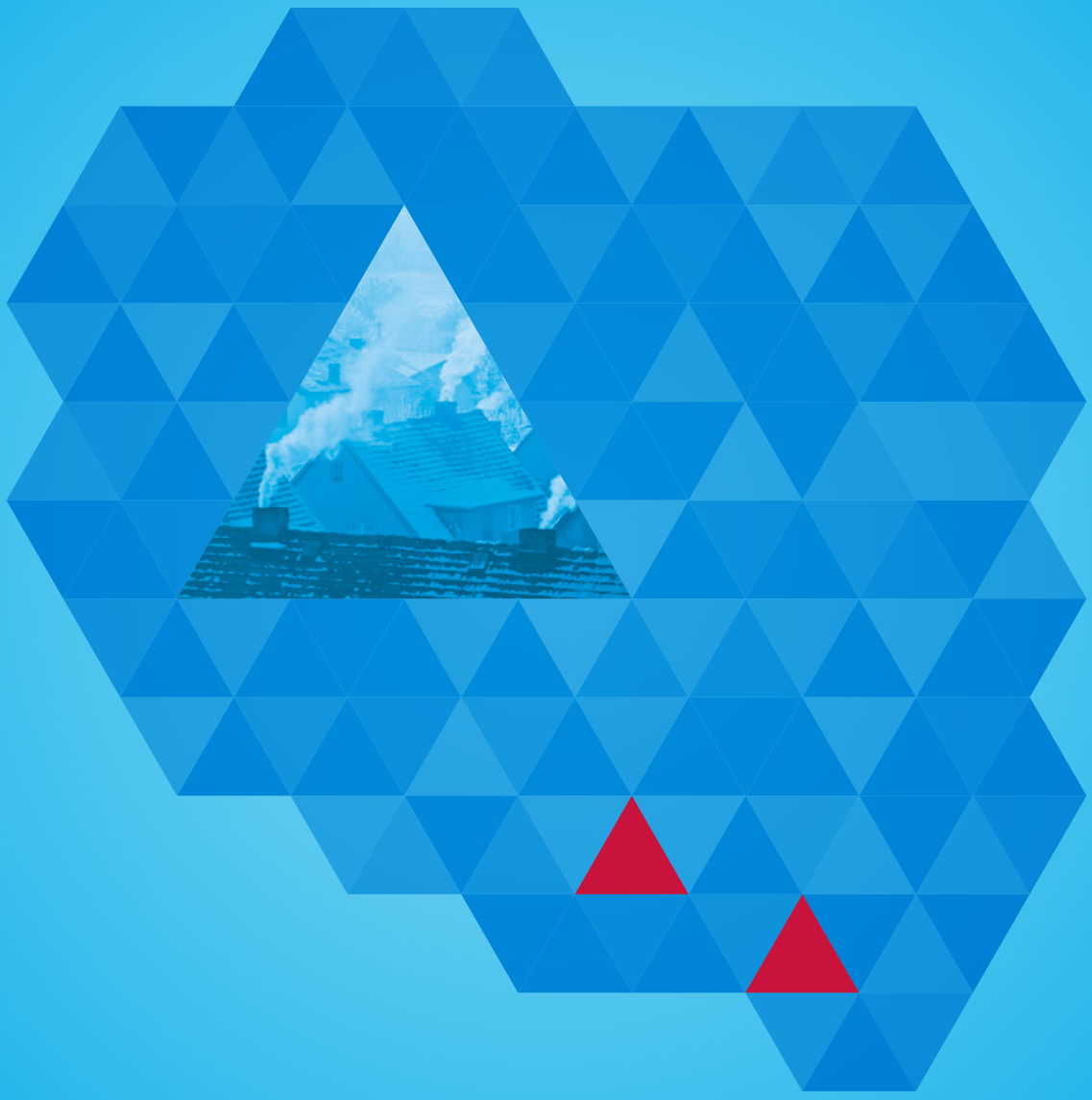
POLAND CATCHING-UP REGIONS 2

FIGHTING SMOG: ENERGY EFFICIENCY AND ANTI-SMOG IN SINGLE FAMILY BUILDINGS IN POLAND



European Commission
MINISTRY OF INVESTMENT AND ECONOMIC DEVELOPMENT
WORLD BANK GROUP

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FIGHTING SMOG: ENERGY EFFICIENCY AND ANTI-SMOG IN SINGLE FAMILY BUILDINGS IN POLAND

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WORLD BANK GROUP

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

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ABBREVIATIONS AND ACRONYMS

BGK	Poland Development Bank
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy efficiency
EIB	European Investment Bank
EU	European Union
ESCO	Energy service company
GoP	Government of Poland
IBS	Institute for Structural Research
IEE	Institute of Environmental Economics
IFI	International financial institution
LEME	List of Eligible Materials and Equipment
LIHC	Low income high cost
LoC	Line of credit
MoIED	Ministry of Investment and Economic Development
M&V	Monitoring and verification
NFOSiGW	National Fund for Environment Protection and Water Management
PFI	Participating financial institution
SFB	Single family building
TA	Technical assistance
WB	World Bank

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EXECUTIVE SUMMARY

KEY MESSAGES:

1. **The most cost-effective way to reduce both particulate and CO_2 emissions is to couple switching from non-compliant solid fuel boilers to gas boilers, heat pumps, renewable energy (RE) heating systems such as biomass, wherever possible, and compliant solid fuel boilers, as mandated in the anti-smog resolutions, with thermal retrofits of the single family building (SFB).** These options will also lead to fuel cost savings compared to the current polluting solid fuel boilers and will not require fuel purchase subsidies for poor SFBs in the long run. Boiler replacement and fuel switching must go hand in hand with thermal retrofit, since boiler replacement alone will increase fuel costs and CO_2 emissions, and thermal retrofit alone will have limited impacts on reducing air pollution. Full thermal retrofit of the SFB is recommended, because it will substantially reduce the size of new boilers and result in significant fuel savings and CO_2 emission reductions. Partial thermal retrofit costs less in upfront investment, but requires larger new boilers that will last for decades to come, and may increase the fuel bills which would require fuel subsidies for the poor.

2. **Anti-smog resolutions and enforcement are key to create market demand for boiler replacement and fuel switching, and solid fuel quality standards are essential to reduce air pollution.** Low market uptake of boiler replacement, fuel switching, and thermal retrofit would be the single biggest risk for the financial mechanisms of energy efficiency in SFBs. In the absence of government mandates for thermal retrofit, financial incentives in the form of upfront subsidies and tax breaks would be critical to increase market demand and penetration.

3. **The total investment needed to replace non-compliant solid fuel boilers and undertake *full* thermal retrofits for SFBs is estimated to be around PLN 30.1 billion (EUR 7.1 billion) in Małopolskie and Śląskie, and PLN 154.1 billion (EUR 36.3 billion) across the country,** of which the investment for poor SFBs would be PLN 4.7 billion (EUR 1.1 billion) in Małopolskie and Śląskie and PLN 23.5 billion (EUR 5.5 billion) across the country; and for non-poor SFBs PLN 25.4 billion (EUR 6.0 billion) in Małopolskie and Śląskie, and PLN 130.5 billion (EUR 30.7 billion) across the country. The total investment needed to replace non-compliant solid fuel boilers and undertake *partial* thermal retrofit for the SFBs is estimated to be around PLN 20.1 billion (EUR 4.7 billion) in Małopolskie and Śląskie, and PLN 104.5 billion (EUR 24.6 billion) across the country, of which the investment for poor SFBs would be PLN 2.9 billion (EUR 0.68 billion) in Małopolskie and Śląskie and PLN 14.5 billion (EUR 3.4 billion) across the country; and for non-poor SFBs PLN 17.2 billion (EUR 4.0 billion) in Małopolskie and Śląskie, and PLN 90 billion (EUR 21.2 billion) across the country.

4. **For the eligible poor SFBs, the government could provide 90-100 percent of subsidies for boiler replacement, fuel switching, and thermal retrofits, channeled through municipalities.** The poor SFBs are encouraged to pay at least 10 percent of the investments to ensure ownership and sustainability. The local governments could also consider fuel subsidies for an initial two-three years to help poor SFBs transition to improved fuels, even though fuel subsidies are not necessary nor sustainable in the long run, since full thermal retrofit reduces fuel bills.

5. **For the non-poor SFBs, the government could provide 20 percent subsidy for fuel switching to gas, heat pumps, and RE systems and thermal retrofit, together with tax incentives, channeled through commercial banks who would provide loans for the remaining investment.** The proposed upfront subsidies are intended to increase market uptake of fuel switching and thermal retrofit for non-poor SFBs and could be limited to the 60 percent of the lower income SFBs among non-poor SFBs. Additional subsidies could be considered to reward those non-poor SFBs for installing higher-than-standard efficient boilers and switching to RE. Furthermore, tax incentives (tax credits or tax deductions) for fuel switching and thermal retrofit, are recommended for all SFBs, though it is likely that SFBs in the top 40 percent of income would benefit the most from it.

6. **The subsidies required are estimated to be around PLN 6.7 billion (EUR 1.6 billion) in Małopolskie and Śląskie, and PLN 32.5 billion (EUR 7.6 billion) across the country, of which 90 percent subsidies for poor SFBs would be PLN 4.2 billion (EUR 1.0 billion) in Małopolskie and Śląskie, and PLN 21.2 billion (EUR 5.0 billion) across the country; and 20 percent subsidies for the 60 percent of the lower income of the non-poor SFBs PLN 2.4 billion (EUR 570 million) in Małopolskie and Śląskie, and PLN 11.3 billion (EUR 2.7 billion) across the country.** In addition, the commercial banks would finance an investment of PLN 23 billion (EUR 5.4 billion) to support non-poor SFBs in Małopolskie and Śląskie, and PLN 119.2 billion (EUR 28.0 billion) across Poland to replace solid fuel boilers and undertake full thermal retrofit.

7. **Given the large scale public funds needed, it is recommended that the government could prioritize providing subsidies first to SFBs in the most polluted 33 cities.** The subsidies required for the most polluted 33 cities are roughly estimated to be around PLN 3.3 billion (EUR 773 million), of which PLN 2.1 billion (EUR 503 million) would be for poor SFBs and PLN 1.1 billion (EUR 270 million) for the non-poor SFBs. This will provide a quick win and have a major impact on reducing air pollution in the country, with the minimum amount of required public funds. To this end, the national government is launching a pilot program that targets the 23 smaller cities among the 33 most polluted cities in Poland, to be implemented by BGK, where the national government provides 70 percent, regional governments 20 percent, and municipal governments 10 percent of subsidies for poor SFBs.

8. **The anti-smog and energy efficiency are long-term efforts, and the required subsidies could be programmed over a 10-year time period.** Annual subsidies are estimated to be around PLN 667 million (EUR 157 million) in Małopolskie and Śląskie, and PLN 3.3 billion (EUR 765 million) across the country, of which annual subsidies for poor SFBs would be PLN 424 million (EUR 100 million) in Małopolskie and Śląskie, and PLN 2.1 billion (EUR 498 million) across the country; and for non-poor SFBs PLN 243 million (EUR 57 million) in Małopolskie and Śląskie, and PLN 1.1 billion (EUR 268) million across the country.

9. **In the near term, Małopolskie and Śląskie regional and municipal governments could use the existing limited EU funds in the Regional Operational Program (ROP) to provide subsidies to the most polluted cities first.** In this regard, the regional and municipal governments could use the existing ROP funds to make the 30 percent contribution to the pilot national program that targets the 23 most polluted cities and to provide subsidies to other most polluted cities for boiler replacement, fuel switching, and thermal retrofit in SFBs.

10. **Given the huge needs for public funds, additional EU funds would be necessary to help Poland fight smog and improve energy efficiency in SFBs.** And concessional loans from multi-lateral development banks would be welcomed to provide credit lines through local participating banks to meet the huge financing needs for boiler replacement, fuel switching, and thermal retrofit.

11. **It is essential to coordinate the use of public funds from the government and EU at both the national and regional levels, and it is recommended that a National Fund for Anti-Smog and Energy Efficiency be established to pool various funding resources.** The entities who will manage the financial support and financing mechanisms for anti-smog and energy efficiency in SFBs should meet the following criteria: (a) a proven track record of experience to disburse public funds effectively, efficiently, and quickly; (b) a wide network with local commercial banks to channel funds through participating banks for non-poor SFBs; (c) the ability to work with regional and municipal governments to channel funds through them for poor SFBs; and (d) simple application and approval procedures, and streamlined process. Such a National Fund could have different implementing agencies, with commonly defined eligibility criteria and procedures and close coordination, and their roles and responsibilities could be split by market segments, for example, poor vs non-poor SFBs. The national government could provide 70 percent, regional government 20 percent, and the SFBs or municipal government could cover the remaining 10 percent of investments.

12. **Finally, technical assistance, capacity building, and public education and awareness campaigns are critical to the success of the anti-smog and energy efficiency program.** In particular, the municipal governments would require substantial technical support from energy advisors to undertake walk-in energy audits, prioritize SFBs, and conduct monitoring and reporting. In addition, standardized IT systems, agreement for procurement, etc. for all the municipalities would simplify the procedures and greatly help the municipalities to manage such programs. Furthermore, public education campaigns to raise awareness and change people's behavior towards clean energy are equally important and should be an integral part of such programs.

13. **The World Bank team will discuss with the EC and the national/regional governments to define the scope of work for the next phase of this study from July 2018 to June 2019.** The next phase of this study could (a) help develop detailed program design and operationalize the financial support and financing mechanisms for anti-smog and energy efficiency in SFBs; and (b) undertake a market analysis of the demand from SFBs to better understand the market uptake for these investments.

1. OBJECTIVE OF DEVELOPING FINANCIAL INSTRUMENTS TO SUPPORT SFBs

Poland plans to reduce low-stack air pollution through energy efficiency (EE) upgrades of Single Family Buildings (SFBs). The World Bank (WB) is supporting the Government of Poland (GoP) to design financial instruments and delivery mechanisms for the implementation of thermal retrofits and replacement of non-compliant solid fuel boilers. Poland has about 5.4 million SFBs and about 50 percent of Poles (about 19 million people) live in SFBs. Two regions (Małopolskie and Śląskie) were selected as pilot regions for this project; together they have approximately 1.1 million SFBs. In general, the WB recommends the creation of a single anti-smog and energy efficiency fund that would help finance the replacement of non-compliant boilers and thermal retrofits in the poor SFBs, and a commercial solution for the non-poor SFBs coupled with tax incentives and targeted subsidies. Such an approach would ensure coordination of EE activities at various levels of government in Poland.

The design and deployment of financial instruments and support mechanisms to encourage EE practices in SFBs is driven in large part by the objectives of the program and the priorities of the GoP. The GoP wishes to prioritize both reduction of particulate emissions and improved energy efficiency in SFBs. Anti-smog resolutions adopted by some regions in Poland mandate the replacement of solid-fuel boilers not compliant with new regulations as per a defined timeline. The Małopolskie and Śląskie regions were the first to pass such resolutions1, and the WB team based its analytical work on data and information from these two regions. The replacement of non-compliant solid fuel boilers with boilers compliant with new regulations has a significant impact on reducing air pollution. But this will also increase fuel costs for SFBs which will have to purchase higher quality and higher priced fuels for the new boilers compared to cheaper fuels such as poor quality coal, firewood and trash they may have used earlier. Regulations do not however mandate existing SFBs to undertake thermal retrofits.2 Thermal retrofits of SFBs to meet present building codes would substantially lower the heat load of the dwelling and enable a lower capacity efficient boiler to be installed, thereby significantly lowering energy use and CO_2 emissions. While thermal retrofits of SFBs is beneficial, it entails a significant investment and has limited impact on reducing air pollution.

The WB presented its initial findings in its Interim Report to the GoP in December 2017, which was discussed at a stakeholder meeting in January 2018. Based on discussions with the GoP and its agencies and the European Commission (EC), it was decided that the financial support mechanisms and instruments should support both replacement of non-complaint solid fuel boilers and thermal retrofits of SFBs.

Based on the stakeholder meeting in January 2018 and stakeholder consultations in May 2018, the revised scope of this study was to develop financial support mechanisms and financial instruments to support the poor and non-poor SFBs in Małopolskie and Śląskie regions and across Poland, respectively, to replace non-compliant solid fuel boilers, switch to cleaner fuels, and undertake full or partial thermal retrofits.

The above is a significant departure from the original scope of this WB support program when it was initiated in mid-2017. At the time, the objective was to develop financial instruments to support SFBs in Małopolskie and Śląskie regions to replace non-compliant solid fuel boilers in compliance with the requirements of the anti-smog resolutions to reduce air pollution. The revised objectives will have a much greater impact on air pollution, energy use, and CO_2 emissions, but will entail a significantly higher investment, some of which may have to be subsidized to incentivize SFBs to implement measures not mandated by any regulations.

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[1] In Małopolskie, all non-compliant boilers have to be replaced by the end of 2026 with solid fuel boilers that comply with eco-design requirements, gas heating, district heating, electricity, heat pump, or light fuel oil boiler as permitted by regulations. In Śląskie, all non-complaint solid fuel boilers have to be replaced by 2027 with Class 5 norm boilers or other heating equipment permitted by regulations. Both regions have a phased implementation schedule for replacement of non-compliant boilers.

[2] Building codes for new construction include thermal insulation guidelines. But existing SFB stock is grandfathered in and not mandated to install insulation.

Given the high investment needs and funding for subsidies, the WB team recommends that the GoP prioritize implementation of a program in regions with anti-smog resolutions, and/or the 33 most polluted cities in Poland. The program could later be rolled out across the country. To present the GOP with a range of options, the WB has analyzed the following market segments to reduce air pollution and improve energy efficiency in SFB's.

- Poor and non-poor SFBs in Małopolskie and Śląskie regions
- Poor and non-poor SFBs in the 33 most polluted cities in Poland
- Poor and non-poor SFBs across Poland

The investment and subsidy needed and program impacts (reduction in air pollutants, energy savings, CO_2 reduction, etc.) for each of the above market segments has been estimated based on SFBs shifting from old non-compliant solid fuel boilers to gas boilers, heat pumps and coal boilers that meet regulatory standards, and undertaking partial or full thermal retrofitting of SFBs.

It is important to note that the design of financial instruments and incentive mechanisms to support a regulatory mandate – replacement of non-compliant boilers in SFBs – has the objective to support SFBs compliance with the mandatory new regulations recognizing that the investment required may be a barrier for certain segments of homeowners. On the other hand, instruments and mechanisms to support thermal retrofits of existing SFBs are not linked to any regulatory mandate and are designed to improve energy efficiency in SFBs. Thus, financial instruments and mechanisms designed to support replacement of non-compliant boilers are likely to have higher uptake compared to instruments for thermal retrofits. In consultation with the GoP and the EC, and consistent with the revised objectives of this study, the WB has developed two broad categories of financial instruments: financial support mechanism to support poor SFBs and incentivize non-poor SFBs, and financial instruments to support non-poor SFBs.

2. OPTIONS TO REDUCE AIR POLLUTION AND IMPROVE ENERGY EFFICIENCY

The stakeholder meeting in January 2018 gave clear direction that the GoP's objective is to develop a program to reduce air pollution and improve energy efficiency through thermal retrofits of SFBs. This is logical, since thermal retrofits of SFBs can lower the heat demand of SFBs and the capacity of boilers and save fuel costs.

Poland can reduce air pollution and improve energy efficiency in SFBs through the replacement of non-compliant solid-fuel boilers with coal and gas boilers, heat pumps, and other heating systems that meet regulatory and building codes, coupled with thermal retrofits of SFBs (Table E.1). Thermal retrofits of SFBs results in substantial fuel cost savings but are quite expensive and have a limited impact on reducing air pollution. Given the high cost of thermal retrofits, the option of partial thermal retrofits, especially for poor SFBs, largely financed through public subsidies, was also examined. But, it was not the most cost-effective option given the high capital costs and the lower energy savings. Thus, consistent with the GoP's objectives to improve energy efficiency, this study recommends boiler replacements and full thermal retrofits of SFBs.

As noted above the WB team has separately analyzed the opportunity for improving heating systems in SFBs in Małopolskie and Śląskie regions, SFBs in the 33 most polluted cities, and SFBs across Poland. Initially, the WB had considered different options for poor SFBs and non-poor SFBs based on access and cost of more expensive fuels such as gas and electricity. But based on discussions with stakeholders, the analysis has been revised to include all heating system options for all SFBs. The WB recommends the following options for poor and non-poor SFBs to reduce air pollution and improve energy efficiency.

POOR AND NON-POOR SFBs IN POLAND

Switching from non-compliant solid fuel boilers to gas boilers, renewable energy (RE) such as biomass, and heat pump, coupled with full thermal retrofits, is not only the most cost-effective way to reduce both particulate and CO_2 emissions, but also results in savings in fuel costs. It is recommended that all SFBs currently connected to gas networks (about 40 percent of the SFBs across Poland), switch from non-complaint solid fuel boilers to gas boilers. The savings in fuel costs when switching to gas boilers along with thermal retrofits of the SFB will obviate the need for fuel purchase subsidies for poor SFBs.

Some regions in Poland, such as Małopolskie, have well developed gas networks with an estimated 64 percent of SFBs having access to gas and have the opportunity to make a larger shift to gas boilers compared to Śląskie where about 36 percent of SFBs are estimated to have access to natural gas. Rural areas have lesser access to natural gas networks compared to urban areas, and poor SFBs in rural areas are less likely to have an opportunity to shift to natural gas for heating. The analysis for Małopolskie and Śląskie is based on available information on the gas network coverage in urban and rural areas. For the 33 most polluted cities and for SFBs across Poland, the analysis is based on the estimated nation-wide average for gas connectivity.

Expansion of the natural gas network to connect a higher proportion of SFBs would enable a greater shift from solid fuel boilers to gas boilers. While this option will further reduce energy consumption, air pollution, and CO_2 emissions,3 the cost to expand the gas network to SFBs vis-à-vis the benefits is yet to be examined. Preliminary discussions with a gas utility indicate that it may be possible in future to develop localized natural gas networks through distributed LNG terminals.

The heat pump option is constrained by the higher installation cost of heat pumps and the presently limited supply of heat pumps in Poland. It is assumed that about four percent of the SFBs may switch to heat pumps, which roughly doubles the percentage of SFBs presently using heat pumps. The use of heat pumps without thermal retrofits of the SFBs is not recommended since expenditure on electricity would be very high in a poorly insulated or uninsulated SFB. Poor SFBs are thus unlikely to switch to heat pumps in the absence of high subsidies to install the system and insulate the SFB. The savings in fuel costs when switching to heat pumps with thermal retrofits of the SFB will obviate the need for fuel purchase subsidies for poor SFBs.

Replacement of non-compliant solid fuel boilers with compliant coal boilers, mandated by the anti-smog resolutions, coupled with full thermal retrofits, can reduce both particulate and CO_2 emissions, and result in fuel cost savings. This is recommended for poor and non-poor SFBs that are presently not connected to the gas network or switching to heat pumps. It is also recommended that a program to support switching to improved coal boilers be coordinated with gas utilities to examine if there is an opportunity to expand the gas network and instead switch to gas heating.

Partial thermal retrofits costs less in upfront investments than full thermal retrofits but requires larger-than-necessary new boilers that will last decades to come. Boiler replacement from non-compliant solid fuel boilers to compliant coal boilers plus partial thermal retrofits would result in marginal fuel cost savings but make the poor SFBs vulnerable to future potential fuel price increase. For fuel switching from coal boilers to gas boilers plus partial thermal retrofit, the fuel bills would increase, which may require fuel subsidies for the poor. Therefore, the WB recommends full thermal retrofits for poor SFBs to ensure sustainability. For the non-poor SFBs, since there is no mandate for thermal retrofit and the financial incentives are limited, the non-poor SFBs may choose partial thermal retrofits, but financial incentives should be provided to incentivize full thermal retrofits only.

[3] If the natural gas network connection to SFBs were expanded to over three-fourths of the SFBs (from 40 percent at present), and these SFBs were to all switch to gas boilers, and a further 15 percent of SFBs were to switch to heat pumps with under 10 percent of SFBs using coal boilers, annual fuel savings (GJ) would increase by 17 percent over the base case analysis but annual expenditure on fuel by SFBs would increase by about 79 percent. This option would further reduce CO_2 emissions by over 42 percent, and particulate emission would further reduce by less than 2 percent. The increased shift to gas and heat pumps would lower overall investments for non-poor SFBs by about 4 percent (not including the cost of expanding the gas network which could be substantial). Thus, the expanded use of natural gas for heating is recommended if energy savings and a reduction in CO_2 emissions is a priority.

TABLE E.1.
Cost (PLN) and Emission Reductions from Replacement of Old Solid-Fuel Boilers with Alternative Technologies and Thermal Retrofits in a single SFB

COSTS AND EMISSION REDUCTIONS OF REPLACEMENT OF OLD COAL BOILER AND THERMAL RETROFIT OF SFBs											
	Replacement with ECO-design coal boiler	ECO- design coal boiler +partial thermal retrofit of SFB***	ECO- design coal boiler +full thermal retrofit of SFB****	Switching from old coal to gas boiler	Gas boiler + partial thermal retrofit of SFB***	Gas boiler + full thermal retrofit of SFB****	Switching from old coal boiler to heat pump	Heat pump + partial thermal retrofit of SFB***	Heat pump + full thermal retrofit of SFB****	Partial thermal retrofit only***	Full thermal retrofit only****
Annual Fuel savings(GJ)	-14.7	57.5	98	12.6	72.8	106.5	112.0	128.4	137.6	42.4	89.6
Annual fuel cost savings (PLN)*	-1,857	501	1,825	-3,794	-584	1,219	-2.500	141	1,624	995	2,101
Total investment**(PLN)	13,500	38,500	63,500	7,500	32,500	57,500	25,000	50,000	75.000	25,000	50,000
Annual reduction in particulate emissions (kg)	95	97	98	100	100	100	100	100	100	28	60
Annual reduction in CO_2 emissions	-4.1+	1.9	5.3	2.4	5.5	7.3	1.1	4.8	6.9	2.7	5.7

+ The automatic-fed coal boiler consumes more coal than the old solid fuel boiler and replaces the use of wood. It also consumes electricity for its operations.
* The new coal boiler requires higher priced coal; gas and electricity are more expensive than coal.
** A 5-10 kW automatic Ecodesign coal boiler costs about 9,000 PLN; a gas boiler costs about 4,000 PLN; and a heat pump costs about 20,000 PLN. This is in comparison to about 2,500 PLN for a "smoker" or manually fed boiler (total investment Includes cost of duct work and installation cost for new boiler; does not include replacement of heaters and heat control devices mounted on heaters).
*** Partial retrofits include wall insulation and modernization of the central heating system components.
**** Full retrofits include wall, roof, and floor insulation, and modernization of the central heating system components.

3. INDICATIVE INVESTMENTS NEEDED TO SUPPORT SFBs IN POLAND

ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

Małopolskie and Śląskie have both adopted anti-smog resolutions and are utilizing funds from the EC's Regional Operational Program (ROP) and other sources of financing support SFBs replace non-compliant solid fuel boilers. The two regions are also keen to utilize available funds to support heating system replacement and thermal retrofits of SFBs as suggested by the WB. The GoP could consider prioritizing launching a program initially in these two regions. The learning from implementing programs in the two regions would be useful to launch a nation-wide program to support poor and non-poor SFBs.

Poor SFBs in Małopolskie and Śląskie. The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the two regions, is estimated to be about PLN 4.7 billion (EUR 1.1 billion, see Table 2). This estimate assumes that old solid fuel boilers are replaced in all eligible poor SFBs, which account for 10 percent of the SFBs in the two regions.[4] It is further assumed that about 80 percent of these poor SFBs will be thermally retrofitted under the program.[5] Thermal retrofits of poor SFBs in the two regions has a significant cost implication and represents about three-fourths of the total estimated investment.[6]

Given the high cost of thermal retrofits, stakeholders had suggested examining the option of lower cost and partial retrofits of poor SFBs. An analysis of the potential for energy savings vis-à-vis the cost of retrofits indicated that partial retrofits would be a less cost-effective option compared to full retrofits.[7] The investment analysis thus assumes full thermal retrofits of poor SFBs in the two regions.

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[4] The total investment required to support poor SFBs is lower than the estimate provided in the Interim Draft report presented in December 2017 since poor SFBs are estimated to constitute only 10 percent of SFBs as opposed to 20 percent assumed earlier.

[5] World Bank. Poland: Diagnostic Assessment and Analysis of Energy Efficiency Opportunities and Strategies in Single-Family Buildings. Completed in September 2017. Instytut Ekonomii Środowiska (Institute for Environmental Economics, IEE) estimated SFBs that require replacement of boilers and thermal retrofits based on surveys conducted in 2016 by Atmoterm S.A., data from the Central Statistical Office, and its own estimates. The average cost of replacing boilers and thermal retrofits of SFBs was estimated based on data gathered from equipment manufacturers by the IEE.

[6] A full thermal retrofit of a SFB is defined as insulation of walls, roof, floor and modernization of the heating systems including piping, radiators, thermostats/regulators all done to code specifications. The cost of thermal retrofits also varies significantly. While, the IEE estimated the cost of a full thermal retrofit to be about PLN 81,703, anecdotal information from equipment installers indicates that the cost of a thermal retrofit of an SFB could vary from PLN 25,000 to PLN 50,000 since many SFBs have some insulation. This analysis assumes that the average cost of a full thermal retrofit of an SFB to be PLN 50,000.

[7] Insulation of only the walls of the SFB and modernization of the heating systems (partial retrofits) at a cost of PLN 35,000, which can reduce the heat load of an SFB by about 44 percent (at about 70 percent of the cost of a full retrofits) was also analyzed. The analysis indicated that from the standpoint of reducing air pollution, it would be better to undertake a full retrofit since a partial retrofit would result in lower fuel cost savings and less than 10 percent reduction in CO_2 emissions compared to a full retrofit of the SFB.

TABLE E.2.
Indicative Funds Required to Support Poor SFBs in Małopolskie and Śląskie Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	53,610	13,500	PLN 723.74m (EUR 170.29 m)
Replacement of coal/solid fuel to new gas boilers	33,750	7,500	PLN 253.13 m (EUR 59.56 m)
Replacement of coal/solid fuel to new heat pumps	3,640	25,000	PLN 91.0 m (EUR 21.41 m)
Partial thermal retrofits[2]	72,800	25,000	PLN 1,820.0 m (EUR 428.24 m)
Total with partial retrofits			2,887.86 m (679.50 m)
Full thermal retrofits[2]	72,800	50,000	PLN 3,640.0 m (EUR 856.47 m)
Total with full retrofits			PLN 4,707.86 m (EUR 1,107.73 m)

[1] IEE has estimated that 910,000 SFBs (out of total 1.1m SFBs) in the two regions require replacement of solid fuel boilers to comply with the anti-smog resolutions. IBS has estimated that in Poland on average 10 percent of SFBs are poor. For that reason, 10 percent of the 910,000 SFBs that need boiler replacement are assumed to be poor (91,000 SFBs). Based on access to a gas network in Małopolskie and Śląskie, it is assumed that 50 percent and 25 percent of the poor SFBs in the two regions, respectively, will switch to gas heating. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.

[2] 80 percent of the poor SFBs that would need to replace boilers as mandated by anti-smog resolutions are estimated to need thermal retrofits under the program (72,800 SFBs). The cost of thermal retrofits varies significantly. While, the IEE has estimated cost of full thermal retrofits for a typical SFB to be about PLN 81,703, anecdotal information from equipment installers indicates that the average cost of a full thermal retrofits of an SFB is PLN 50,000. This analysis assumes that the average cost of a full thermal retrofits of an SFB ranges is PLN 50,000. The investment required for retrofit would be much higher if the costs were PLN 81,700. The cost of partial retrofits is estimated to be PLN 25,000.

[i] The estimates in this table are based on average costs of boiler replacements and thermal retrofits in an average sized SFB.

[ii] Cost of the program implementation/administration (energy assessment of SFBs, processing and evaluation of applications/proposals, disbursement of funds, monitoring and verification, etc.) is not included in the estimates shown in this table.

Non-Poor SFBs in Małopolskie and Śląskie. Non-poor SFB in the two regions would need to invest about PLN 25.4 billion (EUR 6.0 billion, see Table E.3) to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards, and undertake full thermal retrofits. Since non-poor SFBs may only receive a partial subsidy as an incentive from the state, home owners would have to finance much of this investment from personal savings and commercial loans. It is thus likely that non-poor SFBs may only undertake partial or no retrofits since it is not mandated by regulations. Replacement of non-compliant boilers is however mandated by anti-smog resolutions in the two regions.

TABLE E.3.
Indicative Funds Required to Support Non-Poor SFBs in Małopolskie and Śląskie Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	380,520	13,500	PLN 5,137.0 m (EUR 1,208.71 m)
Replacement of coal/solid fuel to new gas boilers	405,720	7,500	PLN 3,042.90 m (EUR 716.00 m)
Replacement of coal/solid fuel to new heat pumps	32,760	25,000	PLN 819.0 m (EUR 192.71 m)
Partial thermal retrofits[2]	327,600	25,000	PLN 8,190.0 m (EUR 1,927.0 m)
Total with partial retrofits			PLN 17,188.92 m (EUR 4,044.45 m)
Full thermal retrofits[2]	327,600	50,000	PLN 16,380.0 m (EUR 3,854.12 m)
Total with full retrofits			PLN 25,378.92 m (EUR 5,971.51 m)

[1] 90 percent of the 910,000 SFBs in Małopolskie and Śląskie that need replacement of boilers are assumed to be non-poor. Based on access to a gas network in Małopolskie and Śląskie, it is assumed at 64 percent and 36 percent of the non-poor SFBs in the two regions, respectively, will switch to gas heating. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.
[2] 40 percent of the non-poor SFBs in the two regions are estimated to need thermal retrofits. Only the SFBs participating in the program and switching from old solid-fuel boilers to new coal and gas boilers and heat pumps are considered for thermal retrofits.

ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN 33 MOST POLLUTED CITIES IN POLAND

The thirty-three most polluted cities in Poland are estimated to be populated by ten percent of the Polish population. Given the urgent need to reduce air pollution in the country, the GoP could consider prioritizing launching a program initially in these 33 cities. Based on national averages, these cities are estimated to have a total of 542,857 SFBs. The WB team has analyzed the investment needed by poor and non-poor SFBs in the 33 cities.

Poor SFBs in 33 Most Polluted Cities. The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the 33 cities, is estimated to be about PLN 2.4 billion (EUR 560 million, see Table E.4). The number of solid fuel boilers required to be replaced is estimated based on national averages as determined by IEE surveys. As in the case of poor SFBs in Małopolskie and Śląskie, it is assumed that about 80 percent of poor SFBs that need to replace solid fuel boiler will be thermally retrofitted under the program.

TABLE E.4.
Indicative Funds Required to Support Poor SFBs in 33 Most Polluted Cities in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	30,096	13,500	PLN 406.30 m (EUR 95.60 m)
Replacement of coal/solid fuel to new gas boilers	13,680	7,500	PLN 102.60 m (EUR 24.14 m)
Replacement of coal/solid fuel to new heat pumps	1,824	25,000	PLN 45.60 m (EUR 10.73 m)
Partial thermal retrofits	36,480	25,000	PLN 912.0 m (EUR 214.59 m)
Total with partial retrofits			PLN 1,466.50 m (EUR 345.06 m)
Full thermal retrofits[2]	36,480	50,000	PLN 1,824.0 m (EUR 429.18 m)
Total with full retrofits			PLN 2,378.50 m (EUR 559.65 m)

[1] 10 percent of the 542,857 SFBs in the 33 cities are assumed to be poor. The number of solid fuel boilers to be replaced is estimated based on national surveys conducted by IEE. It is assumed that all SFBs with access to a gas network will switch to gas boilers. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.

Non-Poor SFBs in 33 Most Polluted Cities. The total investment needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the 33 cities, is estimated to be about PLN 13.2 billion (EUR 3.1 billion, see Table E.5). It is assumed that about 40 percent non-poor SFBs will need to be thermally retrofitted. Since non-poor SFBs may only receive a partial subsidy as an incentive from the state, home owners would have to finance much of this investment from personal savings and commercial loans. It is thus likely that non-poor SFBs may only undertake boiler replacement in regions which have anti-smog resolutions and undertake partial or no retrofits since it is not mandated by regulations.

TABLE E.5.
Indicative Funds Required to Support Non-Poor SFBs in 33 Most Polluted Cities in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	270,864	13,500	PLN 3,656.66 m (EUR 860.39 m)
Replacement of coal/solid fuel to new gas boilers	123,120	7,500	PLN 923.40 m (EUR 217.27 m)
Replacement of coal/solid fuel to new heat pumps	16,416	25,000	PLN 410.40 m (EUR 96.56 m)
Partial thermal retrofits	164,160	25,000	PLN 4,104.0 m (EUR 965.65 m)
Total with partial retrofits			PLN 9,094.46 m (EUR 2,139.87 m)
Full thermal retrofits	164,160	50,000	PLN 8,208.0 m (EUR 1,931.29 m)
Total with full retrofits			PLN 13,198.46 m (EUR 3,105.52 m)

[1] 84 percent of the 542,857 SFBs in the 33 cities are assumed to need replacement of solid fuel boilers, and 90 percent of these SFBs are assumed to be non-poor.

ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN POLAND

As per the revised objectives for this study, the GoP also wishes to launch a program to support poor and non-poor SFBs across Poland to replace non-compliant solid fuel boilers and undertake thermal retrofits. The analysis assumes that all the poor and non-poor SFBs, which currently use solid fuel boilers, but have access to the natural gas network, will switch from non-compliant solid fuel boilers to gas boilers,[8] and about four percent of non-poor SFBs, with no access to the gas network, will switch from non-compliant solid fuel boilers to heat pumps. The remaining SFBs (with no access to the gas network) are assumed to replace the old solid fuel boiler with new coal boilers compliant with new regulations and standards. With this assumed shift, the use of solid fuel and old coal boilers in SFBs in Poland will reduce from about 84 percent to about 55 percent, gas boilers will go up from about 14 percent to 40 percent, and heat pumps (and other heating sources) will increase from about 2 to 5 percent. All these options would need to be coupled with thermal retrofits; 80 percent for poor SFBs and 40 percent for non-poor SFBs.

Poor SFBs in Poland. The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs across Poland, is estimated to be about PLN 23.5 billion (EUR 5.5 billion, see Table E.6). The number of SFBs requiring replacement of solid fuel boilers across Poland is assumed to be 84 percent of the total as estimated based by nation-wide surveys conducted by IEE. Ten percent of these SFBs are assumed to be poor SFBs, and as in the case of poor SFBs in other market segments, about 80 percent of these poor SFBs are assumed to require thermal retrofits.

TABLE E.6.
Indicative Funds Required to Support Poor SFBs in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	296,983	13,500	PLN 4,009.27 m (EUR 943.36 m)
Replacement of coal/solid fuel to new gas boilers	135,248	7,500	PLN 1,014.36 m (EUR 238.67 m)
Replacement of coal/solid fuel to new heat pumps	18,597	25,000	PLN 464.92 m (EUR 109.39 m)
Partial thermal retrofits	360,662	25,000	PLN 9,016.56 m (EUR 2,121.54 m)
Total with partial retrofits			PLN 14,505.11 m (EUR 3,412.97 m)
Full thermal retrofits2	360,662	50,000	PLN 18,033.12 m (EUR 4,243.09 m)
Total with full retrofits			PLN 23,521.61 m (EUR 5,534.51 m)

Non-Poor SFBs in Poland. The total investment needed to replace non-compliant solid fuel boilers with compliant coal boilers, switch from non-compliant solid fuel boilers to gas boilers and heat pumps and undertake thermal retrofits of non-poor SFBs across the entire country is estimated to be about PLN 130.5 billion range (EUR 30.7 billion, see Table E.7). The estimate assumes that 40 percent of SFBs that replace old solid fuel boilers will be thermally retrofitted under the program. Given the high cost of thermal retrofits of the SFBs, it is unlikely that all SFBs requiring insulation will undertake retrofits in the absence of subsidies and regulations mandating thermal retrofits of SFBs. Even replacement of solid fuel boilers may take place only in regions with anti-smog regulations.

[8] Across Poland, about 40 percent of SFBs are estimated to have access to the natural gas network

TABLE E.7.
Indicative Funds Required to Support Non-Poor SFBs in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	2,672,847	13,500	PLN 36,083.43 m (EUR 8,490.22 m)
Replacement of coal/solid fuel to new gas boilers	1,217,236	7,500	PLN 9,129.27 m (EUR 2,148.06)
Replacement of coal/solid fuel to new heat pumps	167,370	25,000	PLN 4,184.25 m (EUR 984.53 m)
Partial thermal retrofits	1,622,981	25,000	PLN 40,574.52 m (EUR 9,546.95 m)
Total with partial retrofits			PLN 89,971.46 m (EUR 21,169.76 m)
Full thermal retrofits	1,622,981	50,000	PLN 81,149.04 m (EUR 19,093.89 m)
Total with full retrofits			PLN 130,545.98 m (EUR 30,716.70 m)

[1] 84 percent of the 5,367,000 SFBs in Poland are assumed to need boiler replacement and 90 percent of these SFBs are assumed to be non-poor.

4. ESTIMATED ENERGY SAVINGS AND REDUCTION IN AIR POLLUTION AND CO_2

POOR AND NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs in Małopolskie and Śląskie is shown in Table E.8 and Table E.9 . The replacement of just the old solid fuel boilers without thermal retrofits of the SFBs reduces air pollution but results in increased energy consumption since the new coal boilers use electricity and higher grade coal (and not wood and trash), which also costs more. Wood is considered CO_2 neutral, hence replacing wood with coal results in increased CO_2 emission, also the use of electricity in the new boilers leads to increased CO_2 emissions. The coupling of the boiler replacement program, with thermal retrofits of the SFBs, is clearly the better option since it results in energy and cost savings and lower particulate and CO_2 emissions.

TABLE E.8.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in Małopolskie and Śląskie

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 1,585,857	4,376,231 (45%)	7,718,229 (79%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-275.0	-31.0 (-13%)	107.0 (47%)
Annual reduction in particulate emissions (tons, and % savings)	7,740	7,847 (120%)	7,901 (121%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 238,537*	201,216 (33%)	451,884 (73%)

* Annual reduction in CO_2 is negative, meaning SFBs will emit more CO_2.

TABLE E.9.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in Małopolskie and Śląskie

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 40,841,892	11,593,260 (22%)	40,978,476 (79%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-3,360.0	-1,074.0 (-88%)	210.0 (17%)
Annual reduction in particulate emissions (tons, and % savings)	50,513	51,274 (147%)	51,655 (148%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 3,351,348	310,716 (9%)	2,403,576 (73%)

POOR AND NON-POOR SFBs IN 33 MOST POLLUTED CITIES IN POLAND

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs in the 33 most polluted cities in Poland is shown in Table E.10 and Table E.11.

TABLE E.10.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in 33 Most Polluted Cities

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 882,907	2,143,474 (36%)	3,840,158 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-132.0	-12.0 (-8%)	55.0 (39%)
Annual reduction in particulate emissions (tons, and % savings)	3,862	3,923 (98%)	3,953 (99%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 140,539	89,194 (23%)	219,974 (58%)

TABLE E.11.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in 33 Most Polluted Cities

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 22,654,901	4,582,526 (15%)	19,852,690 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-1,529.0	-451.0 (-62%)	154.0 (21%)
Annual reduction in particulate emissions (tons, and % savings)	24,911	25,453 (123%)	25,724 (124%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 2,200,565	-132,970 (-7%)	1,044,058 (53%)

POOR AND NON-POOR SFBs IN POLAND

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs across Poland is shown in Table E.12 and Table E.13.

TABLE E.12.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in Poland

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 8,657,532	21,231,576 (36%)	37,988,345 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-1,301.0	-117.0 (-8%)	548.0 (39%)
Annual reduction in particulate emissions (tons, and % savings)	38,188	38,782 (98%)	39,079 (99%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 1,386,522	883,454 (24%)	2,175,696 (58%)

TABLE E.13.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in Poland

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 223,336,866	45,665,101 (12%)	196,476,027 (51%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-15,115.0	-4,463.0 (-49%)	1,519 (17%)
Annual reduction in particulate emissions (tons, and % savings)	246,313	251,658 (97%)	254,331 (98%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 21,729,684	-1,299,906 (-5%)	10,330,273 (42%)

5. FINANCIAL SUPPORT MECHANISMS AND FINANCING INSTRUMENTS TO SUPPORT POOR AND NON-POOR SFBs

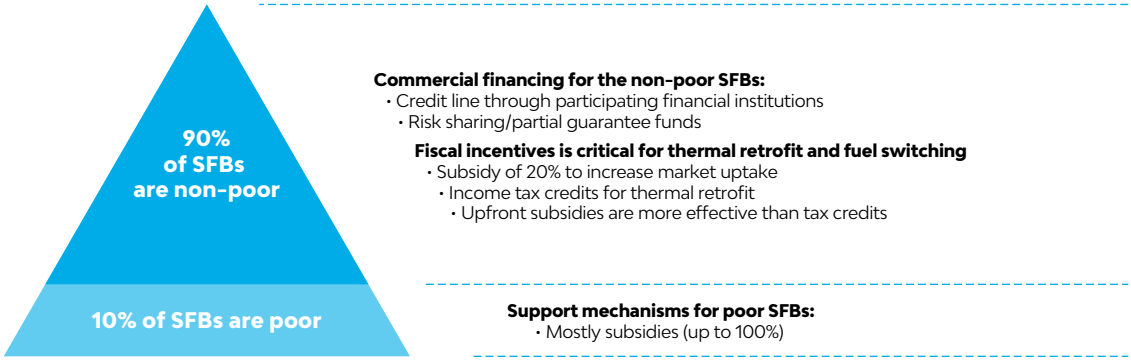
FINANCIAL SUPPORT MECHANISMS AND FINANCING INSTRUMENTS TO SUPPORT POOR AND NON-POOR SFBs

We considered various financial instruments and support mechanisms and discussed their applicability with stakeholders in Poland. The consensus among stakeholders was to develop two categories of instruments:

- Public financial support mechanisms to support poor SFBs through subsidies of 90-100 percent.
- Commercial financial instruments to support non-poor SFBs, coupled with partial subsidies and fiscal incentive mechanisms.

The characterization and consensus among stakeholders for distinct financial instruments to target poor and non-poor SFBs is consistent with the approach of the GoP, which aims to promote EE in SFBs principally through the following four mechanisms: 1) Policies and regulations; 2) Programs to support poor SFBs with subsidies; 3) Programs to support non-poor SFBs through loans, tax credits, etc.; and 4) national information campaigns. The financing support mechanisms and financing instruments applicable to poor and non-poor SFBs in Poland is illustrated in Figure E.1.

FIGURE E.1.
Financing Instruments for the Poor and Non-Poor SFBs



I. **Public finance support mechanism for the poor SFBs:** For the eligible poor SFBs, the government could provide 90-100 percent of subsidies for boiler replacement, fuel switching, and thermal retrofits, channeled through municipalities. The national government could provide 70 percent of the subsidies for boiler replacement and thermal retrofits for the poor SFBs, while the regional and municipal governments could provide 20 percent of the subsidies. The poor SFBs are encouraged to contribute at least 10 percent of the investments to ensure ownership and sustainability. Recognizing that some poor SFBs may be unable to make a 10 percent contribution, some local municipalities at their discretion could also choose to support poor SFBs by providing the remaining 10 percent of investment costs and require the poor SFBs to provide services in-kind to the municipality in lieu of the 10 percent contribution. In-kind services, as suggested by regional stakeholders, could include un-paid services to fulfil some municipal activities such as cleaning, construction, etc.

Local municipalities or regional administrations could also at their discretion provide fuel subsidies to poor SFBs for a fixed time period of two-three years. While the analysis indicates that a full thermal retrofit of an SFB results in savings in fuel expenditure obviating the need for fuel purchase subsidies, regional stakeholders were of the opinion that some fuel subsidies may be needed when poor SFBs switch to more expensive fuels for heating during the transition period.

II. **Commercial financing scheme for the Non-Poor SFBs:** Commercial lines of credit dedicated to finance eligible EE projects for eligible non-poor SFBs. The credit lines could additionally support equipment manufacturer/supplier develop equipment leasing programs for non-poor SFBs. The credit lines would help the participating financial institutions (PFIs) develop an anti-smog and EE portfolio and supplement traditional retail lending by banks. International financial institutions (IFIs) could have an important role to play to leverage additional commercial financing.

Based on WB team discussions with commercial banks and the experience from the Bank Gospodarstwa Krajowego's (BGK) Thermo-modernization Fund, there is a concern of limited market demand for thermal retrofits, since it is not mandated by the government and has a long payback period. It is thus recommended that financial incentives in the form of subsidies and tax credits/deductions be considered to incentivize the non-poor SFBs to undertake thermal retrofits and fuel switching. International experience has demonstrated that upfront subsidies are generally more effective than tax breaks to incentivize such investments. Since replacement of non-compliant solid fuel boilers to compliant coal boilers is mandated by anti-smog resolutions (in some regions of Poland), and while it reduces air pollution it increases CO_2 emissions, it is suggested that no subsidies be provided to do so. However, subsidies would be needed to incentivize non-poor SFBs for fuel switching (to gas boilers, heats pumps, and other viable alternative technologies) and thermal retrofits. The government could provide a 20 percent subsidy to the 60 percent of the lower income SFBs among the non-poor SFBs. Based on data from the Household Budget Survey for Poland (2015) conducted by the Central Statistical Office, it is estimated that the 60 percent of the lower income SFBs have an annual income below PLN 40,692 (EUR 9,575) and expenditure of PLN 32,683 (7,690), with savings far less than the investment costs for thermal retrofits.

To further increase the financial incentives for the non-poor SFBs, the government could also consider providing fiscal incentives instruments such as tax credits and tax deduction schemes, in addition to upfront subsidies of 20 percent. Such fiscal incentives would primarily benefit the upper 40 percent income strata of the non-poor SFBs, since poor and lower-income SFBs may not have adequate income to benefit from tax credits and tax deductions[9].

Given the scale of investments and subsidies needed, we recommend that the government prioritize subsidies to the most polluted 33 cities to achieve quick wins and major impacts on air pollution with minimum public funds. Subsidies would be channeled through the PFIs who will provide loans to SFBs (similar to the thermal modernization Fund operated by BGK) – see the Box 1 that describes the JAWOR program aimed at retrofitting SFBs in the Małopolskie region for the necessity of a broad distribution network to the noon-poor SFBs. BGK is presently designing a program for 23 of the 33 cities, which have fewer than 100,000 people.

BOX E.1.
"Jawor" Program for Thermal Retrofitting of SFBs

JAWOR program. JAWOR (Program Priorytetowy Jawor: poprawa efektywności energetycznej – termomodernizacja budynków jednorodzinnych) is managed by the regional Fund for Environmental Protection and Water Management (WFOŚiGW) in Kraków and provides soft loans to Małopolskie SFBs to undertake thermal retrofits. SFBs may utilize the funds for undertaking the thermal retrofitting of external walls, roofs and flat roofs, and floors on ground, and for the replacement of windows and doors provided the project results in a minimum 25 percent reduction in energy use as determined by an energy audit or energy assessment. The budget for the program was PLN 15 million in 2017.

[9] A tax deduction scheme reduces the taxable income by a fixed amount. And a tax credit reduces the tax by a fixed amount as permitted by the scheme. A tax credit is generally more advantageous than a tax deduction.

The process. SFBs first file an online application form followed by the submission of the loan application (in person or by mail) to the WFOŚiGW office in Kraków. Approved applicants sign a blank promissory note in the WFOŚiGW office, which is the main of the two methods of securing the loan (the other collateral may involve a mortgage, a monetary deposit, a guarantee agreement, for example)[10]. The loan is provided to borrowers after they make the investment in the retrofitting project or complete a project phase (two tranches are allowed, at the maximum) and upon submission of invoices to WFOŚiGW.

Loan terms. JAWOR provides a loan up to 90 percent of investment costs at a low interest rate of 2 percent and with tenor of up to 10 years. On top of the blank promissory note, SFBs provide another form of collateral to secure the loan (see also footnote above). The program has a provision to write-off 20 percent of the principal (and the interest on that 20 percent). The minimum loan amount under JAWOR is PLN 20,000 and the maximum PLN 100,000. The maximum eligible costs for retrofitting are defined: 150 PLN/m^2 for insulation of walls, roof, flat roofs and floors on ground, and 400 PLN/m^2 for replacement of windows and doors.

Program impact. In 2017, WFOSiGW had signed 129 loan agreements and disbursed PLN 5.92 million to SFBs (that amount has been disbursed on the basis of agreements signed in 2016 and 2017), which represents almost 40 percent of 2017 budget. The average loan amount was about PLN 51,680. Borrowing procedures as well as the terms and conditions seem quite intricate for the beneficiary (the requirement for the applicant to pay a visit in person at the WFOŚiGW office in Kraków, the requirement of an energy audit or energy assessment, and the requirement for SFBs to first make the investment or a part thereof, and to provide two collaterals to secure the loan), which may be a disincentive for potential beneficiaries.

There has been an upward trend in the number of JAWOR applications submitted: 2016 (105), 2017 (152), 2018 (50 as of Jun 15), but the scale is still small when compared to the needs (there are about 560,000 SFBs in Małopolskie). As a lesson learnt from JAWOR program, it seems that a much broader distribution network, e.g. through commercial banks, coupled with simple and streamlined procedures, will be indispensable to reach out to a large audience of beneficiaries in Poland.

FINANCIAL SUPPORT MECHANISMS AND FINANCING INSTRUMENTS TO SUPPORT POOR AND NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

The required subsidies are estimated to be around PLN 6.7 billion (EUR 1.6 billion) in Małopolskie and Śląskie, of which 90 percent subsidies for poor SFBs would be about PLN 4.2 billion (EUR 1.0 billion) in Małopolskie and Śląskie, and 20 percent subsidies for the 60 percent of the lower income of the non-poor SFBs would be about PLN 2.4 billion (EUR 571.5 million) in Małopolskie and Śląskie. In addition, the commercial banks and personal savings would finance an investment of PLN 23 billion (EUR 5.4 billion) to support non-poor SFBs in Małopolskie and Śląskie.

In the near term, Małopolskie and Śląskie regional and municipal governments could use the existing limited EU funds to provide subsidies to the most polluted cities first. In this regard, the regional and municipal governments could use the existing EU funds to make the 30 percent contribution to the pilot national program that targets the 23 most polluted cities and to provide subsidies to other most polluted cities for boiler replacement, fuel switching, and thermal retrofit in SFBs.

A NATIONAL FUND FOR ANTI-SMOG AND EE

Given the large scale of public funds, additional EU funds would be necessary to help Poland fight smog and improve energy efficiency in SFBs. And concessional loans from multi-lateral development banks would be welcomed to provide credit lines through local participating banks to meet the huge financing needs for boiler replacement, fuel switching, and thermal retrofit.

[10] In case of loans below PLN 45,000 PLN, the Fund may decide to accept only one securing method (a promissory note).

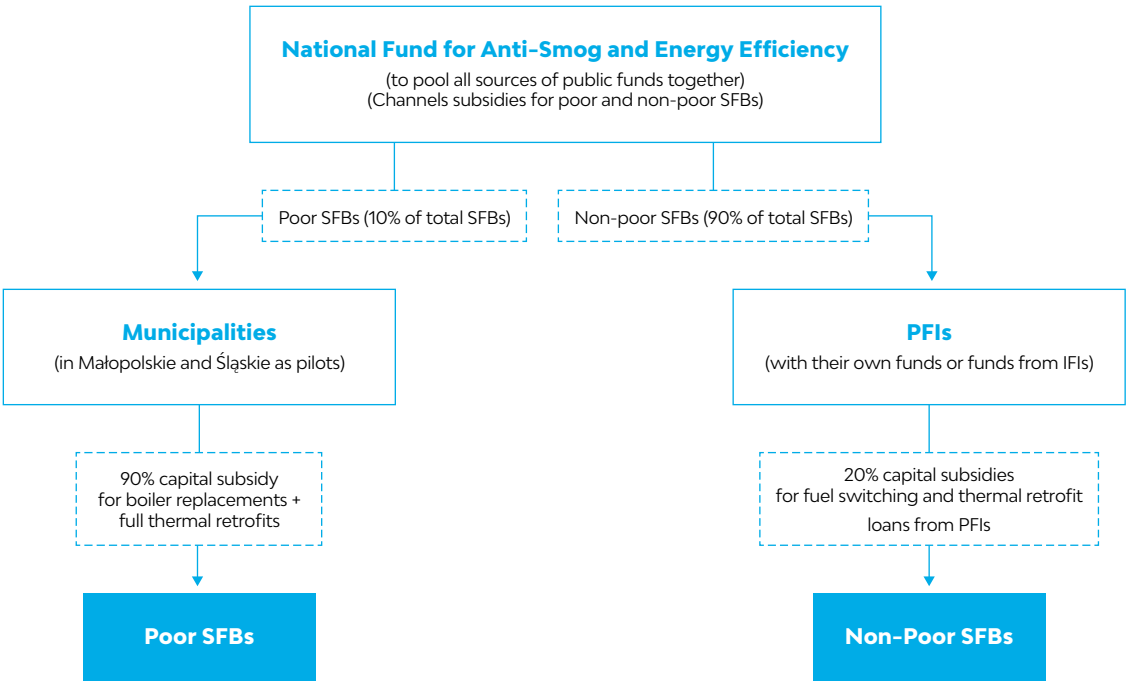
It is essential to coordinate the use of public funds from the government and EU at the national, regional and local levels, and it is recommended that a National Fund for Anti-Smog and Energy Efficiency be established to pool various funding resources, and channel all public finance support mechanisms to poor and non-poor SFB, as eligible under the program. To supplement the National Fund, the regional and municipal governments could provide additional financing to support programs in their jurisdictions. The National Fund would channel subsidies to poor SFBs through municipalities, and for eligible non-poor SFBs through Participating Financial Institutions (PFIs). The primary criteria for the Fund manager are provided in the Box E.2.

BOX E.2.
Criteria for Fund Manager of the National Fund for Anti-Smog and Energy Efficiency

The entity/-ies who will manage the financial support and financing mechanisms for anti-smog and energy efficiency in SFBs should meet the following criteria: (a) a proven track record of experience to disburse public funds effectively, efficiently, and quickly; (b) a wide network with local commercial banks to channel funds through participating banks that have country wide retail operations and ongoing banking relationships with non-poor SFBs; (c) the ability to work with regional and municipal governments to channel funds through them for poor SFBs; and (d) simple application and approval procedures, and streamlined process.

Such a National Fund could have different implementing agencies, with commonly defined eligibility criteria and procedures and close coordination, and their roles and responsibilities could be split by market segments, for example, poor vs non-poor SFBs. For instance, the NFOSiGW and the Ministry of Environment have already proposed a PLN 25 billion (EUR 5.9 billion) fund to support boiler replacement and thermal retrofits of SFBs; while BGK has operated a successful thermal modernization fund that provides 20 percent subsidies for thermal retrofit and is piloting financial support to the poor SFBs in the most polluted 23 cities. Figure E.2 illustrates the proposed flow of funds from the National Fund to poor and non-poor SFBs.

FIGURE E.2.
National Fund for Anti-Smog and EE in SFBs in Poland



Role of Regional Administrations and Municipalities.

The regional governments would co-fund measures within their administrative regions, provide financing to participating municipalities, and be responsible for setting program targets and results monitoring. The municipalities would principally be responsible for supporting programs directed at poor SFBs within their jurisdictions, including identification of poor SFBs based on defined criteria, program implementation support, and SFB-level monitoring and verification. While some municipalities may choose to directly support poor SFBs implement measures, others may choose to provide financing to implementation partners who meet eligibility criteria of the National Fund supporting poor SFBs. The specific roles and operational processes will have to be defined in the operational phase of a program to support poor SFBs.

PRIORITIZING AND SEQUENCING FINANCIAL SUPPORT TO THE SFBs IN POLAND

Given the huge financing needs and the challenging task to roll out the anti-smog and EE program nationwide, it is recommended that the program start with heavily polluting regions, particularly those who have adopted anti-smog resolutions to demonstrate their political commitment in an enabling regulatory environment. Therefore, the National Fund(s)[11] for Anti-Smog and EE could prioritize subsidies to the 33 most polluted cities in Poland. This will further reduce the need for public funds to provide subsidies to non-poor SFBs.

The subsidies required for the most polluted 33 cities are roughly estimated to be around PLN 3.3 billion (EUR 773 million), of which PLN 2.1 billion (EUR 504 million) would be for the poor SFBs and PLN 1.1 billion (EUR 270 million) for the non-poor SFBs. This will provide quick wins and have a major impact on reducing air pollution in the country, with the minimum amount of required public funds. To this end, the national government is launching a pilot program that targets the 23 smaller cities among the 33 most polluted cities in Poland, to be implemented by BGK, where the national government provides 70 percent, regional governments 20 percent, and municipal governments 10 percent of subsidies for poor SFBs.

STRENGTHENING REGULATIONS AND ENFORCEMENT TO INCREASE MARKET DEMAND

Anti-smog resolutions and enforcement are key to create market demand for boiler replacement and fuel switching, and solid fuel quality standards are essential to reduce air pollution. Low market uptake of boiler replacement, fuel switching, and thermal retrofit would be the single biggest risk for the financial mechanisms of energy efficiency in SFBs. In the absence of government mandates for thermal retrofit, financial incentives in the form of upfront subsidies and tax breaks would be critical to increase market demand and penetration.

[11] If the GoP chooses to create more than one fund, the coordination has to be ensured. The implementation mechanisms in these funds should be the same. These funds could e.g. prioritize subsidies to different specific market segments.

6. SEGMENTATION OF SFBs AS POOR AND NON-POOR

SFBs may be categorized as poor and non-poor households. Poverty here is defined in terms of energy poverty, which has a broader definition than income poverty, according to the study by the Instytut Badań Strukturalnych (IBS) of Poland.

International experience shows that the most practical and operational way to provide subsidies to support low-income households for EE and building retrofit is to use the income levels as the definition. For example, New York state defines low-income households as 60 percent of the area median income, while Washington DC defines low-income households as 80 percent of area median income. New York state provides 100 percent subsidies to low-income households up to $4,000 per household for building retrofits and other EE measures, funded by a system benefit fund collected from electricity surcharges to all consumers. They also provide 20 percent subsidy for the rest of households to incentivize building retrofits.

POOR SFBs

The GoP has not developed or adopted a definition for energy poverty in Poland. IBS has researched energy poverty issues extensively and prepared the most definitive reports on the subject. The latest report by IBS prepared in January 2018 redefined energy poverty based on its latest surveys and research.[12] It now estimates that about 9.8 percent of households in Poland (and 12.2 percent of Poles) are energy poor.[13] Based on this revised estimate, the draft report assumes that 10 percent of SFBs in Poland are energy poor. This is significantly different from earlier estimates made by IBS based on the WB previous assumption that 20 percent of households are energy poor[14]. An appendix in the main report provides some additional definitions of energy poverty used in other countries.

NON-POOR SFBs

The remaining 90 percent of SFBs in the country are categorized as "non-poor SFBs." This is a diverse category of SFBs with a broad range of incomes and expenditures. Based on income and expenditure profiles of households reported by the Household Budget Survey for Poland (2015) and conducted by the Central Statistical Office, it is likely that the bottom three quintiles of non-poor SFBs have annual incomes below PLN 40,692 and expenditures of PLN 32,683. Non-poor SFBs in these income quintiles are unlikely to be able to afford to invest in boiler replacement and thermal retrofits and may need subsidies to incentivize them. Households in the top two quintiles are likely to have the capacity to make investments to improve home heating systems. Given the large investment needs, it is suggested that subsidies be provided to the bottom 60 percent of non-poor SFBs and be limited to investments made to switch from coal to other fuels and for full thermal retrofits. The program for non-poor SFBs could also be initially rolled out in the 33 most polluted cities in Poland.

[12] Ubóstwo energetyczne w Polsce 2012-2016 Zmiany w czasie i charakterystyka zjawiska, Brief Report, Styczeń 2018 r. Katarzyna Sałach & Piotr Lewandowski

[13] IBS has estimated energy poor households in each region of Poland and it estimates 10 percent of households in Małopolskie and 7.2 percent of households in Śląskie are energy poor.

[14] Energy Poverty in Poland – Buzzword or a Real Problem? Aleksander Szpor, IBS (Instytut Badań Strukturalnych) Policy Paper 2/2016, January 2016.

7. FINANCIAL SUPPORT MECHANISMS AND FINANCIAL INSTRUMENTS TO SUPPORT POOR SFBs (INITIALLY IN MAŁOPOLSKIE, AND ŚLĄSKIE)

PROGRAM COST FOR THE POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE, 33 MOST POLLUTED CITIES AND POLAND

Subsidies: The total investment needed to support poor SFBs in the Małopolskie and Śląskie regions or the 33 most polluted cities or in other regions of Poland to replace non-compliant solid fuel boilers and undertake thermal retrofits is shown in Table E.2, Table E.4 and Table E.6. The GoP proposed that national funds cover 70 percent and regional and municipal funds 20 percent of the cost. The remaining 10 percent may be covered by poor SFBs or municipalities, which may seek services in-kind from poor SFBs in lieu of payment. Based on this proposed financing scheme, the 90 percent subsidy requirements for both full and partial thermal retrofits for the poor SFBs in the two regions, 33 most polluted cities, and Poland is shown in Table E.14. Subsidies for poor SFBs would be channeled through municipalities.

The required subsidies are estimated to be around PLN 4.2 billion (EUR 1.0 billion) in Małopolskie and Śląskie, and PLN 21.2 billion (EUR 5.0 billion) across the country for the poor SFBs for replacement of solid fuel boilers and full thermal retrofits; and PLN 2.6 billion (EUR 612) million in Małopolskie and Śląskie, and PLN 13 billion (EUR 3.1 billion) across the country for the poor SFBs for replacement of solid fuel boilers and partial thermal retrofits.

The annual funding required to finance subsidies will be spread over a 10-year implementation period of the program. Annual subsidies are estimated to be around PLN 424 million (EUR 100 million) in Małopolskie and Śląskie, and PLN 2.1 billion (EUR 500 million) across the country for the poor SFBs for replacement of solid fuel boilers and full thermal retrofits; and PLN 260 million (EUR 61 million) in Małopolskie and Śląskie, and PLN 1.3 billion (EUR 307 million) across the country for the poor SFBs for replacement of solid fuel boilers and partial thermal retrofits.

TABLE E.14.
Subsidies Required for the Poor SFBs (PLN/Euro, billions)

SUBSIDIES FOR POOR SFBs	BOILER REPLACEMENT, FUEL SWITCHING + FULL THERMAL RETROFIT	BOILER REPLACEMENT, FUEL SWITCHING + PARTIAL THERMAL RETROFIT
Małopolskie and Śląskie	PLN 4.2/EUR 1.0	PLN 2.6/EUR 0.6
33 Most Polluted Cities	PLN 2.1/EUR 0.5	PLN 1.3/EUR 0.3
Poland	PLN 21.2/EUR 5.0	PLN 13.1/EUR 3.1

Program administrative costs, technical assistance and capacity building: The funds required for program administration to support poor SFBs in Małopolskie and Śląskie will depend on a number of factors. For instance, this report recommends that municipalities take the lead to support poor SFBs in Małopolskie and Śląskie. Małopolskie Voivodeship (or regional administration) has 182 gmina (or municipalities), and the Śląskie Voivodeship has 167 gmina. The overall program will thus support about 91,000 poor SFBs in these two regions

spread over 349 municipalities. The funds required for program administration of each municipality is likely to vary widely based on the number of poor SFBs in each jurisdiction, the capacity of the local administration, and the availability of municipal revenues for administering such programs.

The cost to establish and administer a National Anti-Smog and EE Fund(s), as recommended in this report, can be estimated based on the experience of BGK and the NFOSiGW, which have managed and operated large funds.

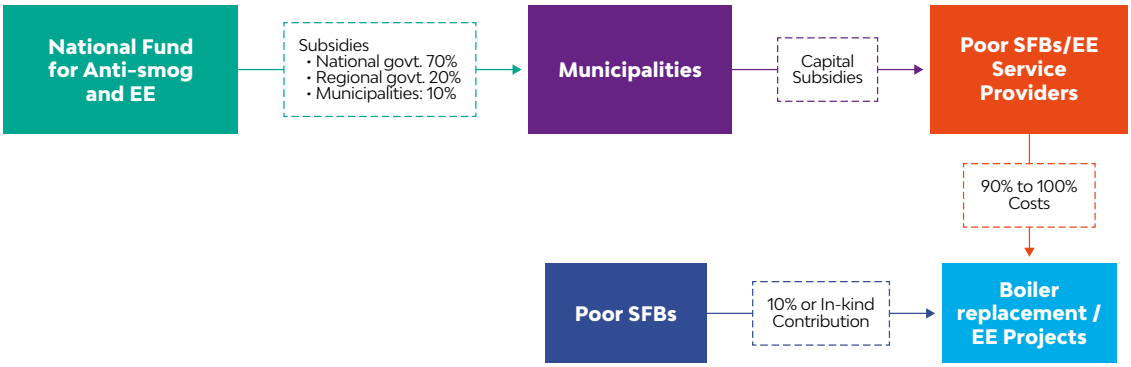
Furthermore, additional funds would be required to build capacity and provide technical assistance for the municipalities to administrate the fund to SFBs. The municipal governments would require substantial technical support from energy advisors to undertake walk-in energy audits, prioritize SFBs, and conduct monitoring and reporting. In addition, standardized IT systems, agreement for procurement, etc. for all the municipalities would simplify the procedures and greatly help the municipalities to manage such programs. It is estimated that several tens of millions of euros would be needed for capacity building of municipalities. EIB's ELENA program funds could be tapped for this purpose.

FINANCIAL SUPPORT MECHANISMS FOR THE POOR SFBs

Assuming that poor SFBs, which constitute 10 percent of SFBs, are provided with 90 percent public subsidies[15], poor SFBs in just Małopolskie and Śląskie would need subsidies financing of about PLN 4.2 billion (EUR 1.0 billion) to meet the capital investment needs of boiler replacement and full thermal retrofits. The proposed National Fund for Anti-Smog and EE would channel subsidy financing through local municipalities to eligible poor SFBs. The National Fund would be financed by the GoP, which may tap into multiple sources of financing, including regional and municipal government budgets.

Figure E.3 illustrates the flow of funds in a public financing support mechanism to benefit poor SFBs. The municipalities would principally support poor SFBs undertake boiler replacements and thermal retrofits program. The poor SFBs would receive about 90 percent in subsidy financing and finance the remaining 10 percent in cash or through in-kind services to the municipality. Given the lack of knowledge and capacity among poor SFBs, the municipality could directly contract with qualified energy service providers to implement boiler replacement and thermal retrofits in poor SFBs, if feasible. The bulk procurement of equipment by municipalities and/or by implementation partners could help lower the cost of procurement. The bulk procurement could also lower transactions cost. A simple approach to monitoring and verification is recommended. The main report provides detailed descriptions of the structural, institutional and implementation framework of the proposed public financing support mechanism.

FIGURE E.3.
Public Financing Support Mechanism for Poor SFBs



Legend: EE – energy efficiency, SFB – single family building

[15] The GoP suggested 100 percent subsidies for poor SFBs

8. FINANCIAL SUPPORT MECHANISMS AND FINANCIAL INSTRUMENTS TO SUPPORT NON-POOR SFBs

PROGRAM COST FOR THE NON-POOR SFBs IN POLAND

Investments: The total investment needed to support non-poor SFBs across Poland to replace non-compliant solid fuel boilers and undertake thermal retrofits is estimated to be PLN 130.5 billion (EUR 30.7 billion), as shown in Table E.15.

Subsidies: If a subsidy were to be restricted to only investments in heating systems that use gas or heat pumps and move the SFBs away from coal, and for undertaking full thermal retrofits, a 20 percent subsidy for the 60 percent of the lower income SFBs among the non-poor SFBs would require about PLN 11.3 billion (EUR 2.7 billion).

Based on the experience of pilot projects implemented in the municipality of Skawina, the IEE suggests that a subsidy of PLN 10,000 to PLN 30,000 (about EUR 2,350 to 7,000) may be a good incentive for SFBs to implement EE in heating systems. Based on the estimated number of non-poor SFBs which need to undertake thermal retrofits (1,622,981 SFBs), the funding required to provide a subsidy of PLN 10,000 per non-poor SFB would amount to over PLN 16 billion (nearly EUR 4 billion), which is more than a 20 percent subsidy, and may not be viable. The annual funding required for subsidies will be spread over the implementation period of the program, which could be over the next seven to eight years.

To achieve quick wins and major impacts on air pollution, with the minimum public funds required, the WB recommends that the National Fund prioritize subsidies to those regions that adopted anti-smog resolutions and/or the most polluted 33 cities. The subsidy required for non-poor SFBs in these 33 cities is estimated to be around PLN 1.1 billion (EUR 269 million). The program costs are shown in Table E.15.

TABLE E.15.
Program costs for Non-Poor SFBs (PLN/Euro, billions)

	SUBSIDIES	INVESTMENTS	TOTAL
Małopolskie and Śląskie	PLN 2.4/EUR 0.57	PLN 23/EUR 5.4	PLN 25.4/EUR 6.0
33 Most Polluted Cities	PLN 1.1/EUR 0.27	PLN 12.1/EUR 2.8	PLN 13.2/EUR 3.1
Poland	PLN 11.3/EUR 2.7	PLN 119.2/EUR 28.0	PLN 130.5/EUR 30.7

Program administrative costs, technical assistance, and awareness raising: Additional funding is also required for program administration, provision of technical assistance (TA) to stakeholders, and development of awareness campaigns to promote the GoP support for improved EE in SFBs. The funds required for program administration, TA and awareness programs to support non-poor SFBs across Poland will depend on the capacity of institutions responsible for program implementation. This report recommends that non-poor SFBs will be supported principally through commercial financial instruments, with limited subsidies and tax incentives. The responsibility for financing rests largely with commercial financial institutions, and the non-poor SFB will undertake program implementation with the support of service providers and equipment installers.

The PFIs would need TA to undertake aggressive marketing campaigns to raise awareness amongst non-poor SFBs and develop investment pipelines. The funds required for a nationwide awareness program to educate SFBs and disseminate information on financing instruments and benefits from EE investments will be the key to overcome the low market uptake barrier. Funds required for program administration and TA for the PFIs will

depend on the experience of the banks with administering credit lines for EE. Some of the large commercial banks in Poland have significant experience with EE credit lines. In addition, funds for TA will be needed to develop protocols and establish procedures to finance SFBs. The funds required for TA must be estimated in consultation with the PFIs.[16]

The cost to administer tax credit or tax deduction schemes for non-poor SFB is best estimated by the Ministry of Finance and the tax authorities who will have to make changes to the tax reporting and filing systems. And the administration costs for the National Fund, which may channel some subsidies for non-poor SFBs through the PFIs, will be part of the overall costs of establishing the Fund.

COMMERCIAL FINANCING INSTRUMENTS FOR NON-POOR SFBs

The 90 percent of SFBs in Poland assumed to be non-poor will need to invest an estimated PLN 130.5 billion (EUR 30.7 billion) to replace non-complaint solid fuel boilers with compliant coal and gas boilers and heat pumps and undertake full thermal retrofits. This investment would likely be phased over the next several years based on a timeline for compliance to be defined by the GoP.

This scale of financing is only possible through leveraging of commercial financing mechanisms such as credit lines, retail financing, consumer credit mechanisms, and self-financing by consumers. Funds from International Financing Institutions (IFIs) could be mobilized to provide EE credit lines to eligible commercial banks in Poland. The IFI credit line could stimulate the local debt markets to leverage additional funds through credit enhancement instruments. It would be preferable to extend credit lines to multiple eligible commercial banks that have large retail banking operations. Discussions with some commercial banks in Poland have indicated that banks would prefer a credit line of at least EUR 100 million or more for it to be attractive as a new financing product. It would be preferable to extend credit lines to five to six eligible commercial banks that have large retail banking operations and retail branches across the country.

FISCAL TAX INCENTIVES FOR NON-POOR SFB

BOX E.3.
Potential Tax Deduction and Tax Credit schemes for Encouraging EE in SFBs

To illustrate with an example, assume a household in Poland in the top fifth income quintile with an annual income of PLN 96,242. Assume that the taxable income of this SFB is PLN 90,000 and the tax rate is 20 percent. Under a tax credit scheme that provide a tax credit of, say, PLN 10,000 for making eligible investments in improved heating systems, the taxable income would be lowered to PLN 80,000 and the overall benefit to the SFB from the tax credit scheme would be PLN 2,000.

Under a tax deduction scheme of, say, PLN 5,000, the same household would be able to lower its taxes by this amount and would benefit by PLN 5,000, which is more than under the tax credit scheme.

In addition to capital subsidies, the government may also consider a tax credit or tax deduction linked to the purchase of eligible equipment, coupled with financing support through a dedicated credit line, as additional incentives for non-poor SFBs to invest in boiler replacements, thermal retrofits and fuel switching.

The schematic below (Figure E.4) illustrates the basic structure for a tax incentive scheme. A tax credit to SFBs would require the SFB to make an investment in an eligible EE project and then lower the taxable income by the allowable credit when filing annual income tax returns. A tax deduction would lower the tax by the allowable amount (see Box E.2 for an example).

While a tax credit or tax deduction will lower tax revenues to the Polish treasury, a key consideration is to examine if

[16] Allocating a percentage of the total line of credit for TA is not appropriate. For instance, the EBRDs POLSEFF program for SMEs provided a line of credit of EUR 150 m and other grant funds of EUR 28 m, which is over 18 percent. Clearly, given the scale of the investment program for non-poor SFBs, applying a percentage would likely overestimate the funds required for TA.

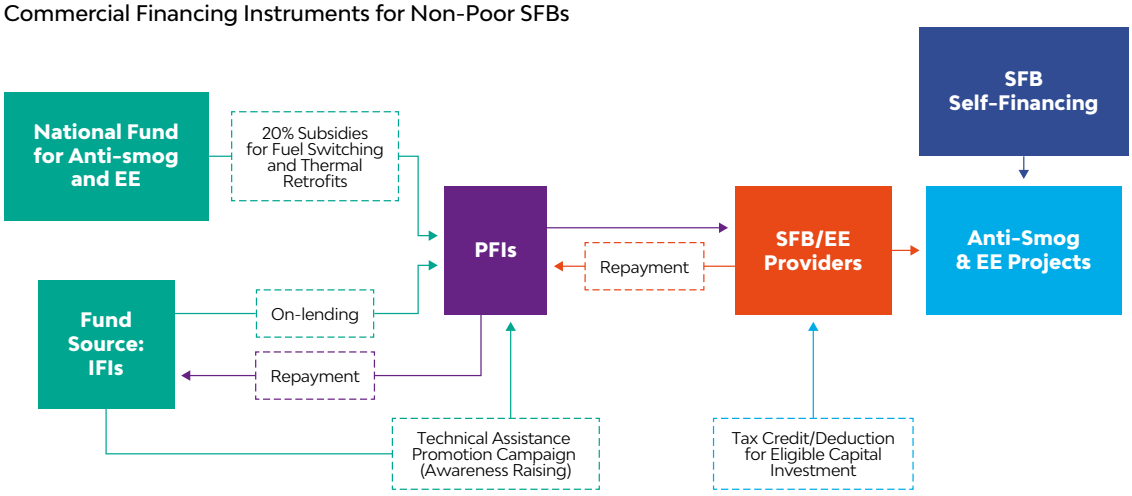
the tax credits and/or deduction have a greater positive financial or economic impact on the Polish economy in terms of lower energy use and reduced emissions. The analysis of tax credit/deduction schemes also needs to be compared with an analysis of impacts of a direct (and capped) subsidy scheme, which, if well designed, could be more attractive to SFBs. It should also be noted that the tax credit or tax deduction scheme will benefit residents of non-poor SFBs who file tax returns. Poor SFBs and SFBs in lower household income quintiles are unlikely to benefit from the scheme since they may not have adequate income to benefit from the tax credit scheme.

FIGURE E.4.
Tax Incentives for Non-Poor SFBs

THE OVERALL FINANCING SUPPORT STRUCTURE FOR NON-POOR SFBs

Figure E.5 illustrates the commercial financing mechanism, coupled with public financing incentives, to support non-poor SFBs in Poland. The main report provides detailed descriptions of the structural, institutional, and implementation framework of the proposed commercial financing instrument, complemented by tax incentives and targeted subsidies to support non-poor SFBs.

FIGURE E.5.
Commercial Financing Instruments for Non-Poor SFBs



Legend: IFI – international financial institution, PFI – participating financial institution, EE – energy efficiency

9. SUMMARY OF OPTIONS TO REDUCE AIR-POLLUTION, IMPROVE EE, AND POTENTIAL FINANCING AND IMPLEMENTATION MECHANISMS

The options to reduce air pollution and improve EE, the financing mechanisms that could be deployed, the potential sources of funds, the disbursement of funds, and proposed implementation for the poor and non-poor SFBs are summarized in Table E.16.

TABLE E.16.
Summary of Options to Reduce Air Pollution in Poland and Potential Financing and Implementation Mechanisms

GOAL	A1. Poor SFBs (Pilot in Małopolskie and Śląskie)		A2. Non-Poor SFBs across Poland	
MAIN ASSUMPTION	• 10 percent poor SFBs in Małopolskie and Śląskie • Focus on replacement of non-compliant solid fuel boilers and thermal retrofits of poor SFBs		• 90 percent non-poor SFBs across Poland • Focus on replacement of non-compliant solid fuel boilers and thermal retrofits of non-poor SFBs	
	SOLUTION	COMMENT/TRADE OFF	SOLUTION	COMMENT/TRADE OFF
TARGET GROUP	B1*	• Replacement of old non-compliant solid fuel boilers with new coal and gas boilers, heat pumps, and other heating systems that meet regulatory standards has the most significant impact on reducing air pollution but increases fuel costs and carbon emissions. • Partial thermal retrofits are not justified due to the high cost and lower impact on energy savings and CO_2 emissions. • Full thermal retrofits at a higher cost can achieve higher fuel cost savings and greater reduction in CO_2 emissions. But thermal retrofits alone have limited impacts on air pollution. • Replacement of old non-compliant solid fuel boilers with new heating systems that meet regulatory requirements, coupled with thermal retrofits is recommended since it reduces both air pollutants and carbon emissions, and results in fuel cost savings for poor SFBs. Fuel subsidies are not required due to the lower expenditure on fuel purchase (**recommended option**). • Requires significant public resources to support poor SFBs through substantial subsidies of 90 to 100 percent. • The pilot regions are among the most polluted areas in Poland.	B3	• Switching from old solid fuel boilers to gas and heat pumps can reduce both air pollution and CO_2 emissions, but will increase fuel costs. • Replacement of old non-compliant solid fuel boilers with new coal boilers that meet regulatory standards has the most significant impact on reducing air pollution but increases fuel costs and carbon emissions. • Full thermal retrofits at a higher cost can achieve higher fuel cost savings and greater reduction in CO_2 emissions. But, thermal retrofits alone have limited impacts on air pollution. • Switching from old solid fuel boilers to a mix of new coal boilers, gas boilers, and heat pumps, coupled with thermal retrofits is recommended, since it reduces both air pollutants and carbon emissions, and results in fuel cost savings (recommended option). • Market uptake of thermal retrofits measures may be low given the high cost and the absence of a regulatory mandate for thermal retrofits in existing stock of SFBs. • May require public subsidies to encourage SFBs to make investments, which would have a significant impact on public financing.
FINANCING INSTRUMENT / SUPPORT MECHANISM	C1, C4	• A National Fund is established and managed by a national agency. • More than one National Fund may also be established with consistent implementation mechanisms and procedures. • Poor SFBs in Małopolskie and Śląskie are initially supported through subsidies ranging from 90-100 percent. • Municipalities may require poor SFBs to contribute some funds or provide services in-kind to qualify for subsidies. • Poor SFBs are unlikely to have adequate income to benefit from tax credits and tax deductions.	C2-C4	• Financing from PFIs leverages commercial financing mechanisms. • Lines of credit from IFIs could encourage commercial banks to develop financial products to support SFBs undertake heating system retrofits. • Tax credits and deductions require SFBs to make upfront investments and claim benefits in annual tax filings. This is generally less attractive than upfront subsidies. • Lease financing for suppliers and installers is less risky for banks, but suppliers and installers do not have experience with providing consumer financing.
			C5	• A 20 percent subsidy for non-poor SFBs may be needed as an incentive but will have a significant impact on use of public resources. • Subsidies targeted to specific segments of non-poor SFBs with lower income would lower the burden on public funds required for subsidies. • Subsidies for non-poor SFBs could be limited to SFBs at the bottom 60 percent of income and only for switching from coal to other fuels for heating and for thermal retrofits.
SOURCE OF FUNDS	D3	• Pooling of public funds from various GoP budgetary sources (70 percent of total Fund resources) • Funds from regional and municipal governments (20 percent of Fund resources) • The municipalities or the poor SFBs contribute 10 percent	D1, D2, D4	• IFIs provide lines of credit to PFIs. • PFIs provide additional financing from own funds. • Customer financing through retail loans and personal savings.
			D3	• The national EE Fund allocates some resources to provide incentives to non-poor SFBs.
CHANNELING FUNDS	E1	• The National Fund channels public funds as subsidies to poor SFBs through municipalities	E2	• The National Fund channels subsidies for non-poor SFBs through PFIs.
			E3	• IFIs provide lines of credit to PFIs for on-lending to non-poor SFBs. • PFIs make direct loans to non-poor SFBs.
IMPLEMENTATION ISSUES		• Municipalities have to identify poor SFBs based on the definition of energy poverty. • Municipalities become responsible for procuring contractors to undertake implementation of services for poor SFBs, which may not be easy given public procurement laws. Other implementation partners may be needed. • May require municipalities to hire more staff to manage and administer program; municipality budgets are generally stretched thin. • May increase monitoring and verification (M&V) costs. • Equity issue since not all SFBs will benefit from financing support.		• Not all non-poor SFBs would be eligible for commercial financing. • PFIs would become responsible to channel public subsidies to SFBs not availing financing from the PFI. • Commercial banks become responsible for M&V of use of funds.

*List of index used - see next page

A	**GOALS**	
1	Improve EE and reduce smog (thermal retrofits and boiler replacements) in poor SFBs	
2	Improve EE and reduce smog (thermal retrofits and boiler replacements) in non-poor SFBs	
B	**TARGET GROUPS**	
1	Only poor SFBs	
2	Poor + non-poor SFBs	
3	Only non-poor SFBs	
C	**FINANCING INSTRUMENT/ SUPPORT MECHANISM**	
1	Subsidies for poor (public funds)	
2	Commercial loans to SFBs (principally for non-poor)	
3	Commercial lease financing to producers, suppliers, and installers	
4	Tax credits/rebates for SFBs	
5	Public subsidies to non-poor SFBs for boiler replacement and thermal retrofits (ca. 20 percent)	
D	**SOURCE OF FUNDS**	
1	Line of credit from IFIs	
2	Guarantee/risk-share mechanism	
3	Public funds	
4	Leveraged money from private banks and customers	
E	**CHANNELING OF FUNDS**	
1	National Antismog and EE Fund → municipalities	
2	National Antismog and EE Fund → PFIs	
3	IFIs → PFIs	

10. NEXT STEPS/PHASE

The final report presents the options to reduce air pollution and improve EE in poor and non-poor SFBs in Małopolskie and Śląskie, the 33 most polluted cities in Poland, and SFBs across Poland. The report also estimates the funding required to support poor and non-poor SFBs through a mix of public financial support mechanisms and commercial financial instruments and estimates the reduction in air pollution and energy savings from the program. Detailed descriptions of the structural, operational, and institutional framework to establish a National Anti-Smog and EE Fund(s) to channel public financing as subsidies, develop commercial lines of credit for commercial financing, and offer tax incentives is also provided in the main report. The information in this report builds on an earlier analysis by the WB team and is guided by the suggestions of GoP, EC, participating regions and a broad range of stakeholders.

As a next step, the World Bank team will consult with EC and GoP to define the scope of work for the next phase. Based on the decision of the GoP, an operational framework needs to be developed to support the implementation of programs. The operational framework and implementation plan would provide a comprehensive approach to implementing a program to support poor and non-poor SFBs undertake improvements in heating systems. The next phase also needs to develop the structure of a National Fund, and its operational and implementation mechanisms, to provide subsidies to eligible poor and non-poor SFBs.

1. INTRODUCTION

Poland has reached high-income status in a relatively short period. Few countries have experienced a decade of broad-based productivity-driven growth. With an average 3.6 percent per year, such fast and stable growth has rapidly led to above 70 percent of the average European Union (EU) GDP per capita at the end of 2016. Much of this economic growth is due to sound macroeconomic management and policies that strengthened institutions and invested in human capital.

Securing Poland's high-income transition will require effective institutions and strategies to ensure inclusive and sustainable growth. As home to 33 of 50 of the most polluted cities in Europe, transition to a low-emissions economy is one of complex challenges that remain.

Poor air quality is detrimental to the health of residents within Poland and across the EU. While the country has made significant progress to reduce air quality pollutants such as SO_2, NOx and heavy metals, it is not in compliance with EU standards for particulate matter (PM). Its elevated levels of particulate pollution (PM2.5) has led to premature mortality rates, amongst the highest in EU member states (46,020 in 2014).

Energy affordability is also a concern. Poland does not have a definition for energy poverty. The Instytut Badań Strukturalnych (IBS) of Poland has researched energy poverty issues and prepared the most definitive reports on the subject, but these definitions have not been adopted by the Government of Poland (GoP). The IBS' latest report in January 2018 estimates that about 9.8 percent of households in Poland (and 12.2 percent of Poles) are energy poor. Based on this revised estimate, the report assumes that 10 percent of single family residential buildings (SFB) in Poland are poor.

SFBs could offer significant benefits to address air pollution if the country shifts towards greater energy efficiency (EE) programs and products. The country has achieved significant success in scaling up thermal retrofits in multi-family buildings through grant incentives provided by the Thermo-Modernization program, but retrofits of SFBs are a challenge given the geographical spread of SFBs and the high transactions cost to address this market.

Poland plans to reduce low-stack air pollution through improved EE of SFBs. The World Bank (WB) is supporting the GoP's objectives through the design of financial instruments and delivery mechanisms for the replacement of solid fuel boilers and thermal retrofits. Some regions in Poland, such as Małopolskie and Śląskie, have adopted anti-smog resolutions which mandate the replacement of non-compliant solid fuel boilers in SFBs.

The design and deployment of financial instruments and support mechanisms to support EE in SFBs is driven in large part by the objectives of the program and the priorities of the GoP. The guidance to the WB team provided initially by the European Commission (EC) was to develop financial instruments that would help SFBs implement EE in compliance with the anti-smog regulations in Małopolskie and Śląskie regions and lower emissions. The current anti-smog resolutions only mandate the replacement of solid-fuel boilers not compliant with new regulations, as per a (separate) timeline established by the two regions. There are no regulations to mandate SFBs to undertake thermal retrofits, though it would reduce energy use by lowering the heating load of the SFB, and lead to fuel cost savings and lower CO_2 emissions. The GoP indicated to the WB that it also wishes to support poor SFBs undertake thermal retrofits and boiler replacements.

The design of financial instruments and incentive-based mechanisms to support a regulatory mandated replacement of non-compliant solid fuel boilers in SFBs is intended to support SFBs make investments is likely to have higher uptake among SFBs, especially in there is certainty in the enforcement of regulations. Financial instruments and support mechanisms designed to support thermal retrofits of existing SFBs, which is not mandated by regulations, may not be as attractive especially given the very high cost of retrofits.

Two sub-activities were implemented in support of the objectives of the GoP and EC:

Sub-activity 1. Diagnostic Assessment and Analysis of Energy Efficiency Opportunities and Strategies in SFBs:

This sub-activity assessed the opportunities, regulations, strategies, barriers, institutional frameworks, and implementation programs of EE improvements in SFBs. OT was implemented by global and local experts who conducted desk research and undertook field visits for interviews, consultations and meetings with stakeholders. The field visits also supported the gathering of information and data for this sub-activity.

Sub-activity 2. Development of Implementation Scale-Up Options and Schemes for Financing of EE Improvements in SFBs:

This sub-activity undertook a study to identify and develop financial instruments and support mechanisms for the replacement of boilers and for thermal retrofits of existing poor and non-poor SFBs. This sub-activity was undertaken by global and local experts through extensive consultations, and meetings with stakeholders.

2. OBJECTIVES OF THE STUDY: REDUCING SMOG AND IMPROVING ENERGY EFFICIENCY

The design and deployment of financial instruments and support mechanisms to encourage EE practices in SFBs is driven in large part by the objectives of the program and the priorities of the GoP. The GoP wishes to prioritize both reduction of particulate emissions and improved energy efficiency in SFBs. Anti-smog resolutions adopted by some regions in Poland mandate the replacement of solid-fuel boilers not compliant with new regulations as per a defined timeline. The Małopolskie and Śląskie regions were the first to pass such resolutions1, and the WB team based its analytical work on data and information from these two regions. The replacement of non-compliant solid fuel boilers with boilers compliant with new regulations has a significant impact on reducing air pollution. But this will also increase fuel costs for SFBs which will have to purchase higher quality and higher priced fuels for the new boilers compared to cheaper fuels such as poor quality coal, firewood and trash they may have used earlier. Regulations do not however mandate existing SFBs to undertake thermal retrofits.2 Thermal retrofits of SFBs to meet present building codes would substantially lower the heat load of the dwelling and enable a lower capacity efficient boiler to be installed, thereby significantly lowering energy use and CO_2 emissions. While thermal retrofits of SFBs is beneficial, it entails a significant investment and has limited impact on reducing air pollution.

The WB presented its initial findings in its Interim Report to the GoP in December 2017, which was discussed at a stakeholder meeting in January 2018. Based on discussions with the GoP and its agencies and the European Commission, it was decided that the financial support mechanisms and instruments should support both replacement of non-complaint solid fuel boilers and thermal retrofits of SFBs.

Based on the stakeholder meeting in January 2018 and stakeholder consultations in May 2018, the revised scope of this study was to develop financial support mechanisms and financial instruments to support the poor and non-poor SFBs in Małopolskie and Śląskie regions and across Poland, respectively, to replace non-compliant solid fuel boilers, switch to cleaner fuels, and undertake full or partial thermal retrofits.

The above is a significant departure from the original scope of this WB support program when it was initiated in mid-2017. At the time, the objective was to develop financial instruments to support SFBs in Małopolskie and Śląskie regions to replace non-compliant solid fuel boilers in compliance with the requirements of the anti-smog resolutions to reduce air pollution. The revised objectives will have a much greater impact on air pollution, energy use, and CO_2 emissions, but will entail a significantly higher investment, some of which may have to be subsidized to incentivize SFBs to implement measures not mandated by any regulations.

Given the high investment needs and funding for subsidies, the WB team recommends that the GoP prioritize implementation of a program in regions with anti-smog resolutions, and/or the 33 most polluted cities in Poland. The program could later be rolled out across the country. To present the GOP with a range of options, the WB has analyzed the following market segments to reduce air pollution and improve energy efficiency in SFB's:

- Poor and non-poor SFBs in Małopolskie and Śląskie regions[3]
- Poor and non-poor SFBs in the 33 most polluted cities in Poland
- Poor and non-poor SFBs across Poland

[1] In Małopolskie, all non-compliant boilers have to be replaced by the end of 2026 with solid fuel boilers that comply with eco-design requirements, gas heating, district heating, electricity, heat pump, or light fuel oil boiler as permitted by regulations. In Śląskie, all non-complaint solid fuel boilers have to be replaced by 2027 with Class 5 norm boilers or other heating equipment permitted by regulations. Both regions have a phased implementation schedule for replacement of non-compliant boilers.

[2] Building codes for new construction include thermal insulation guidelines. But existing SFB stock is grandfathered in and not mandated to install insulation.

[3] In this report, the single family building (SFB) is understood, depending on the context, either as a household living in a single family building or a building, for instance "poor SFBs" means a poor household living in an SFB.

The investment and subsidy needed and program impacts (reduction in air pollutants, energy savings, CO_2 reduction, etc.) for each of the above market segments has been estimated based on SFBs shifting from old non-compliant solid fuel boilers to gas boilers, heat pumps and coal boilers that meet regulatory standards, and undertaking partial or full thermal retrofitting of SFBs.

It is important to note that the design of financial instruments and incentive mechanisms to support a regulatory mandate – replacement of non-compliant boilers in SFBs – has the objective to support SFBs compliance with the mandatory new regulations recognizing that the investment required may be a barrier for certain segments of homeowners. On the other hand, instruments and mechanisms to support thermal retrofits of existing SFBs are not linked to any regulatory mandate and are designed to improve energy efficiency in SFBs. Thus, financial instruments and mechanisms designed to support replacement of non-compliant boilers are likely to have higher uptake compared to instruments for thermal retrofits. In consultation with the GoP and the EC, and consistent with the revised objectives of this study, the WB has developed two broad categories of financial instruments: financial support mechanism to support poor SFBs and incentivize non-poor SFBs, and financial instruments to support non-poor SFBs.

The stakeholder meeting in January 2018 gave clear direction that the GoP's objective is to develop a program to reduce air pollution and improve energy efficiency through thermal retrofits of SFBs. This is logical, since thermal retrofits of SFBs can lower the heat demand of SFBs and the capacity of boilers and save fuel costs.

3. OPTIONS FOR REDUCING SMOG AND IMPROVING ENERGY EFFICIENCY

Poland can reduce air pollution and improve energy efficiency in SFBs through the replacement of non-compliant solid-fuel boilers with coal and gas boilers, heat pumps, and other heating systems that meet regulatory and building codes, coupled with thermal retrofits of SFBs (Table 1). Thermal retrofits of SFBs results in substantial fuel cost savings but are quite expensive and have a limited impact on reducing air pollution. Given the high cost of thermal retrofits, the option of partial thermal retrofits, especially for poor SFBs, largely financed through public subsidies, was also examined. But, it was not the most cost-effective option given the high capital costs and the lower energy savings. Thus, consistent with the GoP's objectives to improve energy efficiency, this study recommends boiler replacements and full thermal retrofits of SFBs.

As noted above the WB team has separately analyzed the opportunity for improving heating systems in SFBs in Małopolskie and Śląskie regions, SFBs in the 33 most polluted cities, and SFBs across Poland. Initially, the WB had considered different options for poor SFBs and non-poor SFBs based on access and cost of more expensive fuels such as gas and electricity. But based on discussions with stakeholders, the analysis has been revised to include all heating system options for all SFBs. The WB recommends the following options for poor and non-poor SFBs to reduce air pollution and improve energy efficiency.

3.1 POOR AND NON-POOR SFBs IN POLAND

Switching from non-compliant solid fuel boilers to gas boilers, renewable energy (RE) such as biomass, and heat pump, coupled with full thermal retrofits, is not only the most cost-effective way to reduce both particulate and CO_2 emissions, but also results in savings in fuel costs. It is recommended that all SFBs currently connected to gas networks (about 40 percent of the SFBs across Poland), switch from non-complaint solid fuel boilers to gas boilers. The savings in fuel costs when switching to gas boilers along with thermal retrofits of the SFB will obviate the need for fuel purchase subsidies for poor SFBs.

Some regions in Poland, such as Małopolskie, have well developed gas networks with an estimated 64 percent of SFBs having access to gas and have the opportunity to make a larger shift to gas boilers compared to Śląskie where about 36 percent of SFBs are estimated to have access to natural gas. Rural areas have lesser access to natural gas networks compared to urban areas, and poor SFBs in rural areas are less likely to have an opportunity to shift to natural gas for heating. The analysis for Małopolskie and Śląskie is based on available information on the gas network coverage in urban and rural areas. For the 33 most polluted cities and for SFBs across Poland, the analysis is based on the estimated nation-wide average for gas connectivity.

Expansion of the natural gas network to connect a higher proportion of SFBs would enable a greater shift from solid fuel boilers to gas boilers. While this option will further reduce energy consumption, air pollution, and CO_2 emissions,[4] the cost to expand the gas network to SFBs vis-à-vis the benefits is yet to be examined. Preliminary discussions with a gas utility indicate that it may be possible in future to develop localized natural gas networks through distributed LNG terminals.

The heat pump option is constrained by the higher installation cost of heat pumps and the presently limited supply of heat pumps in Poland. It is assumed that about four percent of the SFBs may switch to heat pumps, which roughly doubles the percentage of SFBs presently using heat pumps. The use of heat pumps without thermal retrofits of the SFBs is not recommended since expenditure on electricity would be very high in a poorly insulated or uninsulated SFB. Poor SFBs are thus unlikely to switch to heat pumps in the absence of high subsidies to install the system and insulate the SFB. The savings in fuel costs when switching to heat pumps with thermal retrofits of the SFB will obviate the need for fuel purchase subsidies for poor SFBs.

[4] If the natural gas network connection to SFBs were expanded to over three-fourths of the SFBs (from 40 percent at present), and these SFBs were to all switch to gas boilers, and a further 15 percent of SFBs were to switch to heat pumps with under 10 percent of SFBs using coal boilers, annual fuel savings (GJ) would increase by 17 percent over the base case analysis but annual expenditure on fuel by SFBs would increase by about 79 percent. This option would further reduce CO_2 emissions by over 42 percent, and particulate emission would further reduce by less than 2 percent. The increased shift to gas and heat pumps would lower overall investments for non-poor SFBs by about 4 percent (not including the cost of expanding the gas network which could be substantial). Thus, the expanded use of natural gas for heating is recommended if energy savings and a reduction in CO_2 emissions is a priority.

Replacement of non-compliant solid fuel boilers with compliant coal boilers, mandated by the anti-smog resolutions, coupled with full thermal retrofits, can reduce both particulate and CO_2 emissions, and result in fuel cost savings. This is recommended for poor and non-poor SFBs that are presently not connected to the gas network or switching to heat pumps. It is also recommended that a program to support switching to improved coal boilers be coordinated with gas utilities to examine if there is an opportunity to expand the gas network and instead switch to gas heating.

Partial thermal retrofits costs less in upfront investments than full thermal retrofits but requires larger new boilers that will last decades to come. Boiler replacement from non-compliant solid fuel boilers to compliant coal boilers plus partial thermal retrofits would result in marginal fuel cost savings but make the poor SFBs vulnerable to future potential fuel price increase. For fuel switching from coal boilers to gas boilers plus partial thermal retrofit, the fuel bills would increase, which may require fuel subsidies for the poor. Therefore, the WB recommends full thermal retrofits for poor SFBs to ensure sustainability. For the non-poor SFBs, since there is no mandate for thermal retrofit and the financial incentives are limited, the non-poor SFBs may choose partial thermal retrofits, but financial incentives should be provided to incentivize full thermal retrofits only.

With the assumed shift in use of home heating systems, the use of non-compliant solid fuel boilers in SFBs in Poland will reduce from about 84 percent to about 55 percent, the use of gas boilers will increase from about 14 percent to 40 percent, and the use of heat pumps and other heat sources including renewable energy systems will likely go up from about 2 to 5 percent (Figure 1).

FIGURE 1.
Mix of Heating Sources in SFBs Before and After the Boiler Replacement Program

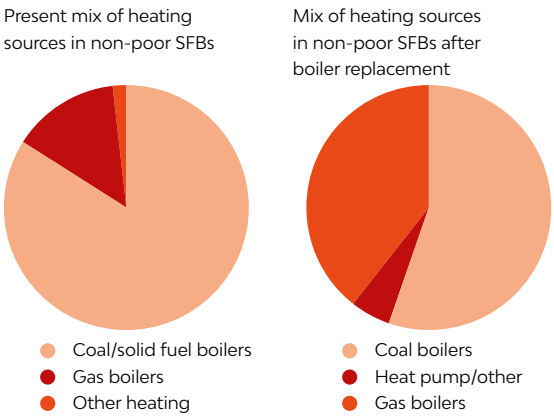


TABLE 1.
Cost (PLN) and Emission Reductions from Replacement of Old Solid-Fuel Boilers with Alternative Technologies and Thermal Retrofits in a single SFB

COSTS AND EMISSION REDUCTIONS OF REPLACEMENT OF OLD COAL BOILER AND THERMAL RETROFIT OF SFBS											
	Replacement with ECO-design coal boiler	ECO-design coal boiler +partial thermal retro-fit of SFB***	ECO-design coal boiler +full thermal retro-fit of SFB****	Switching from old coal to gas boiler	Gas boiler + partial thermal retro-fit of SFB***	Gas boiler + full thermal retro-fit of SFB****	Switching from old coal boiler to heat pump	Heat pump + partial thermal retrofit of SFB***	Heat pump + full thermal retro-fit of SFB****	Partial thermal retrofit only***	Full thermal retrofit only****
Annual Fuel savings(GJ)	-14.7	57.5	98	12.6	72.8	106.5	112.0	128.4	137.6	42.4	89.6
Annual fuel cost savings (PLN)*	-1,857	501	1,825	-3,794	-584	1,219	-2.500	141	1,624	995	2,101
Total investment**(PLN)	13,500	38,500	63,500	7,500	32,500	57,500	25,000	50,000	75.000	25,000	50,000
Annual reduction in particulate emissions (kg)	95	97	98	100	100	100	100	100	100	28	60
Annual reduction in CO_2 emissions	-4.1+	1.9	5.3	2.4	5.5	7.3	1.1	4.8	6.9	2.7	5.7

+ The automatic-fed coal boiler consumes more coal than the old solid fuel boiler and replaces the use of wood. It also consumes electricity for its operations.

* The new coal boiler requires higher priced coal; gas and electricity are more expensive than coal.

** A 5-10 kW automatic Ecodesign coal boiler costs about 9,000 PLN; a gas boiler costs about 4,000 PLN; and a heat pump costs about 20,000 PLN. This is in comparison to about 2,500 PLN for a "smoker" or manually fed boiler (total investment Includes cost of duct work and installation cost for new boiler; does not include replacement of heaters and heat control devices mounted on heaters).

*** Partial retrofits include wall insulation and modernization of the central heating system components.

**** Full retrofits include wall, roof, and floor insulation, and modernization of the central heating system components.

4. INDICATIVE FUNDS NEEDED TO SUPPORT SFBs

4.1 ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

Małopolskie and Śląskie have both adopted anti-smog resolutions and are utilizing funds from the EC's Regional Operational Program (ROP) and other sources of financing support SFBs replace non-compliant solid fuel boilers. The two regions are also keen to utilize available funds to support heating system replacement and thermal retrofits of SFBs as suggested by the WB. The GoP could consider prioritizing launching a program initially in these two regions. The learning from implementing programs in the two regions would be useful to launch a nation-wide program to support poor and non-poor SFBs.

4.1.1 POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the two regions, is estimated to be about PLN 4.7 billion (EUR 1.1 billion, see Table 2). This estimate assumes that old solid fuel boilers are replaced in all eligible poor SFBs, which account for 10 percent of the SFBs in the two regions.[5] It is further assumed that about 80 percent of these poor SFBs will be thermally retrofitted under the program.[6] Thermal retrofits of poor SFBs in the two regions has a significant cost implication and represents about three-fourths of the total estimated investment.[7]

Given the high cost of thermal retrofits, stakeholders had suggested examining the option of lower cost and partial retrofits of poor SFBs. An analysis of the potential for energy savings vis-à-vis the cost of retrofits indicated that partial retrofits would be a less cost-effective option compared to full retrofits.[8] The investment analysis thus assumes full thermal retrofits of poor SFBs in the two regions.

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[5] The total investment required to support poor SFBs is lower than the estimate provided in the Interim Draft report presented in December 2017 since poor SFBs are estimated to constitute only 10 percent of SFBs as opposed to 20 percent assumed earlier.

[6] World Bank. Poland: Diagnostic Assessment and Analysis of Energy Efficiency Opportunities and Strategies in Single-Family Buildings. Completed in September 2017. Instytut Ekonomii Środowiska (Institute for Environmental Economics, IEE) estimated SFBs that require replacement of boilers and thermal retrofits based on surveys conducted in 2016 by Atmoterm S.A., data from the Central Statistical Office, and its own estimates. The average cost of replacing boilers and thermal retrofits of SFBs was estimated based on data gathered from equipment manufacturers by the IEE.

[7] A full thermal retrofit of a SFB is defined as insulation of walls, roof, floor and modernization of the heating systems including piping, radiators, thermostats/regulators all done to code specifications. The cost of thermal retrofits also varies significantly. While, the IEE estimated the cost of a full thermal retrofit to be about PLN 81,703, anecdotal information from equipment installers indicates that the cost of a thermal retrofit of an SFB could vary from PLN 25,000 to PLN 50,000 since many SFBs have some insulation. This analysis assumes that the average cost of a full thermal retrofit of an SFB to be PLN 50,000.

[8] Insulation of only the walls of the SFB and modernization of the heating systems (partial retrofits) at a cost of PLN 35,000, which can reduce the heat load of an SFB by about 44 percent (at about 70 percent of the cost of a full retrofits) was also analyzed. The analysis indicated that from the standpoint of reducing air pollution, it would be better to undertake a full retrofit since a partial retrofit would result in lower fuel cost savings and less than 10 percent reduction in CO_2 emissions compared to a full retrofit of the SFB.

TABLE 2.
Indicative Funds Required to Support Poor SFBs in Małopolskie and Śląskie Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	53,610	13,500	PLN 723.74m (EUR 170.29 m)
Replacement of coal/solid fuel to new gas boilers	33,750	7,500	PLN 253.13 m (EUR 59.56 m)
Replacement of coal/solid fuel to new heat pumps	3,640	25,000	PLN 91.0 m (EUR 21.41 m)
Partial thermal retrofits[2]	72,800	25,000	PLN 1,820.0 m (EUR 428.24 m)
Total with partial retrofits			2,887.86 m (679.50 m)
Full thermal retrofits[2]	72,800	50,000	PLN 3,640.0 m (EUR 856.47 m)
Total with full retrofits			PLN 4,707.86 m (EUR 1,107.73 m)

[1] IEE has estimated that 910,000 SFBs (out of total 1.1m SFBs) in the two regions require replacement of solid fuel boilers to comply with the anti-smog resolutions. IBS has estimated that in Poland on average 10 percent of SFBs are poor. For that reason, 10 percent of the 910,000 SFBs that need boiler replacement are assumed to be poor (91,000 SFBs). Based on access to a gas network in Małopolskie and Śląskie, it is assumed that 50 percent and 25 percent of the poor SFBs in the two regions, respectively, will switch to gas heating. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.
[2] 80 percent of the poor SFBs that would need to replace boilers as mandated by anti-smog resolutions are estimated to need thermal retrofits under the program (72,800 SFBs). The cost of thermal retrofits varies significantly. While, the IEE has estimated cost of full thermal retrofits for a typical SFB to be about PLN 81,703, anecdotal information from equipment installers indicates that the average cost of a full thermal retrofits of an SFB is PLN 50,000. This analysis assumes that the average cost of a full thermal retrofits of an SFB ranges is PLN 50,000. The investment required for retrofit would be much higher if the costs were PLN 81,700. The cost of partial retrofits is estimated to be PLN 25,000

[i] The estimates in this table are based on average costs of boiler replacements and thermal retrofits in an average sized SFB.
[ii] Cost of the program implementation/administration (energy assessment of SFBs, processing and evaluation of applications/ proposals, disbursement of funds, monitoring and verification, etc.) is not included in the estimates shown in this table.

4.1.2 NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

Non-poor SFB in the two regions would need to invest about PLN 25.4 billion (EUR 6.0 billion, see Table 3) to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards, and undertake full thermal retrofits. Since non-poor SFBs may only receive a partial subsidy as an incentive from the state, home owners would have to finance much of this investment from personal savings and commercial loans. It is thus likely that non-poor SFBs may only undertake partial or no retrofits since it is not mandated by regulations. Replacement of non-compliant boilers is however mandated by anti-smog resolutions in the two regions.

TABLE 3.
Indicative Funds Required to Support non-Poor SFBs in Małopolskie and Śląskie Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	380,520	13,500	PLN 5,137.0 m (EUR 1,208.71 m)
Replacement of coal/solid fuel to new gas boilers	405,720	7,500	PLN 3,042.90 m (EUR 716.00 m)
Replacement of coal/solid fuel to new heat pumps	32,760	25,000	PLN 819.0 m (EUR 192.71 m)
Partial thermal retrofits[2]	327,600	25,000	PLN 8,190.0 m (EUR 1,927.0 m)
Total with partial retrofits			PLN 17,188.92 m (EUR 4,044.45 m)
Full thermal retrofits[2]	327,600	50,000	PLN 16,380.0 m (EUR 3,854.12 m)
Total with full retrofits			PLN 25,378.92 m (EUR 5,971.51 m)

[1] 90 percent of the 910,000 SFBs in Małopolskie and Śląskie that need replacement of boilers are assumed to be non-poor based. Based on access to a gas network in Małopolskie and Śląskie, it is assumed at 64 percent and 36 percent of the non-poor SFBs in the two regions, respectively, will switch to gas heating. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.
[2] 40 percent of the non-poor SFBs in the two regions are estimated to need thermal retrofits. Only the SFBs participating in the program and switching from old solid-fuel boilers to new coal and gas boilers and heat pumps are considered for thermal retrofits.

4.2 ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN 33 MOST POLLUTED CITIES IN POLAND

The thirty-three most polluted cities in Poland are estimated to be populated by ten percent of the Polish population. Given the urgent need to reduce air pollution in the country, the GoP could consider prioritizing launching a program initially in these 33 cities. Based on national averages, these cities are estimated to have a total of 542,857 SFBs. The WB team has analyzed the investment needed by poor and non-poor SFBs in the 33 cities.

4.2.1 POOR SFBs IN 33 MOST POLLUTED CITIES

The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the 33 cities, is estimated to be about PLN 2.4 billion (EUR 560 million, see Table 4). The number of solid fuel boilers required to be replaced is estimated based on national averages as determined by IEE surveys. As in the case of poor SFBs in Małopolskie and Śląskie, it is assumed that about 80 percent of poor SFBs that need to replace solid fuel boiler will be thermally retrofitted under the program.

TABLE 4.
Indicative Funds Required to Support Poor SFBs in 33 Most Polluted Cities in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	30,096	13,500	PLN 406.30 m (EUR 95.60 m)
Replacement of coal/solid fuel to new gas boilers	13,680	7,500	PLN 102.60 m (EUR 24.14 m)
Replacement of coal/solid fuel to new heat pumps	1,824	25,000	PLN 45.60 m (EUR 10.73 m)
Partial thermal retrofits	36,480	25,000	PLN 912.0 m (EUR 214.59 m)
Total with partial retrofits			PLN 1,466.50 m (EUR 345.06 m)
Full thermal retrofits[2]	36,480	50,000	PLN 1,824.0 m (EUR 429.18 m)
Total with full retrofits			PLN 2,378.50 m (EUR 559.65 m)

[1] 10 percent of the 542,857 SFBs in the 33 cities are assumed to be poor. The number of solid fuel boilers to be replaced is estimated based on national surveys conducted by IEE. It is assumed that all SFBs with access to a gas network will switch to gas boilers. Four percent are assumed to switch to heat pumps, and the remaining to compliant coal boilers.

4.2.2 NON-POOR SFBs IN 33 MOST POLLUTED CITIES

The total investment needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs in the 33 cities, is estimated to be about PLN 13.2 billion (EUR 3.1 billion, see Table 5). It is assumed that about 40 percent non-poor SFBs will need to be thermally retrofitted. Since non-poor SFBs may only receive a partial subsidy as an incentive from the state, home owners would have to finance much of this investment from personal savings and commercial loans. It is thus likely that non-poor SFBs may only undertake boiler replacement in regions which have anti-smog resolutions and undertake partial or no retrofits since it is not mandated by regulations.

TABLE 5.
Indicative Funds Required to Support Non-Poor SFBs in 33 Most Polluted Cities in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	270,864	13,500	PLN 3,656.66 m (EUR 860.39 m)
Replacement of coal/solid fuel to new gas boilers	123,120	7,500	PLN 923.40 m (EUR 217.27 m)
Replacement of coal/solid fuel to new heat pumps	16,4,16	25,000	PLN 410.40 m (EUR 96.56 m)
Partial thermal retrofits	164,160	25,000	PLN 4,104.0 m (EUR 965.65 m)
Total with partial retrofits			PLN 9,094.46 m (EUR 2,139.87 m)
Full thermal retrofits[2]	164,160	50,000	PLN 8,208.0 m (EUR 1,931.29 m)
Total with full retrofits			PLN 13,198.46 m (EUR 3,105.52 m)

[1] 84 percent of the 542,857 SFBs in the 33 cities are assumed to need replacement of solid fuel boilers, and 90 percent of these SFBs are assumed to be non-poor.

4.3 ESTIMATED TOTAL INVESTMENT IN POOR AND NON-POOR SFBs IN POLAND

As per the revised objectives for this study, the GoP also wishes to launch a program to support poor and non-poor SFBs across Poland to replace non-compliant solid fuel boilers and undertake thermal retrofits. The analysis assumes that all the poor and non-poor SFBs, which currently use solid fuel boilers, but have access to the natural gas network, will switch from non-compliant solid fuel boilers to gas boilers,[9] and about four percent of non-poor SFBs, with no access to the gas network, will switch from non-compliant solid fuel boilers to heat pumps. The remaining SFBs (with no access to the gas network) are assumed to replace the old solid fuel boiler with new coal boilers compliant with new regulations and standards. With this assumed shift, the use of solid fuel and old coal boilers in SFBs in Poland will reduce from about 84 percent to about 55 percent, gas boilers will go up from about 14 percent to 40 percent, and heat pumps (and other heating sources) will increase from about 2 to 5 percent. All these options would need to be coupled with thermal retrofits; 80 percent for poor SFBs and 40 percent for non-poor SFBs.

4.3.1 POOR SFBS IN POLAND

The total investment (principally as subsidy) needed to replace non-compliant solid fuel boilers with gas boilers, heat pumps and coal boilers compliant with new anti-smog regulations and standards and undertake full thermal retrofits of poor SFBs across Poland, is estimated to be about PLN 23.5 billion (EUR 5.5 billion, see Table 6). The number of SFBs requiring replacement of solid fuel boilers across Poland is assumed to be 84 percent of the total as estimated based by nation-wide surveys conducted by IEE. Ten percent of these SFBs are assumed to be poor SFBs, and as in the case of poor SFBs in other market segments, about 80 percent of these poor SFBs are assumed to require thermal retrofits.

TABLE 6.
Indicative Funds Required to Support Poor SFBs in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	296,983	13,500	PLN 4,009.27 m (EUR 943.36 m)
Replacement of coal/solid fuel to new gas boilers	135,248	7,500	PLN 1,014.36 m (EUR 238.67 m)
Replacement of coal/solid fuel to new heat pumps	18,597	25,000	PLN 464.92 m (EUR 109.39 m)
Partial thermal retrofits	360,662	25,000	PLN 9,016.56 m (EUR 2,121.54 m)
Total with partial retrofits			PLN 14,505.11 m (EUR 3,412.97 m)
Full thermal retrofits2	360,662	50,000	PLN 18,033.12 m (EUR 4,243.09 m)
Total with full retrofits			PLN 23,521.61 m (EUR 5,534.51 m)

[9] Across Poland, about 40 percent of SFBs are estimated to have access to the natural gas network

4.3.2 NON-POOR SFBs IN POLAND

The total investment needed to replace non-compliant solid fuel boilers with compliant coal boilers, switch from non-compliant solid fuel boilers to gas boilers and heat pumps and undertake thermal retrofits of non-poor SFBs across the entire country is estimated to be about PLN 130.5 billion range (EUR 30.7 billion, see Table 7). The estimate assumes that 40 percent of SFBs that replace old solid fuel boilers will be thermally retrofitted under the program. Given the high cost of thermal retrofits of the SFBs, it is unlikely that all SFBs requiring insulation will undertake retrofits in the absence of subsidies and regulations mandating thermal retrofits of SFBs. Even replacement of solid fuel boilers may take place only in regions with anti-smog regulations.

TABLE 7.
Indicative Funds Required to Support non-Poor SFBs in Poland Undertake Boiler Replacements and Thermal Retrofits

	NUMBER OF SFBs[1]	UNIT COST (PLN)	TOTAL INVESTMENT
Replacement of coal/solid fuel to new coal boilers	2,672,847	13,500	PLN 36,083.43 m (EUR 8,490.22 m)
Replacement of coal/solid fuel to new gas boilers	1,217,236	7,500	PLN 9,129.27 m (EUR 2,148.06)
Replacement of coal/solid fuel to new heat pumps	167,370	25,000	PLN 4,184.25 m (EUR 984.53 m)
Partial thermal retrofits	1,622,981	25,000	PLN 40,574.52 m (EUR 9,546.95 m)
Total with partial retrofits			PLN 89,971.46 m (EUR 21,169.76 m)
Full thermal retrofits	1,622,981	50,000	PLN 81,149.04 m (EUR 19,093.89 m)
Total with full retrofits			PLN 130,545.98 m (EUR 30,716.70 m)

[1] 84 percent of the 5,367,000 SFBs in Poland are assumed to need boiler replacement and 90 percent of these SFBs are assumed to be non-poor.

5. ESTIMATED ENERGY SAVINGS AND REDUCTION IN PARTICULATE AND CO_2 EMISSIONS

5.1 POOR AND NON-POOR SFBs IN MAŁOPOLSKIE AND ŚLĄSKIE

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs in Małopolskie and Śląskie is shown in Table 8 and Table 9. The replacement of just the old solid fuel boilers without thermal retrofits of the SFBs reduces air pollution but results in increased energy consumption since the new coal boilers use electricity and higher grade coal (and not wood and trash), which also costs more. Wood is considered CO_2 neutral, hence replacing wood with coal results in increased CO_2 emission, also the use of electricity in the new boilers leads to increased CO_2 emissions. The coupling of the boiler replacement program, with thermal retrofits of the SFBs, is clearly the better option since it results in energy and cost savings and lower particulate and CO_2 emissions.

TABLE 8.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in Małopolskie and Śląskie

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 1,585,857	4,376,231 (45%)	7,718,229 (79%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-275.0	-31.0 (-13%)	107.0 (47%)
Annual reduction in particulate emissions (tons, and % savings)	7,740	7,847 (120%)	7,901 (121%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 238,537*	201,216 (33%)	451,884 (73%)

* Annual reduction in CO_2 is negative, meaning SFBs will emit more CO_2.

TABLE 9.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in Małopolskie and Śląskie

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 40,841,892	11,593,260 (22%)	40,978,476 (79%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-3,360.0	-1,074.0 (-88%)	210.0 (17%)
Annual reduction in particulate emissions (tons, and % savings)	50,513	51,274 (147%)	51,655 (148%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 3,351,348	310,716 (9%)	2,403,576 (73%)

5.2 POOR AND NON-POOR SFBs IN 33 MOST POLLUTED CITIES IN POLAND

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs in the 33 most polluted cities in Poland is shown in Table 10 and Table 11.

TABLE 10.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in 33 Most Polluted Cities

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 882,907	2,143,474 (36%)	3,840,158 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-132.0	-12.0 (-8%)	55.0 (39%)
Annual reduction in particulate emissions (tons, and % savings)	3,862	3,923 (98%)	3,953 (99%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 140,539	89,194 (23%)	219,974 (58%)

TABLE 11.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in 33 Most Polluted Cities

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 22,654,901	4,582,526 (15%)	19,852,690 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-1,529.0	-451.0 (-62%)	154.0 (21%)
Annual reduction in particulate emissions (tons, and % savings)	24,911	25,453 (123%)	25,724 (124%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 2,200,565	-132,970 (-7%)	1,044,058 (53%)

5.3 POOR AND NON-POOR SFBs IN POLAND

The estimated energy and cost savings and reduction in particulate and CO_2 emissions from replacement of non-complaint solid fuel boilers and thermal retrofits of poor and non-poor SFBs across Poland is shown in Table 12 and Table 13.

TABLE 12.
Energy Savings and Reduction in Air Pollution and CO_2 in Poor SFBs in Poland

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 8,657,532	21,231,576 (36%)	37,988,345 (64%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-1,301.0	-117.0 (-8%)	548.0 (39%)
Annual reduction in particulate emissions (tons, and % savings)	38,188	38,782 (98%)	39,079 (99%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 1,386,522	883,454 (24%)	2,175,696 (58%)

TABLE 13.
Energy Savings and Reduction in Air Pollution and CO_2 in Non-Poor SFBs in Poland

	BOILER REPLACEMENTS ONLY	BOILER REPLACEMENTS + PARTIAL THERMAL RETROFITS OF SFBS	BOILER REPLACEMENTS + FULL THERMAL RETROFITS OF SFBS
Annual Fuel savings (GJ and % savings compared to baseline, i.e. no changes)	- 223,336,866	45,665,101 (12%)	196,476,027 (51%)
Annual fuel cost savings (PLN, millions and % savings compared to baseline)	-15,115.0	-4,463.0 (-49%)	1,519 (17%)
Annual reduction in particulate emissions (tons, and % savings)	246,313	251,658 (97%)	254,331 (98%)
Annual reduction in CO_2 emissions (tons, and % savings)	- 21,729,684	-1,299,906 (-5%)	10,330,273 (42%)

6. FINANCING MECHANISMS TO REDUCE SMOG AND IMPROVE EE IN SFBs

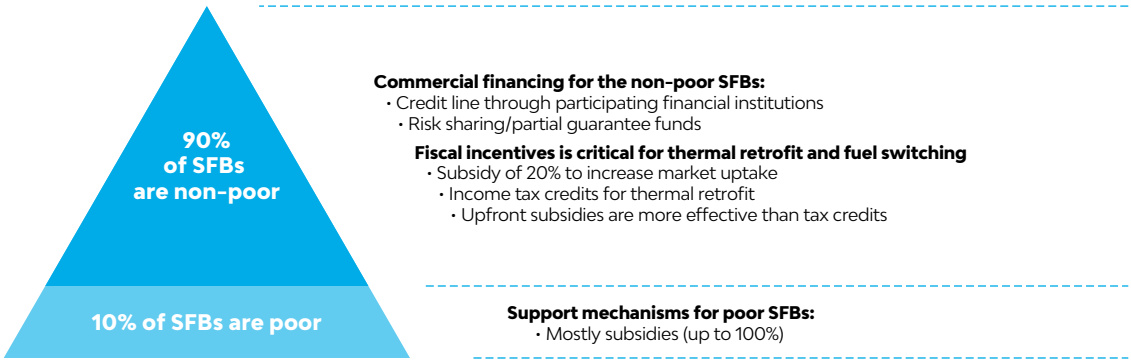
6.1 FINANCIAL SUPPORT MECHANISMS AND FINANCING INSTRUMENTS TO SUPPORT POOR AND NON-POOR SFBs

As noted in the Interim Report of December 2017,[10] the WB team applied multiple criteria to narrow the financial instruments that would be applicable to Poland in the context of the SFB market segmentation and regulatory environment. The framework used to assess various financial instruments is provided in Appendix 1. As noted in Section 2, the consensus among stakeholders was to develop two categories of instruments:

- Public financial support mechanisms to support poor SFBs through subsidies of 90-100 percent.
- Commercial financial instruments to support non-poor SFBs, coupled with partial subsidies and fiscal incentive mechanisms.

The characterization and consensus among stakeholders for distinct financial instruments to target poor and non-poor SFBs is consistent with the approach of the GoP, which aims to promote EE in SFBs principally through the following four mechanisms: 1) Policies and regulations; 2) Programs to support poor SFBs with subsidies; 3) Programs to support non-poor SFBs through loans, tax credits, etc.; and 4) national information campaigns. The financing support mechanisms and financing instruments applicable to poor and non-poor SFBs in Poland is illustrated in Figure 2: Financing Instruments for the Poor and Non-Poor SFBs.

FIGURE 2.
Financing Instruments for the Poor and Non-Poor SFBs



I. **Public finance support mechanism for the Poor SFBs:** For the eligible poor SFBs, the government could provide 90-100 percent of subsidies for boiler replacement, fuel switching, and thermal retrofits, channeled through municipalities. The national government could provide 70 percent of the subsidies for boiler replacement and thermal retrofits for the poor SFBs, while the regional and municipal governments could provide 20 percent of the subsidies. The poor SFBs are encouraged to contribute at least 10 percent of the investments to ensure ownership and sustainability. Recognizing that some poor SFBs may be unable to make a 10 percent contribution, some local municipalities at their discretion could also choose to support poor SFBs by providing the remaining 10 percent of investment costs and require the poor SFBs to provide services in-kind to the municipality in lieu of the 10 percent contribution. In-kind services, as suggested by regional stakeholders, could include un-paid services to fulfil some municipal activities such as cleaning, construction, etc.

[10] Poland Catching-up Regions: Financial Instruments to Support Energy Efficiency Measures in Single Family Buildings in Poland, Interim Report, Draft, December 2017.

Local municipalities or regional administrations could also at their discretion provide fuel subsidies to poor SFBs for a fixed time period of two-three years. While the analysis indicates that a full thermal retrofit of an SFB results in savings in fuel expenditure obviating the need for fuel purchase subsidies, regional stakeholders were of the opinion that some fuel subsidies may be needed when poor SFBs switch to more expensive fuels for heating during the transition period.

II. **Commercial financing scheme for the Non-Poor SFBs:** Commercial lines of credit dedicated to finance eligible EE projects for eligible non-poor SFBs. The credit lines could additionally support equipment manufacturer/supplier develop equipment leasing programs for non-poor SFBs. The credit lines would help the participating financial institutions (PFIs) develop an anti-smog and EE portfolio and supplement traditional retail lending by banks. International financial institutions (IFIs) could have an important role to play to leverage additional commercial financing.

Based on WB team discussions with commercial banks and the experience from the Bank Gospodarstwa Krajowego's (BGK) Thermo-modernization Fund, there is a concern of limited market demand for thermal retrofits, since it is not mandated by the government and has a long payback period. It is thus recommended that financial incentives in the form of subsidies and tax credits/deductions be considered to incentivize the non-poor SFBs to undertake thermal retrofits and fuel switching. International experience has demonstrated that upfront subsidies are generally more effective than tax breaks to incentivize such investments. Since replacement of non-compliant solid fuel boilers to compliant coal boilers is mandated by anti-smog resolutions (in some regions of Poland), and while it reduces air pollution it increases CO_2 emissions, it is suggested that no subsidies be provided to do so. However, subsidies would be needed to incentivize non-poor SFBs for fuel switching (to gas boilers, heats pumps, and other viable alternative technologies) and thermal retrofits. The government could provide a 20 percent subsidy to the 60 percent of the lower income SFBs among the non-poor SFBs. Based on data from the Household Budget Survey for Poland (2015) conducted by the Central Statistical Office, it is estimated that the 60 percent of the lower income SFBs have an annual income below PLN 40,692 (EUR 9,575) and expenditure of PLN 32,683 (7,690), with savings far less than the investment costs for thermal retrofits.

To further increase the financial incentives for the non-poor SFBs, the government could also consider providing fiscal incentives instruments such as tax credits and tax deduction schemes, in addition to upfront subsidies of 20 percent. Such fiscal incentives would primarily benefit the upper 40 percent income strata of the non-poor SFBs, since poor and lower-income SFBs may not have adequate income to benefit from tax credits and tax deductions[11].

Given the scale of investments and subsidies needed, we recommend that the government prioritize subsidies to the most polluted 33 cities to achieve quick wins and major impacts on air pollution with minimum public funds. Subsidies would be channeled through the PFIs who will provide loans to SFBs (similar to the Thermal Modernization Fund operated by BGK) – see the Box 1 that describes the JAWOR program aimed at retrofitting SFBs in the Małopolskie region for the necessity of a broad distribution network to the non-poor SFBs. BGK is presently designing a program for 23 of the 33 cities, which have fewer than 100,000 people.

[11] A tax deduction scheme reduces the taxable income by a fixed amount. And a tax credit reduces the tax by a fixed amount as permitted by the scheme. A tax credit is generally more advantageous than a tax deduction. Given the scale of investments and subsidies needed, we recommend that the government prioritize subsidies to the most polluted 33 cities to achieve quick wins and major impacts on air pollution with minimum public funds. Subsidies would be channeled through the PFIs who will provide loans to SFBs (similar to the Thermal Modernization Fund operated by BGK). BGK is presently designing a program for 23 of the 33 cities, which have fewer than 100,000 people.

BOX E.1.
"Jawor" Program for Thermal Retrofitting of SFBs

JAWOR program. JAWOR (Program Priorytetowy Jawor: poprawa efektywności energetycznej – termomodernizacja budynków jednorodzinnych) is managed by the regional Fund for Environmental Protection and Water Management (WFOŚiGW) in Kraków and provides soft loans to Małopolskie SFBs to undertake thermal retrofits. SFBs may utilize the funds for undertaking the thermal retrofitting of external walls, roofs and flat roofs, and floors on ground, and for the replacement of windows and doors provided the project results in a minimum 25 percent reduction in energy use as determined by an energy audit or energy assessment. The budget for the program was PLN 15 million in 2017.

The process. SFBs first file an online application form followed by the submission of the loan application (in person or by mail) to the WFOŚiGW office in Kraków. Approved applicants sign a blank promissory note in the WFOŚiGW office, which is the main of the two methods of securing the loan (the other collateral may involve a mortgage, a monetary deposit, a guarantee agreement, for example)[12]. The loan is provided to borrowers after they make the investment in the retrofitting project or complete a project phase (two tranches are allowed, at the maximum) and upon submission of invoices to WFOŚiGW.

Loan terms. JAWOR provides a loan up to 90 percent of investment costs at a low interest rate of 2 percent and with tenor of up to 10 years. On top of the blank promissory note, SFBs provide another form of collateral to secure the loan (see also footnote above). The program has a provision to write-off 20 percent of the principal (and the interest on that 20 percent). The minimum loan amount under JAWOR is PLN 20,000 and the maximum PLN 100,000. The maximum eligible costs for retrofitting are defined: 150 PLN/m^2 for insulation of walls, roof, flat roofs and floors on ground, and 400 PLN/m^2 for replacement of windows and doors.

Program impact. In 2017, WFOSiGW had signed 129 loan agreements and disbursed PLN 5.92 million to SFBs (that amount has been disbursed on the basis of agreements signed in 2016 and 2017), which represents almost 40 percent of 2017 budget. The average loan amount was about PLN 51,680. Borrowing procedures as well as the terms and conditions seem quite intricate for the beneficiary (the requirement for the applicant to pay a visit in person at the WFOŚiGW office in Kraków, the requirement of an energy audit or energy assessment, and the requirement for SFBs to first make the investment or a part thereof, and to provide two collaterals to secure the loan), which may be a disincentive for potential beneficiaries.

There has been an upward trend in the number of JAWOR applications submitted: 2016 (105), 2017 (152), 2018 (50 as of Jun 15), but the scale is still small when compared to the needs (there are about 560,000 SFBs in Małopolskie). As a lesson learnt from JAWOR program, it seems that a much broader distribution network, e.g. through commercial banks, coupled with simple and streamlined procedures, will be indispensable to reach out to a large audience of beneficiaries in Poland.

6.2 RATIONALE FOR SEGMENTATION OF SFBs AS POOR AND NON-POOR

SFBs may be segmented by income, geography, and other socio-economic considerations (such as number of persons and/or children per household, pensioners, disabled persons, etc.). In the interest of simplicity and having few financial instruments, and in consultation with stakeholders, SFBs are categorized as poor and non-poor households. Poverty here is defined in terms of energy poverty, which has a broader definition than income poverty according to the study by the Instytut Badań Strukturalnych (IBS) of Poland.

[12] In case of loans below PLN 45,000 PLN, the Fund may decide to accept only one securing method (a promissory note).

6.2.1 POOR SFBs

The GoP has not developed or adopted a definition for energy poverty in Poland. IBS has researched energy poverty issues extensively and prepared the most definitive reports on the subject. The latest report by IBS prepared in January 2018 redefined energy poverty based on its latest surveys and research.[13] It now estimates that about 9.8 percent of households in Poland (and 12.2 percent of Poles) are energy poor.[14] Based on this revised estimate, the draft report assumes that 10 percent of SFBs in Poland are energy poor. This is significantly different from earlier estimates made by IBS based on the WB previous assumption that 20 percent of households are energy poor.[15] This category of poor SFBs will likely need to be fully subsidized to make investments in boiler replacements and thermal retrofits.

International experience shows that the most practical and operational way to provide subsidies to support low-income households for EE and building retrofit is to use the income levels as the definition. For example, New York state defines low-income households as 60 percent of the area median income, while Washington DC defines low-income households as 80 percent of area median income. New York state provides 100 percent subsidies to low-income households up to $4,000 per household for building retrofits and other EE measures, funded by a system benefit fund collected from electricity surcharges to all consumers. They also provide 20 percent subsidy for the rest of households to incentivize building retrofits. Appendix 2 provides some additional definitions of energy poverty used in other countries.

6.2.2 NON-POOR SFBs

Assuming, as noted above, that 10 percent of SFBs are categorized as "Poor SFBs", the remaining 90 percent of SFBs in the country are "Non-Poor SFBs." This category of SFBs has a broad range of incomes and expenditures. Based on data from the Household Budget Survey for Poland (2015) conducted by the Central Statistical Office, it is estimated that the first quintile of households in Poland has an annual income of PLN 15,540 and expenditure of PLN 19,323, implying they live on credit to meet expenses.[16] The first quintile of households includes poor and non-poor SFBs. The second quintile has an annual income of PLN 29,718 and expenditure of PLN 25,628, and the third quintile has an annual income of PLN 40,692 and expenditure of PLN 32,683. The fourth and fifth quintiles of households have annual incomes of PLN 54,255 and PLN 96,242 against expenditures of PLN 41,918 and PLN 66,524, respectively.

The Household Budget Survey of 2015 reported that households in the fifth quintile held almost 40.7 percent of the income of total households, compared with 6.6 percent for households in the first quintile. Households in the fifth quintile spent 69.1 percent of available income, compared to 124 percent for households in the first quintile. The Household Budget Survey reports that households in the first quintile are dependent on savings, loans, and/or credits, to meet household expenditures. The survey also infers that the poorest families bear a greater burden for expenditures on permanent housing costs (payments to the owners, water supply and other dwelling-related services, and energy carriers).

Based on the income and expenditure profiles of households, the bottom three quintiles of non-poor SFBs are thus unlikely to have the capacity to invest in boiler replacements and thermal retrofits from personal savings. Even conventional commercial debt service products may be inaccessible to this group of SFBs. Households in the top two quintiles are likely to have the capacity to make investments to improve home heating systems.

It is thus very likely that many non-poor SFBs, especially those in the lower three quintiles of income, may also

[13] Ubóstwo energetyczne w Polsce 2012-2016 Zmiany w czasie i charakterystyka zjawiska, Brief Report, Styczeń 2018 r. Katarzyna Sałach & Piotr Lewandowski.

[14] IBS has estimated energy poor households in each region of Poland and it estimates 10 percent of households in Małopolskie and 7.2 percent of households in Śląskie are energy poor.

[15] Energy Poverty in Poland – Buzzword or a Real Problem? Aleksander Szpor, IBS (Instytut Badań Strukturalnych) Policy Paper 2/2016, January 2016.

[16] Estimated based on data for income and expenditure per capita for each quintile for 2015. Data from the Household Budget Survey for 2015, Statistical Information and Elaborations, Central Statistical Office, Warsaw 2016. Budżety Gospodarstw Domowych W 2015 R, Informacje i opracowania statystyczne, Główny Urzad Statystyczny, Warszawa, 2016.

need subsidies to incentivize them to make investments in boiler replacement and thermal retrofits. This has major implications for a program to support non-poor SFBs to make improvements in home heating systems. Given the large investment needs, it is suggested that subsidies be provided to the bottom 60 percent of non-poor SFBs and be limited to investments made to switch from coal to other fuels and for full thermal retrofits. The program for non-poor SFBs could also be initially rolled out in the 33 most polluted cities in Poland.

The provision of heavy subsidies to poor SFBs and some subsidies to a segment of the non-poor SFBs is essentially a fiscal program that channels public funds from the treasury to benefit SFBs. Given the scale of funds required to support this program (see Section 4), it is suggested to establish a National Fund to channel funds to SFBs.

6.3 A NATIONAL FUND FOR ANTI-SMOG AND EE

Given the large scale of public funds, additional EU funds would be necessary to help Poland fight smog and improve energy efficiency in SFBs. And concessional loans from multi-lateral development banks could be used to provide credit lines through local participating banks to meet the huge financing needs for boiler replacement, fuel switching, and thermal retrofit.

It is essential to coordinate the use of public funds from the government and EU at both the national, regional, and local levels, and it is recommended that a **National Fund for Anti-Smog and Energy Efficiency** be established to pool various funding resources, and channel all public finance support mechanisms to poor and non-poor SFB, as eligible under the program. To supplement the National Fund, the regional and municipal governments could provide additional financing to support programs in their jurisdictions. The National Fund would channel subsidies to poor SFBs through municipalities, and for eligible non-poor SFBs through Participating Financial Institutions (PFIs). The primary criteria for the Fund manager are provided in the Box 2.

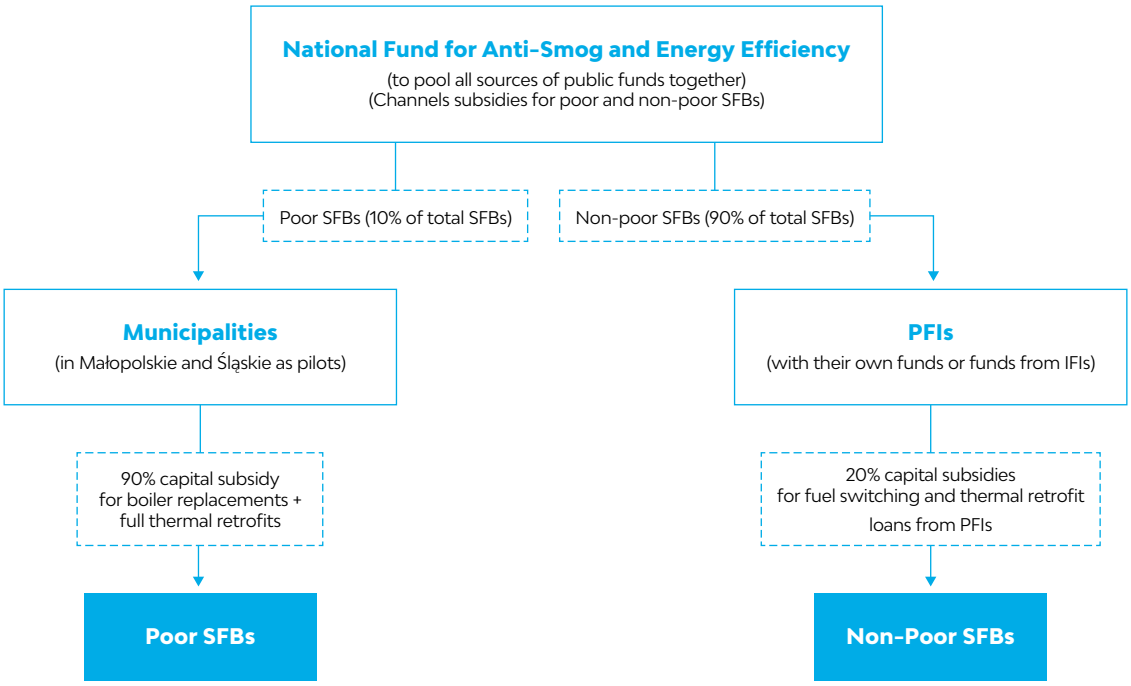
Such a National Fund could have different implementing agencies, with commonly defined eligibility criteria and procedures and close coordination, and their roles and responsibilities could be split by market segments, for example, poor vs non-poor SFBs. For instance, the NFOSiGW and the Ministry of Environment have already proposed a PLN 25 billion (EUR 5.9 billion) fund to support boiler replacement and thermal retrofits of SFBs; while BGK has operated a successful thermal-modernization fund that provides 20 percent subsidies for thermal retrofit and is piloting financial support to the poor SFBs in the most polluted 23 cities. Figure 3 illustrates the proposed flow of funds from the National Fund to poor and non-poor SFBs.

BOX 2.

Criteria for Fund Manager of the National Fund for Anti-Smog and Energy Efficiency

The entity/-ies who will manage the financial support and financing mechanisms for anti-smog and energy efficiency in SFBs should meet the following criteria: (a) a proven track record of experience to disburse public funds effectively, efficiently, and quickly; (b) a wide network with local commercial banks to channel funds through participating banks that have country wide retail operations and ongoing banking relationships with non-poor SFBs; (c) the ability to work with regional and municipal governments to channel funds through them for poor SFBs; and (d) simple application and approval procedures, and streamlined process.

FIGURE 3.
National Fund for Anti-Smog and EE in SFBs in Poland



6.3.1 ROLE OF REGIONAL ADMINISTRATIONS AND MUNICIPALITIES.

The regional governments would co-fund measures within their administrative regions, provide financing to participating municipalities, and be responsible for setting program targets and results monitoring. The municipalities would principally be responsible for supporting programs directed at poor SFBs within their jurisdictions, including identification of poor SFBs based on defined criteria, program implementation support, and SFB-level monitoring and verification. While some municipalities may choose to directly support poor SFBs implement measures, others may choose to provide financing to implementation partners who meet eligibility criteria of the National Fund supporting poor SFBs. The specific roles and operational processes will have to be defined in the operational phase of a program to support poor SFBs.

6.3.2 PRIORITIZING AND SEQUENCING FINANCIAL SUPPORT TO THE SFBs IN POLAND

Given the huge financing needs and the challenging task to roll out the anti-smog and EE program nationwide, it is recommended that the program start with heavily polluting regions, particularly those who have adopted anti-smog resolutions to demonstrate their political commitment in an enabling regulatory environment. Therefore, the National Fund(s)[17] for Anti-Smog and EE could prioritize subsidies to the 33 most polluted cities in Poland. This will further reduce the need for public funds to provide subsidies to non-poor SFBs and provide quick wins and have a major impact on reducing air pollution in the country, with the minimum amount of required public funds. To this end, the national government is launching a pilot program that targets the 23 smaller cities among the 33 most polluted cities in Poland, to be implemented by BGK, where the national government provides 70 percent, regional governments 20 percent, and municipal governments 10 percent of subsidies for poor SFBs.

[17] If the GoP chooses to create more than one fund, the coordination has to be ensured. The implementation mechanisms in these funds should be the same. These funds could e.g. prioritize subsidies to different specific market segments.

6.3.3 STRENGTHENING REGULATIONS AND ENFORCEMENT TO INCREASE MARKET DEMAND

Anti-smog resolutions and enforcement are key to create market demand for boiler replacement and fuel switching, and solid fuel quality standards are essential to reduce air pollution. Low market uptake of boiler replacement, fuel switching, and thermal retrofit would be the single biggest risk for the financial mechanisms of energy efficiency in SFBs. In the absence of government mandates for thermal retrofit, financial incentives in the form of upfront subsidies and tax breaks would be critical to increase market demand and penetration.

6.4 FINANCIAL SUPPORT MECHANISMS (SUBSIDIES) TO SUPPORT POOR SFBs

The total investment needed to support poor SFBs in the Małopolskie and Śląskie regions or the 33 most polluted cities or in other regions of Poland to replace non-compliant solid fuel boilers and undertake thermal retrofits is provided in Section 4. As noted earlier, poor SFBs would likely need 90-100 percent subsidies to replace non-compliant solid fuel boilers and undertake thermal retrofits.

6.4.1 SUBSIDIES REQUIRED TO SUPPORT POOR SFBs

The total amount of subsidies estimated to be needed to support poor SFBs in Małopolskie and Śląskie, 33 most polluted cities, and across Poland replace non-compliant solid fuel boilers and undertake full or partial thermal retrofits is provided in Table 14.

6.4.1.1 Małopolskie and Śląskie

The total amount of subsidies required for poor SFBs in Małopolskie and Śląskie is estimated to be around PLN 4.2 billion (EUR 1.0 billion) for supporting full thermal retrofits, and PLN 2.6 billion (EUR 0.6 billion) for supporting partial thermal retrofits.

In the near term, Małopolskie and Śląskie regional and municipal governments could use the existing limited EC funds to provide subsidies to the most polluted cities first. In this regard, the regional and municipal governments could use the existing EC funds to make the 30 percent contribution to the pilot national program that targets the 23 most polluted cities and to provide subsidies to other most polluted cities for boiler replacement, fuel switching, and thermal retrofit in SFBs.

6.4.1.2 33 Most Polluted Cities

The subsidies required for poor SFBs in the 33 most polluted cities of Poland is roughly estimated to be around PLN 2.1 billion (EUR 504 million) for supporting full thermal retrofits, and PLN 1.3 billion (EUR 0.3 billion) for supporting partial thermal retrofits.

6.4.1.3 SFBs Across Poland

The subsidies required for poor SFBs across Poland are roughly estimated to be around PLN 21.2 billion (EUR 5 billion) for supporting full thermal retrofits, and PLN 13.1 billion (EUR 3.1 billion) for supporting partial thermal retrofits.

6.4.1.4 Annual Funding of Subsidies

The annual funding required to finance subsidies will be spread over a 10-year implementation period of the program. Annual subsidies are estimated to be around PLN 424 million (EUR 100 million) in Małopolskie and Śląskie, and PLN 2.1 billion (EUR 500 million) across the country for the poor SFBs for replacement of solid fuel boilers and full thermal retrofits; and PLN 260 million (EUR 61 million) in Małopolskie and Śląskie, and PLN 1.3 billion (EUR 307 million) across the country for the poor SFBs for replacement of solid fuel boilers and partial thermal retrofits.

TABLE 14.
Subsidies Required for the Poor SFBs (PLN/Euro, billions)

SUBSIDIES FOR POOR SFBs	BOILER REPLACEMENT, FUEL SWITCHING + FULL THERMAL RETROFIT	BOILER REPLACEMENT, FUEL SWITCHING + PARTIAL THERMAL RETROFIT
Małopolskie and Śląskie	PLN 4.2/EUR 1.0	PLN 2.6/EUR 0.6
33 Most Polluted Cities	PLN 2.1/EUR 0.5	PLN 1.3/EUR 0.3
Poland	PLN 21.2/EUR 5.0	PLN 13.1/EUR 3.1

6.4.2 OTHER PROGRAM COSTS FOR SUPPORTING POOR SFBs

Program administrative costs: The funds required for program administration to support poor SFBs in Małopolskie and Śląskie, the 33 most polluted cities, or across Poland will depend on a number of factors. For instance, this report recommends that municipalities take the lead to support poor SFBs. The Małopolskie Voivodeship (or regional administration) has 182 gmina (or municipalities), and the Śląskie Voivodeship has 167 gmina. A program to support poor SFBs in just these two regions would have to assist about 91,000 poor SFBs spread over 349 municipalities. The funds required for program administration of each municipality is likely to vary widely based on the number of poor SFBs in each jurisdiction, the capacity of the local administration, and the availability of municipal revenues for administering such programs. The program administrative costs for supporting poor SFBs is best estimated by the regions and municipalities based on their experience of implementing other social assistance programs.

Technical assistance and capacity building: Additional funds would be required to build capacity and provide technical assistance for the municipalities to administrate the fund to poor SFBs. The municipal governments would require substantial technical support from energy advisors to undertake walk-in energy assessments, prioritize SFBs, and conduct monitoring and reporting. In addition, standardized IT systems, agreement for procurement, etc. for all the municipalities would simplify the procedures and greatly help the municipalities to manage such programs. It is estimated that several tens of millions of euros would be needed for capacity building of municipalities. EIB's ELENA program funds could be tapped for this purpose.

Administrative cost to operate the National Fund. The cost to establish and administer a National Anti-Smog and EE Fund as recommended in this report, can be estimated based on the experience of BGK and the NFOSiGW, which have managed and operated large funds.

6.5 FINANCIAL SUPPORT MECHANISMS (SUBSIDIES) TO SUPPORT NON-POOR SFBs

As noted earlier, even non-poor SFBs may need subsidies to incentivize them to undertake EE measures in heating systems.

6.5.1 SUBSIDIES REQUIRED TO SUPPORT NON-POOR SFBs

The total amount of subsidies estimated to be needed to support non-poor SFBs in Małopolskie and Śląskie, 33 most polluted cities, and across Poland replace non-compliant solid fuel boilers and undertake full thermal retrofits is provided in Table 15. The Table also provides the investment that non-poor SFBs will have to make, which is very substantial.

This report has proposed the non-poor SFBs in the bottom 60 percent of income strata be provided a 20 percent subsidy applicable only for switching from coal to other heating fuels and for undertaking thermal retrofits. Based on the experience of pilot projects implemented in the municipality of Skawina, the IEE suggests that a subsidy of PLN 10,000 to PLN 30,000 (about EUR 2,350 to 7,000) may be an attractive incentive for SFBs to implement EE in heating systems. Based on the estimated number of non-poor SFBs which need to undertake thermal retrofits (1,622,981 SFBs), the funding required to provide a subsidy of PLN 10,000 per non-poor SFB would amount to over PLN 16 billion (nearly EUR 4 billion), which is more than a 20 percent subsidy, and may not be viable.

To achieve quick wins and major impacts on air pollution, with the minimum public funds required, the WB recommends that the National Fund prioritize subsidies to those regions that have adopted anti-smog resolutions and/or the most polluted 33 cities.

6.5.1.1 Małopolskie and Śląskie

The total amount of subsidies required for non-poor SFBs in Małopolskie and Śląskie is estimated to be around PLN 2.4 billion (EUR 0.57 billion) for supporting a switch from coal and for full thermal retrofits.

6.5.1.2 33 Most Polluted Cities

The subsidies required for non-poor SFBs in the 33 most polluted cities of Poland is roughly estimated to be around PLN 1.1 billion (EUR 270 million) for supporting a switch from coal and for full thermal retrofits.

6.5.1.3 SFBs Across Poland

The subsidies required for poor SFBs across Poland are roughly estimated to be around PLN 21.2 billion (EUR 5 billion) for supporting a switch from coal and for full thermal retrofits.

6.5.1.4 Annual Funding of Subsidies

The annual funding required to finance subsidies will be spread over a 10-year implementation period of the program. Annual subsidies are estimated to be around PLN 240 million (EUR 57 million) in Małopolskie and Śląskie, and PLN 1.1 billion (EUR 270 million) across the country to support a segment of the non-poor SFBs switch away from coal boilers and undertake full thermal retrofits.

TABLE 15.
Program costs for Non-Poor SFBs (PLN/Euro, billions)

	SUBSIDIES	INVESTMENTS	TOTAL
Małopolskie and Śląskie	PLN 2.4/EUR 0.57	PLN 23/EUR 5.4	PLN 25.4/EUR 6.0
33 Most Polluted Cities	PLN 1.1/EUR 0.27	PLN 12.1/EUR 2.8	PLN 13.2/EUR 3.1
Poland	PLN 11.3/EUR 2.7	PLN 119.2/EUR 28.0	PLN 130.5/EUR 30.7

6.5.2 OTHER PROGRAM COSTS FOR SUPPORTING NON-POOR SFBs

Program administrative costs: The funds required for program administration to support non-poor SFBs in Małopolskie and Śląskie, 33 most polluted cities or across Poland will depend on the capacity of institutions responsible for program implementation. This report recommends that non-poor SFBs will be supported principally through commercial financial instruments, with limited subsidies and tax incentives. The responsibility for financing thus rests largely with commercial financial institutions and self-financing by the non-poor SFB. Program implementation will take place with the support of commercial service providers and equipment installers.

Technical assistance and awareness raising: Technical assistance (TA) to stakeholders and development of awareness campaigns to promote the GoP support for improved EE in heating systems in SFBs is critical to over the barriers to low market uptake. The PFIs would need TA to undertake aggressive marketing campaigns to raise awareness amongst non-poor SFBs and develop investment pipelines. The funds required for a nationwide awareness program to educate SFBs and disseminate information on financing instruments and benefits from EE investments will depend on the experience of the banks with administering credit lines for EE. Some of the large commercial banks in Poland have significant experience with EE credit lines. In addition, funds for TA will be needed to develop protocols and establish procedures to finance SFBs. The funds required for TA must be estimated in consultation with the PFIs.[18]

Tax credit schemes. The cost to administer tax credit or tax deduction schemes for non-poor SFB is best estimated by the Ministry of Finance and the tax authorities who will have to make changes to the tax reporting and filing systems. And the administration costs for the National Fund, which may channel some subsidies for non-poor SFBs through the PFIs, will be part of the overall costs of establishing the Fund.

6.5.3 SUMMARY OF OPTIONS TO REDUCE AIR-POLLUTION, IMPROVE EE AND POTENTIAL FINANCING AND IMPLEMENTATION MECHANISMS

The options to reduce air pollution and improve EE, the financing mechanisms that could be deployed, the potential sources of funds, the disbursement of funds, and proposed implementation for the poor and non-poor SFBs is summarized in Table 16. The details of the financing support mechanisms and instruments for poor and non-poor SFBs is provided in the following sections.

[18] Allocating a percentage of the total line of credit for TA is not appropriate. For instance, the EBRDs POLSEFF program for SMEs provided a line of credit of EUR 150 m and other grant funds of EUR 28 m, which is over 18 percent. Clearly, given the scale of the investment program for non-poor SFBs, applying a percentage would likely overestimate the funds required for TA.

TABLE 16.
Summary of Options to Reduce Air Pollution in Poland and Potential Financing and Implementation Mechanisms

GOAL	A1. Poor SFBs (Pilot in Małopolskie and Śląskie)	
MAIN ASSUMPTION	• 10 percent poor SFBs in Małopolskie and Śląskie • Focus on replacement of non-compliant solid fuel boilers and thermal retrofits of poor SFBs	
	SOLUTION	COMMENT/TRADE OFF
TARGET GROUP	B1*	• Replacement of old non-compliant solid fuel boilers with new coal and gas boilers, heat pumps, and other heating systems that meet regulatory standards has the most significant impact on reducing air pollution but increases fuel costs and carbon emissions. • Partial thermal retrofits are not justified due to the high cost and lower impact on energy savings and CO_2 emissions. • Full thermal retrofits at a higher cost can achieve higher fuel cost savings and greater reduction in CO_2 emissions. But thermal retrofits alone have limited impacts on air pollution. • Replacement of old non-compliant solid fuel boilers with new heating systems that meet regulatory requirements, coupled with thermal retrofits is recommended since it reduces both air pollutants and carbon emissions, and results in fuel cost savings for poor SFBs. Fuel subsidies are not required due to the lower expenditure on fuel purchase (**recommended option**). • Requires significant public resources to support poor SFBs through substantial subsidies of 90 to 100 percent. • The pilot regions are among the most polluted areas in Poland.
FINANCING INSTRUMENT / SUPPORT MECHANISM	C1, C4	• A National Fund is established and managed by a national agency. • More than one National Fund may also be established with consistent implementation mechanisms and procedures. • Poor SFBs in Małopolskie and Śląskie are initially supported through subsidies ranging from 90-100 percent. • Municipalities may require poor SFBs to contribute some funds or provide services in-kind to qualify for subsidies. • Poor SFBs are unlikely to have adequate income to benefit from tax credits and tax deductions.
SOURCE OF FUNDS	D3	• Pooling of public funds from various GoP budgetary sources (70 percent of total Fund resources) • Funds from regional and municipal governments (20 percent of Fund resources) • The municipalities or the poor SFBs contribute 10 percent
CHANNELING FUNDS	E1	• The National Fund channels public funds as subsidies to poor SFBs through municipalities
IMPLEMENTATION ISSUES		• Municipalities have to identify poor SFBs based on the definition of energy poverty. • Municipalities become responsible for procuring contractors to undertake implementation of services for poor SFBs, which may not be easy given public procurement laws. Other implementation partners may be needed. • May require municipalities to hire more staff to manage and administer program; municipality budgets are generally stretched thin. • May increase monitoring and verification (M&V) costs. • Equity issue since not all SFBs will benefit from financing support.

*List of index used - see next page

A2. Non-Poor SFBs across Poland

- 90 percent non-poor SFBs across Poland
- Focus on replacement of non-compliant solid fuel boilers and thermal retrofits of non-poor SFBs

SOLUTION	COMMENT/TRADE OFF
B3	• Switching from old solid fuel boilers to gas and heat pumps can reduce both air pollution and CO_2 emissions, but will increase fuel costs. • Replacement of old non-compliant solid fuel boilers with new coal boilers that meet regulatory standards has the most significant impact on reducing air pollution but increases fuel costs and carbon emissions. • Full thermal retrofits at a higher cost can achieve higher fuel cost savings and greater reduction in CO_2 emissions. But, thermal retrofits alone have limited impacts on air pollution. • Switching from old solid fuel boilers to a mix of new coal boilers, gas boilers, and heat pumps, coupled with thermal retrofits is recommended, since it reduces both air pollutants and carbon emissions, and results in fuel cost savings (recommended option). • Market uptake of thermal retrofits measures may be low given the high cost and the absence of a regulatory mandate for thermal retrofits in existing stock of SFBs. • May require public subsidies to encourage SFBs to make investments, which would have a significant impact on public financing.
C2-C4	• Financing from PFIs leverages commercial financing mechanisms. • Lines of credit from IFIs could encourage commercial banks to develop financial products to support SFBs undertake heating system retrofits. • Tax credits and deductions require SFBs to make upfront investments and claim benefits in annual tax filings. This is generally less attractive than upfront subsidies. • Lease financing for suppliers and installers is less risky for banks, but suppliers and installers do not have experience with providing consumer financing.
C5	• A 20 percent subsidy for non-poor SFBs may be needed as an incentive but will have a significant impact on use of public resources. • Subsidies targeted to specific segments of non-poor SFBs with lower income would lower the burden on public funds required for subsidies. • Subsidies for non-poor SFBs could be limited to SFBs at the bottom 60 percent of income and only for switching from coal to other fuels for heating and for thermal retrofits.
D1, D2, D4	• IFIs provide lines of credit to PFIs. • PFIs provide additional financing from own funds. • Customer financing through retail loans and personal savings.
D3	• The national EE Fund allocates some resources to provide incentives to non-poor SFBs.
E2	• The National Fund channels subsidies for non-poor SFBs through PFIs.
E3	• IFIs provide lines of credit to PFIs for on-lending to non-poor SFBs. • PFIs make direct loans to non-poor SFBs.
	• Not all non-poor SFBs would be eligible for commercial financing. • PFIs would become responsible to channel public subsidies to SFBs not availing financing from the PFI. • Commercial banks become responsible for M&V of use of funds.

**List of index used*

A	**GOALS**	
1	Improve EE and reduce smog (thermal retrofits and boiler replacements) in poor SFBs	
2	Improve EE and reduce smog (thermal retrofits and boiler replacements) in non-poor SFBs	
B	**TARGET GROUPS**	
1	Only poor SFBs	
2	Poor + non-poor SFBs	
3	Only non-poor SFBs	
C	**FINANCING INSTRUMENT/ SUPPORT MECHANISM**	
1	Subsidies for poor (public funds)	
2	Commercial loans to SFBs (principally for non-poor)	
3	Commercial lease financing to producers, suppliers, and installers	
4	Tax credits/rebates for SFBs	
5	Public subsidies to non-poor SFBs for boiler replacement and thermal retrofits (ca. 20 percent)	
D	**SOURCE OF FUNDS**	
1	Line of credit from IFIs	
2	Guarantee/risk-share mechanism	
3	Public funds	
4	Leveraged money from private banks and customers	
E	**CHANNELING OF FUNDS**	
1	National Antismog and EE Fund → municipalities	
2	National Antismog and EE Fund → PFIs	
3	IFIs → PFIs	

7. FINANCIAL SUPPORT MECHANISMS FOR POOR SFBs

As described earlier, the IBS estimates that about 10 percent of SFBs may be categorized as energy poor. The final definition of poor SFBs by GoP agencies will determine the number of SFBs supported through public financial support mechanism. The broad consensus among stakeholders in Poland, including the GoP, is that poor SFBs will receive subsidies to replace non-compliant solid fuel boilers and undertake thermal retrofits to lower energy consumption and emissions. As discussed earlier, the replacement of old non-compliant solid fuel boilers with new coal boilers compliant with new regulations, along with thermal retrofits, reduces costs associated with energy use. Poor SFBs benefitting from the program will not require fuel purchase subsidies despite the higher costs of better quality coal.

Figure 4 illustrates some of key financing options for public financing, which stakeholders believe are most relevant to Poland.

FIGURE 4.
Financial Support Mechanisms for Poor SFBs

7.1 DEDICATED NATIONAL FUND FOR ANTI-SMOG AND EE

As discussed earlier, it is proposed that a **National Fund for Anti-Smog and Energy Efficiency** be established to pool various funding resources, and channel all public finance support mechanisms to poor and non-poor SFB, as eligible under the program. To supplement the National Fund, the regional and municipal governments could provide additional financing to support programs in their jurisdictions. The National Fund would channel subsidies to poor SFBs through municipalities, and through PFIs for eligible non-poor SFBs. The National Fund could be operated by a GoP designated agency such as the BGK or NFOSiGW.

The primary focus of the National Fund would be principally to support poor SFBs who are unable to make investments from personal savings or qualify for commercial loans to finance EE implementation, and whose relationships with commercial banks may be limited to deposit services and not debt finance products.

Such a National Fund could have different implementing agencies, with commonly defined eligibility criteria and procedures and close coordination, and their roles and responsibilities could be split by market segments, for example, poor vs non-poor SFBs.

The National Fund could also provide additional grant funds for TA to build the capacity of municipalities and other stakeholders involved in programs for poor SFBs, and grant funds for education and awareness programs for all stakeholders.

It is expected that a dedicated National Fund to direct subsidies would help overcome some of the barriers to making financing available to poor SFBs to participate in EE projects, (i.e. lack of capital to install new boilers and thermal retrofits, lack of knowledge of EE options, the real and perceived risks of high operational costs for utilizing higher quality fuels, and the inability to use traditional credit finance schemes for this project).

7.2 NATIONAL ANTI-SMOG AND EE FUND TO SUPPORT POOR SFBs

7.2.1 OPERATIONAL STRUCTURE OF THE NATIONAL FUND

The schematic below Figure 5 illustrates the basic structure for a National Fund. It would be financed by the GoP, which may tap into multiple sources of financing and channel subsidy financing through local municipalities to eligible poor SFBs that qualify under the terms of the fund. The funding would be provided as grants to poor SFBs, paired with project implementation support from the municipalities. Project implementation services would be provided by designated service providers, whose services would be paid by the municipality from the National Fund. It may additionally finance TA and awareness and education programs to target all stakeholders, including the service providers, municipalities, and the poor SFBs.

The municipality would be responsible to identify poor SFBs eligible to be financed under the scheme and would designate multiple service providers to undertake boiler replacements and thermal retrofits, as defined under the scheme.

FIGURE 5.
Schematic of an EE Fund to Support Poor SFBs

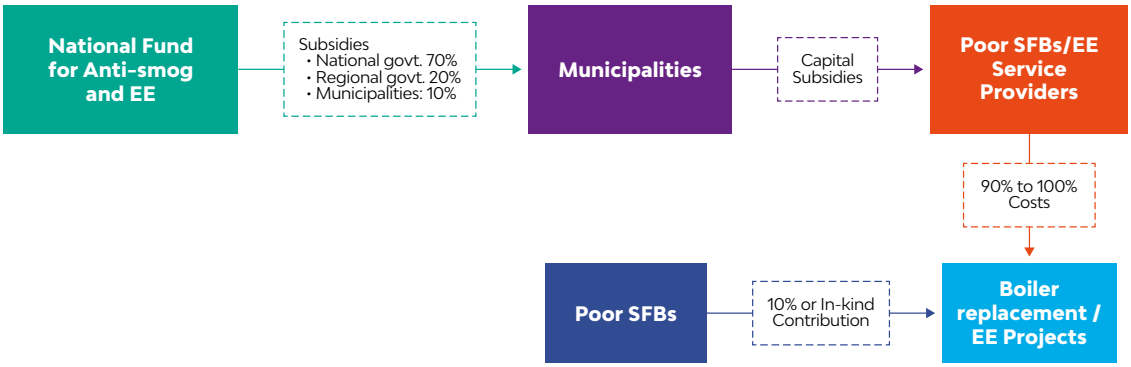


Table 17 summarizes some of the principal benefits and limitations of a National Fund to support poor SFBs.

TABLE 17.
Principal Benefits and Limitations of a National Fund to Support Poor SFBs

DESCRIPTION	BENEFITS	LIMITATIONS
The National Fund would channel subsidy financing to eligible poor SFBs to implement eligible EE projects as required by regulations or other GoP priorities. The fund would be finance the GoP, though its own resources and additional funds it mobilizes. Poor SFBs are provided direct and free implementation support for eligible EE projects. Poland, Bulgaria, Czech Republic, Slovenia, Armenia, Belarus, FYR Macedonia, Kazakhstan, Kosovo, Montenegro, Serbia have all undertaken grant programs for EE upgrades in SFBs.	The fund may be managed by BGK, or the NFOSiGW or an agency designated by the GoP. The local municipality, which has close links to its residents, would be responsible to identify poor SFBs as per the guidelines and definitions established by the GoP. The local municipality would be the program administrator and would pay service providers for EE implementation services in poor SFBs. Free riders – non-poor SFBs – would not benefit from subsidies since the program is targeted only at poor SFBs. The program would provide fully-subsidized implementation services to poor SFBs. The municipality through reports prepared by the service provider easily monitors program results. Quick uptake and positive energy and emissions impacts. Funds are complemented with technical assistance and implementation services, and awareness and education campaigns. Poland has experience with grants and subsidies for EE in SFBs.	The fund needs good management, governance, accountability, and monitoring and evaluation. Significant funding is required for a program that fully subsidizes all poor SFBs. Requires a legal framework and legislation to structure the fund, and channel financing through the municipalities. Transactions costs can be high, depending on the fund's design and implementation mechanism. Subsidies may distort the market for commercial financing for non-poor SFBs as they may also seek subsidies (as presently present experienced in Małopolskie and Śląskie).

7.2.1.1 Terms and Operational Aspects of the Dedicated National Fund

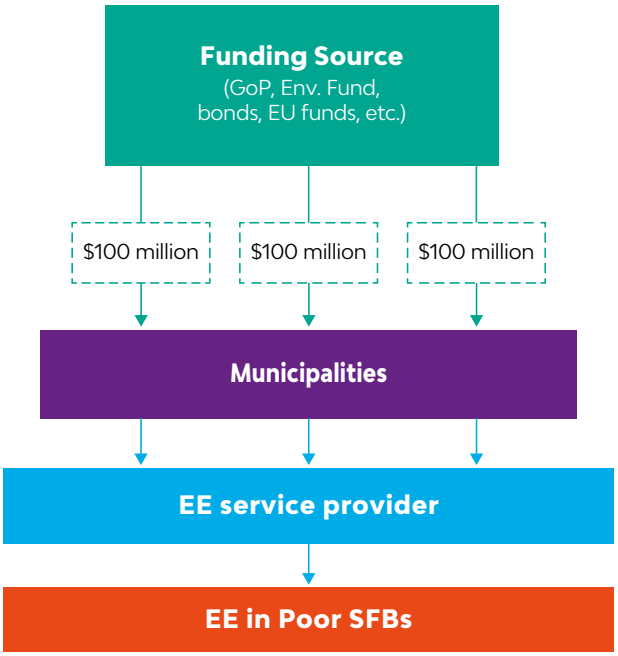
Some of the typical terms and operational aspects of a dedicated National Fund to channel subsidies to poor SFBs are summarized below. The actual terms and conditions of the National Fund are to be discussed with the GoP, the proposed fund manager, the municipalities, and other stakeholders.

Structure of the National Fund: The GoP and the manager of the National Fund (BGK or NFOSiGW, or other) would mobilize financing from various sources and create a fund to provide financing to implement eligible EE programs to poor SFBs that lack the ability to make investments or access credit facilities. The primary criteria for the Fund manager are provided in the Box 2 in section 6.3.

The manager would define the terms and conditions of the program, the eligible projects, the level of subsidy per poor SFB, the implementation mechanism, and the monitoring and verification mechanism.

Figure 6 illustrates a hypothetical structure where the fund manager may provide financing to multiple municipalities to finance eligible EE projects in poor SFBs. The municipalities may leverage additional funds to add to the financing provided from the fund and expand the program to additional poor SFBs.

FIGURE 6.
Illustrative Structure of an EE Fund for Poor SFBs



Indicative funding required: As noted in Section 4, poor SFBs in just Małopolskie and Śląskie would need subsidy financing of about PLN 2.2 billion (EUR 1.0 billion) to meet the capital investment needs for boiler replacements and thermal retrofits. This investment would likely be phased over the next seven to eight years to meet the regulatory mandates in Małopolskie and Śląskie. Poor SFBs across Poland are estimated to need subsidy funding of about PLN 21.2 billion (EUR 5.0 billion).

Sources of the EE Fund: The GoP and its agencies would raise public funds to support the subsidies financing program to facilitate implementation of EE in poor SFBs. Sources of financing may include government budget, tax revenues, special purpose bonds, and EU funds to finance the program. Monies would be channeled to municipalities at no cost, but the fund would receive a portion for management and operational costs.

Additional funds for technical assistance (TA): It is proposed that the National Fund also provide funds for TA as an additional grant to help develop the capacity of the municipalities and the service providers to implement the program for poor SFBs. The TA could also help develop a methodology to identify poor SFBs within a municipality (based on the GoP's definition of poor SFBs), standardize project appraisal methods and procedures, reduce transaction costs, and strengthen the capacity of municipalities to procure services providers, implement the program, and monitor and evaluate results. The TA could also be used to support the service providers by developing standardized procedures and lists of eligible equipment and materials that can be installed under the program.

Leveraging additional funds for the National Fund: The National Fund would leverage funds from municipalities and the regional administrations to cover about 20 percent of funding needs. Municipalities have experience with raising finances for programs that they undertake to benefit their constituents, including poor households, and they have a direct interest in expanding program services.

Definition of Poor SFBs and eligibility for assistance: The GoP is responsible to develop a definition for poor SFBs that includes both income and energy poverty. Analysis by the IBS suggests that about 10 percent of households nationally may be categorized as energy poor. Legislative support may be required for the definition of poor SFBs since it affects the use of public resources. The documentation required for proof of eligibility should also be clearly defined. In Poland, the municipalities operate social assistance programs, and are perhaps best suited to identify poor SFBs based on the GoP definition, and implement support programs.

Legislative support for program: Targeted subsidies to specific SFBs may require supportive legislation and policies given the substantial public funds which will be directed to a small segment of the SFB population. The role of municipalities to direct subsidies and support implementation through service providers may also require changes to local policies.

Investments eligible for financing under the fund: EE projects in poor SFBs that improve thermal insulation of buildings and replacement of boiler systems to comply with regulatory requirements and other priorities of the GoP would be covered under the facility. A list of eligible projects or project selection criteria will be prepared by the TA of the National Fund.

Duration of programs for Poor SFBs: Poor SFBs need support to comply with a timeline to be established by the GoP and regional administrations. The National Fund should be designed to operate within the GoP's timeline. For example, in Małopolskie and Śląskie, the timeline for replacing non-compliant solid fuel boilers is defined by anti-smog regulations.

Payment for service providers: The municipality would pay the service providers based on the defined eligibility criteria for projects and SFBs that qualify under the scheme. Payment would be made against agreed documentation required under the scheme (TA consultants can help define the process and documentation requirements).

Market transformation effect: A National Fund to subsidize implementation for poor SFBs (coupled with commercial financing schemes for non-poor SFBs) can help transform and expand the market for EE products and bring down the cost of equipment and materials. The expansion of the market and a potential reduction in costs can help expand the program to additional poor SFBs not covered under the initial scheme (such as those in the lowest two quintiles of household income).

Design and reporting of the National Fund: A simple design of the National Fund to channel subsidies to poor SFBs, and a simple reporting system will increase compliance and lower transaction costs. The TA consultants under the program can develop processes and procedures to disburse and monitor, report and evaluate the scheme. Validation of such use of funds should depend principally on agreed documentation provided by the service providers and the SFBs. Audits and physical checks could be conducted on a random basis to keep monitoring costs low.

Lessons learned from EE subsidies programs in Poland: Some regions in Poland, such as Małopolskie and Śląskie, have supported EE subsidies in SFBs. Key lessons relevant to the National Fund are as follows:

Simple processes. Poland has implemented several programs to support SFBs implement EE, though none of the programs specifically targeted poor SFBs. The application processes, program requirements, monitoring processes, and the subsidy amount are different across programs. Some programs required expensive energy audits while others had specific energy consumption targets. A program funded through the regional environment fund favored municipalities, which offered higher subsidies, which led to even higher subsidies which were not warranted. It is critical that the program requirements be kept simple to increase compliance and lower transaction costs.

Programs for poor SFBs should develop a simple financing process under which a service provider can implement eligible projects defined in a published List of Eligible Materials and Equipment (LEME). Installers could be certified to lower performance risk. A simple application and certification process for financing EE in poor SFBs will be of benefit to participants and lower transaction costs.

Defined subsidies. Municipalities decided the amount and varied from 30 to 100 percent. Since municipalities vied with each other to provide greater subsidies, SFBs expected high levels of subsidies, which distorted the market for financing EE. The natural rate of replacement of boilers dropped after the program ended since SFBs waited for subsidies to be re-introduced.

A subsidy of 90 percent is suggested to poor SFBs with a contribution of 10 percent from the SFB to ensure ownership (the 10 percent contribution could be in-kind services to the local municipality). The subsidy should, however, be capped based on the average cost to install new boilers and perform thermal retrofits. As suggested earlier, in case funds are limited, the program could target the poorest of poor SFBs.

Free-ridership. Earlier SFBs EE programs provided generous subsidies, which largely benefited non-poor SFBs due to better access to program information, knowledge of program requirements, and ability to navigate the application process. Free-ridership was high and customers who may have anyway made the investment without any or with minimal incentives, benefited. Poor SFBs, which were not directly targeted by the programs, did not benefit as much. Subsidies from the National Fund must benefit only SFBs specifically designated as energy poor (as defined by the GoP).

Co-financing by regional and municipal authorities. Municipalities are used to co-finance programs to leverage internal funds. The National Fund will leverage additional financing from the regional and municipal authorities (the GoP suggests 20 percent contribution from regions and municipalities).

Simple reporting and monitoring systems. Previous programs had different monitoring and reporting requirements, which made compliance difficult and expensive. Monitoring, reporting, and evaluation procedures should be simple and consistent across institutions to keep transactions costs low.

Implementation support for SFBs. The municipalities and service providers would support the SFBs process to obtain financing, implementation of the project, and certification of the use of funds. The process to obtain building permits to install insulation also needs to be simplified. This will greatly reduce the burden on poor SFBs to implement projects.

7.2.2 INSTITUTIONAL FRAMEWORK FOR EE FUND FOR FINANCING POOR SFBs

It is proposed that the National Fund be a program to channel public funds to support implementation of eligible EE projects in poor SFBs. As described in the operational structure, the BGK, the NFOSiGW, or another GoP designated entity will manage the fund. The municipalities would be responsible for the implementation since they have direct relationships with their poor SFBs. Private sector service providers would provide implementation services and would be impaneled or contracted by the municipalities.

The BGK and the National Fund have disbursed financing for various public schemes including for EE projects in residential buildings and SFBs (though these programs did not specifically target poor SFBs). The BGK, as a developmental bank that operates several funds, has the additional ability to raise funds and would perhaps be a better institution to manage the National Fund.

The municipalities in Poland administer social assistance programs for poor households and are well positioned to operationalize the subsidies. It is however likely that the municipalities may have to bolster their internal capacity (human resources and technical capacity) to operate a scheme targeting several thousand poor SFBs. For instance, it is estimated that in Małopolskie and Śląskie there are about 91,000 poor SFBs that would need boiler replacement and 80 percent of these would need thermal retrofit. Some of the more populous municipalities may have to add staff to manage the project, and the budgetary implication of this should be factored in the design of the program.

Equipment manufacturers, suppliers, and installers note that the industry can meet the demand to replace boilers and perform thermal retrofits in SFBs. This capacity needs to be verified given the large number of poor (and non-poor) SFBs that will participate to comply with GoP regulations.

The key institutions to implement the scheme are illustrated below (Figure 7). The specifics of program design and implementation will need to be discussed with relevant stakeholders.

FIGURE 7.
Institutional Structure to Implement the EE Fund for Poor SFBs

Technical Assistance under the National Fund: As described earlier, it is recommended to designate funds for TA and support to municipalities, service providers and other relevant stakeholders to comply with the requirements for subsidy financing under the National Fund to benefit poor SFBs.

The TA providers (eligible firms or a number of experts) may be hired directly by the fund's manager to support the program. The TA may include capacity building of municipality personnel to evaluate and monitor financing of poor SFBs, development of templates to collect and report information, preparation of eligibility criteria for projects eligible for subsidy financing under the fund and/or lists of eligible equipment and materials, criteria for eligible equipment and material suppliers and installers (such as impaneled suppliers, certified installers, etc., if necessary for program implementation). The TA experts could also support service providers, if practical.

Awareness and Information Campaigns: Part of the funds should finance awareness and engagement campaigns to promote the National Fund. The firms (or experts) may be hired directly by the fund manager to support the municipalities, poor SFBs, and other stakeholders. The scope and mode of the campaign is determined by a study to understand the characteristics of the market.

7.2.3 IMPLEMENTATION MECHANISM FOR EE FUND FOR POOR SFBs

The implementation of the National Fund has two processes: first for the fund manager to disburse funds to the municipalities, and second for the municipalities to engage service providers (or impanel them).

7.2.3.1 Implementation Mechanism for National Fund to Disburse Funds to Municipalities

The municipality would enter into an agreement with the manager to receive funds and agree to the terms of use. The key program implementation issues to be finalized, in consultation with relevant stakeholders, are discussed below.

Municipality eligibility. Initially, only municipalities in Małopolskie and Śląskie would be eligible to participate in a pilot program. The GoP may then expand the program to other regions and municipalities in Poland. Given the huge financing needs, it is recommended that the National Fund prioritize subsidies to SFBs in the regions that adopted anti-smog resolutions and/or the most polluted 33 cities first.

Agreement between the fund manager and municipality. The key elements of the agreement between the fund manager and the municipality are illustrated in Figure 3, and would include beneficiaries of the scheme (poor SFBs as defined by the GoP), the amount of subsidy or cap on subsidies to be provided to each poor SFB, projects eligible to be funded under the scheme, standardized agreements between municipalities and service providers, and monitoring and reporting formats.

SFBs eligibility. SFBs eligible to receive subsidies under the scheme would be poor SFBs, as defined by the GoP.

Agreement with service providers. A standardized agreement for procuring service providers could be developed with the assistance of TA consultants to ensure consistency in the terms of the agreement between municipalities and service providers. This will streamline program administration and monitoring and reporting.

Program monitoring and reporting. The fund manager, in consultation with TA experts will prepare standard formats for program monitoring and reporting. Standardized templates will ensure consistency in reporting across municipalities and program evaluation.

7.2.3.2 Implementation Mechanism for EE Fund Disbursement from Municipalities to Service Providers

The municipality would enter into an agreement with service providers to administer the scheme and implement EE projects in poor SFBs. Municipalities could also impanel service providers and have them compete to provide services to poor SFBs. Some of the key program implementation issues to be finalized in consultation with relevant stakeholders are discussed below.

Projects eligible for financing. Replacement of non-compliant solid fuel boilers and thermal retrofits of poor SFBs as recommended the National Fund would be eligible for financing under the scheme. The EE project would not include any major structural changes to the structure of the SFB beyond the addition of insulation material as required for thermal retrofits.

The service provider will make an assessment of the equipment to be installed in the poor SFB and provide the municipality with its estimate based on standardized procedures. The municipality will verify compliance against the scheme's requirements and provide approval to the service provider to proceed with installation services.

New construction of SFBs would not be eligible for subsidies since they would be expected to meet current codes and regulations as a condition for their building permit.

List of eligible materials and equipment. A list of eligible materials and equipment (LEME) from manufacturers that comply with program requirements would be developed with the assistance of experts provided through the TA (Table 18). A list of materials and equipment and installation costs excluded from financing should accompany the LEME.

A product certificate for eligible equipment and materials, along with documentation provided by the service provider, could be adequate proof of compliance with program requirements. This will ease the implementation process and lower transaction costs.

TABLE 18.
Sample LEME for Program Implementation in Poor SFBs

THERMAL RETROFIT MATERIALS (including specifications/compliance with standards)
• Wall insulation • Roof insulation • Floor insulation • Radiators, pipes, regulation equipment • Window replacement
BOILER REPLACEMENT
• Coal boilers that meet regulatory specifications

Payment for services. The agreement between the municipality and the service provider would include the payments to be made and any cap on payments per SFB. The schedule of payments should also be included in the terms of the agreement.

Performance standards and warranties. The municipality and the service provider would agree on the performance standards to be met for installations and any warranties and certifications to be provided based on standard industry practice.

Program controls, monitoring and validation. A simple monitoring and validation process is suggested for the National Fund to support poor SFBs. This will make compliance easier and lower transaction costs.

Program monitoring and validation to certify use of funds as per program requirements should largely be based on a review of relevant documents such as adherence to project selection criteria, invoices for purchases of eligible materials and equipment (for example, purchases compliant with a LEME for the program), etc.

A small percentage of poor SFBs, (e.g. 10 percent) could be surveyed through site visits by authorized advisors to verify program implementation. Authorized advisors could be municipality staff or hired experts.

Program portal. It is suggested that a user-friendly web portal be hosted to include the standardized guides, LEME, equipment certificates, etc., which would support the fund manager, the municipalities, and service providers.

Certification of installers. The TA experts, in consultation with stakeholders, could support the development of procedures to certify installers of boilers and thermal retrofits in SFBs. The use of certified installers would help to ensure the fund is in compliance with program requirements.

Appendix 3 provides examples of National EE Funds in some countries.

7.2.4 NEXT STEPS IN THE DEVELOPMENT OF A NATIONAL FUND FOR POOR SFBs

The key next steps in the development of the National Fund include:

- Discussions with relevant ministries on the availability of public financing to establish a National Fund for subsidy financing of poor SFBs
- Discussions with BGK, NFOSiGW or other GoP agencies about the terms to develop the National Fund
- Discussions with the GoP on the definition of poor SFBs

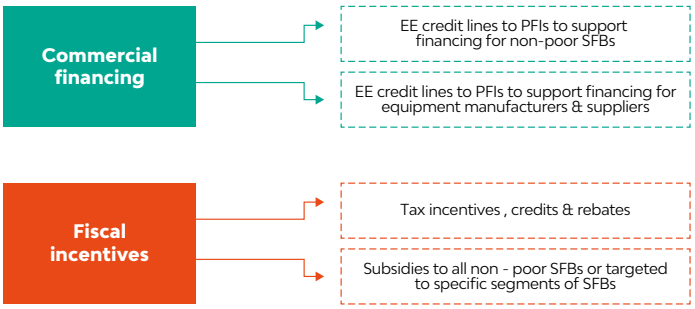
8. FINANCING INSTRUMENTS TO SUPPORT NON-POOR SFBs

Commercial financing instruments and fiscal incentives will be provided to support non-poor SFBs replacement of non-compliant solid fuel boilers and implementation of thermal retrofits. This will be coupled with other available retail consumer financing schemes including self-finance. A small subsidy may also be provided as an incentive given the large investment to be incurred by non-poor SFBs, especially to undertake thermal retrofits. This option has the support of all stakeholders and is consistent with discussions held in January 2018.

90 percent of households in Poland are categorized as non-poor based on research by the IBS. However, as noted earlier, the lowest three quintiles of this household segment may not have the capacity to finance boiler replacements and thermal retrofits without subsidies and incentives. The top two quintiles of households will most likely benefit from commercial financing instruments.

Figure 8 below illustrates some of the commercial financing instruments and fiscal incentives available to support non-poor SFBs.

FIGURE 8.
Financial Instruments to Support Non-Poor SFBs



8.1 COMMERCIAL FINANCING – CREDIT LINE FOR NON-POOR SFBs

IFIs could extend dedicated credit lines to participating financial institutions (PFIs) in Poland to finance boiler replacement and thermal retrofits in non-poor SFBs. The GoP and the EU could also support such commercial financing instruments.

The objective of the credit line would be to incentivize PFIs to develop a new lending portfolio or product specifically to finance non-poor SFBs to undertake qualifying projects. To incentivize PFIs to participate in the program, funds may be made available at rates lower than the costs for PFIs to raise funds in local capital markets, and/or with longer tenor financing.

The credit line may need to be supported with additional grant funds for TA to build the capacity of PFIs and support the implementation of the program, and funds for awareness programs to disseminate information on the product to various stakeholders. PFIs may allocate additional funds from their own resources to enhance the credit line, depending on the attractiveness of the product line and the lending objectives of the bank and its risk profile.

The credit line would principally support non-poor SFBs which qualify for commercial loans to finance EE implementation, and have existing relationships with commercial banks through deposits, home mortgages and or other debt finance products. The lower income tiers of the non-poor SFBs market segment may not qualify to obtain commercial financing.

It is expected that a dedicated EE credit line would help overcome some of the barriers to making financing available to non-poor SFBs to implement EE projects, which include lack of knowledge of the market opportunity, perceived risks of lending for relatively small-scale EE projects in SFBs, and demand for capital from other bank lending portfolios and products which may be more attractive financially or less risky.

8.2 CREDIT LINE TO FINANCE EE IN HEATING SYSTEMS IN NON-POOR SFBs

8.2.1 OPERATIONAL STRUCTURE OF THE EE CREDIT LINE

The schematic below (Figure 9) illustrates the basic structure for an EE credit line, which may be offered to PFIs for on-lending to non-poor SFBs. The IFI may provide funds (the line of credit) to multiple PFIs, which apply and qualify under the terms of the credit line. The terms of lending from the IFI to the PFI may include concessional financing terms such as lower cost financing and/or longer tenor, grant funds for TA, awareness programs, etc. The PFI would pay back the IFI as per the terms of the credit line.

The PFI would in turn on-lend funds to the sub-borrower (directly to the SFB owner or an equipment manufacturer or supplier) to finance qualifying EE projects. The PFI would apply its normal credit checking process to provide debt finance to SFBs. The terms of lending from the PFI to the SFB would be based on the bank's retail lending practices to be competitive in the marketplace. Some IFIs, including the WB, do not favor on-lending at interest rates below prevalent market rates to avoid distortions in local debt markets. The non-poor SFB (borrower) would make loan repayments to the PFI as per the terms of the loan.

The program would include a targeted subsidy channeled through the National Fund (described in the section on public financing support mechanisms for poor SFBs) to incentivize some categories of non-poor SFBs to implement EE projects. Subsidies would be routed to non-poor SFBs through the PFI.

FIGURE 9.
Schematic of an EE Credit Line to Support SFBs

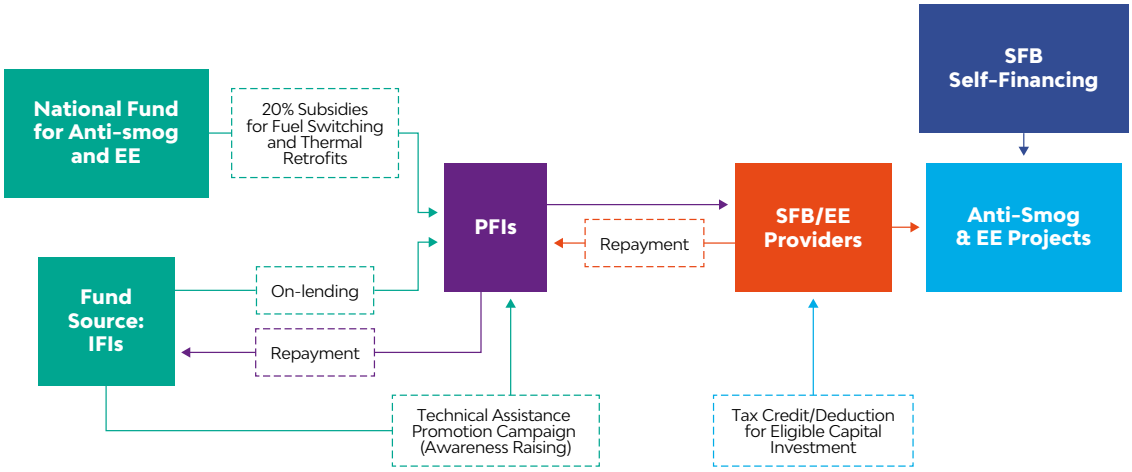


Table 19 summarizes some of the principal benefits and limitations of an EE credit line to finance SFBs participation.

TABLE 19.
Summarizes some of the Principal Benefits and Limitations of a Credit Line to Finance Non-Poor SFBs Implement EE Projects.

DESCRIPTION	BENEFITS	LIMITATIONS
The EE credit line is a financing mechanism through which eligible commercial bank receive a line of credit from IFIs (EBRD, EIB, WB, etc.) to extend financing of eligible EE measures in SFBs. Homeowners (non-poor SFBs) obtain financing from participating banks. The financing may cover thermal retrofits and boiler replacements, or any one of them depending on customer preference and eligibility to obtain bank financing. Many countries including China, Germany, India, Poland, Serbia, Turkey, Tunisia, Sri Lanka, and Bangladesh have used lines of credit through commercial banks to finance EE projects.	Polish banks have experience with credit lines for energy efficiency in SMEs. Some large Polish banks are receptive to the idea of an EE credit line for qualifying SFBs. EE credit lines have proven their ability to leverage private capital. An EE credit line can mainstream financing for EE. Eligible homeowners would be able to finance EE measures by obtaining loans at standard or preferential terms (interest, equity, tenor, etc.) Creditworthy homeowners with a banking relationship with the retail bank may more easily qualify for financing. A well-designed credit line can incentivize the bank to build capacity and create a new EE financing product based on their experience disbursing the credit line. Attractive terms to participating banks could benefit customers through expanded services from the FI. Participating banks follow normal bank lending procedures and risk analysis, which lowers the risk of defaults. Financing through the credit line can be monitored through normal bank procedures and reporting systems. A subsidy component could be included as part of the financing terms for eligible customers.	Homeowners without a relationship with the retail bank may have to undergo additional due diligence. Banks are reluctant to leverage additional commercial capital to the credit line due to different loan underwriting and reporting practices. IFI credit lines with reporting systems, which require changes to the IT systems of the bank, are unlikely to succeed.

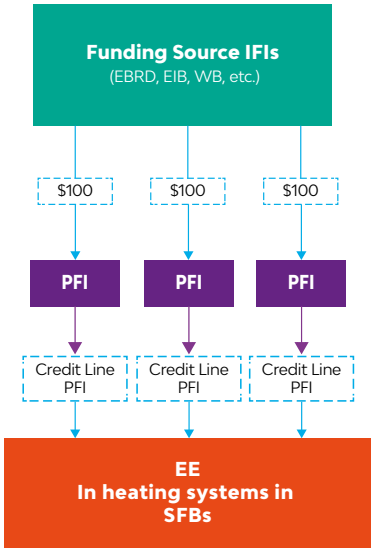
8.2.1.1 Terms and Operational Aspects of the Credit Line

Some of the typical terms and operational aspects of an EE credit line are summarized below. The actual terms and conditions of the line of credit are negotiated between the IFI and the PFIs.

Typical Structure of a Credit Line: IFIs may extend a line of credit (LOC) for a fixed time period to Polish Banks targeting EE projects that improve heating systems in SFBs. The objective would be to facilitate the participating banks to on-lend financing to SFBs to implement eligible projects. On-lending to SFBs is at the PFIs credit risk.

Figure 10 below illustrates a hypothetical structure where one or more IFI may extend lines of credit to multiple Polish banks to provide loans for eligible EE projects in SFBs. It is suggested that credit lines be extended to all major commercial banks that meet eligibility criteria of the IFIs; the major commercial banks in Poland (five to six) have a large percentage of the retail market share in Poland and would be able to finance the majority of non-poor SFBs across the country. The PFIs may leverage additional funds to add to the credit line and expand the credit facility for SFBs.

FIGURE 10.
Illustrative Structure of an EE Credit Line



Indicative funding required: As noted in Section 4, non-poor SFBs in Poland would need to invest an estimated PLN 130.5 billion (EUR 30.7 billion) to replace non-complaint solid fuel boilers with compliant coal and gas boilers and heating pumps and thermal retrofits. This investment would likely be phased over the next several years based on a timeline for compliance to be defined by the GoP.

A subsidy of 20 percent to incentivize 60 percent of the non-poor SFBs to undertake fuel switching (away from coal) and thermal retrofits is estimated to need between PLN 11.3 billion (EUR 2.7 billion) in public financing, which would be routed from the National Anti-Smog and EE Fund through the PFIs.

IFI credit lines would only support a fraction of the market needs and much of the financing will have to be leveraged from retail financing, consumer credit mechanisms, and self-financing by consumers. Discussions with some commercial banks in Poland have indicated that banks would prefer a credit line of at least EUR 100 million or more for it to be attractive as a new financing product. It would be preferable to extend credit lines to multiple eligible commercial banks with large retail banking operations.

Eligibility of PFIs: IFIs have specific and stringent eligibility criteria to extend lines of credit to commercial banks. Some of the typical criteria for eligibility to participate in a EE credit line for SFBs may include capital base of the bank; standard bank performance ratios; existing lending portfolio and loan value; retail customer base; number of retail branches across the country; experience with credit lines (for EE and/or other products); senior management commitment to and interest in EE lending; prior experience and track record in EE lending; availability of qualified staff and dedicated teams; bank's internal organization; risk assessment and management procedures; etc.

It is likely that several of the largest commercial banks in Poland with extensive retail banking experience may meet the eligibility criteria of IFIs. However, only a few commercial banks have experience with EE lending.

Terms of a Credit Line: The IFIs are typically able to raise funds at lower costs and may extend the credit line to participating banks at preferential terms to promote the implementation of EE in SFBs. For instance, IFIs may offer a credit line at a rate lower than the cost of raising capital in Polish capital markets (see summary information on Polish banks below), and with longer tenor. Preferential terms for the banks would help them develop new debt products for non-poor SFBs at lower transaction costs. The credit line could also be designed to separately pay for some of the additional transactions costs associated with developing an EE portfolio for non-poor SFBs. The participating financial institutions will on-lend these funds at a market rate to non-poor SFBs to avoid market distortion.

It is common practice for EE credit lines to be supported by a TA provided as a grant to participating banks. The TA is primarily used for the PFIs to undertake marketing campaigns to raise awareness and identify deals of investments, as well as improve the capacity of participating banks to develop and manage an EE portfolio. The TA may help to standardize project appraisal methods and procedures, build project pipeline and reduce transaction costs, and strengthen participating financial institutions' capacity to identify and manage project risks associated with EE projects. Credit lines to commercial banks in Poland to promote EE in SMEs have included TA funds and are noted by banks to have been effective in supporting banks and SMEs.

Additional grant funds for awareness and education campaigns to promote the credit line is also favored by commercial banks. In fact, commercial banks in Poland stressed the importance of vigorous marketing of a new lending product both within the bank and to customers for the program to be effective.

Grant funds could also be used to provide incentives for beneficiaries of the credit facility. For instance, EBRD's POLSEFF program provided a EUR 150m line of credit to PFIs to on-lend for EE in SMEs in Poland, and an additional EUR 28m, about 19 percent of the total credit line facility, in a TA grant. It should be noted that the percentage or amount of funds to be provided as grant could vary significantly based on the specific requirements of the program, including the program costs to be covered the grant amount.

Leveraging additional funds for the credit line from PFIs: Some IFIs including the WB, may require the PFIs to leverage additional internal capital to make more financing available through the credit line facility. This requirement potentially has the benefit of aligning the interests of the IFI and the PFI, and the advantage of expanding the credit facility to benefit additional SFBs. Funds raised by PFIs from different sources will have different terms which may be reflected in the on-lending terms offered to SFBs. The PFI may have to develop a blended product to offer a standard product to SFBs. The PFI may also need separate processing, monitoring and reporting systems for managing a credit line with funds with different financing terms.

Discussion with some commercial banks in Poland indicate that the banks would prefer a credit facility which does not require additional internal funds to be leveraged as a conditionality of the credit line. The banks acknowledge that while expanding the size of the credit facility would be an advantage, the leveraging of internal funds may require additional steps in internal loan processing and reporting.

Polish Bank Retail Loans: Current customer loan offerings from Polish banks are broadly based on the following terms:

Typical Interest rate: EURIBOR/WIBOR reference rate plus 5 percent

Tenor: Typically, 3-5 years (up to 7 years for some loans)

Collateral: equipment financed (for equipment financing), and other assets for standard loan financing

Some of the banks met by the WB team acknowledge that financing for thermal retrofits and boiler replacements in SFBs may require longer tenors given the high upfront investment and relatively long payback.

A study of the personal loan market in Poland by PwC in 2014 indicates that about 44 percent of personal loans taken from banking institutions in Poland are for home repairs (rising to 53 percent of loans taken from Personal Loan Companies).[19] It should be noted that while credit facilities are restricted to banks regulated by Polish Banking Law, the granting of secured or unsecured loans by lending companies and insurers is not a regulated activity though they must comply with provisions in civil law relating to loans and collateral.

Credit terms for beneficiaries of the credit line: Since IFIs are generally able to offer funds to a PFI at a lower cost than the cost of funds to the PFI from local capital markets, a credit line is attractive to PFIs. This makes the financing product attractive for the PFIs to market and create a new debt portfolio.

[19] Personal Loan Market in Poland, Study by PwC, 2014

There however is a risk that an EE credit line at preferential terms may subsidize the PFI and distort local debt markets. On-lending at preferred rates is also not favored by IFIs due to its potential to distort the retail debt markets. In fact, WB credit lines typically require on-lending at market rates to avoid such market distortions. PFIs generally market the line of credit at terms that are competitive in the local retail debt market.

It was noted by some banks that SFBs wishing to take loans for thermal retrofits and boiler replacements may need loan tenor of at least 10 years to make the product attractive. The PFI would apply its normal retail loan processing and credit appraisal processes to on-lend credit line funds to SFBs. This would include standards checks for creditworthiness and loan default risk analysis. The credit line facility would thus benefit SFB owners with good creditworthiness and existing banking relationships with the PFIs since the cost of due diligence for such customers would likely be lower. This reinforces the rationale for a credit line facility to principally benefit non-poor SFBs with long standing banking relationships.

Subsidies for Non-Poor SFBs. It is recommended that the credit line facility be coupled with a small subsidy to make the loan more attractive and increase market uptake. Fiscal incentives (such as tax credits) could also be provided to make financing attractive to non-poor SFBs. Subsidies could also be targeted to only benefit SFBs in the first, second and third quintile of income who may be less creditworthy than higher income SFBs; the subsidy would lower the requirement for debt financing and make the loan product more attractive to customers.

Investments eligible for credit line financing: EE projects in non-poor SFBs that improve thermal insulation of buildings and replacement of boiler systems to comply with requirements of the anti-smog resolution and other relevant national and regional performance standards (or higher standards) would be covered under the facility. A list of eligible projects or project selection criteria would typically be prepared by the accompanying TA to the credit line facility.

Market transformation effect: A well-designed credit line can help transform the market for EE financing by developing the capacity of local banks to develop and manage the risks of an EE portfolio, especially among SFBs. A successful program could induce banks to launch an EE financing product. The IFIs contributing to the credit line can play an important role in market transformation by supporting Polish banks.

Design and reporting of EE credit line: A simple design of a credit line, which is adaptable to Polish banks' normal loan processing and risk management procedures, and simple reporting systems are preferred.

Risk-sharing facilities. Polish banks met by the WB team voiced their preference for a line of credit over risk sharing facilities. Risk sharing facilities can help lower the risk of defaults, but typically are more expensive from the perspective of commercial banks, especially for small-scale lending to SFBs. Banks also note that risk sharing facilities from IFIs require project level reporting rather than portfolio level reporting, which make the product less attractive to banks. Commercial banks also fear that a risk sharing facility may lead to a dilution of their risk assessment procedures and more risky decisions by bank relationship managers.

Risks of low uptake: There is a risk of low uptake of the credit line facility if the lending terms are not favorable compared to local debt market terms, or if SFBs choose not to debt finance thermal retrofits and boiler replacements. However, the regulatory requirements of the anti-smog resolutions and the new solid-fuel boiler emission and solid-fuel standards provide (or will provide) the stimulus for SFBs to implement EE in accordance with the regulatory timeline (assuming that regulations are enforced).

The provision of a subsidy and tax credits coupled with attractive financing terms would help increase uptake of the program.

Lessons learned from other EE lines of credit in Poland and other countries:

A dedicated EE credit line, together with TA, is effective to increase the capacity, interest, and confidence of participating banks in mainstreaming EE financing business line through a learning-by-doing process. A dedicated EE credit line can achieve a double leverage effect by first leveraging substantial debt contributions from the participating banks and equity financing from end-beneficiaries, and later revolving the loans that are paid back to the fund. It offers the

best prospect for program sustainability. There is accumulating evidence that participating banks continue to provide EE financing after the credit line program is completed. Key ingredients for success include:

- strong management commitment;
- dedicated teams both at headquarters and branches;
- incentives to staff;
- technical assistance to the participating financial institutions to help them build capacity and defray some of the start-up costs of such initiatives; and
- aggressive marketing and business development as well as new financial products tailored to EE financing, which are critical to generate sufficient deal flows.

Polish banks have experience with credit lines for EE to support SMEs, and with the BGK thermo-modernization fund (which supports residential buildings but does not explicitly support SFBs). Some of the key lessons relevant to developing a credit line for financing EE in SFBs are as follows:

Standard products that do not require changes to bank processes. Banks in Poland are seeking to cut costs, and a new financing program such as an EE credit line should broadly fit within the existing operational processes of the bank. New financing products that require significant changes to the bank's operational processes would increase costs. Banks prefer not to make changes to their loan processing and risk assessment approach. An EE credit line should be simple to be successful. Bank relationship managers have sales targets to meet and will focus on products that are simple and help them meet those targets.

The POLSEFF line of credit from EBRD for EE in SMEs, for instance, had a simple financing process that relied on a published list of eligible materials and equipment (LEME) and participating banks found it easy to operationalize. An EE credit line for SFBs could similarly rely on an approved list of boilers, equipment and materials, which would be eligible for financing. Installers could be certified to lower performance risk. A simple application and certification process for financing EE in SFBs would incentivize loan managers to push the new financial product. The POLREFF line of credit from EBRD for EE in SFBs has however not been that successful, and the EBRD is revising the operational framework for the line of credit.[20]

Co-financing by the bank. Products that require the bank to co-finance significant funds (leveraging bank funds) to expand the EE credit line may not be very attractive since separate loan processing and reporting procedures could be expensive.

Terms of credit line. The terms of a credit line for SFBs would have to be more attractive than the cost of raising capital in the local capital markets. A long-term loan (10 years +) product for SFBs would be useful. This could be coupled with guarantees from the equipment manufacturers. Banks favor on-lending at market rates, which will not impact their traditional lending practices. Banks also opined that any subsidy offered to customers be limited to about 10-15 percent to reduce market distortions.

Different target groups. Credit lines with different components for different customer groups or borrowers may be overly complex to implement. A single product for non-poor SFBs would be preferred.

Risk sharing or lines of credit. Polish commercial banks have more experience with lines of credit than risk sharing instruments. Risk sharing is perceived to be more complicated than a line of credit. Also, IFIs require reporting for risk sharing products at individual project level rather than on a portfolio basis, which makes compliance difficult and expensive. Banks are also averse to dilute their risk management guidelines and extend financing to more risky customers – the perception is that a risk guarantee may encourage some bank loan managers to make riskier loans to expand the portfolio.

[20] POLREFF program was addressed to owners of flats and single family buildings.

Simple reporting and monitoring systems. Banks prefer new products that do not require significant changes to the IT system and new reporting systems to be installed given the high cost of bank IT systems.

Implementation support for SFBs. The process for non-poor SFBs to certify the use of funds should be simple to make the financing product attractive. The process to obtain building permits to undertake insulation could also be simplified to reduce the burden on SFBs.

Marketing and awareness campaigns. A successful financing program will hinge on effective marketing of the financing product and education of SFB customers. Funds for marketing and awareness should be provided as a grant.

8.2.2 INSTITUTIONAL FRAMEWORK FOR EE LINE OF CREDIT

Typically, EE lines of credit in many countries are extended to developmental banks or a government entity that meets the IFIs criteria for financial intermediaries. This principally is due to the fact that commercial banks in many markets supported by IFIs are unable to meet the criteria for capital adequacy, credit and risk management, etc. The developmental bank may then, at its credit risk, on-lend funds to commercial banks and other banking institutions eligible to receive funds and make loans to intended customer segments. For instance, in Poland, interested IFIs could extend a line of credit to BGK, the national development bank, which could in turn extend credit to PFIs. In the case of the thermal-modernization fund to support EE in commercial and public buildings in Poland, BGK provided lines of credit to commercial banks to on-lend to beneficiaries. While this is a workable approach, it is not a necessary solution since Poland has commercial banks that can independently meet IFIs criteria for financial intermediaries.

The proposed institutional structure for the EE line of credit is thus simple; IFIs may extend lines of credit directly to qualifying commercial PFI in Poland to on-lend funds to SFBs to make investments in eligible EE projects obviating the need for an additional intermediary such as BGK or other government entity. Repayment of the IFI line of credit to the PFI would be dictated and secured through terms and covenants agreed between the IFI and the PFI, and the GoP would not provide any sovereign guarantees.

A summary description of BGK and the commercial banking industry in Poland is provided below to provide a rationale for the proposed structure for IFIs to directly extend lines of credit to eligible commercial banks.

8.2.2.1 BGK – Polish national development bank

BGK is a state-owned national development bank in Poland and operates several funds to promote investments in infrastructure, SMEs, housing, transport, municipalities, student credit, etc. It has several credit lines from EIB and manages EU funds. BGK also provides special credit services, including homeowner mortgages and guarantees to export companies and SMEs; and issues bonds for financing infrastructure projects.

BGK has operated the thermo-modernization fund, which has supported EE investments in buildings since 1999 (it was established with the Parliamentary Act on Supporting Thermal Modernization Investments of 18 December 1998). Since 2008, program activities were broadened to include buildings' refurbishment. The current name is the "Thermal Modernization and Refurbishment Act".

Under the thermal-modernization program, BGK channels subsidies through PFIs , which provide commercial lending to eligible customers. Qualifying customers can get a subsidy of up to 25 percent from the state budget if the renovation lowers energy consumption as per specified norms.[21] An energy audit is required to confirm the minimum threshold of savings to be achieved to qualify for the subsidy. Also, only applicants to the loan program qualify for the subsidy.

[21] Energy savings of minimum 10 percent when only the heating system is modernized; minimum of 15 percent in buildings in which the heating system was modernized after 1984; and minimum 25 percent in other buildings.

8.2.2.2 Commercial Banks in Poland

According to the US State Department's Office of Investment Affairs, Investment Climate Statement, both foreign and domestic investors may place funds in Poland and the country has a healthy equity market that facilitates the free flow of financial resources.[22] Poland also has a wholesale market for trading of treasury bills and bonds. The capital market in Poland provides funding for Polish companies and banks. While credit is allocated on market terms, it is reported that the government has programs that offer below-market rate loans to certain domestic groups, such as farmers and homeowners.

The Polish banking sector is reported to be liquid and major banks in the country are well capitalized. It is reported that good supervision and risk management practices have curtailed excessive risk-taking among banks. It was assessed that the five biggest banks in Poland represent almost 50 percent of total assets of the banking sector (as of end September 2016). The banks in Poland reportedly meet European Banking Authority regulatory requirements and regulatory capital adequacy ratios, and the share of non-performing loans was about five percent of portfolios (close to the EU average). Risk costs in the region have also dropped from 1.7 per cent (of gross loan portfolio) in 2012 to 1.2 percent in 2015 and in 2018 their level is expected to decrease to 0.9 per cent. Further growth in the value of loans is expected.[23]

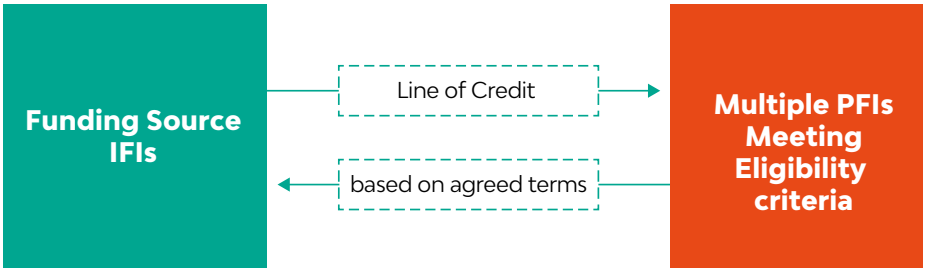
Consumer lending by Polish banks has a year-on-year growth rate of about 7.2 percent (Dec 2016), and is viewed as a profitable product. There also is reportedly a migration of consumers to non-bank credit institutions, which could pose long-term risks for banks since it would hinder their capacity to assess consumer risks. Banks have also extended loan tenor and reduced credit spreads due to competition among commercial banks.[24]

8.2.2.3 EE Line of Credit from IFIs directly to PFIs

Based on the status of financial markets and performance of large commercial banks in Poland and based on the experience of past EBRD and EIB credit lines for Poland, it is proposed that IFIs directly extend lines of credit to multiple eligible PFIs in Poland. Some of the key elements of the program design are described below. The specific of program details will need to be discussed and negotiated with banks and other relevant stakeholders prior to finalization.

Number of participating PFIs. It is suggested that the IFIs extend a LOC to as many eligible PFIs as possible given the large number of SFBs to be targeted through the program (Figure 11). It is likely that several large commercial banks in Poland would qualify for a LOC based on bank performance ratios and the requirements of IFIs. However, to lower the transactions cost, it is suggested that the line of credit be extended to five to six of the major commercial banks in Poland, which have a large share of the market for retail banking and have branches across the country.

FIGURE 11.
IFI Lines of Credit to Multiple PFIs



[22] https://www.export.gov/article?id=Poland-6-Financial-Sector, "Poland-6-Financial-Sector" publish September 08, 2017.
[23] https://financialobserver.eu/poland/deloitte-2017-will-be-very-difficult-for-banks-in-poland/, "Deloitte: 2017 will be very difficult for banks in Poland, Maria Bninska, December 01, 2016.
[24] Financial Stability Report, Narodowy Bank Polski, June 2017

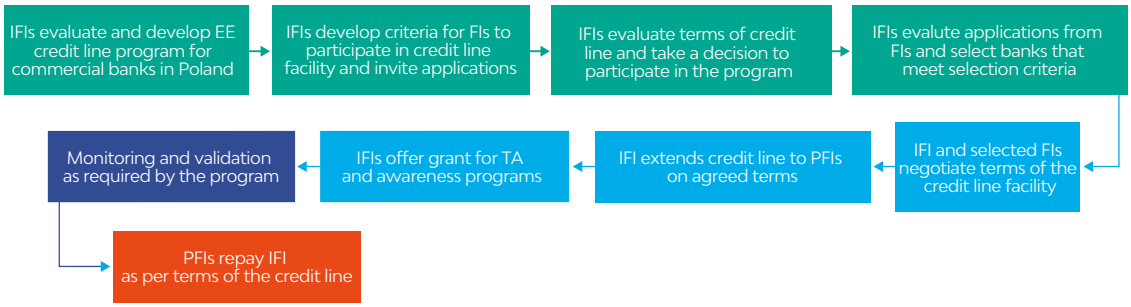
8.2.2.4 Typical IFI eligibility criteria for PFIs

The IFIs have specific criteria that FIs need to meet in order to be eligible to receive a line of credit. Some of the general criteria for eligibility of an FI to serve as a financial intermediary may include the following.

- Adequate capital, liquidity, asset quality, exposure limits, profitability and other standard performance ratios, which indicate that the FI is financially sound to receive and disburse funds from an IFI.
- Adequate operating systems, procedures, and credit and risk management policies.
- Compliance with local banking regulations and other relevant laws and regulations.
- Adequate corporate and financial management and governance systems with documented and transparent policies and procedures.
- Adequate retail lending operations and client base to ensure that the credit line is made available to a large pool of eligible SFBs.
- Retail lending operations with terms and conditions that are consistent with local financial market practice and cover the costs of capital, risk mitigation and provide adequate profit margins as defined by banking regulations.
- Adequate processes to evaluate creditworthiness and payment default risk of borrowers (SFBs), and procedures to mitigate risks.
- Adequate monitoring systems to capture information from SFBs to ensure that funds are utilized only for eligible EE projects.
- Adequate reporting systems to satisfy internal management and audit requirements, and reporting obligations to the IFI which may include information on SFB projects, implemented, disbursements from credit line, repayments, payment default, etc.

The general process for IFIs to select PFI to extend a line of credit is illustrated in Figure 12.

FIGURE 12.
IFI Selection Process for Extending Credit Line to FIs



Technical Assistance under the line of credit: As described earlier, it is common for an EE line of credit to include grant funds to provide TA to the PFIs and SFBs, as necessary. The goal of the TA would be to provide necessary technical advice and support to PFIs and other relevant stakeholders to comply with the requirements for financing under the line of credit and promote increased uptake of the credit facility.

The TA provider (an eligible firm or a number of experts) may be hired directly by the IFI to support all PFIs. The TA may include capacity building of PFI personnel to evaluate and monitor EE loans to SFBs, development of templates to collect and report information, preparation of eligibility criteria for projects eligible for financing under the credit line and/or lists of eligible equipment and materials, criteria for eligible equipment and material suppliers and installers (such as impaneled suppliers, certified installers, etc., if necessary for program implementation). The TA experts could also support suppliers of equipment and materials, if practical.

Awareness and Information Campaigns: It is also common for an EE line of credit to include grant funds to develop and implement awareness and information campaigns with the goal of promoting the financing product and widely disseminating its benefits. The firms (or experts) may be hired directly by the IFIs to support the PFIs, SFB and other relevant stakeholders. The scope of the awareness programs and the mode of information dissemination are generally defined by a study to understand the characteristics of the market.

Entity to process subsidies: Public subsidies to the non-poor SBF would be channeled through the PFI. Channeling the subsidy though the PFI would lower transaction costs and be convenient to the SFB than a process, which required SFBs to apply to a separate entity for the subsidy. The proposed National Fund for Anti-Smog and EE could channel public subsidies for non-poor SFBs through the PFIs.

8.2.2.5 Implementation Mechanism for EE Credit Line

The implementation of the EE credit line for non-poor SFBs has to components: the process for the PFI to on-lend funds to SFBs, and the project implementation mechanism or process for the SFB to implement eligible EE projects.

8.2.2.6 Implementation Mechanism for Credit Line at the PFI

PFIs eligible and approved by the IFIs to receive a line of credit would sign an agreement with the IFI and in turn on-lend funds to the SFB. Some of the key program implementation issues to be finalized in consultation with the IFIs, interested commercial banks and other relevant stakeholders are discussed below.

SFB eligibility: In the interest of program consistency across PFIs, it is proposed that common SFB eligibility criteria be developed for SFBs to obtain financing from a PFI. The TA consultants to the program (hired through IFI grant funds) could develop the eligibility criteria in consultation with the PFIs. In essence, any creditworthy SFB owner would essentially be eligible to participate in the program as long as they meet the due diligence requirements of the PFI and utilize the funds to implement eligible EE projects – this typically, would constitute non-poor SFBs.

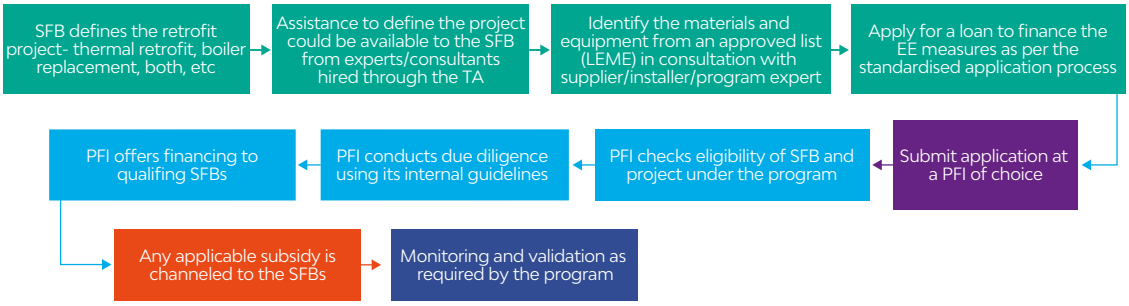
The PFI application and lending process: In the interest of program consistency across PFIs, it is proposed that a standardized lending application process be developed for SFBs to obtain financing from a PFI under the credit line. The TA consultants to the program (hired through IFI grant funds) could develop the standardized forms in consultation with the PFIs.

While the application process would be standardized, the PFIs would finance eligible SFBs applying their normal retail lending practice, due diligence process, and risk analysis. The terms for on-lending would be determined by the PFI, based on its agreement with the IFI. It is possible that lending terms may vary across PFIs and for SFB owners based on their creditworthiness and relationship with the PFI.

The loans could be guaranteed through the equipment as collateral or though other forms of guarantee as dictated by retail lending practice in Poland and compliant with banking regulations. This approach appears acceptable based on the WB team's discussions with some commercial banks.

A simple lending process should be developed to make it easy for SFBs to apply for financing, and for the PFI to process the application. The application process may involve the following steps (see Figure 13).

FIGURE 13.
Steps in Lending of EE Credit Line to SFBs



Terms for SFB financing: While financing will likely be at commercial/market rates of interest, which do not distort the local lending market, SFBs could be provided extended tenors through the credit line facility. For instance, a 10-year tenor may be better suited for financing thermal retrofits of SFBs given the long payback period on the investment. SFBs would also benefit from any assistance provided through the TA, which may help streamline the process and possibly create an online portal to disseminate information.

In keeping with normal lending process, the ceiling for financing could be 70 percent of the eligible cost of EE measures, with the remaining to be financed through equity finance by the SFB. The ceiling on debt financing could be higher based on customer needs and PFIs' lending practices.

Subsidy to Non-Poor SFBs. The financing facility could include a subsidy component to incentivize SFBs (such as the subsidy given under the BGK thermo-modernization fund). The SFB would avail of the subsidy on submission of standardized documents for financing eligible equipment. As noted earlier, the subsidy could be targeted at sub-segments of non-poor SFBs and could be channeled from the National Fund through the PFI.

Equipment eligible for financing. Thermal retrofits of SFBs as recommended by new building codes and/or by experts and boilers that meet the requirements of the anti-smog resolution and the new proposed emission standards for boilers would be eligible for financing under the facility. The EE project may include associated changes which may be required for the heating distribution system, but would not include any major changes to the structure of the SFB beyond the addition of insulation material as required for thermal retrofits.

List of eligible materials and equipment. Based on the successful experience of EBRD's POLSEFF program in Poland, which supported implementation of EE in SMEs, a LEME could be developed by experts provided through the TA component of the credit line. The LEME could be developed as shown below (Table 20) and include eligible equipment and materials from manufacturers that comply with program requirements. The LEME could include the specifications for eligible materials and equipment. A list of materials and equipment and installation costs excluded from financing based on environmental and social considerations could also be prepared to accompany the LEME.

Under the POLSEFF program, materials and equipment included in the LEME had a product certificate, and its submission along with a supplier/installer invoice was adequate proof for program beneficiaries to provide the PFI. A similar approach could be considered for financing non-poor SFBs through the EE credit line. The use of a LEME, which can be modified and updated over time, along with an invoice from an accredited supplier or installer would simplify the process of identifying project eligibility for financing under the credit line, and lower transaction costs associated with monitoring the use of funds from the credit line.

A well-defined process to modify and or add new materials and equipment to the LEME could also be developed to ensure that the LEME is kept up to date.

TABLE 20.
Illustrative LEME for a EE Credit Line to Support SFBs

THERMAL RETROFIT MATERIALS (including specifications/compliance with standards)
• Wall insulation • Roof insulation • Floor insulation • Radiators, pipes, regulation equipment, etc. • Window replacement
BOILER REPLACEMENT (including specifications/compliance with standards and associated heat distribution systems)
• Coal boilers • Gas boilers • Heat pumps • Other solid fuel boilers (biomass)

8.2.2.7 Implementation Mechanism for Credit Line at the SFBs

SFBs that qualify to avail financing from the PFIs for eligible EE projects, will use proceeds of the loan to implement EE projects in compliance with program requirements. Some of the key program implementation issues to be finalized in consultation with the interested commercial banks, consumer groups, and other relevant stakeholders are discussed below.

Assistance to SFBs. SFBs may identify and define eligible EE projects with the support of equipment manufacturers, suppliers and or installers. SFBs could also be provided support through standardized guides prepared by experts supported through the TA accompanying the LOC. The suppliers or program guides could help the SFB define the EE measures and the investment required to be undertaken to comply with the anti-smog resolutions and other relevant laws, regulations, codes and standards.

TAs under EE credit lines for SMEs has been used to provide direct technical assistance to beneficiaries through TA experts. However, given the large number of SFBs eligible to access financing under the credit line, it would be prohibitively expensive to provide such direct support under the proposed credit line.

Program portal. It is suggested that a user-friendly web portal be hosted to include the standardized guides, LEME, equipment certificates, etc., which would support SFBs, equipment manufacturers, suppliers, and installers. The portal could be periodically updated.

Program controls, monitoring, and validation. A simple monitoring and validation process is suggested for the EE credit line to support SFBs. This will lower transaction costs and encourage greater program participation. This is critical given the large number of SFBs that hopefully will avail of this financing facility.

Program monitoring and validation to certify use of funds as per program requirements should largely be based on review of relevant documents such as adherence to project selection criteria, invoices for purchases of eligible materials and equipment (for example, purchases compliant with a LEME for the program), use of authorized or certified suppliers and/or installers, etc. A small percentage of SFB sub-loans, say 5-10 percent, could be verified through site visits by authorized advisors.

The program experts funded through the TA could, in consultation with other stakeholders such as the relevant ministries and trade associations, prepare lists of authorized or certified installers, suppliers, manufacturers, etc. that will support quick validation through review of documents rather than through expensive site visits.

Certification of installers. The experts procured through the program TA could support stakeholders develop procedures for certifying installers of boilers and thermal retrofits in SFBs. This could be done through a consultative process with all relevant stakeholders. The use of certified installers would provide added comfort that financing made available through the EE credit line is utilized in compliance with program requirements. The use of certified installers, coupled with invoices from authorized equipment and material suppliers, could further reduce site visits for verification, and lower transaction and monitoring costs.

Appendix 4 provides some examples of EE lines of credit offered in some countries.

8.2.2.8 Next Steps in the Development of an EE Credit Line

The WB team has met with some of the large commercial banks in Poland to discuss the viability of an EE line of credit to benefit non-poor SFBs. The discussions have been positive, and banks are receptive to developing a credit facility for SFBs. The key next steps in the development of the credit line facility include the following.

- Discussions with IFIs to develop a credit line facility for commercial banks in Poland to on-lend funds to non-poor SFBs;
- Discussions about grant funds to accompany the credit line for associated TA, awareness campaigns, and any incentive programs; and
- Discussion with the GoP regarding subsidies to be provided to non-poor SFBs.

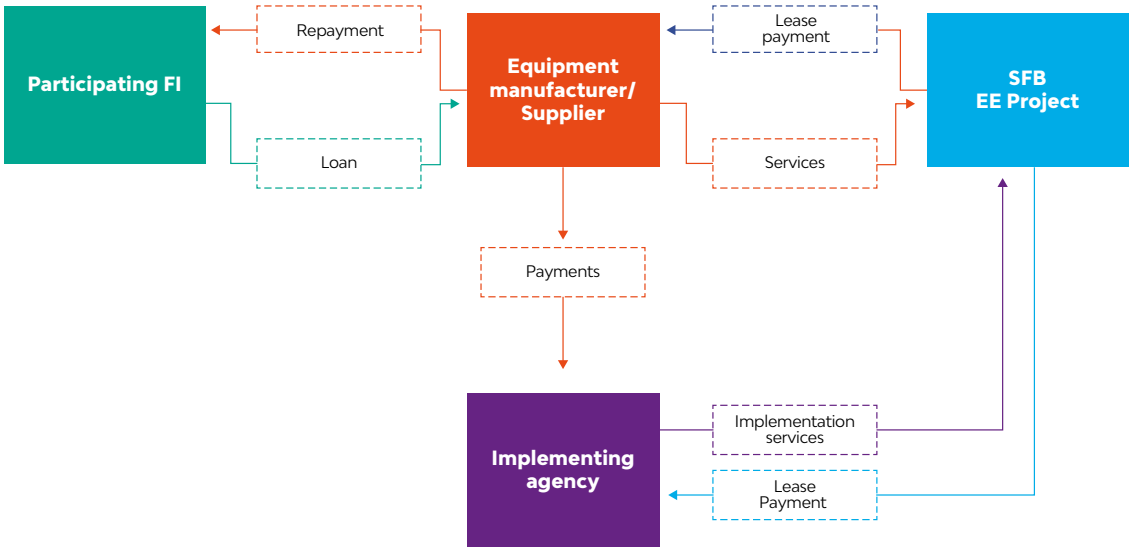
8.2.3 EQUIPMENT LEASING PROGRAMS

An equipment leasing program could be developed as a subset of the line of credit facility from IFIs to PFIs. The PFIs could utilize part of the line of credit to on-lend financing to eligible equipment manufacturers and suppliers (in addition to on-lending directly to non-poor SFBs). The manufacturers and suppliers would in turn lease finance equipment to non-poor SFBs.

8.2.3.1 Operational Structure of an Equipment Leasing Program

The schematic below (Figure 14) illustrates the basic structure for an EE equipment leasing program that may be offered to non-poor SFBs through equipment manufacturers, suppliers, or municipalities.

FIGURE 14.
Schematic of an Equipment Leasing Program Utilizing an EE Credit Line



The IFIs may provide a line of credit to multiple PFIs, which apply and qualify under the terms of the credit line. The terms of lending from the IFI to the PFI may include lower cost financing (than local capital market costs) and/or longer tenor, grant funds for TA, awareness programs, etc. The PFI would pay back the IFI as per the terms of the credit line.

The PFI would in turn on-lend funds to a qualifying manufacturer or supplier to finance qualifying EE equipment such as boilers. The PFI would apply its normal credit checks and follow corporate lending practices to provide debt finance to manufacturers and suppliers. The terms of lending from the PFI to the manufacturer or supplier would be based on local debt market practices. The manufacturer or supplier (borrower) would make loan repayments to the PFI as per the terms of the loan from the PFI.

The manufacturer or supplier would lease eligible equipment to non-poor SFBs and recover the investment through amortized monthly payments.

The program could include a subsidy component financed by public funds (GoP, EC funds to Poland, etc.) to incentivize manufacturers or SFBs to implement EE projects. Such subsidies could be routed through the PFI or a separate public entity.

Table 21 summarizes some of the principal benefits and limitations of an equipment lease financing scheme to implement EE projects in SFBs.

TABLE 21.
Principal Benefits and Limitations of Lease Financing for EE Projects Operated by Manufacturers, Supplier and/or Municipalities

DESCRIPTION	BENEFITS	DISADVANTAGES
This is a commercial financing mechanism through which equipment manufacturers or suppliers could avail financing from PFIs. The manufacturer or supplier availing financing from PFI would in turn provide lease finance to non-poor SFBs for implementing eligible EE measures. SFBs would make monthly lease payments on the investment as per agreed terms. The US and EU have experience with equipment lease financing for residential properties.	It would be cheaper for PFIs to provide debt finance to manufacturers and suppliers compared to directly financing SFBs. The transaction costs for PFIs would be lower. Eligible SFBs would be able to finance EE measures by obtaining lease financing at competitive terms offered by manufacturers/ suppliers. Creditworthy non-poor SFBs may more easily qualify for lease financing. A lease finance scheme lowers upfront investment for non-poor SFBs. The scheme incentivizes equipment manufacturers and suppliers to sell EE equipment and services. Suppliers could also operate leasing programs through bulk procurement of eligible equipment and materials. Lease payments by SFBs could qualify for tax credits. Polish banks have experience with lease financing for corporations and SMEs.	Manufacturers in Poland have no experience with equipment lease programs and may not have the capacity to assess the creditworthiness of SFBs. Small equipment suppliers and installers may not be creditworthy to obtain financing from PFIs. May need policy or legislative changes to enable manufacturers or suppliers to operate leasing programs. Manufacturers and suppliers may promote specific technologies that are more profitable.

The terms and operational aspects of the credit line from the PFIs to equipment manufacturers and supplier would be similar to that described earlier for direct financing of SFBs. The principal difference would be lower transactions costs since the PFIs would have to verify the creditworthiness of corporate entities as opposed to SFBs. Financing of corporate entities could lead to improved financial terms since the risks are likely to be lower.

8.2.3.2 Institutional Framework for EE Line of Credit used for Lease Financing

The institutional framework for a leasing program would be similar to that described for direct financing of non-poor SFBs, with the exception that the PFI would on-lend funds to equipment manufacturers and suppliers, as illustrated in Figure 15. While equipment manufacturers and suppliers are equipped to directly install equipment through their authorized dealers, they may also choose to utilize the services of a separate implementing agency or authorized installers. The use of authorized installers may be preferable to a separate implementation agency, which would add to the transaction costs and may entail additional capacity building and training for a new entity.

The equipment manufacturers and supplier and/or municipalities would benefit from the services provided through the TA and education and awareness programs.

8.2.3.3 Implementation Mechanism for Lease Financing Using the EE Credit Line

The implementation of the EE credit line to support lease financing of equipment by manufacturers and suppliers has to components: the process for the PFI to on-lend funds to equipment manufacturers and suppliers, and the project implementation mechanism or process for the equipment manufacturers and suppliers to implement eligible EE projects in SFBs.

Implementation Mechanism for Credit Line at the PFI. PFIs eligible and approved by the IFIs to receive a line of credit would sign an agreement with the IFI and in turn on-lend funds to the equipment manufacturers and suppliers. The key program implementation issues to be finalized in consultation with the IFIs, interested commercial banks and other relevant stakeholders would be as described earlier for IFI lines of credit to PFIs, with the key difference that on-lending would be to corporate entities, which has the advantage of lowering transaction costs.

Implementation Mechanism for Lease Financing at the SFBs. The equipment manufacturers and suppliers would have to assess the creditworthiness of SFBs that could be problematic since they have no experience with financing customers.

SFBs, which qualify for a leasing program for eligible EE projects, will benefit from equipment being installed at their premises by a qualified installer (coupled with manufacturers guarantees). The leasing program would substantially ease the burden on SFBs to identify and assess EE projects, obtain financing, and hire the services of qualified installers to implement the projects. The PFIs would also have the comfort of dealing with larger corporate and public entities that would be more capable to undertake project implementation and monitor and report results to the PFI.

A key hurdle to implement the leasing program would be any policy, legislative, or regulatory changes which may be needed to permit equipment manufacturers and suppliers to provide lease finance services. A key limitation of the lease finance program, as described in Table 13, could be the inability of manufacturers and suppliers to assess the credit worthiness of SFBs. The lease program is clearly advantageous for financing and installing boilers, which are standardized products.

8.2.3.4 Next Steps in the Development of an Equipment Lease Program for SFBs

The WB team has met with the associations of solid fuel boiler manufacturers and gas boiler and heat pump manufacturers. As noted earlier, the WB has also met with some of the large commercial banks in Poland to discuss the viability of equipment lease finance program to benefit non-poor SFBs. The discussions have been positive, and the manufacturer's associations and banks are receptive to developing a lease finance scheme. The key next steps in the development of an equipment lease finance facility include the following:

- Discussions with equipment manufacturers and suppliers on a framework and terms for an equipment lease finance program;
- Discussions on any grant funds to accompany the lease financing program for non-poor SFBs; and
- Discussion with the GoP and other stakeholders on policy and regulatory changes required to enable manufacturers, suppliers and installers to provide lease finance services to non-poor SFBs.

8.2.4 UTILITY FINANCING OF SFBs

Utilities are well positioned to support SFBs implementation of EE programs given their relationship with customers. Electric and gas utilities may also have an interest in promoting the switch from coal to heat pumps and gas boilers, since it will increase sales. Utilities may also provide financing to customer to undertake EE measures. Indeed, in many countries utilities have been required by their regulators to finance customers' investments in EE products, technologies, and equipment and to use the utility billing mechanism to accept customers' repayment of the funds. The utility's monthly billing system provides a valuable mechanism through which customers can pay back utility supported financing. Utilities also generally have the capacity to provide financing to customers.

The basic structure of a utility financed program is shown in Figure 15, and it principal benefits and limitations are summarized in Table 22. An energy service provider, contracted by the utility to implement the program, could also support the program.

FIGURE 15.
Schematic of a Utility Financed EE Program

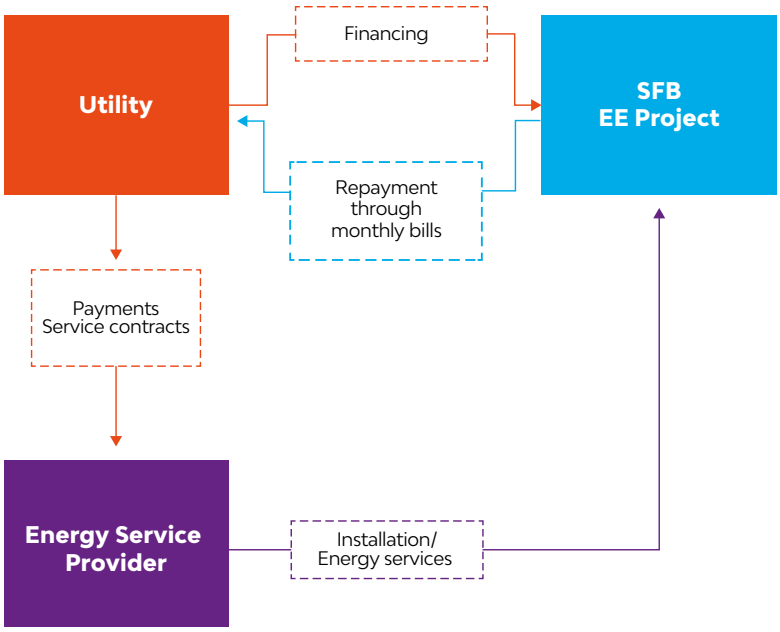


TABLE 22.
Principal Benefits and Limitations of Utility Financed EE Programs for SFBs

DESCRIPTION	BENEFITS	LIMITATIONS
Energy utilities manage and implement EE programs for their customers to provide additional benefits and services or expand energy sales (in case of fuel switching programs). Utilities also implement EE projects when mandated by regulatory agencies. Utilities in Belgium, Denmark, France, Ireland, Italy, Netherlands, UK, USA, and several other countries have implemented DSM/EE projects. The applicability of Utility programs to Poland needs to be examined. Gas and electric utilities could potentially be interested in financing and implementing boiler replacement programs that promote gas boilers and heat pumps to expand their service offering and increase sales.	Customers pay for the EE installation in installments through monthly utility bills. Utility benefits from additional customer services and potentially increased sales from fuel switching programs. Attractive to customers since customers do not incur an initial investment (or incur a low investment) and scheduled repayments are based on savings. Program monitored through utility IT systems. The utility may contract an energy service provider to support SFBs implement EE projects.	Utilities may pass program costs to other customers through tariff increases for all customers. Requires trained staff to manage the EE program. Utilities need to be authorized by the regulator to provide additional EE services or operate a standard offer program.

8.2.4.1 Next Steps in the Development of a Utility Financed EE Program for SFBs

Preliminary discussions with two of the largest electric and gas utilities in Poland indicates that utilities are very interest in supporting implementation of EE in SFBs and are considering pilot studies. This avenue of customer financing needs to be examined further with utilities and regulators in the next phase of this study.

9. FISCAL INCENTIVES

9.1 TAX INCENTIVES, CREDITS AND DEDUCTIONS

In addition to capital subsidies, the government may also consider a tax credit or deductions linked to the purchase of eligible equipment, coupled with financing support through a dedicated credit line, as additional incentives for non-poor SFBs to make investments in boiler replacements, thermal retrofits and fuel switching.

9.1.1 OPERATIONAL MECHANISM

Tax incentives for EE equipment and EE improvement projects are offered to incentivize and promote the adoption of EE technologies and for fuel switching. Incentives may also be performance-based, where the level of incentive is linked to the efficiency or performance of the appliance. The US, for example, also offers incentives that are tailored to achieve performance based on a fixed budget for an EE program.[25]

In the Polish context, the objective is to incentivize SFBs to install new coal and gas boilers and heat pumps and other renewable energy-based heating systems that meet regulatory standards and other emission performance standards. One of the principal barriers to making the switch is the relatively high investment to be made to replace a non-compliant appliance which may not have reached end-of-life since the anti-smog regulations or the GoP program will place a timeline by when solid fuel boilers of a certain age or class of performance have to be replaced with new compliant boilers.[26] A tax deduction and/or tax credit linked to the purchase of the higher performance boiler complaint with new regulations, coupled with financing through a dedicated credit line, may provide adequate incentive for non-poor SFBs to make the switch to boilers compliant with new regulations and standards. A similar tax credit or incentive mechanism could also be developed for installation of thermal insulation.

The schematic below (Figure 16) illustrates the basic structure for a tax incentive scheme. A tax credit to SFBs would require the SFB to make an investment in an eligible EE project and then lower the taxable income by the allowable credit when filing annual income tax returns. A tax deduction would lower the tax by the allowable amount. While a tax credit or deduction will lower tax revenue to the Polish treasury, a key consideration will be to examine if the tax credits and/or deductions have a greater positive financial or economic impact on the Polish economy in terms of lower energy use and reduced emissions. The analysis of tax credit schemes also needs to be compared with an analysis of impacts of a direct (and capped) subsidy scheme, which, if well designed, could be more attractive to SFBs. It should also be noted that tax credit or deduction scheme will benefit non-poor SFBs which file tax returns. Poor SFBs and SFBs in lower household income quintiles are unlikely to benefit from the scheme since they may not have adequate income to benefit from the credit.

FIGURE 16.
Schematic of a Tax Rebate and Credit Scheme to Incentivize Manufacturers and SFBs to Adopt more EE Measures

[25] A Retrospective Look at Federal Energy Efficiency Tax Incentives: How Do Cost and Performance-Based Incentives Compare in Their Ability to Transform Markets? David B. Goldstein and Meg Waltner, Natural Resources Defense Council Lane Burt and Bryan Howard, U.S. Green Building Council

[26] An additional barrier is the higher operational costs due to the higher cost of better quality fuels, especially for SFBs which presently may be using low-quality coal mixed with cheaper firewood and other trash. It is, however, expected that with education and awareness the non-poor SFBs may make the switch to more efficient boilers without an additional benefit to subsidize operational costs.

Table 23 summarizes some of the principal benefits and limitations of an EE credit line to finance SFBs implement EE projects.

TABLE 23.
Principal Benefits and Limitations of Tax Rebate and Credit Schemes to Incentivize Manufacturers and SFBs to Adopt More EE Measures

DESCRIPTION	BENEFITS	LIMITATIONS
Tax credits and rebates for investments in qualifying EE measures such as thermal retrofits and boiler replacement, and fuel switching are provided to SFBs. Funds may be channeled as income tax credits or rebates, or property tax credits. Several countries including the USA, France, Belgium, UK, Austria, etc. have adopted tax incentive and rebate programs.	Attractive to SFBs depending on the cap on tax credit. Program uptake can be tracked through equipment sales and income tax filings. Relatively easy structure for program design. Monitoring does not require energy assessments and audits. Tax incentives and rebates combined with other public and commercial financial instruments can be used to promote and incentivize SFBs to implement desired EE measures. Tax allowances that lower taxable income could also be considered.	Tax rebates are generally less attractive to customers than direct subsidies since it requires making full upfront investment first and the filing of taxes and additional paperwork. Customers need to be educated to benefit from tax credit. Tax credits do not benefit poorer SFBs, which may not have adequate income to benefit from the scheme. Needs policy or legislative changes to permit tax credits and rebates to SFBs.

9.1.1.1 Terms and Operational Aspects of a Tax Credit and Rebate Scheme

Some of the typical terms and operational aspects of a tax credit and rebate scheme to promote EE in SFBs are summarized below. Some of the terms and conditions of the tax credit and rebates scheme need to be discussed and analyzed in detail in consultation with the Ministry of Finance and other relevant ministries since the scheme has an impact on revenue collections by the treasury.

Typical Structure of a Tax Credit Scheme for SFBs. Tax incentives for investment in specific equipment or EE projects and fuel switching can be used to promote and incentivize SFBs to comply with anti-smog and other relevant regulations, lower energy consumption, and reduce emissions. The tax incentives should be designed to lower the investment required to adopt EE measures.

The SFB will initially make the full investment in eligible EE measures, and later claim the allowable credit through the annual income tax filing. Customers would present invoices for equipment and/or services as proof of payment to qualify for the tax credit.

As noted above, this scheme benefits non-poor SFBs that have adequate income to benefit from the scheme. A disincentive of the scheme is that it will require SFBs to claim the credit through their tax return that involves additional paperwork. There also are concerns that claiming tax credits may invite greater scrutiny of the tax return that may dissuade some SFBs from participating in the program.

Poland could also consider providing investment allowances as opposed to tax credits to incentivize SFBs. While tax credits reduce the amount of taxes, a tax allowance lowers the taxable income of the SFB. The merits of one scheme over the other need to be examined in consultation with tax experts and relevant ministries.

Tax Credit or Deduction. For instance, an SFB that installs a new gas boiler and undertakes thermal retrofits is likely to invest an estimated PLN 57,500 depending on the cost of the thermal retrofits. Under a tax credit scheme, the SFB could reduce its taxable income by this amount. Alternately, the GoP could provide a tax deduction, which would reduce taxes by the amount allowed under the scheme.

It is recommended the tax credit or deduction is limited to investment in thermal retrofits, which is not mandated by regulations and needs to be incentivized. Given the big difference in financial incentives of tax credit or rebate, the WB team will consult with the Ministry of Finance in May to make more concrete recommendations that are suitable to the Poland tax system (see Box 3 for a comparison of both instruments).

BOX 3.
Potential Tax Deduction and Tax Credit schemes for Encouraging EE in SFBs

Assume a household in Poland in the top fifth income quintile with an annual income of PLN 96,242. Assume that the taxable income of this SFB is PLN 90,000 and the tax rate is 20 percent. Under a tax credit scheme that provide a tax credit of, say, PLN 10,000 for making eligible investments in improved heating systems, the taxable income would be lowered to PLN 80,000 and the overall benefit to the SFB from the tax credit scheme would be PLN 2,000.

Under a tax deduction scheme of, say, PLN 5,000, the same household would be able to lower its taxes by this amount and would benefit by PLN 5,000, which is more than under the tax credit scheme.

Cap on Incentives. It is common practice to cap the amount of tax incentive given to beneficiaries. Thus, a fixed deduction or a tax credit for an eligible investment could be capped at a certain rate or PLN amount. The cap would depend on an estimate of the level of incentive required to achieve market compliance with regulatory requirements. This requires analysis and consultations with tax consultants and relevant stakeholders. The cap is meant to limit the benefit provided to free riders, while at the same time benefiting SFBs that need the incentive to make EE investments. Equally, it would be important to place a cap for investments made in thermal retrofits of SFBs, which could vary significantly. The cap is also meant to lower the impact on the treasury's revenue collections.

Impact on the Treasury. All tax credit and deductions will lower revenue collections for the treasury and require detailed analysis of revenue collection impacts and potential benefits to society. Performance based tax credit schemes in the US have been estimated to be beneficial in promoting EE with little impact on treasury revenue collections. An assessment of the earlier tax rebate scheme introduced in Poland would serve as a useful guide to design a successful tax credit and/or rebate scheme.

Measure of Success of Tax Credit and Deduction Schemes. The success of tax credit and deduction schemes may be measured in terms of impact on achieving EE and emission reduction goals, limited free-ridership, and low cost to the treasury from lower revenue collections.

Tax Credit Schemes do not Drive Investments. Tax credit schemes by themselves have been found to be inadequate to drive investment decisions.[27] Other factors, such as the certainty of enforcement of regulations, the level of fines for non-compliance, concerns about increase in price of natural gas or electricity, changing government policies, etc. can all serve to dampen the uptake of tax credit schemes.

Cost or Performance based Incentives: Analysis of tax credit schemes in the US, which has a long history of them, has shown that performance-based incentives are more effective than cost-based incentives in promoting EE in the marketplace.[28] But performance-based incentives increase the transaction costs due to higher monitoring and verification costs.

Preparation of Tax Guidelines. A tax credit or rebate scheme has to be accompanied by specific tax guidance to SFBs. The tax authorities in Poland will need to prepare detailed guidelines that address some of the following key issues:[29]

- Definition of eligible EE project and equipment purchase. For example, boilers of certain specifications, thermal retrofits that meet certain standards, etc.
- Cap on tax credit, rebate, or allowance for the equipment purchase or thermal retrofits. The capped amount could also include a lifetime capped amount to limit the total amount of credit from which an SFB could benefit.

[27] Tax Law Design and Draf (volume 2; International Monetary Fund: 1998; Victor Thuronyi, ed.) Chapter 23, Income Tax Incentives for Investment

[28] A Retrospective Look at Federal Energy Efficiency Tax Incentives: How Do Cost and Performance-Based Incentives Compare in Their Ability to Transform Markets? David B. Goldstein and Meg Waltner, Natural Resources Defense Council Lane Burt and Bryan Howard, U.S. Green Building Council

[29] Adapted from the US Internal Revenue Service (IRS) tips for tax credits for EE projects and appliances

- Certification required from manufacturers and/or suppliers to ensure that only qualified investment were made against which benefits are sought (tied to eligibility of projects)
- Expiration date for credits. In the case of Poland, the expiration date could coincide with the GoP's timeline for the program and/or regulatory timelines of anti-smog resolutions and other relevant performance standards and regulations.
- Amount of credit that can be carried forward into next year's tax returns in case an SFB is limited by the amount of the credit or deductions that can be taken in a tax year.
- Preparation of specific tax forms that would need to be filed by the SFB or manufacturer along with the tax returns.

Market transformation effect: A well-designed tax credit scheme can help transform the market for adoption of eligible boilers and thermal retrofits in SFBs and fuel switching. The tax credit scheme would likely have to be coupled with financing schemes and subsidies as applicable to incentivize SFBs to undertake investments in compliance with regulatory requirements.

Risks: There is a risk of low uptake of tax credits by SFBs in lower income brackets that may not have adequate income to benefit from the scheme or not wish to undertake the burden of additional paperwork to qualify for tax credits. In meetings with stakeholders there was also some apprehension that SFBs in low income tax brackets may not be fully reporting income and may be averse to filing returns that may receive more scrutiny.

Lessons Learned from Poland's Experience with Tax Credits Schemes. Poland has experience with the provision of tax credits for investments by corporate businesses, energy efficiency projects implemented by businesses, and renewable energy projects. The GoP should build on the success of earlier schemes to develop a tax credit or rebate scheme for SFBs.

9.1.2 INSTITUTIONAL MECHANISM FOR A TAX CREDIT AND REBATE SCHEME

The institutional mechanism to design and implement a tax credit scheme is straightforward since the responsibility rests solely with government agencies. The ministries of finance, economy, investment and economic development, energy, etc. will need to collaborate to develop a tax credit scheme building on past experience in Poland and elsewhere. Key to the development of an effective tax scheme to incentivize boiler replacements and thermal retrofits of SFBs will be consultations with tax experts, consumer associations, manufacturers, and other relevant stakeholders. A determining factor will be the expected uptake, the societal benefit from reduced energy use and lower emissions, and the impact on the treasury.

9.1.3 IMPLEMENTATION MECHANISM FOR A TAX CREDIT AND DEDUCTION SCHEME

Policy changes. Implementing a tax credit scheme will require clear supportive policies. The relevant ministries will need to collaborate to develop applicable policies to permit SFBs and or manufacturers to benefit from tax credits and deductions applicable specifically to investments in boilers that meet regulatory requirements and thermal retrofits, as required by building standards (but not by regulations). For instance, in the US, the Energy Policy Act of 2005 (EPACT) included several tax incentives intended to encourage efficiency improvements in new and existing residential and commercial buildings and served as a trigger to tax credit schemes in many states (though tax credit schemes have existed in the US since the 1970's).[30]

[30] For example, a residential conservation tax incentive in the US offered in the 1970s and 80s provided homeowners an incentive of 15 percent of expenditures on conservation measures up to USD 2,000.

Applicability of tax Credit Scheme: All SFB owners filing tax returns would be eligible to benefit from a tax credit scheme to promote boiler replacement and thermal retrofit projects and for fuel switching. As described earlier, some lower income SFBs may not have adequate income or may choose not to participate due to the burden of additional tax paperwork.

Definition of Eligible Expenditures. A challenge for policy makers is to clearly and narrowly define expenditures eligible for tax credits or rebates. Given the impact of tax schemes on revenue collections, definition of allowable measures is critical. As discussed in the development of a credit line for PFIs to promote EE among non-poor SFBs, it would be essential to develop a list of eligible equipment and materials (the LEME, as described earlier) which would qualify under the tax credit/rebate scheme. Projects involving thermal retrofits are difficult to define narrowly since they could necessitate structural changes to the SFB, which could be expensive. A cap on eligible expenditures is thus commonly used.

Customers would present invoices for equipment and/or services as proof of payment to qualify for the tax credit.

Free ridership. One of the drawbacks of a tax credit scheme is that it encourages free-riders who may have made the investment in the EE measures anyway. The experience from the US indicates that tax credit linked to performance is more effective than tax credits liked to cost of eligible equipment. In Poland, the tax credit would necessarily be performance based since eligible boilers would have to meet minimum standards as required by relevant regulations. While it is not possible to eliminate free ridership, a well-developed tax credit scheme with caps on investment can limit it.

Tax codes and tax guidelines: Implementation of a tax credit scheme will require the development or adaptation of appropriate tax codes, forms, and tax guidelines for SFBs and or equipment manufacturers. Lack of clear guidance on the new tax credit policy and instructions on qualifying for the credits can cause confusion and uncertainty and impact the uptake of a program that is expensive to implement. Equally, it will be important to have clear processes for certifying compliance to qualify for the credits and or rebates. This requires coordinated action by all relevant ministries and stakeholders.

Defined Expiration date and carry forward guidance: A clear expiration date for tax credits is necessary to reduce uncertainty among stakeholders. SFBs will be apprehensive of tax credit schemes that are not well defined in terms of the time period for eligibility. In Poland, the tax credit could be designed to expire in coincidence with the regulatory timeline for compliance with change of boilers. A different expiration date could be considered for any applicable tax credit for thermal retrofits of SFBs, which is not presently required by regulations.

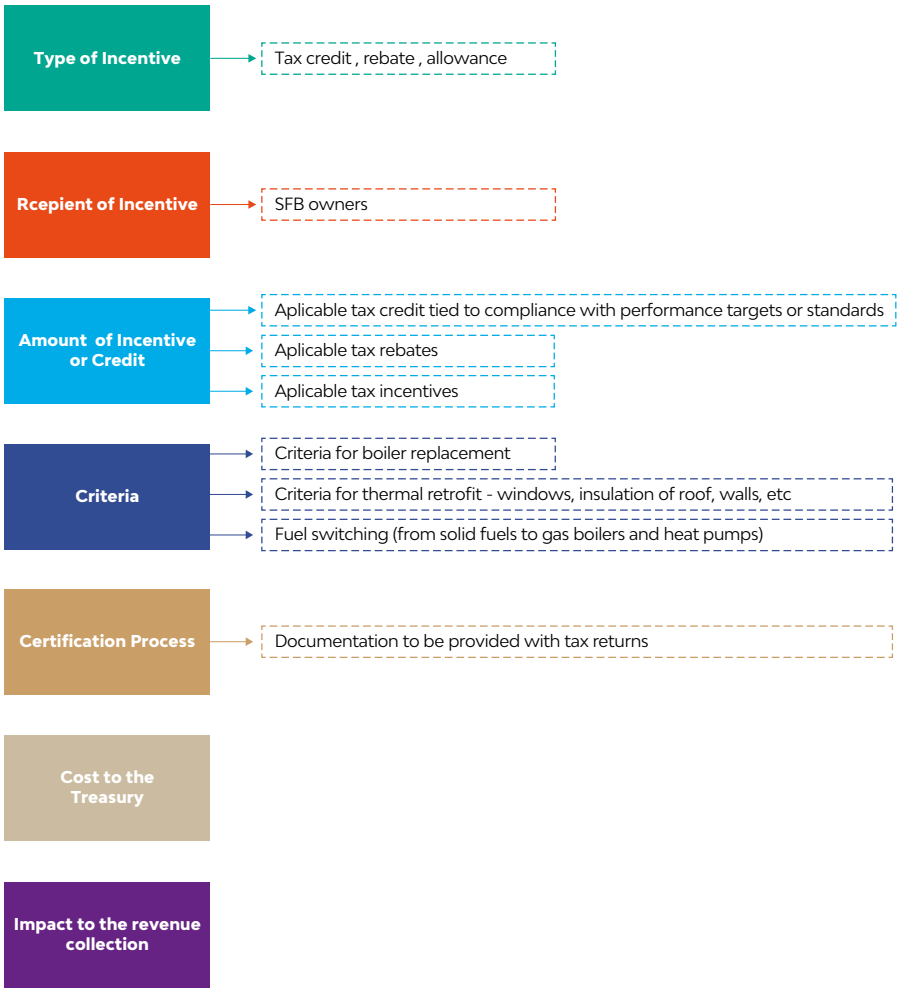
The carry forward period for applicable investments, if applicable, should also be clearly defined since not all SFBs may be able to benefit from tax credits in the year of investment depending on their limits on taking tax credits and deductions.

Monitoring and Reporting of Tax Credit Scheme: Monitoring of the tax credit scheme is relatively simple once a well-designed system is put in place. The tax authorities in Poland would be able to monitor and report the uptake of the tax credit scheme. A key issue to monitor would be the cost to the treasury due to lower revenue collections, which can be limited in a good program.

While monitoring and reporting would be relatively simple, it may not be easy to correlate uptake of the program to the overall objective of achieving change in boiler systems and thermal retrofits. This is principally due to the fact that any market transformation effect would be a result of customer response to multiple schemes including tax credits, financing schemes, subsidies provided, self-financed projects, etc. It would thus not be possible to allocate credit to a specific program to assess its efficacy.

A basic Structure for the Tax Credit Scheme. The basic structure for a tax credit scheme is illustrated in Figure 17.

FIGURE 17.
Structure of a Tax Credit Scheme



Appendix 5 provides examples of tax credits and rebates from some countries.

9.1.4 NEXT STEPS IN THE DEVELOPMENT OF AN EE TAX CREDIT MECHANISM FOR NON-POOR SFBs

The GoP would like to develop a tax credit scheme to especially support non-poor SFBs who may have to depend on commercial financing instruments to replace non-compliant boilers and install thermal insulation. The availability of funds to provide direct subsidies for non-poor SFBs is not clear and tax credits may be the only incentive for making investments. The key next steps in the development of the EE Fund include the following:

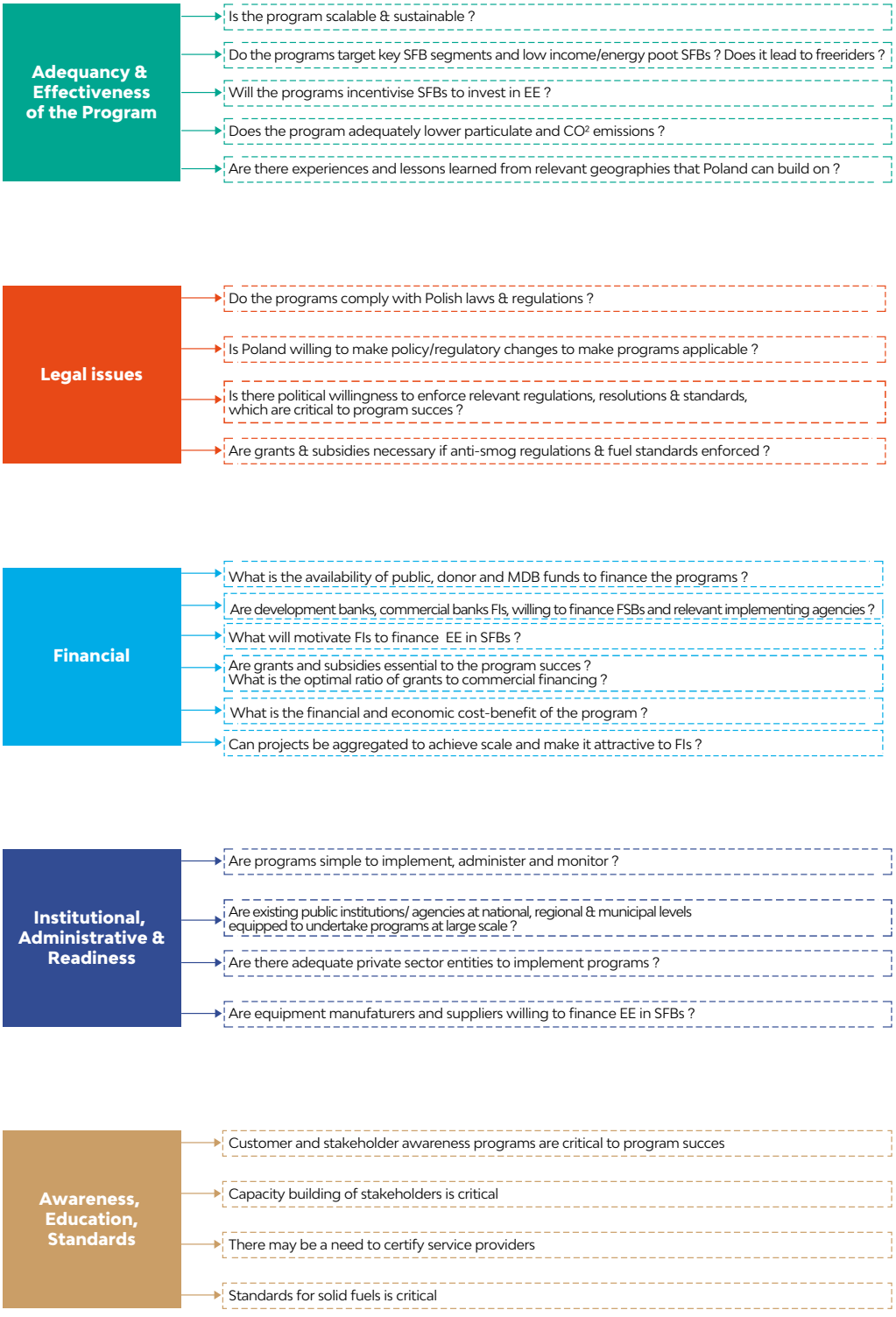
- Discussions with relevant ministries on the viability of structuring a tax credit or rebate scheme in support of incentivizing the implementation of EE measures in SFBs to lower pollution and reduce energy use.
- Discussions with tax experts on the lessons learned from any tax credit schemes that Poland may have offered for EE or other goods or services.
- Discussions with other stakeholders, including customer associations, on the attractiveness of tax credits and rebates.

10. NEXT STEPS

This final report presents the options to reduce air pollution and improve EE in poor and non-poor SFBs in Małopolskie and Śląskie, the 33 most polluted cities in Poland, and SFBs across Poland. The report also estimates the funding required to support poor and non-poor SFBs through a mix of public financial support mechanisms and commercial financial instruments and estimates the reduction in air pollution and energy savings from the program. Detailed descriptions of the structural, operational, and institutional framework to establish a National Anti-Smog and EE Fund(s) to channel public financing as subsidies, develop commercial lines of credit for commercial financing, and offer tax incentives is also provided in the main report. The information in this report builds on an earlier analysis by the WB team and is guided by the suggestions of GoP, EC, participating regions and a broad range of stakeholders.

As a next step, the World Bank team will consult with EC and GoP to define the scope of work for the next phase. Based on the decision of the GoP, an operational framework needs to be developed to support the implementation of programs. The operational framework and implementation plan would provide a comprehensive approach to implementing a program to support poor and non-poor SFBs undertake improvements in heating systems. The next phase also needs to develop the structure of a National Fund, and its operational and implementation mechanisms, to provide subsidies to eligible poor and non-poor SFBs.

APPENDIX 1: CRITERIA TO IDENTIFY FINANCIAL INSTRUMENTS APPLICABLE TO SFBS IN POLAND



APPENDIX 2: DEFINITIONS OF ENERGY POOR HOUSEHOLDS FROM SOME COUNTRIES

Poland:

IBS (Instytut Badań Strukturalnych) of Poland has researched energy poverty and defines energy poor households in two ways:

- Households with monthly expenditure on energy exceeding 13 percent. This principally captures elderly people with small pensions
- Households defined as Low Income High Costs (LIHC), which combines two indicators – low household income (falling below 60 percent of median equated income per household member) and high energy costs (exceeding median equated energy costs). This captures large families with few income earners

IBS estimates that based on threshold of monthly expenditure, 34 percent of Polish citizens are energy poor. And based on the LIHC approach, 17 percent of Polish citizens are poor.

USA:

To provide subsidies under the Low Income Home Energy Assistance Program (LIHEAP) administered by the Human Health Services, the US defines poor households as;

(A) households in which 1 or more individuals are receiving:
- (i) assistance under the State program funded under part A of title IV of the Social Security Act [TANF];
- (ii) supplemental security income payments under title XVI of the Social Security Act;
- (iii) food stamps under the Food Stamp Act 1977; or
- (iv) payments under section 415, 521, 541, or 542 of title 38, United States Code, or under section 306 of the Veterans' and Survivors' Pension Improvement Act of 1978; or

(B) households with incomes which do not exceed the greater of:
- (i) an amount equal to 150 percent of the poverty level for such State; or
- (ii) an amount equal to 60 percent of the State median income;

except that a State may not exclude a household from eligibility in a fiscal year solely on the basis of household income if such income is less than 110 percent of the poverty level for such State, but the State may give priority to those households with the highest home energy costs or needs in relation to household income.

States may choose to set the eligibility lower to serve only the poorest of the poor. Additional requirements may also be used to define poor households. This is done to benefit only those who need the assistance and based on funds available.

Boardman's widely accepted categorization (1991):

a household is defined as fuel poor when it must spend more than 10 per cent of income to ensure adequate energy services)

European Union's working definition of poverty (2007):

Persons, families and groups of persons whose resources (material, cultural and social) are so limited as to exclude them from the minimum acceptable way of life in the Member State to which they belong.

Practical Action: Energy Poverty (2008):

A person is in 'energy poverty' if they do not have access to at least:

(a) the equivalent of 35 kg LPG for cooking per capita per year from liquid and/or gas fuels or from improved supply of solid fuel sources and improved (efficient and clean) cook stoves

AND

(b) 120kWh electricity per capita per year for lighting, access to most basic services (drinking water, communication, improved health services, education improved services and others) plus some added value to local production

An improved energy source for cooking is one which requires less than 4 hours person per week per household to collect fuel, meets the recommendations WHO for air quality (maximum concentration of CO of 30mg/M3 for 24 hours periods and less than 10mg/ M3 for periods 8 hours of exposure), and the overall conversion efficiency in higher than 25 percent

UK:

A household is said to be in fuel poverty if it needs to spend more than 10 percent of its income on fuel to maintain an adequate level of warmth.

France:

'Energy precariousness' based on a household spending more than 10 per cent of its income to meet energy needs.

APPENDIX 3: EXAMPLES OF EE FUNDS

NATIONAL FUNDS FOR GREEN ENERGY FINANCING

Overview: A number of countries have established national funds for financing green energy projects. While some of these funds have partial grant components, they are generally established as revolving funds to assure sustainability. Such green energy revolving funds are special purpose funds established by governments, regulators, and/or donor agencies for financing green energy projects. The experience with such funds indicates that a wide range of financing approaches have been used to deploy the funds. Some funds have been established by donor agencies such as the World Bank. Others have been created by national governments such as in Thailand. In the United States, electricity regulators established Public Benefit Funds using the public benefit charge (PBC) mechanism.

There are many examples of green energy funds. Some of the salient funds are listed below.

Bulgaria Energy Efficiency Fund (BEEF) – Established in Bulgaria in 2005 by the World Bank, GEF and governments of Austria and Bulgaria, BEEF is one of the most successful green energy funds. Its projects included EE improvements in public buildings, industrial processes, street lighting, and heat distribution systems, and off-grid renewable energy. BEEF also successfully supported a number of ESCO projects.

Armenia Renewable resources and Energy Efficiency (R2E2) Fund – Originally established in 2006 (by the World Bank) and modified in 2012 to offer energy service agreements (see Section 4 for details), the R2E2 fund has completed many projects in the public sector, which is generally under-served by other financing mechanisms. Its projects include heat metering and regulation, EE improvement in public and multifamily buildings, and rehabilitation of heating systems. Romania Energy Efficiency Fund – Established by the World Bank and GEF in 2003, this fund was established to help energy users adopt modern technologies for efficient use of energy. Its projects have included replacement of inefficient energy using equipment (such as boilers, motors, pumps, etc.) with energy-efficient equipment, and modernization of process industry equipment and street lighting.

Moldova Energy Efficiency Fund – This fund was established by the Government of Moldova in 2012 under a new Law as an independent and financially autonomous legal entity. The main objective of the Fund is to attract and manage financial resources to finance and implement EE and RE projects. Its projects include thermal insulation, energy management systems, efficient natural gas and biomass boilers, improvement of heating systems efficiency, and solar systems.

Thailand Energy Conservation (ENCON) Fund – The Government of Thailand established the Energy Conservation (ENCON) Fund in 1992, using revenues from a levy on petroleum sales, to foster the expansion of EE and RE projects by mobilizing and leveraging additional investments in mitigation projects. The ENCON Fund was initially available to large-scale industrial and commercial facilities and later opened up to ESCOs and small-to-medium sized enterprises.32

Salix Finance – This organization was established by the U.K. Department of Energy and Climate Change (DECC) as an independent, publicly funded corporation to provide interest-free capital to public institutions. Its projects have included insulation, LED lighting, building energy management systems, cogeneration; and heat recovery systems.

Indian Renewable Energy Development Agency (IREDA) – IREDA was established by the Government of India in 1987 to promote, develop, and extend financial assistance for Renewable Energy and Energy Efficiency projects. It provides project financing, equipment financing, financing for efficient equipment manufacturers, and has financed projects for EE boilers, control systems and lighting, absorption chillers, variable speed drives, cogeneration and industrial process efficiency improvement.

Kerala State Energy Conservation Fund (KSECF) – This Fund was established by the government of the State of Kerala in India. The funding was from the state budget and the financing schemes included energy audit subsidies, interest buy-down for commercial and industrial energy users, EE appliance financing, grants for public sector projects, and a Partial Credit Guarantee Scheme.

Korea Energy Management Corporation (KEMCO) - KEMCO is a public organization responsible for the implementation of energy efficiency, new and renewable energy deployment, and climate change mitigation policies and measures. It was established in 1980 by the Ministry of Commerce, Industry and Energy under the "Rational Energy Utilization Act," and manages the Rational Energy Utilization Fund, which provides long-term and low-interest rate loans along with tax incentives for energy efficiency and conservation investments. KEMCO also offers rebate and incentive programs for high efficiency products.

U.S. Public Benefit Funds – Many states in the U.S. have established funds for EE and end-use RE implementation using the public benefit charge, which is collected as a surcharge on electricity sales. These funds are managed by the utilities, state agencies or independent third parties to implement a wide range of green energy programs.

FUND OF FUNDS

A "fund of funds" (FOF) is an investment strategy of holding a portfolio of other investment funds rather than investing directly in stocks, bonds or projects. A fund of funds may be "fettered", meaning that it invests only in funds managed by the same investment company, or "unfettered", meaning that it can invest in external funds run by other managers. There are different types of FOF, many of which invest in other funds (such as mutual funds) as a diversification strategy. The best example of a FOF in the green energy field is GEEREF.

Global Energy Efficiency and Renewable Energy Fund (GEEREF): GEEREF is a public private partnership (PPP) set up by the European Commission, Germany, and Norway in 2008 to maximize the leverage of public funds. Structured as a 'Fund-of-Funds', GEEREF invests in private equity funds that provide equity finance to small and medium-sized project developers and enterprises. The USD 169.5 million pledged to the GEEREF is administered by the European Investment Bank.

GEEREF invests exclusively in emerging markets outside the EU and particularly focuses on serving the needs of the ACP, which is a group of 79 African, Caribbean and Pacific developing countries. It also invests in Latin America, Asia and neighboring states of the EU (except for Candidate Countries). Priority is given to investment in countries with policies and regulatory frameworks on energy efficiency and renewable energy.

Public Venture Capital Funds

India - Venture Capital Fund for Energy Efficiency: The Venture Capital Fund for Energy Efficiency (VCFEE), established by the Bureau of Energy Efficiency (BEE) in India, is one of the financial instruments under the Framework for Energy Efficient Economic Development of the National Mission for Enhanced Energy Efficiency (NMEEE). The VCFEE provides risk capital support to green energy investments in new technologies, goods and services.

Thailand ESCO Fund: Thailand established the ESCO Fund in 2008 because the financing from the ENCON Fund was not being provided to developers of small energy efficiency and renewable energy projects and to ESCOs.

The ESCO Fund provides capital and technical assistance for clean energy, renewable energy, energy efficiency, and building retrofit projects. It was organized into two phases (2008-2010 and 2011-2012), each funded by an ENCON grant at a value of USD 16.3 million. The fund is managed by the government-appointed non-profit Energy Conservation Foundation of Thailand and Energy for Environment Foundation.

California Clean Energy Fund (CalCEF): California Clean Energy Fund is a private equity and venture capital firm specializing in direct and fund of funds investments. The firm invests in early stage and seed/startup companies. It seeks to invest in private clean energy and transformational clean technology companies focused on low carbon transportation, green building, cleaner fossil fuel, solar, energy efficiency, lighting sector, energy storage, products and services including software, renewable generation, power and communication transmission lines, electric power distribution, demand-side management, and all forms of power including demand and supply side options. It seeks to invest in California and prefers to invest a maximum amount of equity investment of USD 0.5 million.

APPENDIX 4: EXAMPLES OF EE LINES OF CREDIT

World Bank EE Credit Lines in Europe and Central Asia (ECA)

COUNTRY	EE FINANCING SCHEME	$ AMOUNT	TYPE OF INSTRUMENT	IMPLEMENTING INSTITUTIONS	TA
Turkey	Turkey SME Energy Efficiency Project	$201.00 M	Credit Lines	ALK BANK; VAKIF Band; ZIRAAT Bank	Yes
Ukraine	Ukraine –Energy Efficiency Project	$200.00 M	Credit Lines	UKREXIMBANK	Yes
Uzbekistan	Uzbekistan Energy Efficiency Facility For Industrial Enterprises	$125.00 M	Credit Lines	Ministry of Economy and Participating Banks	Yes
Russia	Russia - Energy Efficiency Project		Credit Lines		

Sustainable Energy Financing Facility (SEFF)

The EBRD's Sustainable Energy Financing Facility (SEFF) is a credit line made available to partner banks in member countries for financing EE improvements, at their own risk, in commercial and industrial enterprises and, in some countries, in residential buildings. The SEFF is supported by a comprehensive technical assistance (TA) package under which each loan applicant receives free TA from a team of consultants. Each country has its own tailored approach reflective of local requirements and energy savings needs. The dedicated country TA teams, comprising international and local consultants, support interested companies and borrowers in identifying the best technical solutions for their energy savings requirements, preparing suitable loan documentation, and providing assistance through the application process. The teams also help familiarize local partner bank loan officers with sustainable energy investment opportunities.

Since launching the first SEFF in Bulgaria in 2004, the EBRD has committed almost USD 1.7 billion of commercial funding to 15 facilities in 12 countries. The Slovak Republic is a typical example. The Slovak SEFF (SlovSEFF) program was launched in 2007 when the EBRD provided EUR 60 million (about USD 78 million) through four partner banks to encourage Slovak enterprises to make better use of energy resources. To respond to the high demand, the EBRD extended another EUR 90 million (about USD 117 million) in 2010. By the end of 2011, the EBRD had financed more than 350 sustainable energy projects in the residential and industrial sectors under this facility.

China Energy Efficiency Financing (CHEEF) Project

In the CHEEF project, the WB provided a line of credit for EE project financing to three banks in China—China EXIM Bank, Minsheng Bank, and Huaxia Bank5—that were selected to be the participating lenders. The line of credit was structured as a financial intermediary lending operation with a sovereign guarantee provided by the government of China.[31] The WB loan product for the project was a London Interbank Offer Rate (LIBOR)-based, USD-denominated, single currency, variable-spread loan at USD100 million (for each of the three banks), to be repaid in 17.5 years, including a grace period of five years. The WB funds were on-lent by the Ministry of Finance to the three banks at the same financial terms and conditions and were in turn loaned by the banks to industrial enterprises and energy service companies (ESCOs) for EE investment subprojects at market rates. The participating banks are fully responsible for debt servicing and for bearing all financial risks associated with the WB loan.

[31] Ministry of Finance, World Bank 2008, 2010c

The WB required the banks to co-invest at least USD 100 million in EE projects. The WB project was supported by a Global Environment Facility (GEF) grant to provide TA. As a result, the project has disbursed USD 115 million in International Bank for Reconstruction and Development (IBRD) funds, which leveraged USD 462 million from participating banks and industrial enterprises, with a leverage ratio of 1:4. These investments are expected to save 1.7 million tons of coal equivalent and reduce CO_2 emissions by 4.2 million tons per year.

Thailand Energy Efficiency Revolving Fund

Thailand's Energy Efficiency Revolving Fund (EERF) was established by the government of Thailand to stimulate and leverage commercial financing for EE projects and help commercial banks develop streamlined procedures for project appraisal and loan disbursement. The source of the government funds was the Energy Conservation (ENCON) Fund managed by the Department of Alternative Energy Development and Efficiency (DEDE), the original fund created under

Thailand's Energy Conservation Promotion Act of 1992. The EERF provides capital to Thai banks to fund EE projects, and the banks provide low interest loans to EE projects in industries and buildings.

Phase I of the EERF was launched in 2003 as a three-year program and was renewed for two additional three-year terms. It has been working with 11 participating banks. By April 2010, the EERF had financed 335 EE projects and 112 renewable energy projects. The total investment in these projects was USD 453 million, with an average leverage ratio of about 1:1 from the ENCON Fund investments. The estimated annual energy cost savings were USD 154 million, providing an average payback of about three years. The leverage ratio increased to about 2:1 as participating banks became more familiar with and confident in EE and renewable energy projects, and thus more willing to take risks.

KfW SME Credit Line

The KfW of Germany has provided a dedicated credit line of EUR 50 million (about USD 65 million) to the Small Industries Development Bank of India (SIDBI) to finance EE projects in micro, small, and medium enterprises (MSMEs) in India. The main purpose of this credit line is to provide SIDBI the capacity to encourage MSMEs to undertake energy saving investments in plant and machinery and production processes. KfW also provided a TA component to support SIDBI to identify key target MSME clusters, set up the credit lines, provide technical support, and conduct awareness campaigns in MSME clusters throughout India. The overall objective of the program is to reduce the emission of GHGs, especially CO_2, and thus to contribute to climate change mitigation. Specifically, the program seeks to (a) increase MSME investments in EE, (b) increase the contribution of MSME to ecologically sustainable economic development, and (c) broaden SIDBI's financial instruments (KfW and SIDBI 2010).

APPENDIX 5: EXAMPLES OF TAX CREDITS, INCENTIVES, AND REBATE SCHEMES

France Tax Credit for EE Materials and RES and VAT reduction for EE

In France, the "Tax Credit for EE Materials and RES," program came into force in 2005. The tax credits (15–40 percent) applied to the purchase price of efficient boilers, insulation, heating regulators, and the use of RE systems. Provisional results for 2005 showed substantial increases in single unit sales compared to 2004, in particular for solar water heating, combined solar systems, wood-fired boilers, and condensation boilers. Tax credits were seen to have revitalized the market for energy-saving equipment. The market size in 2006 was estimated at EUR 3–4 billion.

Also, there are several regulations in force in France that allow reduced VAT for EE measures (GreenMax Capital Advisors 2009). The first, introduced in 1999, reduced the tax from 20.6 percent to 5.5 percent for refurbishment of dwellings older than two years. Results from a 2002 study revealed that 61 percent of households that invested in EE benefited from this VAT reduction. In total, seven percent of France's 25 million households have invested in home restorations, with an average investment of EUR2,640 per household. Estimated CO_2 reductions amounted to 0.6 t/household, or 1 MT of CO_2 in total for 2002.

Preferential Tax Programs— Shanghai Building Owners or Property Management Companies for Building Retrofit

Property tax during the period that business is interrupted during the retrofits is reduced if a building retrofit project meets the standard for major maintenance after it is certified by Changning District tax bureau. Property tax during the business-interruption period shall be returned if a building retrofit project cannot meet the standard. In addition, according to the Notice on Promoting Energy Conservation Service Industry through Value Added Tax (VAT), Business Tax, and Enterprise Income Tax Policies, preferential tax policies shall be implemented to ESCOs, or building owners/property managers who use ESCOs for building retrofit.

The United States, GasNetworks Home Heating System Rebate

GasNetworks, a collaborative representing natural gas companies in Massachusetts with an objective to promote EE and use of high-efficiency gas technologies in New England, runs a 2016 cash-back program on behalf of its members. Residential customers of one of the represented utilities can apply for home heating system rebates upon purchase of eligible high-efficiency equipment and its installation by a licensed heating contractor or plumber.

The eligibility criteria place the minimum requirement for participation in the rebate. Anyone listed as a Massachusetts customer of one of the five participating natural gas utilities—Blackstone Gas, Columbia Gas of Massachusetts, Eversource, Liberty Utilities, and National Grid—can apply for the refund.

The program guidelines define the process for claiming the refund, qualifying equipment, and installation-related requirements. To qualify for the rebate, the products must have the prescribed annual fuel utilization efficiency (AFUE) rating, set to ensure compliance with the highest EE standards, while the installations must be performed by a licensed contractor and adhere to applicable codes. The essential rebate information about GasNetworks home heating system rebate is summarized in following table.

TABLE.
Gas Networks Home Heating System Rebate

NEW EQUIPMENT	AFUE RATING	REBATE (UP TO, IN USD)
Furnace (equipped with an electronically commutated motor)	97 percent or greater	600
Furnace (equipped with an electronically commutated motor)	95 percent or greater	300
Boiler (forced hot water system)	95 percent or greater	1,500
Boiler (forced hot water system)	90 percent or greater	1,000
Condensing boiler with on-demand DHW	95 percent or greater	1,600
Condensing boiler with on-demand DHW	90 percent or greater	1,200
Heat recovery ventilator	n.a.	500
After-market boiler reset controls*	n.a.	225

The rebate applies to both the cost of equipment and its installation. The amount of rebate credit may not exceed the cost of equipment, fifty percent of the total cost of equipment and the installation, or USD 100,000 amount per project.

The rebate applications are screened for adherence to the guidelines and are approved within two months from receipt of the application. GasNetworks may perform random house inspections to verify that the purchased equipment has been installed according to the guidelines at the customer premises at the address listed with the utility and that the equipment is operational. If the house is selected for an on-site verification, the company agents will conduct the visit before honoring the rebate. The terms and conditions of the rebate place no restrictions or obligations on the customer once the rebate is redeemed.

Subsidy Programs—The Czech Green Savings Program

The Green Savings Program was initiated by the Czech Ministry of Environment and was implemented from 2009 to 2012. The program provided support for heating installations utilizing renewable energy (RE) sources as well as investments in energy savings in renovated and new buildings. Both single-family houses and multi-family apartment buildings were eligible; EE and RE measures included insulation, biomass boilers, heat pumps, and solar thermal collectors, as well as new passive energy houses.

Funds for the program were generated from the sale of emission credits under the Kyoto Protocol, and these funds were used towards the purchase of some of the EE/RE equipment. Support was given for select combination of measures. The amount of subsidies paid under this program amounted to EUR 710 million. The average subsidy amounted on average to 67 percent. About two-thirds of the energy savings came from apartment buildings, while the rest came from single-family buildings.[32]

An important feature of the program was that product and service providers had to be certified, which was critical in ensuring the quality of measures implemented. While this restriction did result in a slow rollout early on, the program was able to substantially increase its pace and be successful.

[32] M. Valentinovy, "The Green Investment Scheme in the Czech Republic – Green Savings Programme."

Estimated benefits of the program included the following:[33]

- Reduction of CO_2: 1,100,000 t/yr (2008-2013)
- Reduction of local dust pollution: 2,200 t/yr (2008-2013)
- Energy savings in heating: 6.3 PJ
- Increase in heat generation from RE sources: + 3.7 PJ
- Creation or retention of 30,000 jobs
- Reduced dependence on energy imports, emissions of other local pollutants (SO_2, NOx)

The program was revised in 2013. The subsidy was reduced to 25 percent and a minimum energy savings of 40 percent was required. If the reduction was at least 60 percent, the subsidy was increased to 50 percent. Because these subsidies are being financed by the sale of European Union Allowances (EUA), the total funding of the program is not fixed.

The Polish Thermo Modernization Fund – Grant program

The Thermo Modernization Fund, established by the Polish government in 1999, aims at refurbishing the existing building stock in both public and residential buildings. The program was sponsored by the state-owned Bank of National Economy (BGK) and the Ministries of Finance and Infrastructure.

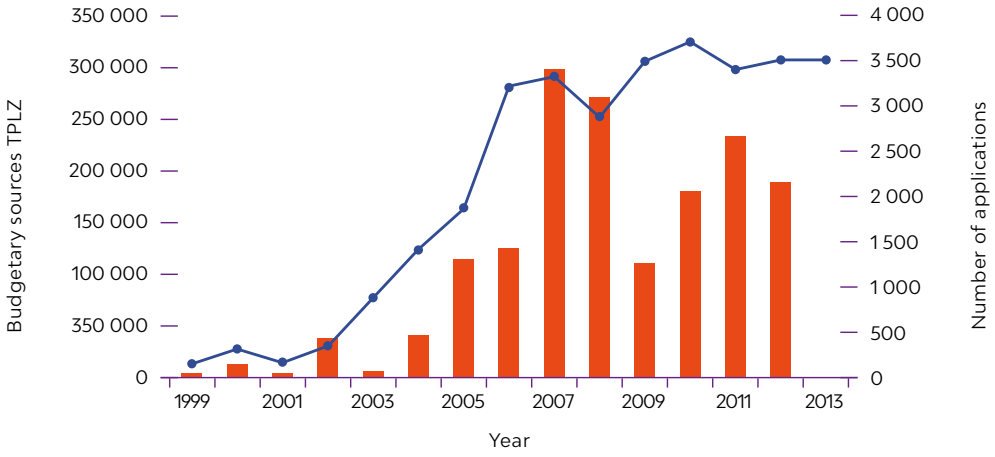
Eligible investments had to meet certain technical and financial criteria, which had to be verified by an energy audit and financial analysis. The energy savings had to amount to at least 25 percent for a comprehensive building refurbishment. In the case of a modernization of indoor heating or local heating systems, as well as DH systems, this figure had to be at least 10 percent, and in the case of refurbishment of buildings constructed before 1961, the threshold was 10 percent.

Individual projects were usually financed by a loan amount of up to 80 percent of the total project costs. Provided that the loan (plus interest) could be repaid within 10 years (the maximum term of the loan), the BGK could offer a grant bonus of up to 25 percent.

Until mid-2002 the Thermo Modernization Fund was not very successful. This was mainly due to complicated application procedures (for housing cooperatives, for example) and high interest rates (up to 30 percent). From 2003 on, after the conditions had been relaxed and promotional activities were implemented, the number of applications increased significantly (see below figure 1). Unfortunately, the fund's resources were not sufficient to meet this growing demand. In terms of applications, 40 percent came from HOAs, 40 percent from housing cooperatives, 7 percent from single-family homeowners, and 13 percent from others. By 2013, the program was opera well with a budget of about EUR 37 million. While the program remains under implementation, no budget for incentives was allocated for 2014.

[33] Pavel Zámyslický, "Contribution of the GIS to low carbon development in the Czech Republic" (Ministry of Environment of the Czech Republic, n.d.).

FIGURE.
Polish Thermo Modernization Fund – Grant program



Source: Rajkiewicz 2013. TPLZ = Thousand Polish zloty (TPLN).

CASE STUDY 6: SUBSIDY PROGRAMS— SHANGHAI SUPPORT TO BUILDING OWNERS AND PROPERTY MANAGERS FOR BUILDING RETROFIT

As an Integrated Building Retrofit Project, the government shall provide 20 percent subsidy of the actual building retrofit investments, with a ceiling of no more than 2 million RMB for a single building. The subsidy shall be 50 percent of the difference between non-depreciation values of the equipment and actual retained values. Further, the newly released Special Fund for Changning District provides subsidies for energy efficiency retrofit projects based on energy saved. The Fund provides RMB 1000/TCE saved to projects for which energy saving can reach more than 50 TCE or equivalent CO_2 emission reduction. And, if the building performance gets improved significantly through the project, the subsidy will cover 25 percent of EE retrofit investment.

Also, existing buildings related to boiler, elevator energy conservation retrofit, window, door, shading, air conditioner system and lighting system shall be subsidized according to the energy saving rate, with a certain rate of the whole investment. The subsidy amount is reviewed by District DRC and related agencies and requires approval from the District Government.

If the business interruption period caused by comprehensive building retrofit is over six months, Changning District shall provide a certain amount of subsidy to compensate for rental loss caused by building retrofit. The Changning District Special Fund will also provide the subsidy of 30 percent of the total rental cost loss if the retrofit takes six months or more, to compensate the interrupted operation due to a retrofit. The subsidy ceiling is RMB 1 million per project.

However, for building retrofit projects that do not reach the intended targets, the subsidy shall be deducted by a certain percentage according to actual investment.

CASE STUDY 7: SUBSIDY PROGRAMS— KfW PROGRAMMES BUILD OR MODERNIZE THREE MILLION HOMES[34]

The government's CO_2 Building Rehabilitation Programme was initiated in 2006, and three million homes were subsidized as of July 5th, 2013. With the promotional funds from the CO_2 Building Rehabilitation Programme with the Federal Minister of Transport, Building and Urban Development (BMVBS), the KfW Group, the Kreissparkasse München Starnberg Ebersberg savings bank and BayernLB, they are supporting measures to save energy and to protect the climate in the building sector. The tenants or owners of three million homes are saving considerable energy costs as a result of the subsidy schemes. Since 2006, KfW has provided more than EUR 50 billion in loans and subsidies within the context of various programmes to promote energy-related modernization and energy-efficient new buildings. To date, three million homes have been modernized in order to reduce their energy consumption or built to be energy efficient.

CASE STUDY 8: FUEL USAGE IN IRELAND

In response to several bouts of severe coal-related winter smog, the Dublin government implemented Dublin's "smoky coal ban" in 1990, which drove a rapid expansion in the consumption of natural gas for residential use (especially for home heating), as well as commercial and transportation use. By 2009, Dublin's air quality had improved dramatically according to the European Green City index that ranked Dublin 21 out of 30 leading European cities.

Dublin initiated its air quality improvement efforts in 1990 with the prohibition of the sale, marketing, and distribution of bituminous coal, which was eventually extended to ban the home burning of bituminous coal altogether in 2012. These measures succeeded in significantly reducing benzene, carbon monoxide, SO_x, and smog levels, with particulate matter concentrations falling 80-90 percent from 1990 to 2014.

Dublin's success encouraged twenty-nine other cities and towns to introduce similar legislation between 1990 and 2013, including a further tightening of the legislation banning the burning of bituminous coal. Similar results throughout Ireland drove the government to issue a nationwide ban on bituminous coal burning in 2015, which is set to take effect in 2018. This expansion is expected to see monetary benefits reaching upwards of USD 57 million per year.

Importantly, political opposition to the ban has been low, allowing for relatively smooth passage and implementation. The population has been largely supportive due to the noticeable improvements in air quality and health, while the lack of an established coal mining industry meant that there was no labor force to bear the brunt of curtailed coal demand. Irish distributors and consumers are able to source increased supplies from British pipeline gas fed from the Scotland interconnector, which, in turn, is connected to Europe's most liquid gas market. Looking ahead, domestic gas production from Shell's Corrib field, located off the north west coast of Ireland, is projected to meet between 40-60 percent of Ireland's annual gas demand after ramp-up.[35]

[34] KfW webpage (https://www.kfw.de/KfW-Group/Newsroom/Aktuelles/Pressemitteilungen/Pressemitteilungen-Details_144064.html)
[35] IGU. Case Studies in Improving Urban Air Quality. http://www.igu.org/sites/default/files/IGU_Urban_Air_Quality%20Report%20 2016_1711.pdf