

<b>Institution: University of Liverpool</b>		
<b>Unit of Assessment:</b> UOA2 - Public Health, Health Services and Primary Care		
<b>Title of case study:</b>  Addressing the Global Burden of Disease from Household Air Pollution: Prevention through equitable scale of clean cooking in Cameroon		
<b>Period when the underpinning research was undertaken: 2000-2020</b>		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Daniel Pope	Professor of Global Public Health	2018 – present
Nigel Bruce	Emeritus Professor of Public Health	2016- present
Elisa Puzzolo	Senior Research Fellow	2014- present
<b>Period when the claimed impact occurred: 2013-2020</b>		
<b>Is this case study continued from a case study submitted in 2014? N</b>		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>The University of Liverpool (UoL) has led research directly identifying household air pollution as the biggest environmental risk for health: responsible for 683,984 annual deaths (7.5% of total disease burden) in 646,000,000 people reliant on polluting solid fuels in sub-Saharan Africa (SSA). Following publication of WHO Guidelines developed by UoL, we are steering international prevention efforts in SSA through scaling clean cooking with gas. Our implementation science research has helped scale adoption of clean cooking with gas in Cameroon in line with an aspirational 58% of the population by 2030. To date this has benefitted 2,623,500 Cameroonians with the potential to save 28,000 lives.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>UoL has made a leading contribution to quantifying the Global Burden of Disease (GBD) from Household Air Pollution (HAP), with Bruce (Emeritus Prof in Public Health, 2016 – present) co-chairing the HAP expert group for comparative risk assessment (CRA) for the 2010 GBD Study, and Pope (Prof in Public Health; 2018 – present) leading the evidence synthesis for HAP CRA. This work estimated that 2,800,000,000 people globally rely on traditional solid fuels (wood, charcoal, etc) for cooking leading to levels of particulate matter (PM2.5) in homes some 20 to 40 times the WHO ‘safe’ air quality guideline levels; this resulted in almost 4.3% of the GBD in 2010, with 4,000,000 premature deaths from childhood pneumonia and a range of adult diseases (REF3.1). Since publication of this seminal work, HAP is now recognised as the leading environmental risk factor of disease burden and international focus with GBD calculations from HAP being made routinely through the GBD collaboration (the original Lancet article published in 2012 has 10,965 citations (REF3.1).</p>		

Our research has subsequently informed and steered international efforts to address this global public health priority. Systematic reviews and meta-analyses conducted by UoL on health impacts from and prevention strategies for HAP were incorporated directly into chapters of WHO Guidelines on Indoor Air Quality from household fuel combustion, led in development by UoL (Bruce – chair; Pope – chapters lead). In implementation of Guideline recommendations for global action for scaling access to cleaner energy, UoL evidence has led to a landmark shift in focus for investment from HAP prevention through improved cookstoves (burning solid fuels more cleanly) to promotion of truly clean cooking with liquified petroleum gas (LPG). This includes results from the largest ever trial of the best available improved solid fuel cookstove at the time that found no impact on child pneumonia in Malawi (REF3.2) and meta-analyses demonstrating the limited impact of improved solid fuel cookstoves on HAP in real life settings (REF3.3). In addition, UoL evidence has led to a better understanding of the exposure-response relationships between HAP, non-communicable disease and child pneumonia and has demonstrated the substantial benefits in health (with no impact on climate) from scaling up adoption of LPG in LMIC settings (REF3.4).

UoL has raised the profile of LPG as the best current option for scaling clean cooking as a readily available, transportable and truly clean fuel with the potential to improve the lives of millions of people. From 2016, UoL research has informed government efforts to scale clean cooking with LPG from 17% to 58% by 2030 (REF3.5). We have (i) demonstrated the lives (28,000) and morbidity (770,000 Disability-Adjusted-Life-Years) that can be saved annually by achieving this target (REF3.4) and (ii) identified affordability of LPG start-up equipment as the key barrier to switching. We subsequently co-led the first ever microfinance initiative in Cameroon (Bottled Gas for a Better Life) to address this barrier (REF3.6). Dissemination of our research through public and ministerial engagement (REF3.6) and national media has facilitated transition from reliance on polluting solid fuels to LPG through evidence-based policy and heightened population awareness. Since 2018, through our CLEAN-Air(Africa) Global Health Research Group (NIHR GBP2,500,000), we are also working with the Governments of Ghana and Kenya to facilitate rapid population transition to clean cooking.

### 3. References to the research (indicative maximum of six references)

- 3.1 Lim S, Vos T, Flaxman A, et al, (**Bruce N, Pope D**). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012; 380(9859): 2224-60. Citations 7,168. DOI: [10.1016/S0140-6736\(12\)61766-8](https://doi.org/10.1016/S0140-6736(12)61766-8).
- 3.2 Mortimer K, Ndamala CB, Naunje AW, Katundu C, Weston W, Havens D, **Pope D**, et al. A cleaner burning biomass-fuelled cookstove intervention to prevent pneumonia in children under 5 years old in rural Malawi (the Cooking and Pneumonia Study): a cluster randomised controlled trial. *Lancet* 2016. Citations 134. DOI: [http://dx.doi.org/10.1016/S0140-6736\(16\)32507-7](http://dx.doi.org/10.1016/S0140-6736(16)32507-7).
- 3.3 **Pope D, Bruce N**, Dherani M, Jagoe K, Rehfuess E. Real-life effectiveness of 'improved' stoves and clean fuels in reducing PM2.5 and CO: systematic review and meta-analysis. *Environmental International* 2017; 101:7-18. Citations 77. DOI: <https://doi.org/10.1016/j.envint.2017.01.012>
- 3.4 Kypridemos, C., **Puzzolo E**, Aunan K, Aamas B, **Pope, D**. Climate and health impacts of achieving Cameroon's LPG adoption targets. *Environ Health Perspect* Apr 2012;128(4):47001. Epub 2020 Apr 1. Citations 2. DOI: <https://doi.org/10.1289/EHP4899>.
- 3.5 **Bruce N**, Anderson de Cuevas R, Cooper J, Ronzi S, **Puzzolo E, Pope D**. The

Government-led initiative for LPG scale-up in Cameroon: Programme development and initial evaluation. *Energy for Sustainable Development* 2018; 46: 103-110. Citations 10. DOI: <https://doi.org/10.1016/j.esd.2018.05.010>

3.6 Ronzi S, **Puzzolo E**, Hyseni L, MBatchou B, **Bruce N**, **Pope D**. Using photovoice methods as a community-based participatory research tool to advance uptake of clean cooking and improve health: The LPG adoption in Cameroon evaluation studies. *Soc Sci Med* 2019; 228: 30-40. Citations 7. DOI: <https://doi.org/10.1016/j.socscimed.2019.02.044>.

#### 4. Details of the impact (indicative maximum 750 words).

##### Impact on Policy and Practice:

The University of Liverpool (UoL) has led research directly identifying household air pollution as the biggest environmental risk for health: in 2019 it was responsible for 683,984 annual deaths, and 38,052,063 years lived with disability (DALYs), or 7.5% of total disease burden, in 646,000,000 people reliant on polluting solid fuels in sub-Saharan Africa (SSA). To address this global public health priority, evidence-based WHO Guidelines (REF5.1), led in development by UoL, have highlighted the urgent need for population transition to clean fuels and technologies in lower-and-middle-income countries (LMICs). Focussing on the time horizon for Sustainable Development Goal (SDG) 7 “Universal Access to Clean Modern Energy by 2030” UoL is now leading efforts to achieve this goal, as noted by the Technical Lead at WHO Head Office “Since their launch [UoL] has spearheaded efforts to implement Guideline recommendations in sub-Saharan Africa including implementation research in Cameroon to inform scaled population adoption of clean cooking” (REF5.1).

UoL is leading the public health response to HAP in primary prevention through clean cooking. Our evidence that cleaner biomass burning cookstoves do not reduce HAP exposure sufficiently to significantly improve health has been instrumental in shifting international focus from ineffective improved cookstove programmes to the scaling adoption of clean fuels, such as liquified petroleum gas (LPG). As the Chairman of the Global LPG Partnership (GLPGP) puts it “...[UoL] **evidence and advocacy has been crucial in supporting efforts to scale domestic use of LPG in LMICs as the only truly scalable fuel for clean cooking that can improve the lives of millions of the world’s poorest people. Their work has ... demonstrate[d] no impacts on global warming from achieving this scale, through reduced deforestation and emissions**” (REF5.2).

##### Impacts in the Cameroon context:

UoL was the first institution to conduct implementation research to inform national efforts by sub-Saharan African countries to scale clean cooking with LPG to aspirational target levels by 2030, under SDG 7. To coincide with publication of the Cameroon government’s National LPG Masterplan in 2016, UoL launched a program of community-based research to provide policy relevant evidence to support the government’s aspirational target to scale population adoption of LPG from 17% to 58% by 2030 (REF3.5). UoL research substantiated this adoption target calculating the potential to save 28,000 lives and 770,000 disability-adjusted-life-years with no impact on global temperatures (REF3.4) – information used by the government (REF5.3). To facilitate implementation of the Masterplan, UoL research identified key barriers experienced by the communities in transitioning to clean cooking, including the prohibitive price of initial purchase of LPG equipment (REF3.6). These results were disseminated directly to Ministry delegates responsible for implementing policies relevant to the LPG Masterplan at a national public and stakeholder engagement event hosted by UoL in 2017 (covered by national media REF5.4). At the event, UoL conveyed the importance of microfinance to support acquisition of equipment necessary to switch to LPG. UoL then co-led the first ever community-led microfinance initiative (6 month repayment scheme for LPG equipment) - the Bottled Gas for a Better Life Study (REF5.5). The success of the scheme through both maintenance and impacts on health (REF5.5) has led to the scheme being scaled across 10 communities in different regions of Cameroon.

The GLPGP Chairman has stated ***“Liverpool, together with GLPGP, led the first ever microfinance initiative (implemented by Cameroonian village banks) focused on making small loans to enable household acquisition of equipment necessary to start using LPG. The Liverpool evaluation of “The Bottled Gas for a Better Life” Program demonstrated the significant positive impacts of LPG uptake on health and use of time, as well as the high repayment rates of the microfinance loans. GLPGP has communicated the Liverpool work to policy makers within the Cameroon government. The learnings from the initial Liverpool microfinance evaluations have been crucial for GLPGP success in expanding its microfinance program work across other poor communities in Cameroon and Kenya – benefitting over 3,000 resource-poor people. In partnership with UNDP, GLPGP is now also launching a LPG microfinance program in Kinshasa, DRC.”*** (REF5.2).

UoL has conducted an extensive programme of awareness raising on HAP, health and benefits of clean cooking. Collaborating with the Ministry for Promotion of Women and the Family (MINPROF) UoL has hosted annual clean cooking community engagement events since 2018 (approximately 1,000 women to date) for Cameroon’s annual International Day for Rural Women, supported by national media. The MINPROF Minister has stated “UoL has raised the profile of clean cooking with bottled gas within our country. This will help our women and children who are most affected having to gather wood and being exposed to cooking smoke” (REF5.6). Through engagement with Cameroon State National Radio and Television company (CRTV) UoL has produced documentaries on cooking, HAP and health with viewing figures indicating a total audience of 2,478,000 (in 2019 and 2020) REF5.7). The Director of Programming at CRTV stated ***“The topic of cooking with wood and health is extremely important to Cameroonians and we have been delighted to film the work of UoL in helping our communities switch to clean cooking”*** (REF5.7).

To date, UoL research in Cameroon has helped keep the national aspirational target for LPG adoption on track. with increased adoption from 17.1% in 2012 to 25% in 2018 – an additional 2,623,500 using gas for clean cooking (REF5.8). As observed by the GLPGP Chairman ***“The work of Liverpool has had, and will continue to have, an important part to play in this upward trajectory towards the Cameroon national goal of LPG usage in 58% of the population by 2030 and to the work GLPGP is undertaking with governments in other African countries”*** (REF5.2).

#### **Impacts across sub-Saharan Africa:**

Given the relevance of its work to national policy, the Cameroon government, through the Ministry of Public Health (REF5.9) and the Ministry of Energy and Water Resources (REF5.9)), supported an expansion of UoL’s work as part of a wider initiative of implementation science research by UoL in sub-Saharan Africa. In 2018 UoL launched the UK NIHR funded (GBP 2,500,000) CLEAN-Air(Africa) Global Health Research Group providing policy relevant research and health systems capacity building in Cameroon, Ghana and Kenya. All countries had established a priority of aspirational scale of LPG to meet SDG7 by 2030 (working with GLPGP) and had engaged with UoL to provide policy relevant community-based evidence to inform policies and strategies to achieve this scale. Already UoL has achieved success with potential wide-reaching population health impact for 47,000,000 Kenyans. By invitation from the Ministry of Health in Kenya, UoL is leading national training of community health workers (CHW) in HAP, Health and Prevention with the Kenyan Ministry of Health. A new UoL training module developed through CLEAN-Air(Africa) (REF5.10) has been now been delivered by UoL experts to 61 Ministry of Health community health leads from the 47 counties of Kenya (REF5.10) in preparation for Kenya’s Universal Health Coverage rollout of the new community health working training curriculum in 2021. As noted by the minister coordinating Kenya’s UHC initiative, ***“The new technical module 13b on household air pollution, health and prevention will be rolled out to 130,000 community health workers across the country in 2021 through a train the trainer approach led by the Ministry of Health. We are very grateful to the University of Liverpool for steering development of the module, piloting and evaluating its***

***implementation and training our ministry of health training leads in preparation for launch. We are pleased to have enlisted their assistance in monitoring and evaluating of this initiative to maximise its impact in improving the lives of our population”***  
(REF5.10).

**5. Sources to corroborate the impact** (indicative maximum of ten references)

5.1 UoL led WHO Indoor Air Quality Guidelines for Household Fuel Combustion (2014). UoL driving implementation of the WHO Guidelines stated by WHO Lead for Energy and Health – Letter and testimonial.

5.2 Confirmation of the crucial role of UoL in scaling domestic LPG use in letter and testimonial from Mr Kimball Chan, Chairman of the Global LPG Partnership.

5.3 UoL-substantiated targets in Cameroon Government Policy Brief: Health and Climate impacts from scaling LPG Adoption in Cameroon.

5.4 UoL public and ministerial engagement dissemination event to inform government policy and practice. Event covered by national media “The Cameroon Star” & “Cameroon Tribune”.

5.5 UoL Launch of Bottled Gas for a Better Life initiative. International recognition of the initiative through Climate and Clean Air Coalition (CCA) and WHO. Impacts and results from UoL evaluation presented through CCA.

5.6 Profile of issues and promotion of solution by UoL verified in letter and testimonial from the Cameroon Minister for Promotion of Women and the Family.

5.7 Letter and testimonial from the Director of Programming at Cameroon State National Radio and Television company (CRTV). Official viewing figures for UoL documentaries supplied by CRTV.

5.8 Shift in LPG usage from 2012 to 2018 (DHS data). Also mentioned in testimonial by GLPGP chairman (REF5.2).

5.9 Letters of support from government of Cameroon (ministries of health and energy) in support of UoL’s CLEAN-Air(Africa) Global Health Research Group application.

5.10 (a) Kenya CHW Module 13b (Household Air Pollution) – note: acknowledgement of key UoL role from Dr Patrick Amoth - Director General of Health (page 4); Lt. Col. Susan K. Mutua – Head of Department of Public Health (Page 5); Dr. Hussein Salim – Head of Department of Primary Health (Page 5). (b) Letter and testimonial Minister responsible for Universal Health Coverage in Kenya (on page 154 of evidence PDF).

(c) This is independently confirmed in the article ‘HAP Training for Community Help Workers’ on page 15 of the Magazine of the Institute of Petroleum East Africa which follows the testimonial.