma prevalence and impact of HAP. Rationale: The impact of reducing HAP on asthma is difficult to predict. Prevalence appears to be increasing globally. Long term cohorts would permit population-based studies from in utero through lifespan. Birth cohort studies with follow up over many years would address major issues.
4. Longer term research for CANCER	20+ years	Impact of HAP exposure on cancer outcomes, including bio-specimens at multiple time points, and genotyping. Rationale: As for studying effects of exposure during development, and can link these efforts depending on ages when subjects enter cohorts.
5. Longer term research for CARDIOVASCULAR DISEASE	Establish as soon as practical, 10-20 years	Association between HAP exposure and CVD morbidity and mortality, including exposure-response relationships. Rationale: As for studying effects of exposure during development, and can link these efforts depending on ages when subjects enter cohorts.
6. Longer term research BURN INJURIES		No specific activities provided by group.
7. Longer term research for OCULAR HEALTH	5-20 years	39 million people worldwide are blind. Two-thirds are women, 87% of whom live in developing countries Rationale:

		Long term studies required to investigate impact of reduced HAP on chronic eye conditions.
8. Longer term research for WOMEN'S EMPOWERMENT	Include as soon as practical	Studies of gender-based violence can be included in longer-term studies established for other purposes.
9. Longer term research for EXPOSURE AND BIOMARKERS	As soon as cohort studies established	No specific activities recommended. Exposure measures and biomarkers are essential to all longer-term studies proposed in this section.

Priority 4: Research and Evaluation Development & Support

Title: Research and Evaluation Development & Support	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* High, and necessary to ensure the transformational potential of other priorities.
Narrative description: The research and evaluation activities described in this report have two overriding features: they are (i) complex and multi-faceted, and (ii) highly interrelated. These qualities argue for structuring a set of activities that will ensure coherence, efficiency and quality in conducting the research studies and program evaluation, and comparability so that the results from different settings and regions can be compared and combined (e.g. in meta-analyses). These activities will also ensure that current and emerging evidence and experience are quickly and effectively synthesized and communicated to the varied audiences that need and can benefit from this information.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: The high value of this priority derives from its position as a necessary and complementary component of the research, evaluation and public health agenda. Without these activities, the transformation potential of these core areas would be severely limited. These activities relate to all three research and evaluation priority areas, and to the public health priorities. For this reason, they are presented as a separate, integrated set (in this Priority Area) rather than distributed across the other priority areas with inevitable overlap, repetition and loss of coherence. As the activities in this priority are needed for other work to be effective and efficient, they should therefore be started as soon as possible. In the interest of timeliness and relative low cost, the Alliance may wish to consider this a core activity for direct funding and implementation.	
Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries) Timeline: Some form of these activities will be required throughout the Alliance's work plan, hence at least until 2020. Two phases are envisioned: Phase I: Years 1 and 2 - Development and initial implementation of activities Phase II: Years 3 and onwards - Ongoing application to research, evaluation and communication needs, with regular review to assess revisions and other needs.	

Geography: Global, with Phase I development, initial testing and application in selected countries.

- *Cost (1 = most costly, 5 = least costly): 4*
- *Timeline (1 = long-time, 5 = immediate): 5 (starting immediately, but ongoing - see timeline)*
- *Funding Potential (1 = low likelihood, 5 = high likelihood): 4*
- *Success(1 = low, 5 = high): 5 (there should be no barriers, in principle, to carrying out these activities)*
- *Breadth (1 = just one Working Group, 5 = many Working Groups): 5 (this is a requirement)*
- *Added Value (1 =modest , 5 = extremely high): 5*

Activity to Deliver Priority	*Estimated Duration*	*Rationale*
1. Build an inventory of current and 'in development' surveillance and research operations and intervention programs that provide opportunities for research and evaluation. Conduct a suitability assessment of these sites, including the appropriate research questions for each one.	Phase I: years 1-2, develop and implement Phase II: assess need for ongoing function	Considerable efficiencies in terms of time and financial resources can be realized if HHE priorities are added into existing research and program infrastructures. This requires that the projects are inventoried; the necessary conditions can be met; sufficient funding is made available for the new component (e.g. exposure assessment); and acceptable collaborative arrangements are made (suitability assessment).
2. Based on the inventory and other new research activities, build and maintain a professional network for health research and evaluation.	Phase I: Years 1-2, develop and implement, initial meeting Phase II: maintain	Many of the activities described in this report, beginning with the Health WG, reach out to a growing community of research and evaluation work. Building an active network will facilitate two-way communication on all aspects of the work. Communication channels include email, online meetings and web platforms. The value of annual meetings should be assessed.

3. Develop a strategic, phased plan for program evaluation which integrates health outcome assessment.	Phase I: Years 1-2, develop Phase II: Review and assess needs for further development	The rationale for developing a program evaluation plan is described further in the main narrative. This plan will help to achieve efficiency, coherence with respect to settings and timing for health outcomes, and coordination of the many different components included in program evaluation. In addition, there are clearly challenges in terms of study design and evaluation methods, which need to be addressed. This effort will require professional time, wide consultation, and one or more workshops and other meetings.
4. Develop harmonized methods and study designs for research and evaluation.	Phase I: Years 1-2, develop Phase II: Maintain	This activity is needed to ensure that the study designs and methods used for research and evaluation are of the highest quality, employ the most efficient new techniques and technology (subject to costs), and that methods are sufficiently comparable to allow comparison across settings. A technical and management group should be convened, and the activity delivered through a set of workshops, with consensus reports available through the information portal (#5).
5. Create an information portal to synthesize and communicate current and new scientific evidence and field experience to a range of audiences (research, government, donor, NGO, etc). May include development of a new internet platform.	Phase I: Years 1-2, develop process; conduct initial reviews and develop products Phase II: Maintain	It is vital that current and new evidence from research and program evaluation be brought together, reviewed appropriately, synthesised and communicated in a timely way through an easily accessible internet portal. This will require professional time for review and synthesis, resources for products, web development and maintenance.

Priority 5: Global Health Community vigorously supports clean, safe cookstoves as a health priority

Title: Global Health Community Commitment is Vital to Reaching 100 Million Cookstoves by 2020	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* High

Narrative description:

Saving lives and improving health is central to the mission of the Alliance. Yet the global health community—composed of health professionals, civil society, health systems, donors, etc.—still does not recognize the real dangers posed by household air pollution or fully appreciate the role cleaner household energy can play in protecting health. It is vital that the Alliance actively and directly engage health advocates in understanding and promoting a shared agenda, one that supports an integrated, global approach to planning, implementing, and measuring the health impacts of improved cookstoves and fuels. With the full commitment of public health professionals, researchers and civil society, the possibility of 100 million households adopting clean, safe cookstoves by 2020 will be significantly increased.

Global health commitment to achieving the 100 by '20 goal of the Alliance is critical to achieving transformational change. UN agency adoption of a comprehensive, global plan for cookstove dissemination positions cleaner, safer cookstoves as a critical solution to premature illness and death. Countries look to the WHO and other UN agencies to provide leadership on public health matters and to facilitate cooperation and joint action. The influence of UN agencies and the WHO extends through a global network of partners, including country governments, international organizations, donors and civil society. The WHO is widely respected for delivering authoritative health information, setting health standards through its 'normative function' (i.e. air quality guidelines) and shaping the research agenda. Cookstove standards developed with guidance from the WHO will have broad acceptance among countries and scientists. A unified, supportive stance by UN organizations for a global cookstove agenda will also convey conviction and underscore the need for immediate action.

Rationale for selection and ranking based purely on 'transformational potential' criterion:

"To save lives, improve livelihoods, empower women, and combat climate change by creating a thriving global market for clean and efficient household cooking solutions" - Alliance Mission Statement

Until significant health protection and improvement is demonstrated through the successful introduction of clean, safe and efficient cookstoves and fuels, the transformational potential of the Alliance will depend largely on cookstoves' impact on economic

development and climate. This result would challenge a central tenet of the Alliance, that of saving lives and improving health. It is vital that the global health community vigorously support clean, efficient and safe cookstoves, and promote adoption of cleaner cooking options as a public health priority, especially in the developing world.

An engaged and committed public health community would demand attention to reduce HAP and the number of women and children who are sickened or die as a result of smoke from cooking fires. They would argue passionately for funding for programs and research, insist on the need for action from public health leaders, NGOs, and political leaders, and work to expand the evidence base for cookstoves. A committed health community would also devote itself to building health system capacity, developing educational tools and resources, support for effective planning, delivery and evaluation.

The transformational potential of this priority lies in the Alliance's capacity to engage a wide variety of partners in pursuit of a common goal. Among UN agencies, the WHO routinely enlists the aid and support of governments and non-governmental agencies around the world to protect health and well-being. Its extensive network of relationships with health professionals enables WHO to maximize scientific expertise through air quality guidelines for the development of global cookstove standards. UN agency direction creates a way for organizations and individuals to contribute to broad adoption of safer cooking methods. Through commitment to a comprehensive agenda for cookstove implementation, partners will better understand the potential of clean, safe cookstoves and become invested in their adoption as a critical solution.

Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries)

Estimated Financial Commitment, Years 2 to 5 = $500,000 USD/year
This financial commitment can be used as a base to leverage significant partner support.

Total 5-Year Financial Commitment = $3 million USD

- *Cost (1 = most costly, 5 = least costly): 4*
- *Timeline (1 = long-time, 5 = immediate): 5*
- *Funding Potential (1 = low likelihood, 5 = high likelihood): 4*
- *Success(1 = low, 5 = high): 5*
- *Breadth (1 = just one Working Group, 5 = many Working Groups): 3*

- *Added Value (1 =modest , 5 = extremely high): 5*

Activity to Deliver Priority	*Sub-Step (if required)*	*Estimated Duration of the Project*	*Rationale*
Develop clear and definitive statements of the health evidence supporting global action. Develop policy statements for use in engaging global health and professional organizations. Include targeted advocacy from respected authorities to leaders in environment, development and related fields. Develop tools and resources to build program implementer knowledge. Identify partners from among researchers, scientists and program implementers to champion this agenda.		6-9 months	Proponents of cleaner stoves need clear, persuasive and factual arguments to make a compelling case for cleaner fuels and stoves. Evidence of cookstoves' impacts on health and estimates of the cost of inaction are important elements of this argument. Developing well-researched and motivating presentations will require the engagement of cookstove, health communication and regional experts to develop and test messages, prepare written materials, draft policy statements and to obtain critical review.
Identify and actively engage key global partners in supporting the Alliance's health agenda.		Year 1	Engage health organizations at global, regional and country levels as active supporters of clean cookstoves and the Alliance, in developed and developing countries, to include: 1. Medical and public health professional societies (e.g. the Global Alliance for Chronic Diseases); 2. Health and development organizations (e.g. DFID, GIZ, USAID, Peace Corps, AMREF, etc); 3. UN organizations (e.g. UNDP, UNICEF, UNHCR); 4. Non-Governmental Organizations (e.g. CARE, World Vision, Mercy Corps, national NGOs); and 5. Emergency aid organizations (e.g. Oxfam, MSF, WFP).

Develop and implement a health communication strategy to raise the visibility and importance of cookstoves among global partners.		Years 1 & 2	A comprehensive health communication strategy will use a variety of channels to reach public health and development audiences, including: 1. Webinars and briefings to build awareness among organization leadership and inspire involvement; 2. Presentations on the state of the science, recent research and online education; 3. Panel discussions, round tables and presentation of related research at annual meetings; 4. Press releases publicizing new research; 5. Photo journalism illustrating the consequences of inaction and benefits of change; 6. Media education and outreach to inform and interest the media in household air pollution and cookstoves; and 7. A Speakers Bureau to present at relevant public health, medicine, science and environmental forums, publications and events for cookstove promotion.
Include *access to clean, efficient household energy* in policies for child survival, priority health guidance, NCD and other related policies.	For LiST, require to complete review and have HAP accepted then pilot tested	Process already initiated; Develop and test over first 24 months	Complete review work, develop guidance, include in specific tools (such as LiST) and test in several countries.
Develop an integrated strategy across UN Agencies and convene all parties to commit to a comprehensive agenda for clean and safe cookstove		1 year	A comprehensive strategy with commitment from UN Agencies and WHO would significantly advance implementation efforts.

implementation.			
Develop global health standards for clean, safe cookstoves and promote their adoption.		18 months	Shared health standards are essential to the success of all sectors of the Alliance. Stove standards should closely align with WHO indoor air quality guidelines which are under development (for 2012).
Integrate all sectors of the Alliance with relevant UN partners to support a harmonized global health action plan for clean, efficient, and safe cookstoves.		Years 2-5	Ongoing commitment to harmonizing evaluation across UN partners will strengthen the Alliance's ability to demonstrate its success.

Priority 6: Government institutions advance adoption of clean, safe cookstoves

Title: Ministries of Health advance cleaner cookstoves and fuels through public health programs	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* High
Narrative description: A number of countries have recently implemented national cookstove programs, with mixed results. Several others are engaged in planning their own national programs. As governments commit to implementing cookstove programs, it is imperative that Ministries of Health (MOH), public health agencies and Non-Governmental Organizations be involved. Government participation should focus on five core public health functions: 1) surveillance of community health; 2) policy development; 3) program planning and implementation; 4) community education and mobilization, and 5) program monitoring and evaluation. Public health can be a catalyst for transition from traditional three-stone fires to cleaner alternatives. Broad adoption of improved cookstoves depends on MOH integrating cookstoves into ongoing public health functions, building evidence-based programs and learning from others' experiences. Integration of cookstove programs with water and sanitation programs has shown promise, as have linkages with maternal and child health programs. Surveillance activities allow MOH to better characterize the extent of household air pollution, estimate the numbers affected and establish a baseline against which to measure changes—all critical starting points for clean energy initiatives. Once cookstove programs are in place, health agencies can conduct periodic evaluations to assess progress on saving lives and improving health. Through monitoring community health and evaluating program effectiveness, public health programs can gather essential data to inform policy development and other decision-making. Government health ministries do not work alone. Civil society groups, community organizations and development agencies all respond to government leadership and are essential partners in program delivery. These partners often augment the information and education function of government. Their participation is critical for mobilizing communities around health issues such as the need for clean cooking solutions.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: Directly engaging MOH in cookstove programs can produce transformational change. National authority for protecting and improving health rests primarily with public health institutions. MOH oversee surveillance, policy development, information and	

service delivery—all core public health functions. Each of these aspects is highly relevant to coordinated country implementation of effective cookstove programs. Strengthening ministry of health capacity to perform any of these core public health functions will benefit cookstove programs enormously.

Early engagement of MOH is a critical link to key stakeholders inside and outside government. Within government, the ministry connects directly to clinical caregivers through hospitals and clinics. Public health professionals also respond to MOH priorities through disease surveillance and research, monitoring and evaluation. Public health is also responsible for collecting and analysing data to inform decision making. Harmonizing data collection and analysis across countries will allow national programs to compare reductions in mortality and morbidity. Countries vary in their capacity to fulfil each of these functions with respect to cleaner cookstoves and fuels. The WHO and CDC will work with MOH to accomplish these tasks. Support to build ministry commitment and capacity will result in greater public health engagement and capacity for clean, efficient, and safe cookstoves at the national level.

Outside government a vast network of community-based organizations, non-governmental organizations and donor agencies are already devoted to health-related issues, many of which share common ground with cookstoves. They provide an even wider network for cookstove promotion and dissemination. To be successful, multiple sectors of the health system and civil society must actively promote clean and safe cookstoves. With the strong support of government, public health workers, health care providers and civil society, significant protection and improvement in the health of vulnerable populations will be possible.

- *Cost (1 = most costly, 5 = least costly): 2*
- *Timeline (1 = long-time, 5 = immediate): 5*
- *Funding Potential (1 = low likelihood, 5 = high likelihood): 3*
- *Success(1 = low, 5 = high): 5*
- *Breadth (1 = just one Working Group, 5 = many Working Groups): 4*
- *Added Value (1 =modest , 5 = extremely high): 4*

Activity to Deliver Priority	*Estimated Duration of the Project*	*Rationale*
Investigate and map the current status	3 months	Identify priority countries for engagement.

of national cookstove planning and the role of MOH.		
Convene global health experts to define key components of a model health policy.	6 months	These guidelines would also provide a framework for engaging MOH.
Develop a toolkit to support Ministries of Health in plan and execute clean cookstove programs. Focusing on the core functions of public health.	1 year	Critical to the success of MOH and to ensuring program effectiveness.
Develop a strategy and tool kit for evaluation of national public health efforts that support cookstove implementation.	1 year	Structured evaluation with a focus on health monitoring is critical to measuring programmatic impact on health.
Create a network and web portal to share best practices, harmonize evaluation, leverage network support high priority country programs (see Priority Area 4).	Years 2 to 10	A global network would leverage the leadership and expertise to support countries that plan to implement cookstove programs and provide best practices.

Priority 7: Designing Health into Innovative Technology

Title: Improving Health and Safety through Innovative Technology	*Rank (versus other main priorities) based purely on 'transformational potential' criterion:* High
Narrative description: The standards for cookstove emissions are rapidly evolving. The most recent scientific evidence suggests that acceptable stove emissions need to be at extremely low levels, although this is a work in progress (see Short to medium term research – Priority Area 1). Precise stove design and manufacturing are required to attain optimum combustion and minimize toxic exposures. Determining the effects of cookstoves on health has become crucially important. Exposure assessments have therefore become much more rigorous. Development of appropriate, unobtrusive, and affordable testing equipment lags behind current needs. Most technology for emissions testing is one-of-a-kind, adapted from other uses. As demand for safe cookstoves grows, so will the need for precision engineering of both cookstoves and assessment equipment. The cost of both is tightly constrained by consumer ability to pay. Innovative technical solutions are needed to produce low-cost cookstoves and to ensure that they deliver in terms of safety and efficiency.	
Rationale for selection and ranking based purely on 'transformational potential' criterion: Innovative solutions to stove design and manufacturing that also deliver on health and safety are vital to the success of the Alliance. Stove designs have evolved in response to changing demand, initially responding to the need to conserve biomass and other solid fuels and later to minimize toxic emissions and safeguard health. Design and production of very low-cost, very clean-burning cookstoves depends on continued innovation and discovery, never losing sight of health priorities. Achieving significant health impacts from clean cookstoves will be realized only if many millions of households can adopt inexpensive, clean-burning cookstoves. Resources are needed to encourage and support investigation and testing. Research and development is an exploratory process, with uncertain outcomes, failures as well as successes. External support will make it possible for laboratories, universities and researchers to continue to investigate experiment and ultimately find solutions.	
Timeline (short-term: 1-2 years; medium-term: 3-5 years; long-term: 6-10 years) – and geography (global or specific countries) The Alliance should plan and invest in an innovative technology fund to promote the research and development of new cookstoves, fuels, emissions and exposure testing devices, and other testing technologies. This $5 million innovation fund will be continually	

replenished to support new and innovative technology. All sectors of the Alliance would benefit.

- *Cost (1 = most costly, 5 = least costly): 3*
- *Timeline (1 = long-time, 5 = immediate): 5*
- *Funding Potential (1 = low likelihood, 5 = high likelihood): 3*
- *Success(1 = low, 5 = high): 5*
- *Breadth (1 = just one Working Group, 5 = many Working Groups): 5*
- *Added Value (1 =modest , 5 = extremely high): 5*

Activity to Deliver Priority	*Estimated Duration of the Project*	*Rationale*
Assess critical areas of cookstoves in need of innovative technology. Establish an innovation fund. Develop a competitive process for accessing these funds. Create an outside board to oversee its use.	1 year	The first step in establishing a substantive program that supports innovative new technologies.
Establish an Innovation Fund and Innovative Technology Program.	10 years	Promoting and supporting innovations in technology could provide the catalysts for transformation.

Health Working Group Early Action Recommendations

Early Action	Rationale	Expected Cost	Expected Timeframe	Priority
Transparent Funding Process **Establish an objective review process that will assist the Alliance in determining important, high-quality proposals to fund.**	Establishing an objective process with support from outside experts is essential to building a credible foundation for conducting health research by the Alliance. Development of a streamlined and efficient process for review of health projects will provide a platform for management of future health research. The process should: 1. Identify outside experts willing to conduct reviews. 2. Define an efficient electronic management system for reviewing proposals. 3. Ensure a transparent decision making process with procedures to address conflict of interest. 4. Provide expert	Provide funding for an initial request for applications of $125,000 for up to 3 proposals; includes development of written policies for the peer-review process (up to $25,000 to establish system).	Immediate and use this process to fund early actions.	Timing: There is a broad consensus that a process to avoid conflict of interest is vital, and must be instituted at the beginning. This applies not only to the health sector. The Alliance should consider implementing this approach across all sectors. Leverage: Moderate to high. Demonstrates to donors and the research community that sound peer-review is in place, instilling confidence and avoiding divisiveness that would rapidly become a serious barrier to collaboration. Transformative: This early action process provides the foundation for a system for the Alliance as a whole, and includes a development and assessment phase.

	guidance to the Alliance on the quality and management of proposed projects.			
Communication & Media **Develop a health communications package bringing together key evidence on health risks and observed impacts of interventions, and relating them to the MDGs.** **Tailor one package for scientific audiences and another to public health professionals.**	The topics of health risk and impact are a primary driver of the Alliance's work. It is vital to effectively communicate the health burden and the health strategy to address this burden.	Estimated $100,000.	Final product ready for publication by December 2011.	Timing: There is consensus that communication in this sector is needed early on. Leverage: Leveraging potential (e.g. with funders, etc) could be considerable. Transformative: Steadily increasing awareness among researchers and other public health professionals could influence their attitudes in a positive direction.
Influencing Key Stakeholders **Engage with established funders of research particularly in high burden areas, e.g. Welcome Trust and Gates Foundation.**	Set up meetings with key funders to understand their perspectives and address their concerns. Develop clear meeting objectives and outcomes.	Estimated up to $100,000.	Timeframe: Immediate start, report in 6 months.	Timing: There is a strong case for starting this process as soon as possible. The Priorities Roadmap and communications QW will be timely and supportive. Leverage: Moderate to high. Longer-term potential to achieve important funding re-allocation. Transformative: Moderate. Could begin influencing attitudes and priorities if all evidence is marshalled.

Health Evaluation **Identify immediate opportunities to invest in current health research that would potentially provide substantial new knowledge, e.g. invest in Indoor Air Pollution/Exposure of PERCH Study.**	Health research can be complex and expensive. Identifying current research with potential for leveraging resources may provide the Alliance valuable information at a fraction of the cost. PERCH Study provides an early opportunity to study impacts of indoor air pollution on severe pneumonia in the context of vaccine studies.	Set a target of $1 million. PERCH estimate is $300,000.		Timing: Planning urgently needed to meet pilot work schedule. Studies to be completed within 2 years. PERCH studies will start piloting early/mid 2011. Leverage: High, the 7 multi-country studies are already funded (Gates Foundation, etc.). Transformative: High, providing evidence on severe pneumonia relatively quickly, high quality studies; links in with vaccine effects and community.
New Investigators and Capacity Building. **Find new Investigators and create a network of health professionals working on cookstoves in sub-Saharan Africa.**	A fellowship program is needed to support promising young investigators from developing countries on indoor air pollution studies. Develop clear objectives, training plans, practical work and supervision. Link these activities to the Alliance and its Working Groups.	Cost: Pilot project development and implementation $150,000.		Timing: Efforts to develop capacity in research, evaluation and policy development should be started as soon as possible. Leverage: Moderate initially, but high over the longer term. Transformative: Moderate initially, but high in longer term.
Direct Policy Support Tools **World Health Organization Indoor Air Quality Guidelines: Household Fuel Combustion.**	This product will serve as valuable tool for effective policy development and implementation.	Cost: Approx $110,000 for completion of Phase I: guideline review, development and publication.	Timeframe**:** Possible wider consultation during 2011; GDG meeting (India) early 2012; publication by Oct/Nov 2012, Year 1 of	Timing: Work already started with completion expected late 2012. Some funding still required to complete, and also to evaluate implementation.

		$100,000-150,000 for Phase II, including an initial 12-month evaluation with countries.	evaluation during 2013.	Leverage: High, principally through establishing need and strategies for intervention policy, and mobilizing resources of international development and countries. Transformative: High: evidence review and synthesis will provide guidance that answers key policy question of what exposure reductions are needed to achieve substantive health benefits, and what technologies and fuels are needed to achieve these.

Annex 1: Summary tables from NIH workshop groups

1. Maternal, neonatal and child health
2. Infections
3. Chronic respiratory
4. Cancer
5. Cardiovascular disease
6. Burns
7. Ocular health
8. Women's empowerment
9. Exposure and biomarkers

NIH Household Air Pollution Research Workshop: Summary Table for Alliance Priorities Roadmap

Maternal Neonatal & Child Health

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
1. Fetal growth restriction, preterm birth	Low birth weight (LBW) effect but not magnitude is established, but pre-term birth (PTB) uncertain. Weak exposure assessment means effect sizes poorly estimated	3-4 multicenter stove RCTs (to include 0-2 yrs and maternal outcome, see topics #1-5 below) with thorough exposure assessment and sub-studies/cohorts designed to allow data analysis as data	Start immediate, recruitment2-3 yrs, follow-up 2 yrs, depending on sample size	5-10 million per RCT depending on existing infrastructure and time of maternal enrollment						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		becomes available (see adult infection group)								
2. Stillbirth	Moderate evidence from HAP literature. Weak exposure assessment means effect sizes poorly estimated	As above-with sub-studies built into RCT	As above	Included above				Key outcome for M/E as can demonstrate lives saved, but may be difficult to assess	To be determined	To be determined
3. Maternal pregnancy complications	No direct evidence; Evidence from other	As above-with sub-studies built into RCT.	Start immediate, 3yrs	Included above						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
(Hemorrhage, Sepsis, Hypertension/ Preeclampsia)	sources of air pollution, SHS and active smoking suggest increased risk for hemorrhage, infection but protection for other outcomes (hypertension, pre-eclampsia)									
4 Neonatal death		Extend cohorts and RCTs	Start immediat	Would require $				Key outcome	3. Neonatal	To be determin

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
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		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Early 0-7 dys Late 8-28 dys		established for topics #1-3 to include the neonatal period (through one month of life)	e, recruitment 2-3 yrs, FU 2 yrs, depending on sample size	to extend				for M/E as can demonstrate lives saved.	death Early 0-7 dys Late 8-28 dys	ed
5. Neonatal sepsis and pneumonia	Moderately good evidence for risk of ALRI up to 5 years, but none for the neonatal age group	Extend cohorts and RCTs established for topics #1-3 to include the neonatal period (through 1 month of life)	Start asap, 2-3yr recruitment, 2 yr follow-up (burden of risk 0-2 yrs)	Additional $2-3 million per trial				Include in 2 or 3 (minimum) evaluations of large scale interventions. May be able to combine with	Identify suitable programmes over next 5 years. If appropriate settings found in	Need estimates. Depends also on design and whether part of a wider evaluatio

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
								evaluation that includes impacts on infant and child pneumonia, also mortality.	this time frame, evaluation of health outcomes may be possible during years 5-10	n study.
6.Breastfeeding/ Nutrition	No direct evidence of adverse effect on production, amount or	2-3 small cohort studies in high-risk exposure settings; assessment	1 yr; priority to reduce maternal exposure and	250K						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	duration; limited data on toxins in breast milk	difficult	improve complemen-tary feeding after 6 months							
7. Neonatal brain Injury and cognitive development	No direct studies, potential for fetal/neonatal brain injury impact on child outcome is very great.	Ideally follow RCT enrolees above		Extend RCT cohorts of low vs. high exposure	Long-term cohort studies from above RCTs, to assess impact on learning, educational attainment, employment, etc		Need estimates			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
8. Early pregnancy failure (infertility, miscarriage, ectopic gestation)	Evidence conflicting in HAP with weak exposure assessment; suggestive from other sources of air pollution, SHS and active smoking	Study designs would require recruitment prior to conception to clarify early pregnancy risks; Build on such cohorts /trials designed for other non-HAP purposes-include at least indirect measurement of HAP	Start immediate, duration 3-4 years	More expensive than enrolling from existing antenatal care clinics						
9. Fetal origins of	No direct evidence				Long-term cohort studies,	Establish as	Need estimate			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programmes which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
later child-hood and adult disease, e.g. asthma, growth & obesity, IHD, COPD, cancer, fertility, etc	from HAP from solid fuel use. Suggestive from other sources of air pollution, including outdoor air pollution, SHS and active smoking				may include intervention component earlier in life	soon as practical, duration up to 30 years+	s. Efficiencies if build on existing research and program evaluations.			

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Infections

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
1. Childhood pneumonia	ARI/ALRI pneumonia using WHO definition of pneumonia is associated with HAP, but many confounders limit interpretation. Preliminary RESPIRE study results are promising for reduction	3-5 additional RCTs comparing cleanest stoves/fuels available vs. improved cookstoves/fuels vs. current stoves/fuels. Includes harmonized operational definitions of pneumonia, severe	Start asap, duration 3 - 5 years	$ 5-10 million USD per new study if use existing infra-structure. 2 studies already funded: Ghana, Nepal; 2 pending funding: Tanzania,						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	in HAP saving lives from severe pneumonia.	pneumonia, very severe pneumonia and etiology studies (X-ray confirmed, hypoxemia), also impact of altitude, effects of malnutrition and micronutrient deficiency Infection group also prioritizes Neonatal sepsis (see also Pregnancy and Neonatal Table)	Start asap, duration 3 - 5 years	Nagpur, Global Network interest. $1 million USD sub-studies of ongoing research such as PERCH						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
2. Adult pneumonia	Probable added risk from HAP but non-validated definitions of pneumonia	2 or 3 RCTs (could be linked with COPD)	Start asap, duration 3 - 5 years	$10+ million USD per RCT						
3. TB	Probable added risk from HAP. Even small effect of HAP, may have huge impact on TB considering GBD.	Sub-studies of #2-3 Adult pneumonia RCT trials if adult trials large enough in highly endemic areas	Start asap, concurrent with adult trials	Additional $1-2 million USD per study						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	Conflicting data									
4. HIV	Probable added risk to HIV OIs from tobacco smoke. HAP not studied. Even small influence from HAP may have huge effects on HIV considering GBD.	Sub-study of 2-3 adult pneumonia RCTs (#1 and 2 above) or leverage existing HIV cohorts (observational only). HAP as a risk factor for HIV opportunistic infections	Start asap, concurrent with pediatric and adult trials	Additional $1-2 million USD per study for sub study; additional $3 - 5 million USD for cohort design						
5. Vaginal infections	Inadequate data	Sub-study of adult pneumonia	Start asap, concurrent with	Additional $1-2 million						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		trials if adult trials large enough	Adult trials	USD per study						
6. Otitis Media	Inadequate data	Sub-studies of 2-3 childhood pneumonia RCT trials	Start asap, concurrent with childhood pneumonia trials	Additional $1-2 million USD per study						
Long-term impact on HIV infection and CV, etc complications associated with HIV meds	No direct evidence of effect of HAP on HIV infection, either acutely or long term				Long-term cohort studies, leveraging existing cohorts.	Build on #4 focused activities – convert RCT to long term cohort	Need estimates.			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Malaria and other vector-borne diseases	Possible increased risk of mosquito-borne diseases as result of less residential HAP (less smoke, more mosquitoes)							Include in 2 or 3 evaluations of large scale interventions. Partner with evaluation experts. Include mechanisms for feedback to implementers as continuous quality improvement. Include effects of HAP on possible	Identify suitable programs over next 5 years (focus on pilot work, and initial evaluation of exposure, safety, etc.). If appropriate settings found in this time frame, should include	Estimates for pilot work in years 0-5 m $100-200K per year. More detailed prospective study will depend on design and whether part of a wider evaluation study.

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities and study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
								changing severity of malaria and mosquito feeding habits.	endemic areas of vector-borne disease, evaluation of health outcomes may be possible during years 5-10	

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Chronic Respiratory Disease

Health and related outcomes and topics	**Summary of current knowledge and critical gaps**	**Key Research Recommendations**								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
COPD in non - smokers	**700,000 people (mainly women) die every yea**r from COPD caused by indoor air pollution.	Determine which interventions to reduce HAP improve COPD health outcomes. Evaluate COPD incidence, prevalence (spirometry with adequate QC/QA), symptoms,	Start ASAP. Exploratory 1-2 years. Definitive 5-10 years. BOLD, PLATINO, PREPOCOL, ATS MECOR,	Exploratory studies $100 to $500k USD Definitive studies $2 – $5 million USD				Determine impact of programs on key non-smoking related COPD outcomes: onset, symptoms, progression, exacerbation, quality of life and mortality. Include COPD (+/- asthma)	Opportunities to link up with existing implementation programs. Initial studies could start within 1-2 years.	Exploratory studies $100 to $500k USD Definitive studies $2 – $5 million USD

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		severity, progression, exacerbation, quality of life and mortality in cross-sectional, cohort and RCTs of interventions. Include evaluation of potential confounders. Assess dose response using direct measures of specific markers (how	World Spirometry Day are existing opportunities					screening as programs are implemented. Interface with HAP measurement studies, mechanistic lab work, biomarkers, dose response relationship assessment, women's empowerment. Cohort and RCT designs within programs, DHS.		

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		clean does a stove need to be?) and Interface with mechanistic lab studies								
Pharmacological interventions for COPD in non-smokers	Whether the pharmacological interventions for smoking related COPD are effective or cost - effective in non - smoking related	Evaluate the effects of drugs used to treat smoking-related COPD in patients with non-smoking related COPD. Early phase clinical studies should predate and	Start ASAP, Early phase studies 1-3 years. Definitive studies 2 - 5 years.	Early phase studies $0.5-1 million USD Definitive RCTs $5 - $10 million USD.						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	COPD is not known. This is a critical knowledge gap.	inform larger efficacy, clinical & cost effectiveness RCTs.								
Asthma	**300 million people worldwide have asthma** and **250,000 people die from asthma each year**. Global prevalence of asthma has				The impact of a reduction in HAP associated with adoption of clean cookstoves on asthma is difficult to predict. Adverse as well as beneficial effects may be	As soon as feasible but may be best to learn lessons from shorter studies before commencing longer-	$10+ million USD			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	increased in recent decades corresponding with adoption of 'cleaner' and 'Western' lifestyles. There is limited and conflicting evidence about the effects of HAP on asthma.				seen. Long-term cohort studies (+/- RCT follow up) are needed to evaluate the origins of asthma **across the lifespan,** from in utero to old age and to understand the factors that cause disease progression, exacerbation and death.	term cohort studies				

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Tobacco	The tobacco epidemic kills 6 million people a year.							Interface with tobacco control research and advocacy community given common areas of interest and need for a coordinated approach to HAP and tobacco control.	Start within 1 year	$0.5 - 1million USD

NIH Household Air Pollution Research Workshop: Summary Table for Alliance Priorities Roadmap

Cancer

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
What is the effect of HAP from coal combustion on cancers other than lung?	Exposure to HAP from coal combustion has been classified as an IARC Group 1 carcinogen, primarily based on evidence for lung cancer.	Case-control studies in China of adults. Some infrastructure exists. Include oral and dermal routes of exposure.	Start ASAP, duration 3-4 years	$ 1 - 1.5 million USD per study						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
What is the effect of biomass combustion on cancer risk?	HAP from biomass combustion has been classified as an IARC Group 2A carcinogen	3-4 cohort studies among women, each focussing on different prevalent biomass sources. Bio-specimens collected at multiple time points. Include oral and dermal routes of exposure.	Start ASAP, duration 5-10 years	$3 - 4 million USD per study						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Are there susceptible and resistant genotypes that modify HAP cancer risk?	No direct evidence yet, tobacco research supports low and high risk genotypes.	3-4 case-control studies of adults, each with different solid fuel source. Bio-specimens and genotyping.	Start ASAP, duration 5 years	$2 million USD per study						
Are there developmental windows of susceptibility to cancer from exposure to indoor air pollution over	No direct evidence for HAP. Evidence from breast cancer and environmental exposure				Long-term cohort studies with bio-specimens at multiple time points, genotyping	Establish as soon as practical, duration 20+ years	If coordinated with other health outcomes to use same infrastructure, $2 million USD/year for			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
the life-course?	studies supports concept.				and epi-genotyping.		cancer component.			
Is HAP cancer risk mediated via germline, somatic, and/or epigenetic changes?	Highly suggestive animal studies support germline pathway. Human tobacco studies also support epigenetic pathway.				Long-term cohort studies with bio-specimens from multiple time points, genotyping and epi-genotyping. Adults, children, pregnant women.	Establish as soon as practical, duration 20+ years	As above, $2 million USD/year for cancer component.			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Integrated cost-benefit assessment of solid fuel interventions.	Intervention studies indicate some risk reduction for cancers, no integrated cost-benefit analysis available.							Economic analysis and time series of existing data. Develop risk prediction models of exposure to solid fuel combustion products and other relevant risk factors for cancer. Use to identify individuals	2-3 years for various prediction models to be developed in parallel. Then 1-2 years for cost benefit analysis applying risk models.	$2 - 3 million USD

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
								at highest risk, then tailor intervention accordingly.		

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Cardiovascular Disease

Health and related outcomes and topics	**Summary of current knowledge and critical gaps**	**Key Research Recommendations**								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
Association between HAP and cardiovascular disease (CVD)	A few small studies showing increase in CV risk factors and biomarkers. Indirect evidence from outdoor air pollution, SHS and active	**Surveillance studies** such as interrupted time series to measure the effect of large-scale interventions on hard CV end-points and surrogate measures (e.g. BP) in multi-country,	Start ASAP, duration 5 - 10 years	$5-10 million USD						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	smoking	multi-ethnic, and at-risk groups.								
Impact of new cookstoves or air filtration on CVD	Some evidence. A few small studies showing improved BP, endothelial and micro-vascular function.	**RCTs** with sensitive CV risk surrogate markers (e.g. BP) and if feasible hard CV outcomes. Best performed in multiple countries to capture regional differences in risk	Start ASAP, duration 2 - 3 years	$1-2 million USD per RCT						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
		propensity and HAP exposure.								
Relationship between personal exposure level and CV risk and outcomes	No direct evidence; indirect evidence from outdoor air pollution.	**Cohort studies** (control for other risk factors)	Start ASAP, duration 5 - 10 years	$2-3 million USD if using existing cohorts						
Impact of HAP exposure on CV clinical outcomes including CVD death	No direct evidence; indirect evidence from outdoor air pollution, SHS and	**Case-control studies** Acute effects of recent exposures (e.g. hours to days) and/or retrospective	Start ASAP, duration 2 - 3 years	Less than $ 1-2 million USD per year if using existing cohorts						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
	active smoking.	analysis of chronic effects using long-term exposure histories. Small cohorts.								
Association between HAP and CV morbidity and mortality	A few small studies showing increase in CV risk factors and biomarkers. Indirect evidence from				**Prospective long-term cohort studies** including personal exposure levels and time course of exposure and CVD	Establish as soon as practical, duration 10-20 years	Roughly $12-30 million USD. Need better estimates.			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	outdoor air pollution, SHS and active smoking				relationship					

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Burn Injuries

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
1. Burn Injury	The explicit incorporation of safety features into cookstove design is a new concept. Ccookstove safety guidelines are in an	Establish guidelines and standard procedures for laboratory testing of cookstoves for burn-safety Vet draft guidelines and procedures; Pilot test under lab conditions. Research, develop	Testing set up will take less than a year, but new cookstove testing will be ongoing	$1 million USD						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	early stage of development and are not yet incorporated into the research, development and testing of new cookstoves.	and test clean-burning cookstoves with built-in safety features Design and evaluate stove thru trials and studies								
	Qualitative research may provide a deeper understandi	Conduct qualitative studies such as community surveys, ethnographic and case studies, focus groups, and	3 years	$1 million USD						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	ng of the social and cultural meaning of cooking, cookstoves, obstacles to use, community responses and unanticipated uses of cookstoves	observational studies to examine cookstove acceptability and use(s) Use findings to inform prevention activities and improve cookstove design								
	Centralized burn registries, particularly in areas	Develop a Global Burn Registry, comprising data from national and regional burn	1-3 years for development, with ongoing	$2 to $5 million USD						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	where cookstoves are widely adopted would permit multiple burn epidemiology studies and provide a more comprehensive assessment of burn injury impact.	registries. Collect and analyze data on burn patients admitted to selected hospitals in multiple countries at different economic levels using standardized data formats.	data collection							

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
	There is limited data available on cookstove related burn injuries Understanding the risk factors for cooking-related burns will help inform prevention efforts and shape the design of	Conduct epi studies to establish global risk estimates for burns in some common cooking-related burn scenarios • Prospective studies • Case-control studies • Medical review studies • Multi-Site/Center studies • Country/community-based, hospital-based, burn center-	2-4 years	$2 to $5 million USD						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
	safer cookstoves	based.								
	There is little information about rates of burn injuries associated with cookstoves currently 1) undergoing RCTs; or 2) being disseminated in multiple countries							1. Perform nested studies on burn injury rates and risk factors; 2. Establish surveillance mechanisms for monitoring 3. Utilize existing data and systems, including linking data (e.g.	3 years for RCTs; 5-10 years for dissemination and related capacity building	$8 – 11 million USD

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
								population with hospital) 4. Build local capacity for ongoing burn monitoring and evaluation		

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Ocular Health

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
1. Cataract	Responsible for 50% of all blindness worldwide. Good evidence of increased risk from HAP.	1. Conduct well-designed epi studies to refine risk estimates; 2. Include quantitative measurements of lens opacities; 3. Include measurement of lens opacities in	Start asap, duration 5 - 10 years	$1 million USD per year						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		RCTs, potential to observe benefit over several years								
2. Trachoma	Endemic in 55 countries where it is responsible for 7% of blindness. Suggestive evidence of increased risk from HAP.	1. Investigate active trachoma in children in RCTs in endemic areas 2. Potential to observe significant benefit in short-term	Start asap, duration 2 -5 years	$1 million USD per year during intervention, less in subsequent data analysis period.						
3. Dry Eye &	Extremely prevalent: 20	1. Investigate in RCTs	Start asap,	$ 0.5 - $1 million USD per						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Ocular Surface Disease (Chronic Eye Pain)	to 50 % of adults in certain populations. RESPIRE study showed >80% decrease in eye soreness after introduction of cleaner cookstoves.	2. Questionnaire assessment of symptoms, visual problems. 3. Include ocular surface and tear film evaluation. High potential as biomarkers. 4. Highly motivating condition for adoption of cleaner cookstoves	duration 1 - 5 years	year during intervention; less for subsequent data analysis period.						
4. Blindness	285 million people				GOAL: Global	Establish as	Explore possible			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
and Vision Impairment	worldwide have visual impairment 39 million people are blind. 2/3 of these are women 87% live in developing countries				reduction of blindness & vision impairment 1. Determine impact of implementing cleaner cookstoves on levels of blindness & vision impairment 2. Determine impact on	soon as practical; duration depends on specific goals.	synergies with ongoing initiatives, e.g., Vision 2020 The Right to Sight; GET 2020Global Elimination of Blinding Trachoma; NTD Initiative.			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
					major blinding diseases (cataract, trachoma, glaucoma, macular degeneration, etc.)					

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Women's Empowerment

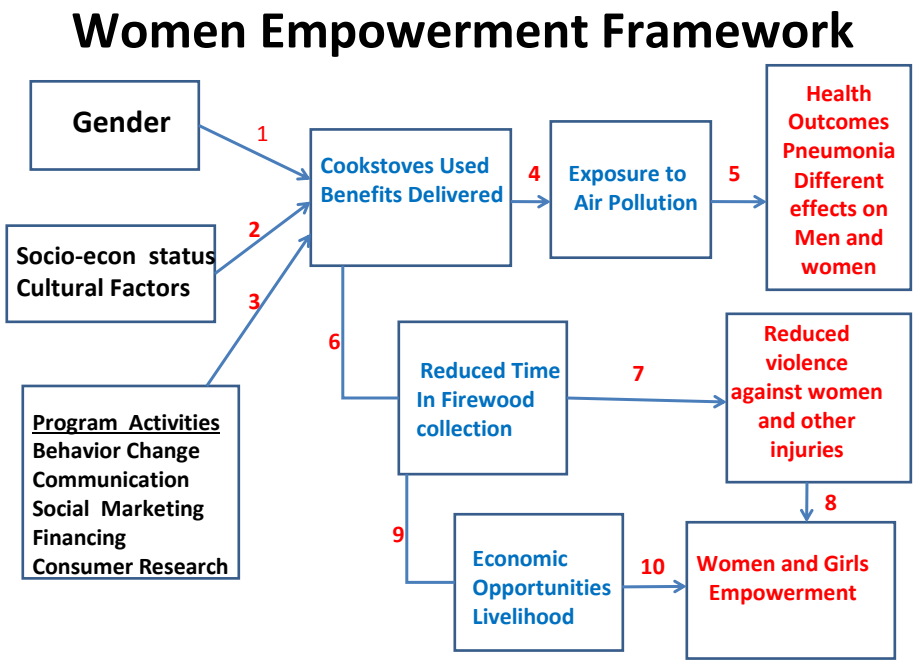
Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
Gender and decision-making	Gender constructs inform household decision-making processes	Exploratory, descriptive research on d-m processes regarding cooking/cookstoves adoption and use: what factors related to decision-making and gender roles in the household; the qualities of the stove itself; the awareness-raising, demonstration and training activities;	Start ASAP, duration 2-3 years	$500K per study						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
		cost of the stove; and HH-level cost/benefit analysis cause cookstoves to be adopted/used over the long term?								
Time-use studies on impact of improved cookstove use	Little direct evidence of cookstoves' impact on women's time allocations. (e.g. Is there a reduction in time spent collecting fuel/cooking?	Time-use, economic studies	Include with RCTs, natural experiments; additional studies on existing projects	Likely included within RCT/NEs; ~$500K for smaller evaluations						

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	If so, how do women use this time?									
Extent of gender-based violence during firewood collection (rape and assault of firewood collectors, for example)	Very little data exists on prevalence of GBV in general; even less so related to specific risk factors. Anecdotal evidence collected in field interviews with firewood				Can be included as variable in studies described above	Establish as soon as practical	Included within other study designs			

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	collectors in DRC, Kenya, Sudan, etc. indicates that physical and/or sexual attack during wood collection is a key protection concern. MSF and IRC studied rape during wood collection in 2005-6 in Darfur. MSF									

Health and related outcomes and topics	Summary of current knowledge and critical gaps	Key Research Recommendations								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures			Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health		
		Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)	Proposed research activities including study design	Time-line	Projected costs (US$)
	study showed 500+ women in one region of Darfur were raped while collecting fuel over 4-month period in 2004-05.									



Cross Cutting Issues

- **Integration of WE framework variables through WE and all other related research**
  - **Biomedical as well as social, behavioral, and economic studies**
- **Inventory of existing studies/opportunities**
- **Clearly integrated mixed methods to account for empowerment- and health-related changes**
- **Integration with other poverty-related projects (e.g., sanitation).**

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Exposure & Biomarkers

Health and related outcomes and topics	**Summary of current knowledge and critical gaps**	**Key Research Recommendations**								
		Issues requiring focused research activities (using new settings or building on existing studies) to answer priority scientific questions as soon as possible, and in any case within 10 years			**Issues that can and should be studied through longer-term studies over a time frame of more than 10 years, using existing or newly established cohort study infrastructures**			**Evaluation of implementation programs which incorporate health outcomes to directly demonstrate impacts on health**		
		Proposed research activities including study design	**Time-line**	**Projected costs (US$)**	**Proposed research activities**	**Time-line**	**Projected costs (US$)**	**Proposed research activities including study design**	**Time-line**	**Projected costs (US$)**
Improve characterization of inter and intra-individual exposure variability and its drivers	Body of literature constrained by varied approaches and weakness of exposure assessments, which in turn prevents accurate understanding of dose response relationships for multiple health outcomes. Lack of suitably robust exposure assessment methods also compromises evaluations	Leverage existing and planned studies; conduct new primary exposure assessment studies: Develop NIH partnership with NIEHS supporting	5 - 10 years	$100-300K USD per study per year						

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	of cookstove interventions. Aims of this effort include: 1) determining how best to characterize the complex mixture of cookstove emissions (PM, BC, CO, PAHs, ultrafines) 2) developing and validating in the field new measurement technologies (environmental and biomarkers) 3) better characterizing	improved and harmonized exposure assessments within existing and newly planned studies of various endpoints								

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	inter- and intra-individual variability and drivers of variability in field settings 4) Developing new modelling approaches for characterizing exposure of most-exposed in evaluating intervention trials. (Conventional modelling approaches have been shown to poorly predict exposures at the high end of distribution.)									

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Characterize emissions of pollutant mixtures from traditional and improved cookstoves using different fuel combinations, and how changes in pollutant mixtures impact emission	Major gap in understanding complex mixtures from variations in stove/fuel combinations and the resultant impacts on toxicity.	Compare 2-3 best available stove technologies likely to meet WHO Interim Target -I in relation to traditional cookstoves. Identify specific technologies for wood, crop residue, charcoal and coal based on global coverage.	3 - 5 years	Depending on balance of in vitro and in vivo tests, costs will range from $300K USD to $1 – 2 million USD per year						

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toxicity		Conduct in vitro and in vivo toxicology studies to assess variations in both Cardiorespiratory tox and a broader array of screening endpoints in relation to ambient particulate matter and diesel emissions.								

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Biomarkers of biomass combustion product exposure	Improve the understanding of currently investigated biomarkers of biomass emissions exposure (levoglucosan, methoxyphenols, PAH metabolites), and develop new, more source-specific and informative short- and long-term biomarkers of exposure.	Review the strengths, weaknesses, potential applications of previously investigated biomarkers of exposure Using a combination of: i) previously investigated and ii) newly developed biomarkers,	<1year 2 - 5 years	$25,000 USD 3 - 5 three-year studies at $300-500K USD per study						

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		develop a single biomarker or mix of biomarkers to biomass combustion products that are source-specific, temporally relevant, and contribute to exposure assessment needs identified by this group								

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