



Ethiopian Energy Authority

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December 2014

Methodologies and Key results of the project:

“Demand Side Management for
Climate Change Adaptation for
the Ethiopian Power Sector”.

The project was implemented between october 2010 and october 2012

The main implementation partners were:

- Nordic climate facility(NCF):Fund owner
- Ethiopian Energy Authority: as power sector regulator and responsible for customer communication, metering installation with EEU, meter reading and data collection.
- HIFAB OY: as the lead consultant
- Ethiopian society of electrical engineer :as local partner

Methodologies of The Project

- In this study three types of data collection and analysis were carried out.
 1. **Historical Electricity use**: 1 year monthly electricity consumption of tens of thousands of customer.
 2. **Customer surveys**: end-user Equipement consumption profile.
 - for metered customers
 - for large sample customers

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3. Special Measurements at Selected customers:

- The project used 50 single-phase(for residential) and 50 three- phase meters(for commercial and industrial).
- The total number of the half-hourly measured residential customer was about 127.
- For non-residential:130 customer data of one month period were collected.
- The analysis was made by using special software called USELOAD.

Proposed actions and results of the project

➤ Electricity consumption scenario for Ethiopia

- From historical data(in 2006/2007-2010/11), the annual growth have been in domestic sector 8.5%, in commercial 7.6%, in LV industry 11% and in HV industry 7.4%.If the same load growth are used also for the next 10 years the consumption scenario looks like as follows .

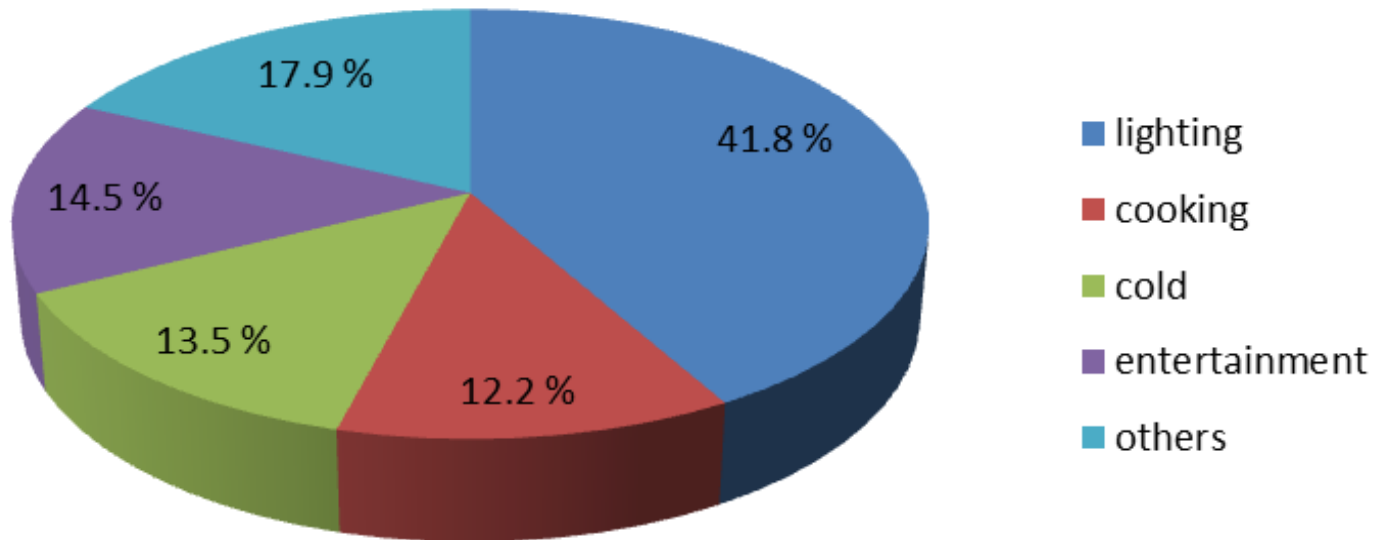
Consumption scenario in Ethiopia during the next 10 years

Gwh/a	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Domestic	1597	1733	1880	2040	2213	2402	2606	2827	3067	3328	3611
commercial	1011	1088	1171	1260	1356	1459	1570	1689	1817	1955	2104
Industry LV	881	978	1086	1205	1338	1485	1648	1830	2031	2255	2502
Industry HV	644	692	743	798	857	921	989	1062	1141	1225	1316

Energy saving potential

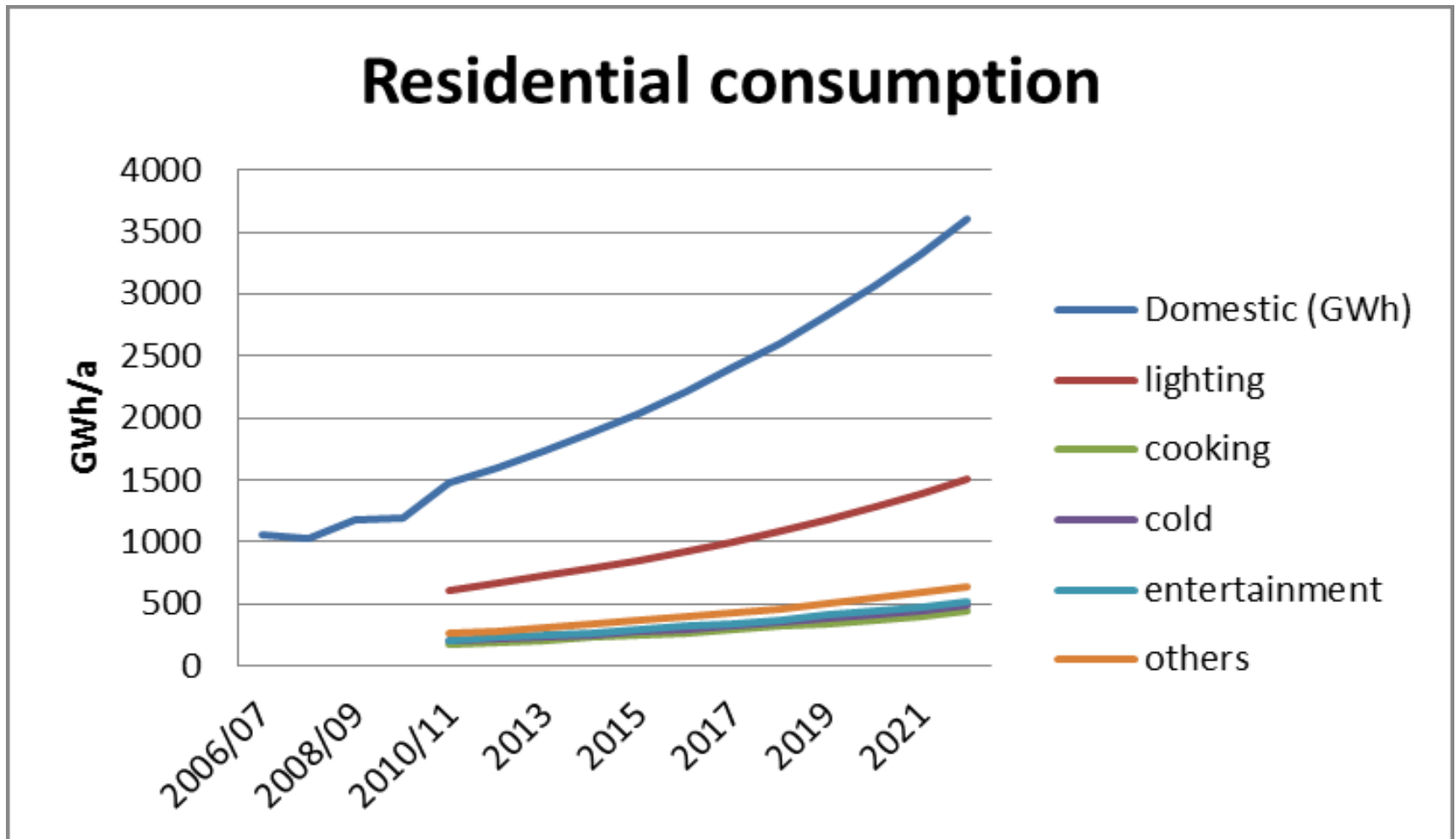
RESIDENTIAL

- On the basis of the interviews, the rough shares of end users were defined



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- Consumption in residential sector and in different end-use segments up to 2021



- On the basis of questionnaires and customer metering, the main DSM potential in residential sectors can be found from lighting, cooking and cold appliances. The main actions related to these were defined by the project group as follows
 - all incandescent lamps are replaced by CFLs in 10 years
 - all big (over 3000 W) injera baking stoves are replaced by more efficient 1500 W stoves.
 - labeling of cold appliances results in new appliances in the saving of 100 kWh/appliance

Estimated energy savings in residential sector

Saving in GWh/a	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
In residential sector										
All incandescent changed	59.3	118.7	178	237	296.7	356	415.4	474.8	534.1	593.5
Injera stove>300w to 150 w	8.8	17.5	26.3	35	43.8	52.6	61.3	70.1	78.8	87.6
Labeling with new cold equipment	5.8	11.6	17.4	23	29.1	34.9	40.7	46.5	52.3	58.1
Total in residential	73.9	147.8	221.8	295.7	369.6	443.5	517.4	591.4	665.3	739.2
Saving in% of total residential consumption	4.3%	7.9%	10.9%	13.4%	15.4%	17%	18.3%	19.3%	20%	20.5%

Savings in industrial and commercial sector

- The main proposed action for significant energy saving in these sectors is Energy Audit.
- The estimation of saving is based on similar action in Finland since 1992.
- In 15 years(1992-2007) saving due to energy audit was: 2.6% annual saving in industry,1.2% in commercial and public sector .In Ethiopia the saving is 50% higher, that means 3.9 and 1.8% in industry and commercial sectors respectively in 2022.
- The next table shows annual savings assuming that 10% saving each year from 2022 saving.

Estimated Energy Saving in Commercial and industrial sector on the basis of energy Audit

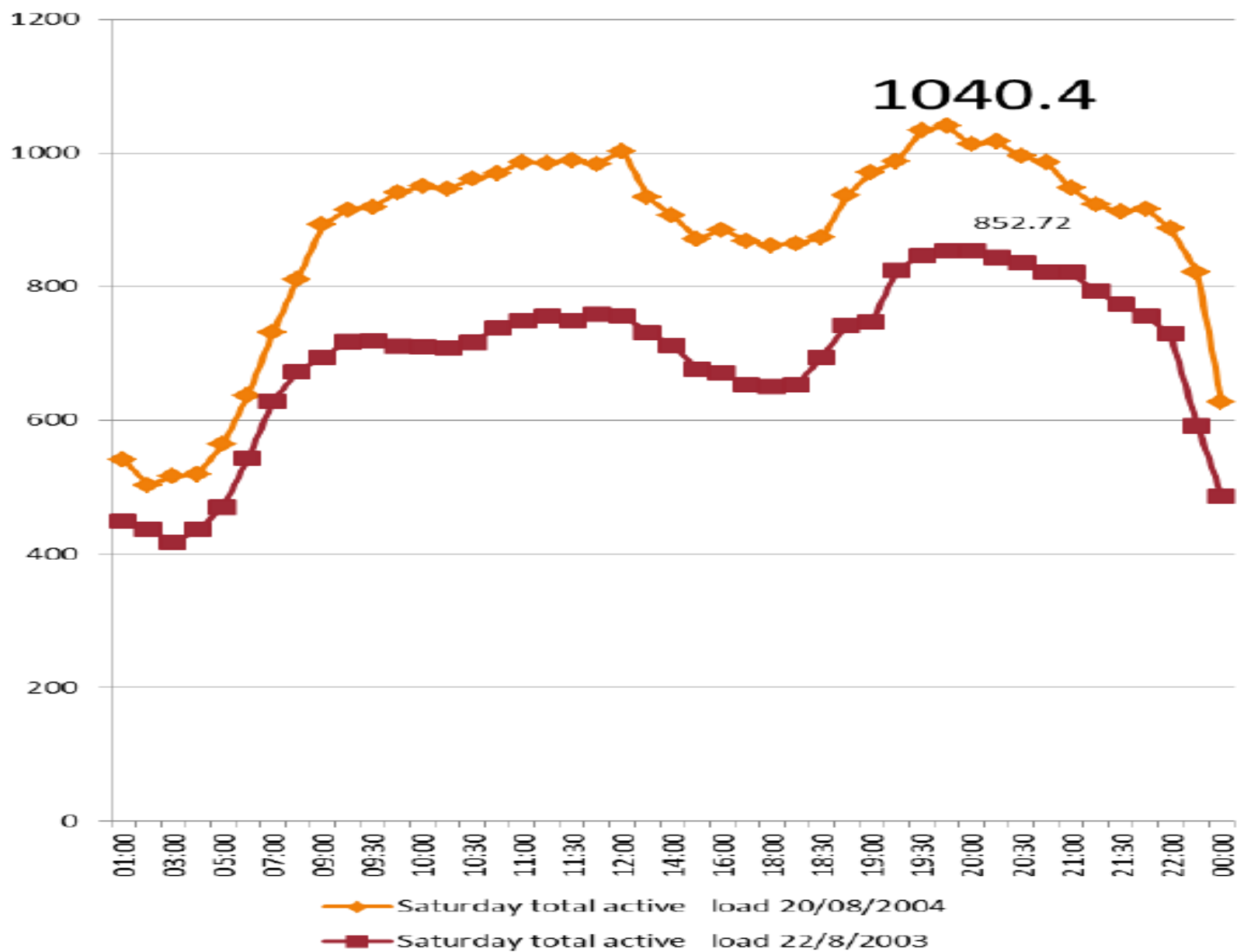
Energy savings in GWh/a	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
In industry	15	30.1	45.1	60.1	75.2	90.2	105.2	120.3	135.3	150
In commercial sector	3.8	7.7	11.5	15.3	19.2	23.0	26.8	30.7	34.5	38.4
Total industrial and commercial	18.9	37.7	56.6	75.5	94.4	113.2	132.1	151.0	169.8	189
Savings in % from total ind. and comm.	0.7%	1.3%	1.7%	2.1%	2.4%	2.7%	2.9%	3.0%	3.1%	3.2%

Total Estimated saving Based on DSM action in next 10 years

Saving in GWH/a	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total in Residential	74	148	222	296	370	444	517	591	665	739
Total in commercial and industrial	19	38	57	75	94	113	132	151	170	189
Total savings	93	186	278	371	464	557	650	742	835	928
Toatal savings in % of total generation	1.6%	3.0%	4.2%	5.1%	5.9%	6.5%	7.0%	7.3%	7.6%	7.7%

Peak load reduction Potential

- The ntk loss in ethiopia is very high in average (over 20%) and during peak hour considerably higher. So peak load reduction decreases the loss
- The following figure shows load curve for Saturday.
- The working day load curve is probably Very similar having two peak load period: the first at noon 11am-2pm and the other in the evening 7-9pm. This means that DSM actions aiming to reduce peak loads have to be allocated to these periods.



The two main actions to reduce the peak loads are:

1. Use energy saving methods in appliances which are in use during the peaks

➤ **Lightings**: according to the interview average use time of lamps is 5.2 hour/day. Average evening peak reduction is
 $593.5 \text{ GWH} / 1900 \text{ h} = 312 \text{ MW}$

➤ **Injera baking stoves**: The estimated energy saving in the year 2022 is about 87.6 GWH. If it is estimated that half of it is obtained during peak, $43.8 \text{ GWH} / 365 \text{ h} = 120 \text{ MW}$

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- Estimated saving from cold appliances in year 2022 is about 58GWH.

Resulting in reduction of $58\text{GWH}/8760\text{h}=6.6\text{MW}$

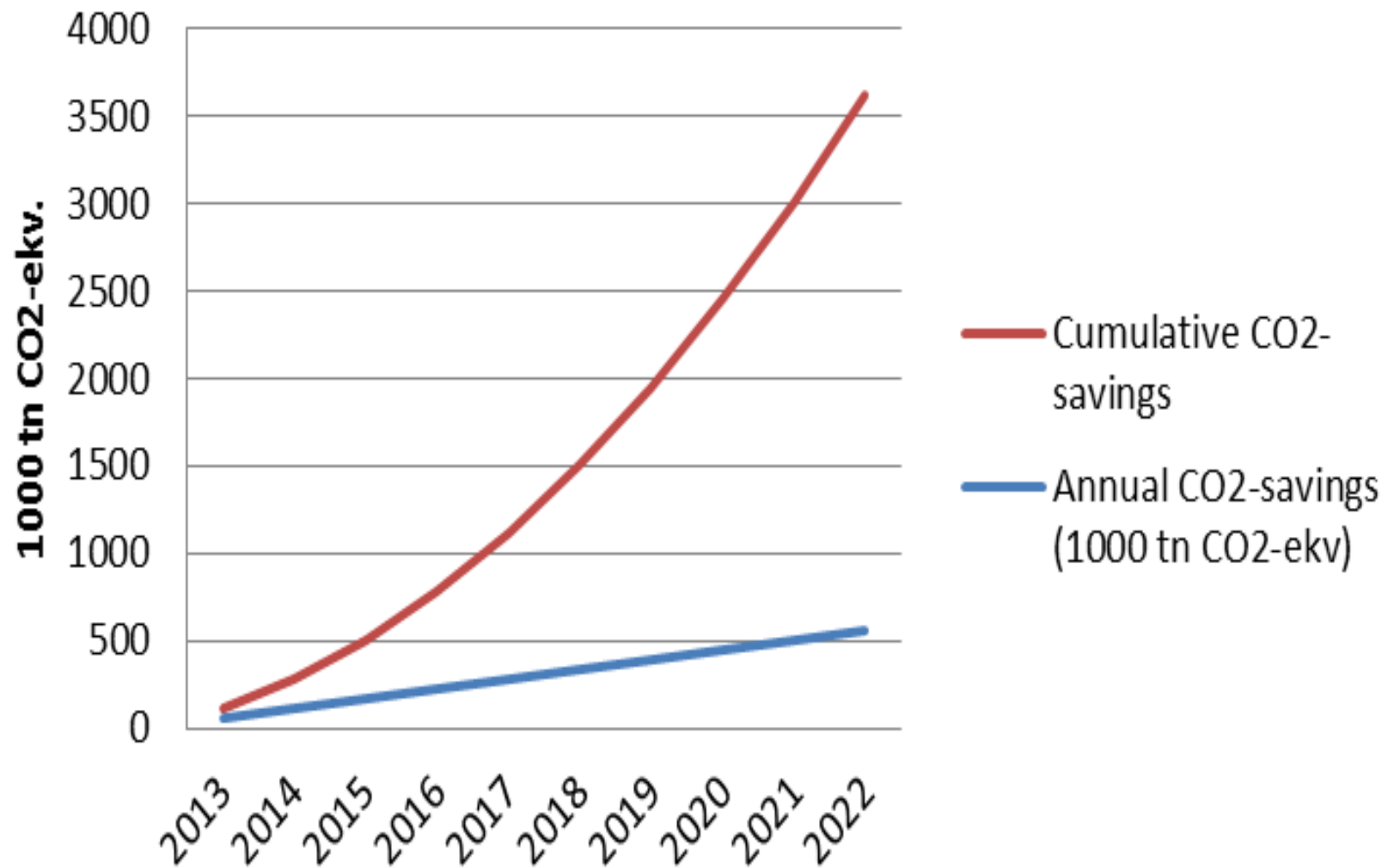
2. Peak load reduction through specific demand response action:

- Price based action like time of use(TOU) pricing
- Contract-based action like direct load control

CO2 savings

- Electricity generation in ethiopia is based on hydro.The savings does not heavily decrease CO2 emmission.
- The following table shows the annual CO2 savings based on the estimated energy savings assuming that the saved energy is exported to the neighboring countries.

Annual and cumulative CO2-savings



THANK YOU