Pellet cookstoves
An affordable and sustainable modern clean cooking solution

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Executive summary

In the debate on clean cooking, traditional cooking solutions such as open fire cooking or cooking in traditional charcoal stoves are contrasted to "transitional" solutions such as improved cookstoves for firewood or charcoal and "modern cooking solutions" such as LPG, electric cooking, ethanol cookstoves or biogas. This paper argues that pellet fired gasifying cookstoves should be considered as modern cooking solution that has particular advantages in terms of affordability, use of local resources and sustainability and given more attention when advocating clean cooking.

Gasification technology allows pellet-fired cookstoves to achieve Tier 4 to Tier 5 levels of emissions and efficiencies of ISO voluntary performance standards making them a clean and highly efficient cooking solution.

There is ample scientific evidence, that pellet cooking has particular advantages in terms of affordability. Taking into account the high efficiency of pellet cookstoves cooking costs are both lower compared to improved charcoal stoves and much cheaper than LPG cooking or electric cooking with few exceptions such as the use of electric pressure cookers.

The International Energy Agency estimates in their Access for All scenario that USD 40-55 billion per year in subsidies would be needed to bring down the cost of LPG and electricity to affordable levels for all households that have switched by 2030. As pellet cooking does not need to be subsidized, building a pellet supply infrastructure can reduce the demand for subsidies significantly.

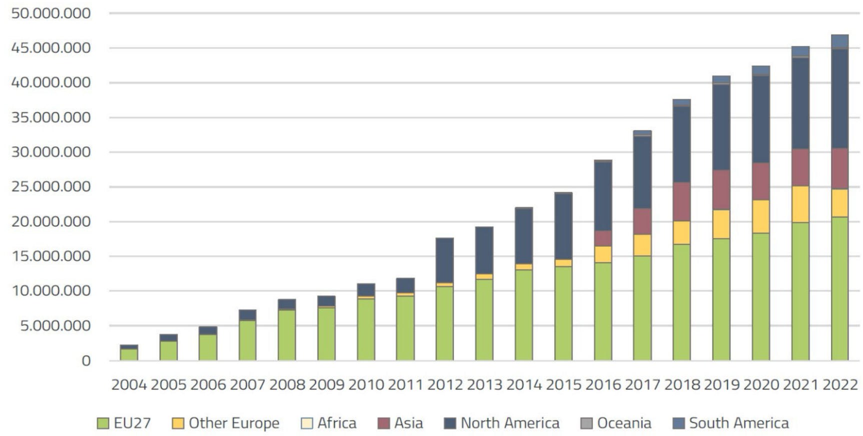
The investment needed to build adequate pellet production capacities amounts to around USD 20 per person. A tier 4 electricity supply able to support cooking also in rural areas would require investments estimated at over USD 400 per person. The economic and social sustainability of a pellet based modern cooking system is underpinned by the fact, that no foreign exchange is needed for fuel imports and job loss in the traditional charcoal and firewood economy can be replaced by work associated to raw material supply to the pelleting plants, pellet production, packaging, distribution, stove manufacturing, and maintenance and even ash and char utilization. Significantly reduced safety hazards, short supply chains and independence of volatile global markets and disadvantageous exchange rates are other advantages.

Finally, a sustainable cooking fuel supply needs to be based on renewable energy and should not lead to the emission of carbon from fossil fuel resources. Utilizing biomass residues that would otherwise be burned or landfilled as well as fast-growing grasses is an efficient and sustainable use of local and renewable resources that needs to be part of the energy system of the future.

Pellets from biomass – a modern fuel

Pelletization is a technology for upgrading biomass that is seeing rapid global growth due to low processing costs, low energy requirements for upgrading and high versatility of the resulting fuel. The energy demand for densifying dry biomass to pellets amounts to about 2% of the energy content of the resulting fuel.[1] Within the last 25 years global pellet production has increased from around 1 million tons to over 65 million tons. The largest global pellet producer is currently China, with a production exceeding 20 million tons. While wood and forestry residues have been the main source of raw material for pellet production up until now, increasing attention is currently going towards utilizing agricultural residues as raw materials.

Figure 1 Evolution of global pellet production (tonnes)

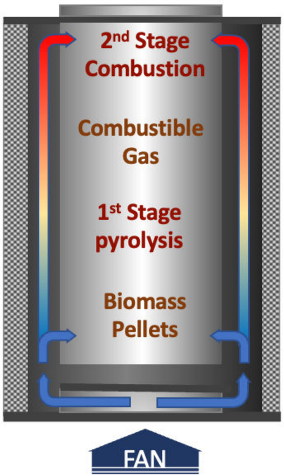


Source: Bioenergy Europe, Statistical Report 2023. Note: this graphic does not include pellet production in China

The success of pelletized biomass is due to its versatility as fuel – it can be used across a wide scale of applications ranging from domestic use for cooking and heating to commercial applications for food processing, industrial use for process steam all the way to use in power plants for electricity generation. At a global level the domestic and industrial use of pellets are of approximately similar size with domestic demand mainly resulting from heating and industrial demand mainly resulting from electricity generation.

[1] Obernberger I., and Thek G. 2010. "The Pellet Handbook. The production and thermal utilization of biomass pellets", Earthscan. ISBN: 978-1-84407-631-4

How do pellet cookstoves work?



Pellet cookstoves work using a gasifying technique – biomass is turned into a combustible gas that is subsequently burned by adding preheated secondary air. This combustion principle leads to extremely low emissions and high efficiencies.

In practice a cylinder is filled with pellets according to the needed cooking time. The cylinder has small holes at the bottom that provide primary combustion air, that is pushed by a fan into the gasifier. The primary air allows the biomass to glow and produce a combustible gas that is then burned by the secondary air that enters at the top of the cylinder.

Pellets are lit at the top by sprinkling and lighting a small amount of Ethanol or some other easy burning material. The size of the gasifier determines how long and at what output power the stove is burning. Typically, gasifiers hold around 600g of pellets which allows them to burn for 40-60 minutes. Larger gasifiers are available for institutional cooking with pot sizes up to 100 l. When the combustion is finished the remaining ashes and char are removed and the cylinder can be refilled and ignited.

The advantage of this batch process is, that the stove construction is very simple and stove costs are low, ranging typically from USD 25-75. The disadvantage is, that cooking time is determined by the amount of pellets in the gasifier and cannot be interrupted at any time or extended over long periods of time, without extinguishing the fire or refueling respectively. Also, the heat output cannot be reduced too much to achieve long times of simmering. Research is ongoing to enhance the downturn properties and allow for simmering with promising results.

Efficiency and emissions of pellet cooking

Both the efficiency and the emissions of the best-performing pellet gasifier cookstoves are close to those of LPG or Ethanol cookstoves. They achieve Tier 4 on PM2.5, Tier 5 on CO and between Tier 4 and 5 for thermal efficiency of ISO voluntary performance targets for cookstoves on the testing bench and, contrary to many improved charcoal or firewood cookstoves, also in the field.[2,3,4] One reason for the excellent performance of pellet cookstoves

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[2] Champion, Wyatt M., and Andrew P. Grieshop. 2019. "Pellet-Fed Gasifier Stoves Approach Gas-Stove like Performance during in-Home Use in Rwanda." *Environmental Science & Technology*. https://doi.org/10.1021/acs.est.9b00009.

[3] Parsons, Stephanie, Ky Tanner, Wyatt Champion, and Andrew Grieshop. 2022. "The Effects of Modified Operation on Emissions from a Pellet-Fed, Forced-Draft Gasifier Stove." *Energy for Sustainable Development* 70 (October): 259–71. https://doi.org/10.1016/j.esd.2022.08.004.

[4] Champion, Wyatt M., Michael D. Hays, Craig Williams, Larry Virtaranta, Mark Barnes, William Preston, and James J. Jetter. 2021. "Cookstove Emissions and Performance Evaluation Using a New ISO Protocol and Comparison of Results with Previous Test Protocols." *Environmental Science & Technology* 55 (22): 15333–42. https://doi.org/10.1021/est.1c03390.

lies in the fact that pelletized biomass is a homogeneous dry fuel allowing a steady gasification and combustion process.
Thus, pellet cooking with state-of-the-art gasifier cookstoves qualifies as clean according to the World Health Organization guidelines.[5]

Research projects are ongoing and new stove and pot designs with further improvements are expected to be introduced to the market shortly.[6]

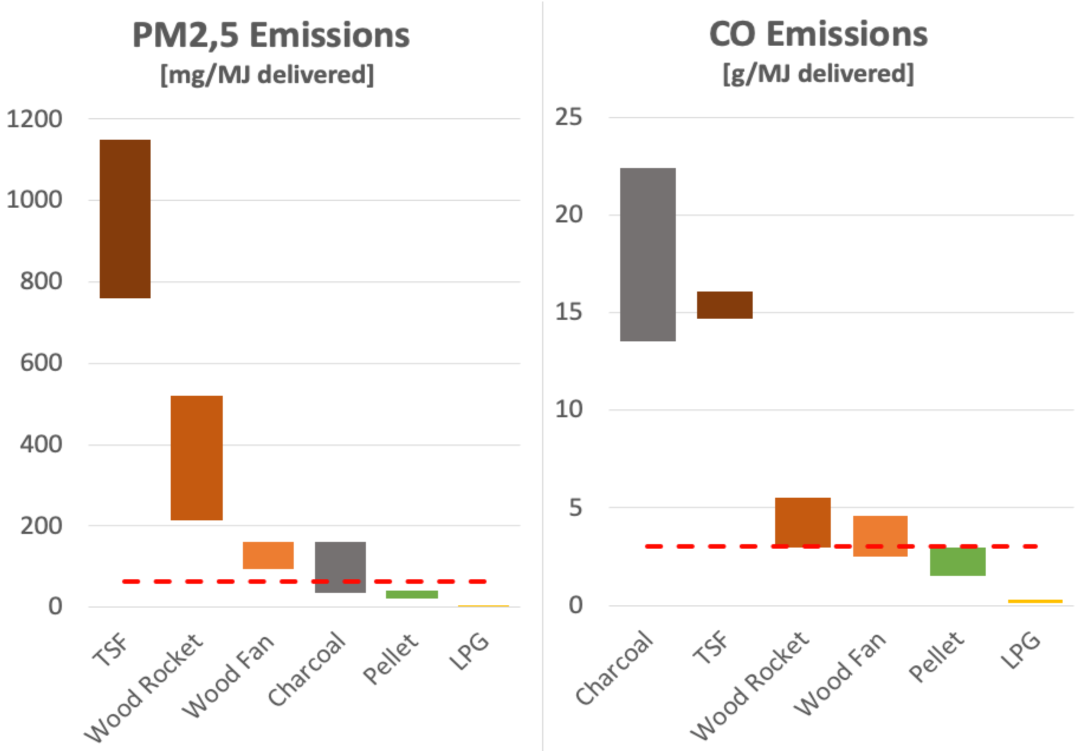

Figure 1: The ranges depict the lowest to highest mean value from the three test different phases (high, medium and low power) of the respective ISO 19867-1 test. The red dotted line depicts the cut-off value that is considered as clean according to the default scenario of the "Voluntary Performance Targets" defined by WHO and ISO 19867-3. Graph: Authors; Data source: Supplementary Information of Champion, Wyatt M., Michael D. Hays, Craig Williams, Larry Virtaranta, Mark Barnes, William Preston, and James J. Jetter. 2021. "Cookstove Emissions and Performance Evaluation Using a New ISO Protocol and Comparison of Results with Previous Test Protocols." *Environmental Science & Technology 55 (22): 15333–42.* *https://doi.org/10.1021/acs.est.1c03390.*

Economic advantages of using pelletized biomass

The fact that the densification of biomass to pellets requires a low amount of energy and is a simple mechanical process using residual material results in significantly lower costs

[5] https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean
[6] For example https://www.leap-re.eu/she/ and http://aprovecho.org/tluds/supamoto-forced-draft-tlud-good-better-best/ and https://www.mdpi.com/1996-1073/16/7/3278 and https://ener-g-africa.com/product/pot-6-litre-eco-pot-copy/ - single-produt-wrap-id

compared to competing "modern" fuels. A survey conducted on behalf of WBA in the summer of 2023 in Kampala, Uganda illustrates this fact taking into account the efficiency of cooking devices.

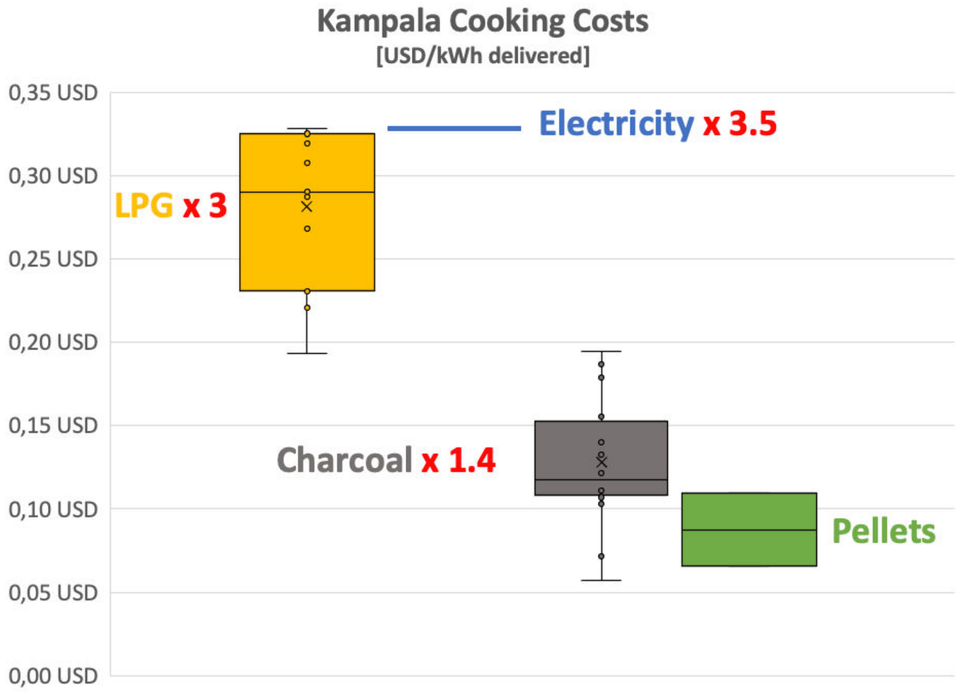

Figure 2: Prices from WBA research, August 2023 in Kampala, assumed pellet price 150-250 USD/t; Thermal efficiencies for LPG (57%), charcoal (39%) and pellets (49%) from ISO 19867-1 test conducted by Champion etal. 2021, https://doi.org/10.1021/est.1c03390, and electric (74%) from Kojima 2022, https://hdl.handle.net/10986/38418.

There is also more detailed research that points to the fact, that pellet cooking is most of the time the (or one of the) most affordable modern cooking solutions.[7, 8, 9, 10]

Given the well-documented fact, that affordability is the main barrier for the adoption of modern cooking solutions, pellet cooking should receive particular attention.[11, 12]

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[7] Gill-Wiehl, Annelise, and Daniel M Kammen. 2022. "A Pro-Health Cookstove Strategy to Advance Energy, Social and Ecological Justice." Nature Energy, September, 4. https://doi.org/10.1038/s41560-022-01126-2.

[8] Gill-Wiehl, Annelise, and Isha Ray. 2023. "Affording a Clean Stack: Evidence from Cookstoves in Urban Kenya." *Energy Research & Social Science* 105 (November): 103275. https://doi.org/10.1016/j.erss.2023.103275.

[9] Bailis, Robert, Emily Ghosh, Margaret O'connor, Elvine Kwamboka, Ylva Ran, Ylva Ran, Ylva Ran, and Fiona Lambe. 2020. "Enhancing Clean Cooking Options in Peri-Urban Kenya: A Pilot Study of Advanced Gasifier Stove Adoption." *Environmental Research Letters*. https://doi.org/10.1088/1748-9326/ab865a.

[10] USAID. 2023. "USAID Alternatives to Charcoal - Cost of Cooking Study - Full Report." USAID.

[11] ESMAP. 2023. "Unlocking Clean Cooking Pathways - A Practitioners Keys to Progress." Washington DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099095503072317708/p1742320fcb6a8051083c008061576a2156.

[12] Kojima, Masami. 2022. "Cooking with Bottled Gas - Issues and Challenges in Developing Countries." ESMAP Papers. Washington DC: World Bank. http://hdl.handle.net/10986/38418.

The economic advantage of using a locally produced fuel is also evident when considering the volatility of LPG prices (the free-on-board prices have historically varied by a factor of 8,5[13]) and the need for foreign exchange which is an increasingly serious constraint in many countries in Africa. The ongoing devaluation of local currencies adds further economic stress to many states of SSA[14, 15] and puts the sustainability of imported fuels for clean cooking in question.
The IEA estimates that during the latest price spike, 100 million new LPG users were forced to revert back to traditional cooking fuels because the price surpassed the widely used World Bank affordability threshold of 5% of monthly income (which is at least 10 times higher than spending on cooking energy in high-income countries).[16]
A recent study indicated that for low-income households in rural India to switch their entire cooking to LPG, a 14.2kg cylinder would have to cost USD 3, or USD 21c/kg - about a third of current FOB prices.[17] This further underlines the fact that significant subsidies are needed if LPG is to play a sizable role in low-income countries. In the IEA's Access for All scenario, the subsidies on LPG and electricity would have to amount to between 60-85% of the costs on average to bring them down to levels consistent with the 5% threshold – amounting to USD 40-55 billion annually by 2030. Many SSA countries do not have the capacities to sustain enough dedicated public funding and would have to rely on international funds through different financing instruments.[18] The resulting situation would essentially be that low-income countries are dependent on both, the suppliers of LPG and the suppliers of financial means. Also, one to two thirds of the funds for LPG subsidies (depending on the FOB to retail price ratio) would not stay in the country but directly flow to LPG producing countries, mostly in the middle east.

Another important factor to consider is the significant reduction of jobs and local low-level opportunities to generate some income when societies are switching from traditional bioenergy use such as charcoal and firewood to LPG. The employment factor per household or energy delivered for LPG is considered to be 20 times lower than that of charcoal and ten

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[13] Kojima, Masami. 2021. "Subsidizing Bottled Gas: Approaches and Effects on Household Use." ESMAP Papers. Washington DC: World Bank. http://hdl.handle.net/10986/35948.

[14] https://www.imf.org/en/Blogs/Articles/2023/05/15/african-currencies-are-under-pressure-amid-higher-for-longer-us-interest-rates

[15] IMF. 2023. "Regional Economic Outlook. Sub-Saharan Africa: The Big Funding Squeeze." International Monetary Fund. https://www.imf.org/en/Publications/REO/SSA/Issues/2023/04/14/regional-economic-outlook-for-sub-saharan-africa-april-2023#Managing-Exchange-Rate-Pressures-in-Sub-Saharan-Africa—Adapting-to-New-Realities.

[16] IEA. 2022. "World Energy Outlook 2022." https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf.

[17] Jeuland, Marc, Manish A. Desai, Elizabeth F. Bair, Nafeesa Mohideen Abdul Cader, Durairaj Natesan, Wilson Jayakaran Isaac, Sankar Sambandam, Kalpana Balakrishnan, Gurusamy Thangavel, and Harsha Thirumurthy. 2023. "A Randomized Trial of Price Subsidies for Liquefied Petroleum Cooking Gas among Low-Income Households in Rural India." *World Development Perspectives* 30 (June): 100490. https://doi.org/10.1016/j.wdp.2023.100490.

[18] Kar, Abhishek, Roshan Wathore, Arunabha Ghosh, Shruti Sharma, Emily Floess, Andrew Grieshop, Rob Bailis, and Nitin Labhasetwar. 2023. "Promoting the Use of LPG for Household Cooking in Developing Countries," July. https://policycommons.net/artifacts/4464826/promoting-the-use-of-lpg-for-household-cooking-in-developing-countries/5262101/.

times lower than that of firewood.[19, 20] As the charcoal and firewood sectors are to a high degree informal, their size in terms of volume, jobs and revenue is hard to estimate. According to FAO statistics, Africa produced more than 37 million tons of charcoal in 2022.[21] IEA's 2023 report on Clean Cooking states an estimate of *"up to 7 million people"* employed. However, the reference given by the IEA, a 2011 World Bank report, provides a rough estimate of *just* the charcoal industry in Sub-Saharan Africa, stating it "*was worth more than US$8 billion in 2007, with more than 7 million people dependent on the sector for their livelihoods*.". It also states that *"it must be acknowledged that estimating employment in a largely informal sector is difficult and likely to lead to an undercount, which further confirms the potential of this sector for local employment and poverty alleviation."*.[22] Thus, switching from traditional biomass to a cooking system based on imported fossil fuels could have dramatic negative effects on national and local economies and job markets, mostly impacting poorer rural communities and smallholder farmers.

Local pellet production has the potential to substitute the jobs or revenue generation both quantitively and qualitatively because it is also based on local solid biomass, the product is solid biomass, and the value chain is similar. Depending on the biomass and the pelleting equipment used, the superior overall efficiency of the pellet system versus traditional bioenergy systems in terms of primary biomass per useful energy delivered does not have to directly translate to fewer jobs or local income generation possibilities. Especially small, more manual pellet production sites that use agricultural or wood residues or purpose grown crops such as elephant grass or short rotation coppice from local farms can introduce significant additional revenues as well as jobs to the local communities. As pellets are solid biomass like charcoal and fuelwood, with similar or superior characteristics in terms of safety, handeling and transport, the logistics and retail value chain could essentially be equivalent. Also, gasifier cookstoves can be produced or assembled locally.

Comparing overall investment costs into a modern cooking infrastructure

Electric cooking is often promoted as the best option to convert traditional cooking to modern cooking. While electrification is fundamental for development, it is worth paying attention in this context to the costs that the development of infrastructure for that purpose will bear, especially for connections that can support cooking in rural areas.

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[19] FAO, and IEA Bioenergy. 2010. "Criteria and Indicators for Sustainable Woodfuels." Rome: FAO. https://www.fao.org/3/i1673e/i1673e00.pdf.

[20] Lee, Chih-Jung, Rebekah Shirley, Maureen Otieno, and Hope Nyambura. 2021. "Powering Jobs: The Employment Footprint of Clean Cooking Solutions in Kenya." *Energy, Sustainability and Society* 11 (1): 27. https://doi.org/10.1186/s13705-021-00299-0.

[21] https://www.fao.org/faostat/en/ - data/FO

[22] Haider, Syed Waqar, Besnik Hyseni, and Klas Sander. 2011. "Wood-Based Biomass Energy Development for Sub-Saharan Africa : Issues and Approaches (English)." ESMAP Papers. Washington DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/843941468009629566/wood-based-biomass-energy-development-for-sub-saharan-africa-issues-and-approaches.

A recent study on the cost of electrifying all households in 40 Sub Saharan African countries, conducted by ETH Zürich, Princeton, MIT and Rwandan researchers, estimated that the *least-cost* electrification in SSA at Tier 3 (of the ESMAP-Multi Tier Scala – min. 200W and 1 kWh/day per household[23]), can be provided at an average levelized cost of energy (LCOE) of 14c USD/kWh with a total investment cost of $203bn for an estimated 952 million people in 2030. For a cooking compatible electricity supply of at least Tier 4 (min. 800W and 3,4 kWh/day) the average LCOE would be 11c USD/kWh and the total investment costs would double to $408bn – 428 USD per person on average. It also finds that Tier 4 electrification relies much more heavily on the grid and that the Tier 4 costs start to increase substantially for the 40% of the population that is hardest to electrify, reaching LCOE costs of more than 30c USD/kWh.[24]

The cost for a western standard pellet mill producing 30.000t of pellets a year is around 6 million USD, assuming wet raw material as e.g. bagasse – the residue of sugar mills. Mills using Chinese equipment can come in at significantly lower costs. The annual demand for pellets of a 5-person household is according to existing experiences around 500kg. That means an investment of 20 USD per person is needed, to create the infrastructure of producing fuel – a factor of 20 lower than the needed investment into an electric supply system achieving Tier 4 supply. This is significant, as capital costs are especially high in developing countries and are often cited as a key obstacle hampering clean and renewable energy investment.[25] The production costs of pellets can vary between $100 and $200 per ton. Assuming approximately $50 per ton for regional transport and distribution, pellets have an LCOE of 3 - 5,5c USD/kWh - between half the costs and one tenth of the costs of electricity supply for cooking.

Currently 50% of the population, over 560 million people, have still no access to electricity and electricity supply is weak with frequent outages in many countries in sub-Saharan Africa.[26] Also, in many countries a significant share of electric generation is based on fossil fuels and cannot be considered as sustainable either.[27]

Pellets could facilitate a fast and cost-efficient transition of the energy system from traditional bioenergy use to a mix of modern bioenergy and electricity. Generally, a domestic pellet industry would be well suited to complement an energy system based on renewables such as wind and solar, as pellets are by far the cheapest way to store renewable energy and particularly economic when it comes to provide heat. Sub-Saharan Africa could, to a large

[23] Mikul, B. & Angelou, N. Beyond Connections - Energy Access Redefined. (Energy Sector Management Assistance Program, Washington, 2015). https://www.esmap.org/node/56715

[24] Egli, Florian, Churchill Agutu, Bjarne Steffen, and Tobias S. Schmidt. 2023. "The Cost of Electrifying All Households in 40 Sub-Saharan African Countries by 2030." *Nature Communications* 14 (1): 5066. https://doi.org/10.1038/s41467-023-40612-3.

[25] https://www.iea.org/commentaries/cost-of-capital-survey-shows-investments-in-solar-pv-can-be-less-risky-than-gas-power-in-emerging-and-developing-economies-though-values-remain-high

[26] IEA, IRENA, UNSD, World Bank, WHO. 2023. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC. © World Bank. License: Creative Commons Attribution—NonCommercial 3.0 IGO (CC BY-NC 3.0 IGO).

[27] Hannah Ritchie and Pablo Rosado (2020) - "Electricity Mix" Published online at OurWorldInData.org. Retrieved from: https://ourworldindata.org/electricity-mix [Online Resource]

extent , leapfrog the fossil age by combining modern bioenergy use with renewable electricity supply.

Scalable production

It is a unique feature of pelletization, that due to the simplicity of the process pellet production can be realized both with small, decentralized units that can produce a few tons of pellets per day and larger industrial units producing 100t or even 1000t per day. The scale of production is thus not an issue of technology and only to some extent a matter of economies of scale but mainly an issue of sustainable raw material availability. Processing costs of a pellet mill may vary between 50 – 100 USD/t. Depending on the cost of raw material overall production costs typically vary between 100 – 200 USD/t[28, 29], resulting in market prices way below the costs of competing fuels.

It should be noted that investigations are still needed to determine the most cost-effective approaches for reliable and consistent small-scale production. Most pelleting plants in the past were dedicated to industrial-scale production.

The advantages of using locally available and renewable resources

What makes pellet cooking particularly attractive is the fact, that gasifying cookstoves work well with a wide range of pelletized raw materials. This means that most locally available residual biogenic materials can be used and upgraded to a valuable renewable fuel. Most attractive from an economic point of view are residues that result from processing units such as sugar mills, rice mills, processing of groundnuts, coffee, or other biomass processing industries such as sawmills.

Residues from harvesting such as corn cobs, straw, cotton stalks etc. are also attractive possible sources of raw material. Finally, purpose-grown crops such as Elephant grass or Napier grass can provide useful raw material. A family could grow all its annual fuel demand on a plot of approximately 10x25 m of Napier grass. Very attractive income possibilities for rural areas can result from producing biomass for fuel: assume a typical world market price for dry biomass of 50 - 100 USD/t and a productivity of 20t of dry biomass per hectare in good growing conditions.

Generally, the transition from traditional bioenergy to modern bioenergy results in many positive changes, socioeconomic as well as environmental. For example, shifting from informal to formal markets results in GDP and tax revenue growth as well as in a more controlled and sustainable biomass use. Also, modern bioenergy introduces more value addition down the processing line and opens the possibility to use, and add value to certain

[28] Nunes, L.J.R., J.C.O. Matias, and J.P.S. Catalão. 2014. “Economic and Sustainability Comparative Study of Wood Pellets Production in Portugal, Germany and Sweden.” *Renewable Energy and Power Quality Journal*, April, 526–31. https://doi.org/10.24084/repqj12.390.
[29] Uasuf, Augusto, and Gero Becker. 2011. “Wood Pellets Production Costs and Energy Consumption under Different Framework Conditions in Northeast Argentina.” *Biomass and Bioenergy* 35 (3): 1357–66. https://doi.org/10.1016/j.biombioe.2010.12.029.

raw materials or residues that would otherwise be useless. Furthermore, it increases substantially the overall efficiency of the bioenergy system and thus results in much less primary biomass used for the same amount of energy, reducing the strain on the environment. The switch to modern bioenergy is also essential to reduce fossil fuel dependencies, that are unsustainable and unrenewable and, in the case of countries without significant foreign exchange or fossil fuel reserves at their disposal, burdensome and risky. [30, 31]

Activities needed to support the development of an African pellet industry

1) Un-used (processing) residue stock take

There are many studies looking at the theoretical, technical, and sustainable potentials of agricultural and wood residues, but they remain mostly based on statistical (FAO) data and are based on many assumptions. While these studies have their merit in bringing an overview of the potential quantity of different residues, they remain very much in the academic discourse and can only give a bird's eye perspective. A country or region wide stock take of the specific sites or hotspots of unused or inefficiently used residues, especially processing residues could create a concrete picture that can inform potential investment projects. One of the most important factors for a successful pellet production project is a sustainable and steady supply of biomass. Thus, knowing the locations, types and volumes of biomass residues that would be available is essential to project developers. A detailed stock take at the country level would significantly help the development of business cases for pellet and pellet-cooking as well as shine a spotlight on opportunities.

2) VAT reduction on pellets and gasifier cookstoves

There is widespread consensus that most modern clean cooking technologies like LPG and electric cooking have to be subsidized to be affordable to a sizable proportion of the population in low and lower-middle income economies. The IEA report on clean cooking is mentioning an additional 40-55 billion $ of annual subsidies that are needed.[32] While cooking with pellet-fed gasifier stoves offers significantly lower costs than LPG or electric cooking, maintaining a level playing field is fundamental for a healthy development of clean cooking solutions. An exclusion of VAT for pellets for cooking as well as cookstoves would contribute to this and balance the tax burden of pellets compared to charcoal and firewood.

3) Remove tariffs and duties from the imports of gasifier cookstoves and cookstove components

[30] Johnson, Francis X. 2017. "Biofuels, Bioenergy and the Bioeconomy in North and South." *Industrial Biotechnology* 13 (6): 289–91. https://doi.org/10.1089/ind.2017.29106.fxj.

[31] Bailis, Rob, and Mbeo Ogeya. 2020. "Envisaging Alternative Bioeconomy Pathways: A Case Study from Rwanda," August. https://www.sei.org/publications/envisaging-alternative-bioeconomy-pathways-a-case-study-from-rwanda/.

[32] Page 62 of IEA. 2023. "A Vision for Clean Cooking Access for All." Paris: International Energy Agency. https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all.

Reduction or removal of tariffs and duties on imported gasifier cookstoves reduces the upfront costs of buying a gasifier stove. Arguably, these costs represent the only major affordability challenge for pellet cooking, especially when they are not reduced, for example with pay as you go schemes or carbon credits.
Reduction or removal of tariffs and duties on imported components, for example precut metal sheets, fans, batteries etc. can make locally produced cookstoves more affordable while also strengthening the business case of cookstove production offering local jobs.

4) Assessment of low-cost production technology for small scale localized pellet production

Localized pellet production centers would offer an ideal replacement of employment in the firewood and charcoal supply chains. Collection of agricultural residues or production of dedicated crops such as Napier grass for use as raw material is labor intensive. Supply chains based on many localized production units can create a large number of jobs related both to raw material supply, pellet production, packaging, storage, logistics and fuel sales as well as cookstove assembly, sales and maintenance.

The missing link is proven technology that is both functional and affordable. Especially the raw material preparation is a challenging issue as pelletization only works within a small range of raw material humidity. Currently there is ample offer for small scale pelletizers but hardly any for appropriate raw material preparation that removes contaminations, secures correct levels of humidity, and operates safely and without dust exposure of workers. Assessing the best suited solutions for local pellet production and communicating the result is important to secure the success of this approach.

5) Capacity building activities

The development of pelleting projects as well as the operation of these projects requires extensive qualification activities. The same is true for pellet stove production and distribution – staff must be educated and aware of all relevant issues, from safety all the way to economic production and handling procedures, quality issues etc.

Training and train the trainers programs need to provide the know-how, that enables an independent and sustainable development of a local pellet economy.

6) Create access to preferential financing for pelleting plants and establish a quality management program linked to it

The availability of attractive financing for the initial investment into pellet production is an essential precondition for kicking off a genuine African pellet industry.

Experiences with pellet plants in Africa and other geographies have shown, that a lack of attention to health and safety issues can lead to serious problems. In Canada pellet plants were affected by fire and dust explosions with such a high frequency that insurance companies refused to offer insurance to new plants. Missing aspiration equipment in a pellet production plant will lead to high exposure of workers to airborne dust. Pellet production plants that do not include a careful control of raw material conditioning before the pelleting stage will suffer from quality issues and poorly planned projects will likely be affected by extensive downtime, with serious implications for the economic viability of the project.

To prevent such developments, it is suggested to implement a quality management scheme and link participation in this scheme to access to preferential financing conditions. Similar quality management schemes have been realized in comparable contexts with excellent outcomes.

A quality management scheme would consist of technical guidelines that need to be taken into account during project planning and development and a pool of experienced consultants that support local project developers and ensure that plants are designed in a way that allows them to operate safely, efficiently and produce a reasonable product quality. In this way also the economic feasibility of projects, which is highly dependent on a proper technical design can be granted.

Conclusions

Pellet cooking fulfills all criteria to be considered a modern sustainable cooking technology. It is clean, efficient, and based on renewable energy use. In addition, it offers unique advantages compared to other modern cooking technologies in terms of affordability and the creation of local employment and value-added.

The challenge of developing an African pellet cooking economy is, that it includes both the introduction of a new fuel and the introduction of a new stove technology. In order to enable pellet cooking it will be necessary to make the financing available for the capital investments needed, to ensure that the quality of the established production plants is adequate and to provide the capacity-building resources to train and educate all persons active in the value chain. It will also be necessary to ensure that there is a level playing field for every clean cooking technology including pellet cooking. As this approach is innovative it will also need resources for research and development as well as for monitoring of market introduction to identify early on issues that need to be addressed to ensure satisfied consumers and continued market uptake.

Contact

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