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Sustainable Energy Future for Uzbekistan: Lectures on Energy Efficiency in Buildings

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Integrating RE solutions in buildings: the case of rooftop solar

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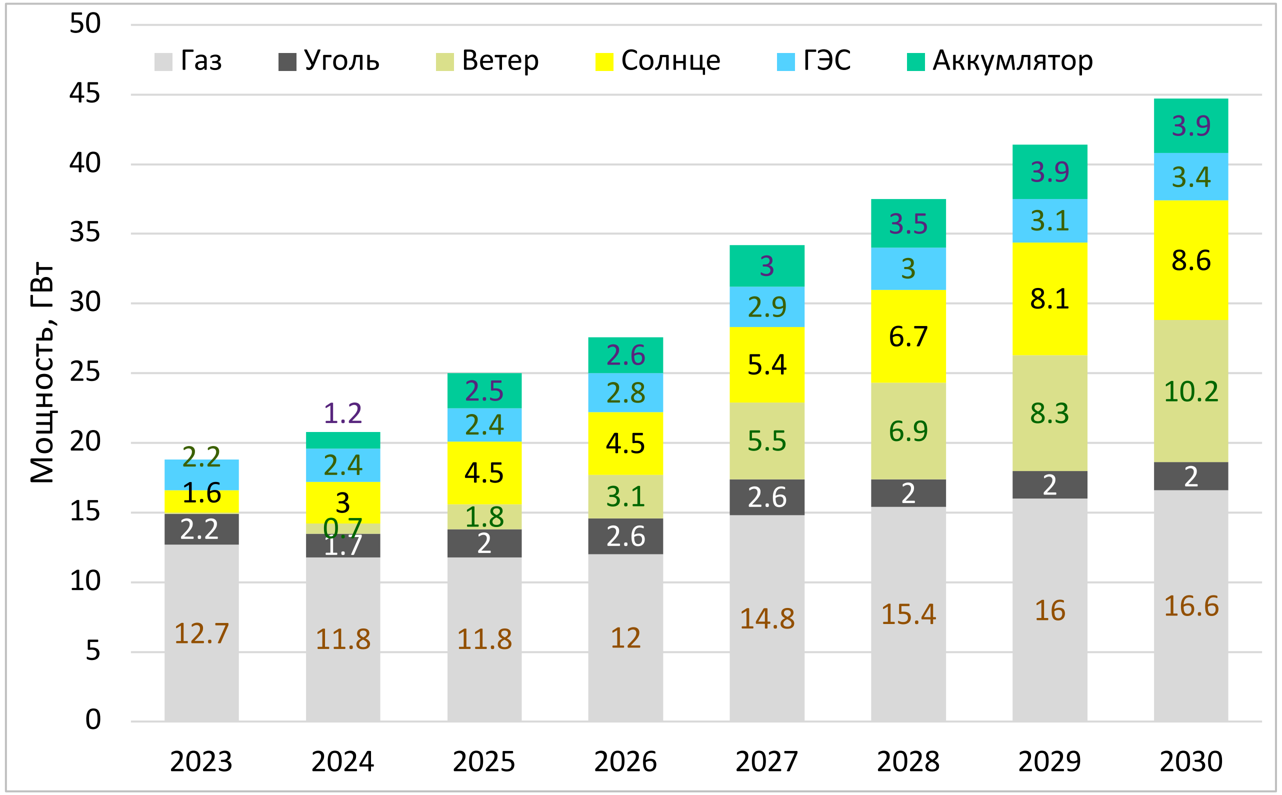
Renewable energy (RE) plans and targets in Uzbekistan

Growth of RE share in Uzbekistan



Source: Ministry of Energy of the Republic of Uzbekistan

- Uzbekistan has ambitious RE plans and targets
- National RE target:
  - More than 25 GW installed capacity
  - or 40% RE in generation mix by 2030
- Plan to reach 4.5 GW of solar in 2025
- This solar capacity increase is driven by 17 large-scale (100-300 MW and one 1000 MW) projects

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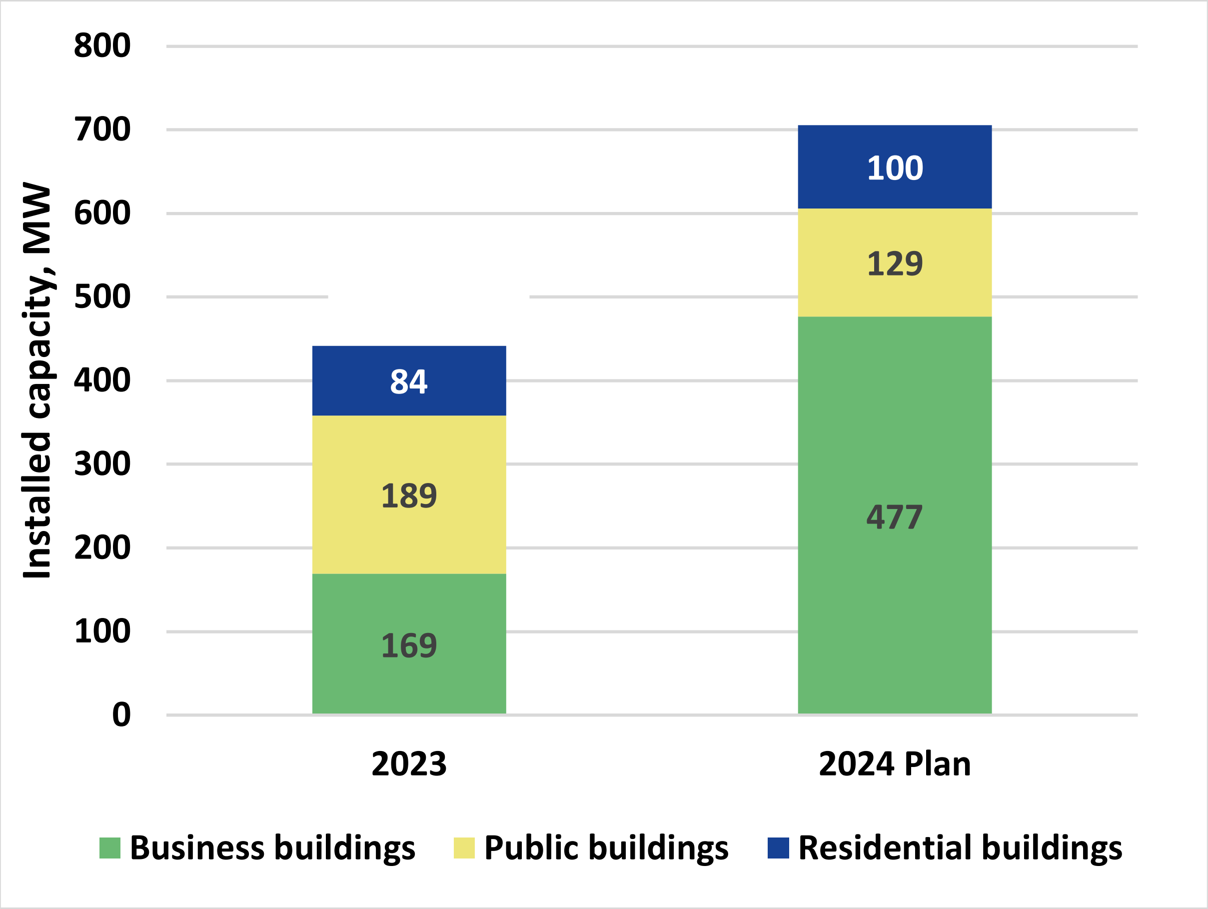
Small-scale and rooftop solar implementation in Uzbekistan

Deployment of small-scale solar in Uzbekistan



Source: Ministry of Energy of the Republic of Uzbekistan

- Push for RTS and small-scale solar initiated by Presidential Decree of 16 February 2023
- Set short-term target of 1750 MW of RTS and small-scale solar
- Support programs:
  - “Солнечный дом” (<50 kW solar for households) – 45 MW contracted by Aug 2024
  - Platform “Зеленая Энергия” (RTS on social and public buildings) – installation of 100 MW planned by end of 2024
- Impressive start and solid RTS deployment results achieved already

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Specifics of small-scale rooftop solar

- Rooftop solar (RTS) is sub-category of distributed solar, RTS represents small-scale projects with 1 kW – 1 MW of installed capacity
- Compared to large-scale solar projects, RTS has its own unique features:
  - Disaggregated base: large number of small users
  - Small scale means: lower PV system efficiency, higher LCOE, longer payback periods
  - Each RTS system should be individually tailored to: power consumption profile of end-user, available roof areas, tariff charged, grid capacities, etc
  - “Unprofessional” customers lacking experience, knowledge of and trust in solar technology
  - Limited investing capacity and shortage of available financing products
- Because of this specifics, implementation and scaling of RTS investments require more coordinated efforts and comprehensive mechanisms of financial and non-financial support

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SECCA study – the case of rooftop solar

Identification of optimal and financially viable RTS options in Tajikistan
and
Developing RTS financing scheme

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Objectives of the study of RTS systems in Tajikistan

- Perform energy modelling and simulations of rooftop solar (RTS) systems in Tajikistan using:
  - > Actual data on: solar insolation, available roof areas, electricity consumption for each building type (business, public, residential), Capex, O&M costs
  - > Hypothetical data about: possible metering schemes and end-user tariff levels

- Identify optimal, superior-to-grid RTS options
- Analyse economically viable RTS options and financially feasible tariff levels

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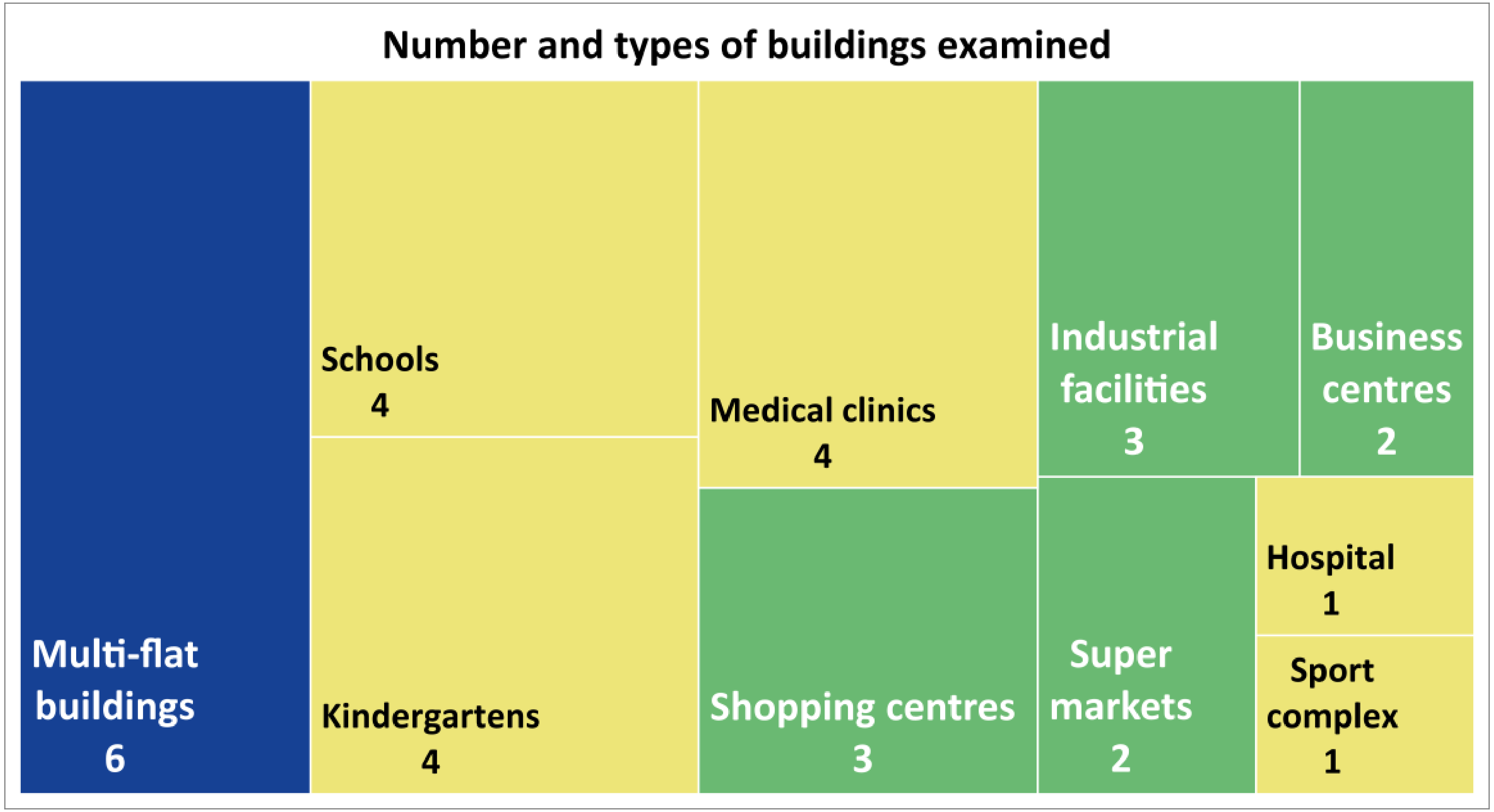
Buildings examined - actual electricity consumption data

Segment key and no. of buildings:

Residential segment	6
Public segment	14
Business segment	10
Total buildings examined	30



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Parameters of buildings used for HomerPro simulations

Name	Segment and usage	Address	Total roof area	Useful roof area (80% of total area)	Max available PV system*	Daily power use	Annual power use
			m2	m2	kW	kWh/day	kWh/year
Dushanbe Mall	Business, shopping centre	Bekhzod Street 47, Dushanbe	8,650	6,920	690	10,960	4,000,465
International Presidential School	Social, school	Karamov Street 101, Dushanbe	12,820	10,250	1,250	1,517	553,747
Residential-1	Residential, living	Nusratullo Makhsum Avenue 61/1, Dushanbe	413	290	21	20	7,424

Note: * - applying max of 1kW PV installed capacity for 5-15m2 of useful roof area

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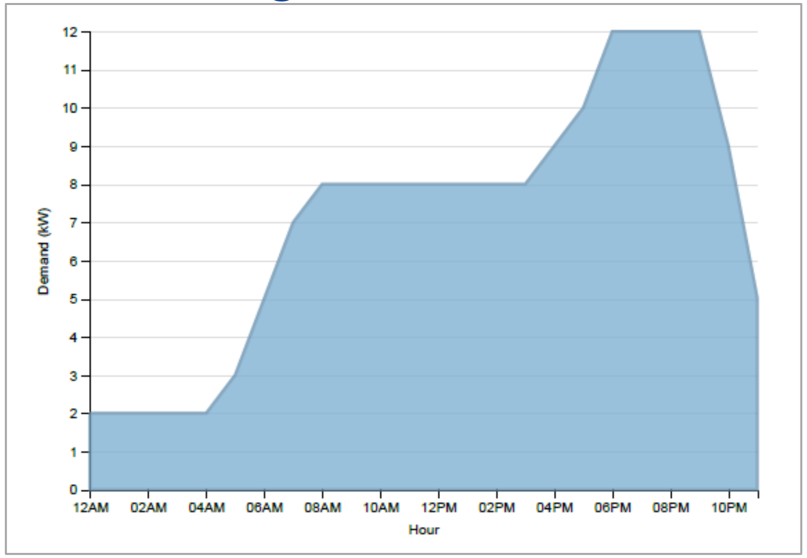
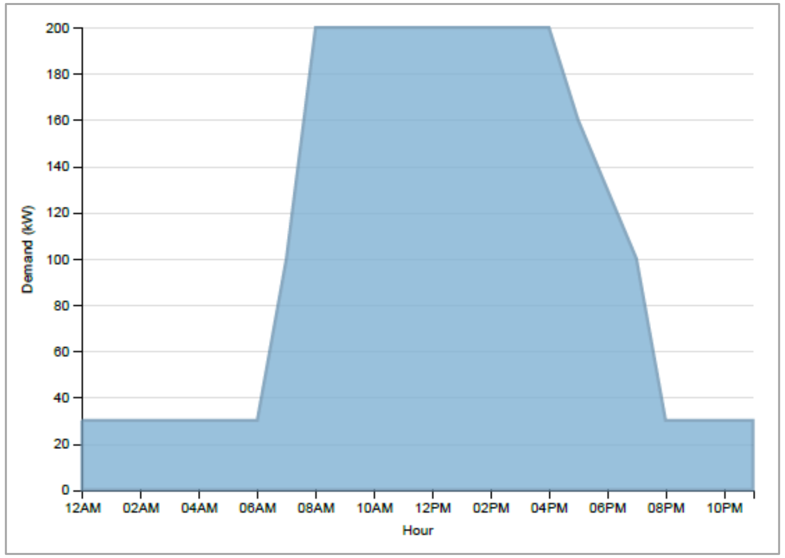
Different hourly load electricity profiles

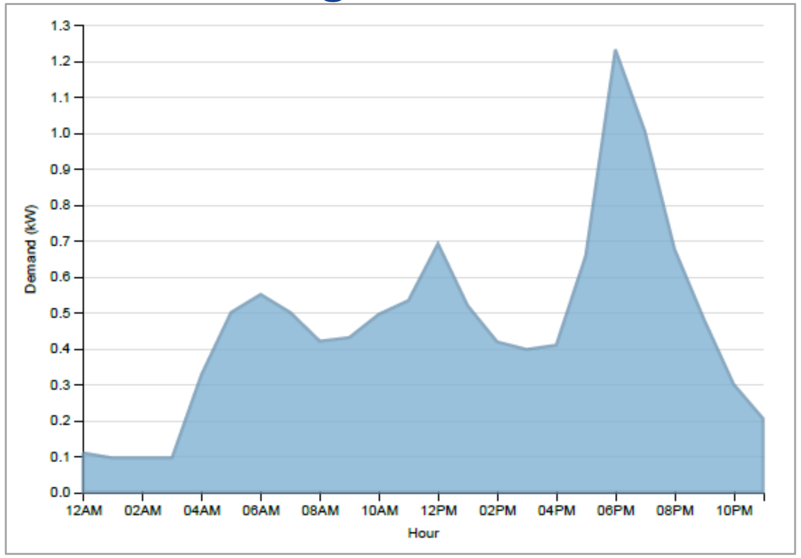
Business segment



Public segment



Residential segment



Practical consumer needs satisfied by modelled and selected RTS systems:

- Business and public segments – all consumer electricity needs
- Residential segment - power required for lighting of general premises and elevators

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Financial and operational assumptions

Investment and operational cost assumptions

RTS system component	Lifetime	O&M	Initial investment	
		USD/year	Amount	Unit of measurement
Project lifetime	25 years			
PV system	25 years	4	418	USD/kW
Storage system: Li-Ion	15 years	1	262	USD/kWh
Storage system: Lead Acid	7 years	1	150	USD/kWh
On-grid convertor	15 years	0.5	38.5	USD/kW
Hybrid convertor	15 years	0.5	180-270	USD/kW
Generator (diesel)	15,000 hours	300	300	USD
Diesel fuel price		1 (USD/litre)		

Financial and economic assumptions

Assumption	Description / amount
Value added tax (VAT)	VAT excluded from calculations
Inflation	Modelling made in real terms, values not adjusted for inflation
Discount rate used	10%

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Principles of rooftop solar modelling with HomerPro

- Large number of iterative HomerPro software runs
- Rooftop solar (RTS) option is compared to base-case
- Base-case = the use of the grid option
- We structured RTS modelling and simulations to include and combine:
  > 3 remuneration schemes and
  > 3 different tariff rate levels

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RTS remuneration schemes and tariff rate levels analysed

- Without net metering
  > consumer is not paid for the surplus PV energy produced and sent to the grid
- Net metering (NEM)
  > rate paid for unconsumed PV energy exported to the grid is equal to the retail end-user electricity tariff (i.e. the import rate is equal to the export rate)
- Net billing
  > export to the grid rate significantly differs from (and usually is considerably lower than) the import rate
- Current tariffs
  > tariffs effective in year 2024 for the specific consumer category (business, public, residential)
- Average tariffs
  > weighted-average end-user tariff of 0.032 USD/kWh for year 2024, which is the estimated average rate of the whole power market of Tajikistan
- Switching values
  > tariff levels at which the RTS system starts to be optimal (superior) compared to the current grid option, it signals the break-even tariff level for viable RTS deployment

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RTS system options modelled

Business segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/kWh	USD/kWh	
1	**Without net metering**	**Current**	**0.064**	**0**	**RTS**
2	Without net metering	Average	0.032	0	Grid
3	**Without net metering**	**Switching value**	**0.039**	**0**	**RTS**
4	**Net metering**	**Current**	**0.064**	**0.064**	**RTS**
5	Net metering	Average	0.032	0.032	Grid
6	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
7	**Net billing**	**Switching value**	**0.064**	**0.032**	**RTS**

Public segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/kWh	USD/kWh	
8	Without net metering	Current	0.028	0	Grid
9	Without net metering	Average	0.032	0	Grid
10	**Without net metering**	**Switching value**	**0.040**	**0**	**RTS**
11	Net metering	Current	0.028	0.028	Grid
12	Net metering	Average	0.032	0.032	Grid
13	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
14	Net billing	Switching value	0.028	0.043	RTS(nm*)

Residential segment

Option No.	Remuneration scheme	Tariff level	Import from the grid rate	Export to the grid rate	Optimal system
			USD/kWh	USD/kWh	
15	Without net metering	Current	0.024	0	Grid
16	Without net metering	Average	0.032	0	Grid
17	**Without net metering**	**Switching value**	**0.057**	**0**	**RTS**
18	Net metering	Current	0.024	0.024	Grid
19	Net metering	Average	0.032	0.032	Grid
20	**Net metering**	**Switching value**	**0.039**	**0.039**	**RTS**
21	Net billing	Switching value	0.024	0.043	RTS(nm*)

Note: nm* - not meaningful in practice

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RTS modelling and simulation results

Out of 21 option simulated, under 9 options RTS is more viable than the grid

All 5 business segment options viable within current tariff rate of 0.064 USD/kWh

- 2 options financially feasible even without net metering
- 3 options feasible with net metering & net billing

4 options of public and residential segment viable, but outside of current tariff range

- Logical, due to end-user tariff subsidisation in these segments
- In 3 out of 4 options, the rate gap of about 20% is manageable

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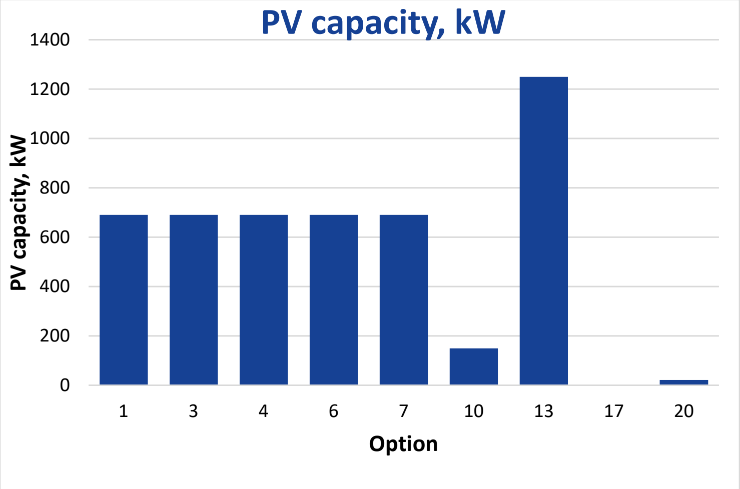
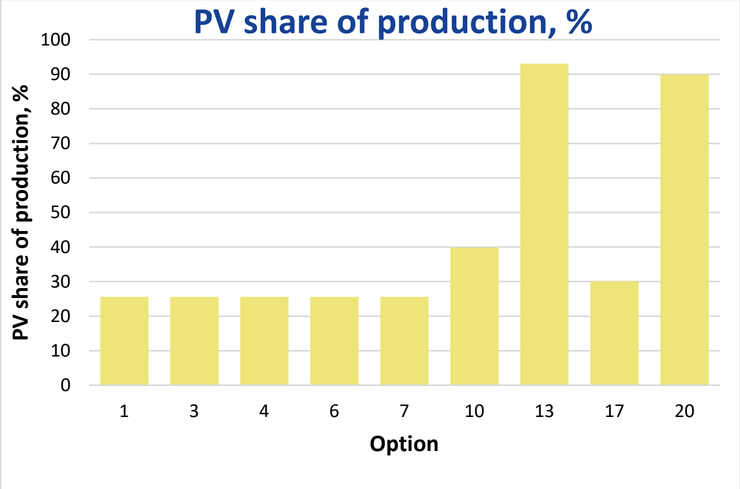
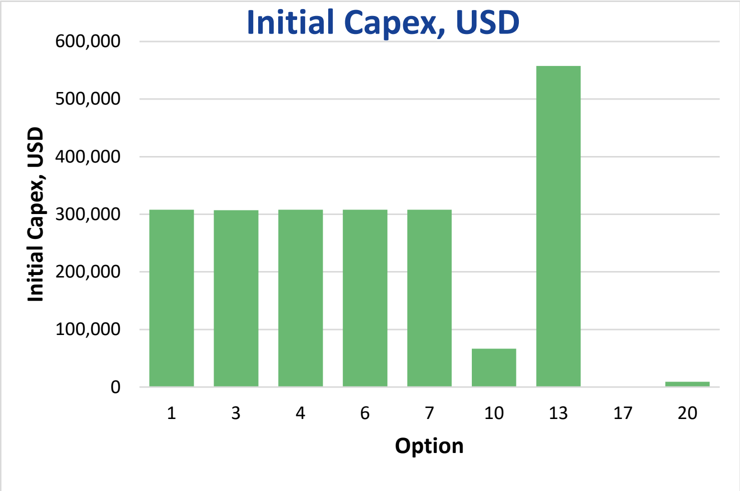
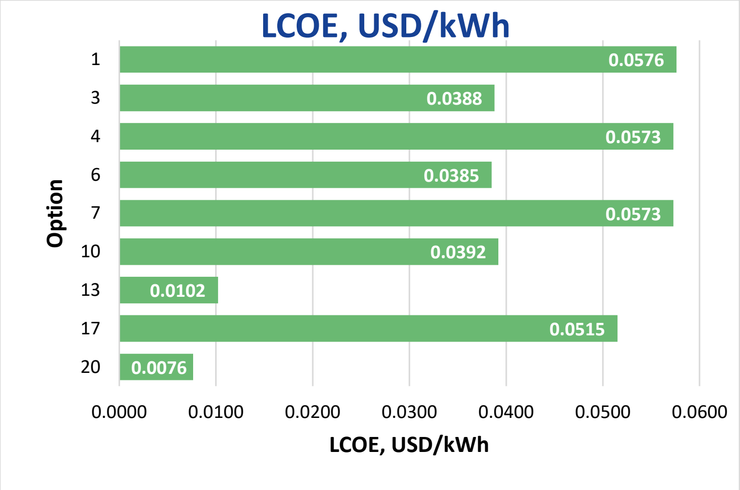
Optimal RTS systems are very different

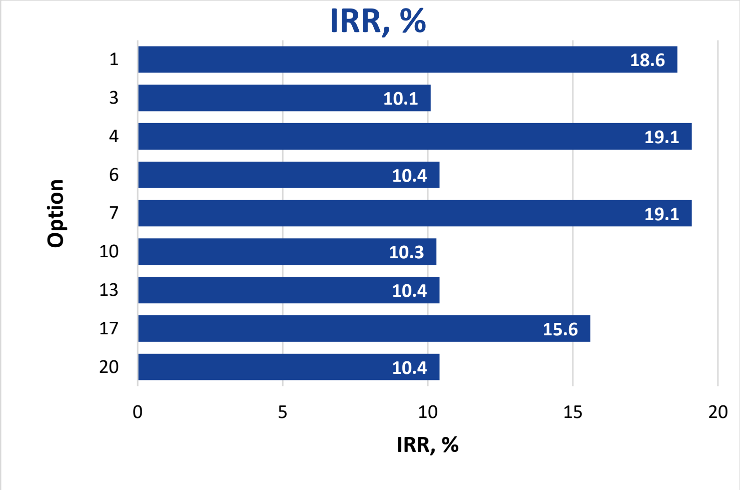
Key operational and economic parameters of optimal RTS systems

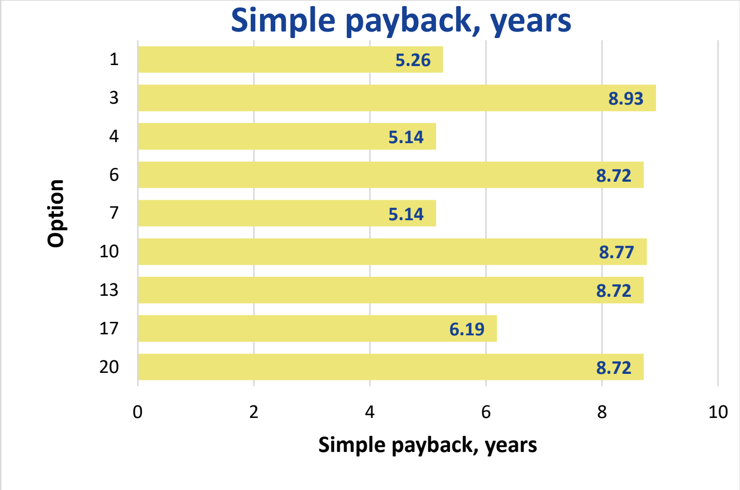












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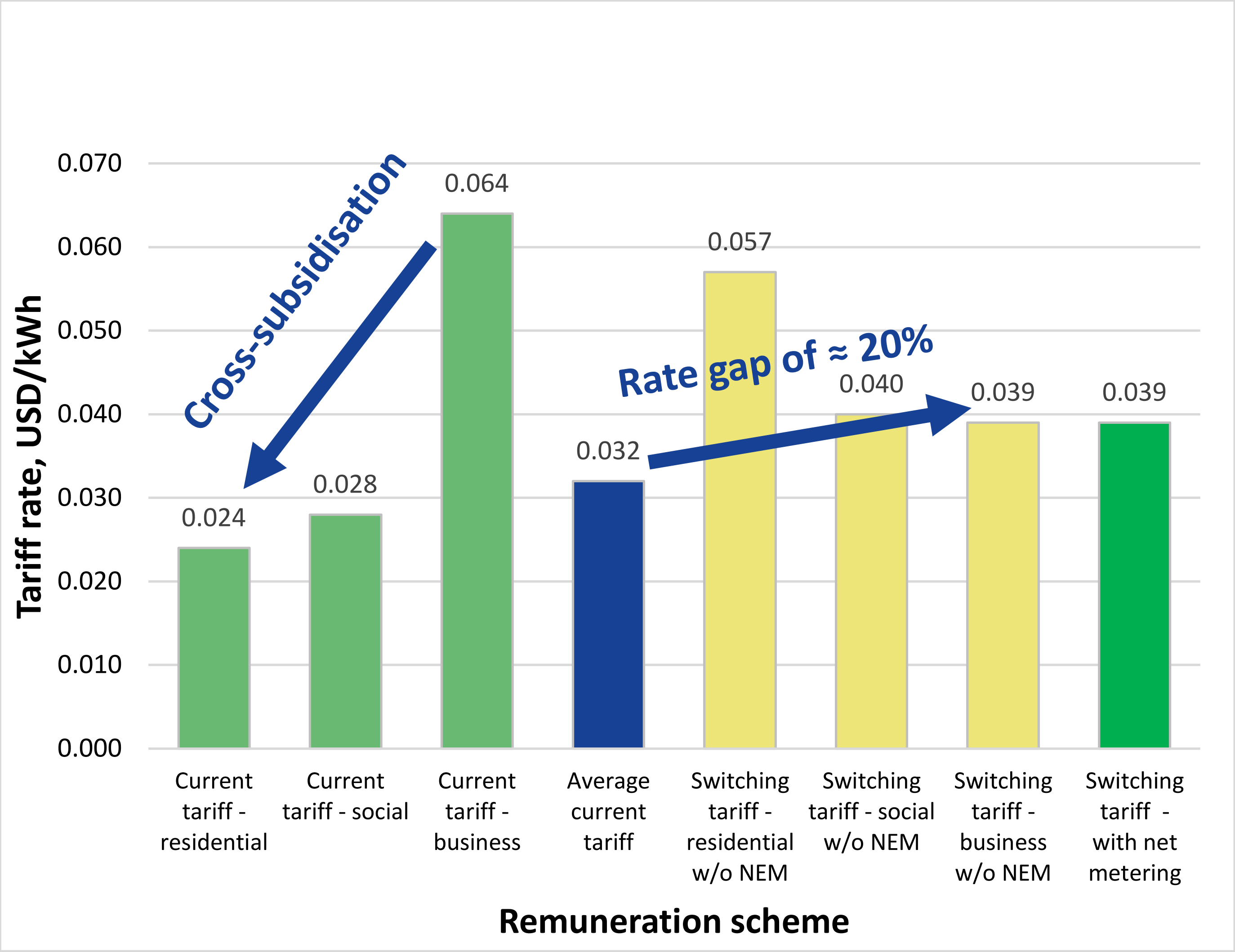
Comparison of switching and current tariff rates



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Conclusions and further work

- Despite below cost-recovery level of average tariffs in Tajikistan, there are certain segments already, where RTS system deployment is financially feasible
- Business segment end-users have the most of identified financially feasible RTS options due to the highest tariff rate charged to this consumer category
- Current tariff level in public and residential segments is insufficient for financially feasible adoption of RTS. However, the rate gap of around 20% is manageable and could be absorbed in relatively short term
- Our ongoing work in Tajikistan: defining key financing scheme parameters, subsidy forms and proportions, selecting appropriate business model for RTS deployment, search for financing and implementation partners.

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Factors of successful RTS integration in buildings

Factors

- Cost-reflecting electricity tariffs
- Regulatory framework and clarity
- Metering arrangements in place
- Subsidies and strong financial support
- Comprehensive and continuous technical assistance
- Dedicated financing products
- Suitable business model
- Technical and grid connection requirements

Results

> Increasing deployment and scaling-up of RTS

> Growth in market awareness, capacity building and user trust

> Financially attractive investments (<5 years payback)

Benefits

> Electricity cost savings

> Hedge against rising tariffs

> Increased property values

> Reduced CO_2 emissions

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Thank you for your attention!

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