

Innovative Energy Technologies in Austria, Market Development 2023

Presentation of Results and Conclusions

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Project Team



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Contents of the Presentation

- Project targets
- Framework conditions of the market development 2023
- Results of the investigated technologies
- Summary
- Conclusions

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Investigated Technologies

- Photovoltaics
- Battery storages in photovoltaic systems
- Solid biomass – fuels
- Solid biomass – boilers and stoves
- Innovative energy storage systems
- Solar thermal systems
- Large scale heat storages in heat grids
- Wind power
- Heat pumps
- Thermal activated building parts

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Project Targets

- Empirical survey and documentation of the market development
- Information processing and analysis
 - Energy output
 - GHG-emission savings
 - Economic effects
 - Innovations and trends
 - Market diffusion compared to roadmaps
- Deriving of conclusions
- Target groups: Energy-, research- and environmental policy, industry, R&D institutes

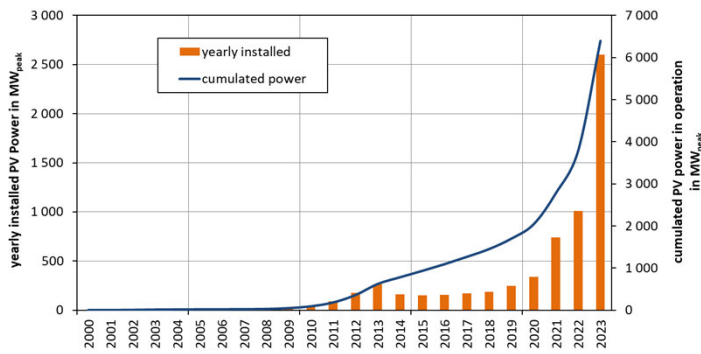
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Framework Conditions Market Development 2023

- + Compulsory climate and energy targets 2030/40/50 for AT, EU and globally
- + Strong investment incentives through federal government and federal states
- Moderate or declining energy prices (compared to 2022)
- Stable natural gas supply situation
- High inflation of 7.8% (compared to 8.6% in 2022)
- Recession, GDP decline of 0.8% (construction industry!)
- Unemployment rising to 5.1% (youth: 10.4%)
- High interest rates, restrictive lending

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Photovoltaics: Market Development 2023



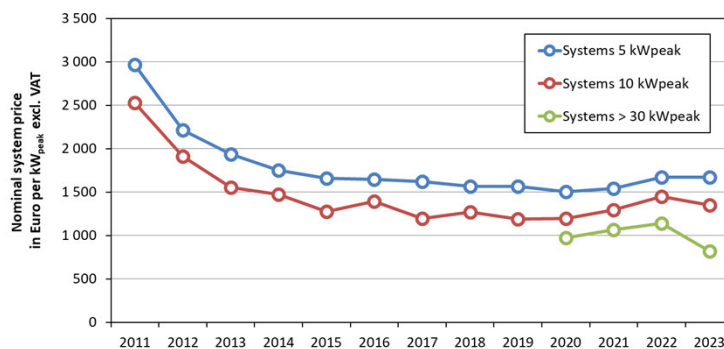
Source: Technikum Wien

- New installations: 2.603 MW_{peak}
- 2022 → 2023: +158 %
- Stock: 6.4 GW_{peak}
- 2022 → 2023: +69 %

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Photovoltaics: System Prices

Average end-customer system prices for grid-connected PV systems



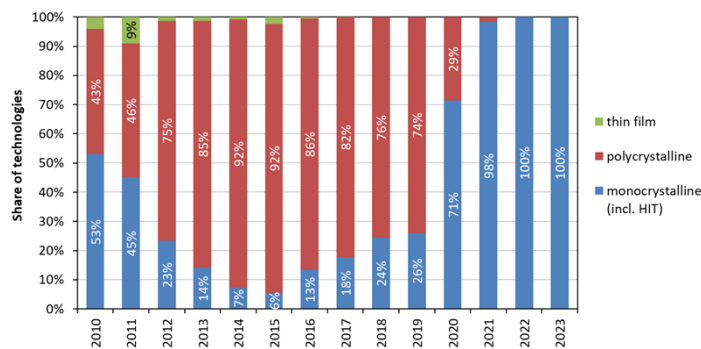
Source: Technikum Wien

2022 → 2023

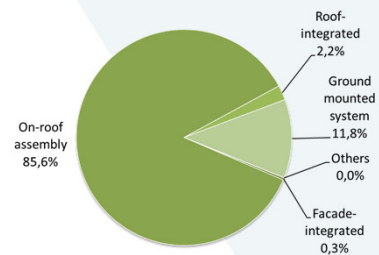
- 5 kW_{peak} systems: ±0.0 %
- 10 kW_{peak} systems: -7.0 %
- >30 kW_{peak} systems: -28.4 %

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Photovoltaics: Technology and Type of Assembly



New installations 2023

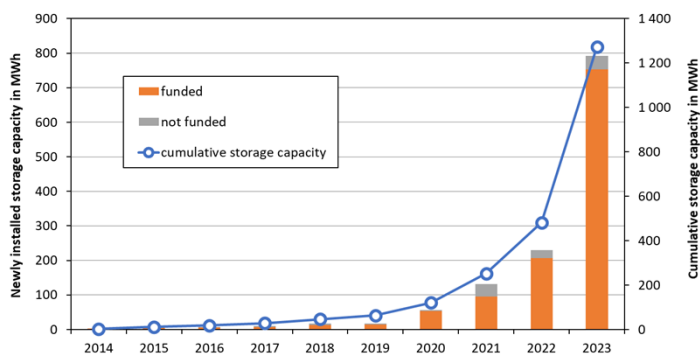


Source: Technikum Wien

Photovoltaics: Conclusions

- Positive development, but the 2030 and 2040 targets are not a sure thing
- Annual expansion of around 2 GW_{peak} required by 2040
- Lack of qualified professionals as a risk factor for 2030 and 2040
- Continuing dependence on Asia in the entire PV value chain
- Increasingly lower market prices at times of high PV production
- Lack of flexibility or lack of digitization of the grids as a risk factor
- Flexible feed-in tariffs, electricity storage and other flexibilities are becoming increasingly important in this context
- State legislation and accelerating procedures are essential (area designation, building regulations, etc.)

PV Battery Storages: Market Development 2023

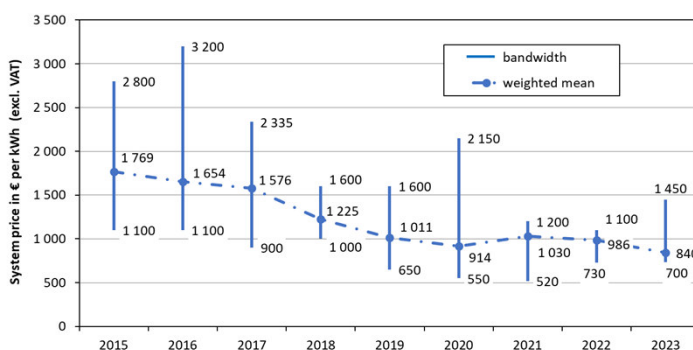


Source: Technikum Wien

- New installations: 753 MWh
2022→2023: +265 %
- Stock: 1,274 MWh
2022→2023: +165 %

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PV Battery Storages: System Prices

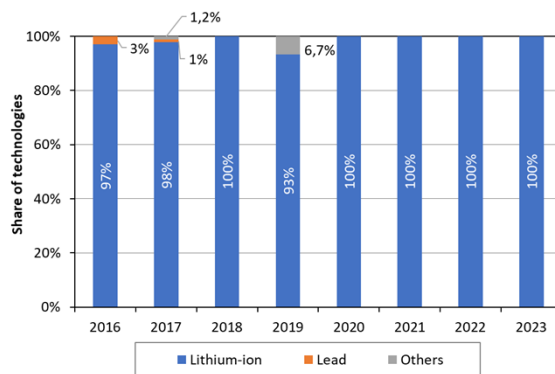


Source: Technikum Wien

- End customer system price
2023: 840 €/MWh
- 2015→2023: -52.5 %
- 2022→2023: -14.8 %

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PV Battery Storages: Share of Technologies



Source: Technikum Wien

- Lithium-ion dominant technology
- High percentage of DC-coupled systems
- Continued high proportion of new installations

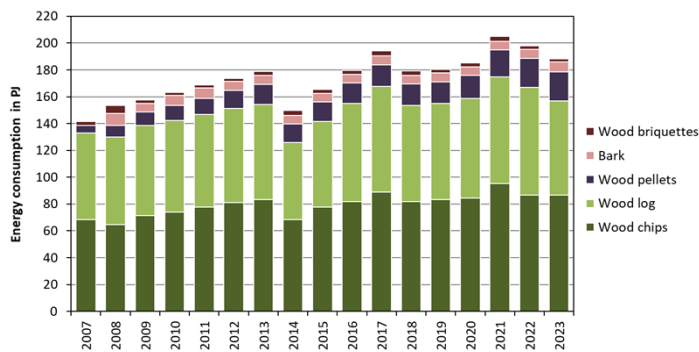
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PV Battery Storages: Conclusions

- Further missing grid and/or system usefulness
- Need for target oriented subsidy mechanisms
- Clear strategies for the expansion of energy storage devices as well as further flexibility are missing

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Solid Biomass – Fuels: Market Development 2023



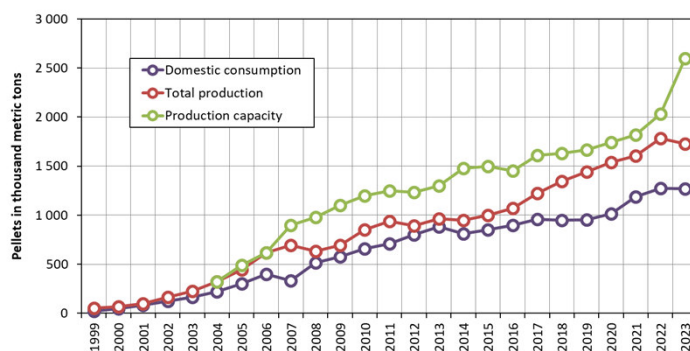
Source: BEST

2022 → 2023:

Briquettes:	-4 %
Pellets:	±0 %
Bark:	+10 %
Wood chips:	±0 %
Logs:	-13 %
Total:	-5 %

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Solid Biomass – Fuels: Production of Pellets

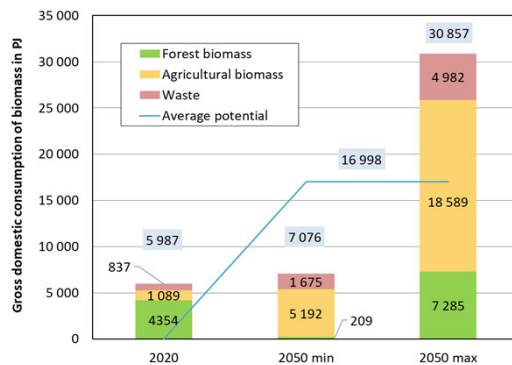


Source: ProPellets Austria

- Continuous expansion of production capacities
- High pellet prices = damage to image

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Solid Biomass – Fuels: Biomass Potentials



Source: Bioenergy Europe (2022), Faaij (2018)

- EU: shift from forest to agricultural biomass
- AT: forest biomass still dominant
- Waste use in terms of a sustainable bioeconomy

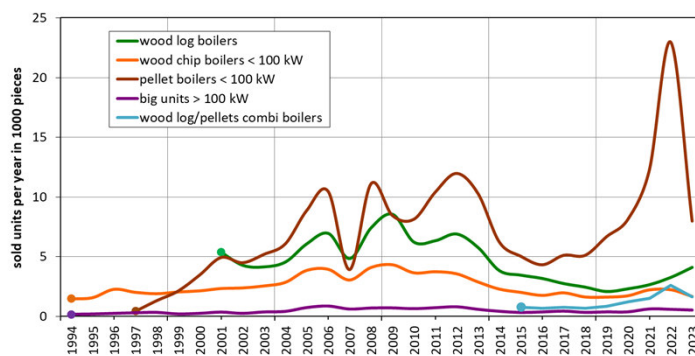
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Solid Biomass – Fuels: Conclusions

- Biomass fuels = independent of time and weather (cf. solar and wind)
- From seasonal storage (final energy) to storage over many decades (forestry)
- Thermal conversion of biomass is part of the circular economy (production of bio-based raw materials such as biochar or pyrolysis oil)
- Extreme increase in biomass prices from 2022 = massive obstacle (competitive disadvantage compared to other renewable technologies)

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Solid Biomass – Boilers: Market development 2023



Source: BEST

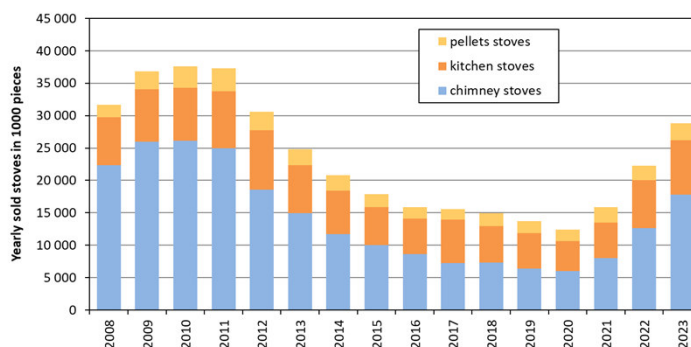
2022 → 2023:

in total 15,924 pieces

Pellet boilers:	-65 %
Combined pellet boilers:	-37 %
Log boilers:	+26 %
Wood chips to 100 kW:	-25 %
Wood chips >100 kW:	-10 %
Total:	-50 %

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Solid Biomass – Stoves: Market Development 2023



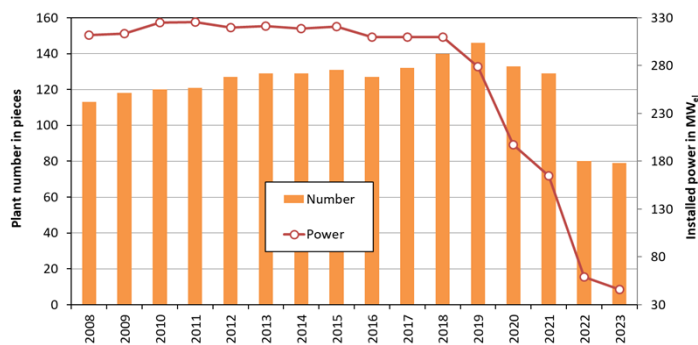
Source: BEST

2022 → 2023:

Pellet stoves:	+13 %
Kitchen stoves:	+14 %
Chimney stoves:	+41 %
Total:	+29 %

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Solid Biomass – Development of Green Power Plants



Source: OeMAG

- 2022 → 2023: -22 % (power)
- Main reason for the decline: expiry of the green electricity tariff
- Strong contradiction to the expansion target anchored in the EAG (+3.6 PJ)

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Solid Biomass – Boilers: Conclusions

- Austrian biomass producers are well prepared for an increased demand (limiting factor: skilled personnel, heating engineer)
- Up to 2050 the supply of space heating through solid biomass will be less important (exception: comfort & back-up system)
- Process heat has a great potential of contributing to the decarbonisation of the energy system (e.g. green gas, synthetic fuels)

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Innovative Energy Storage: Definition

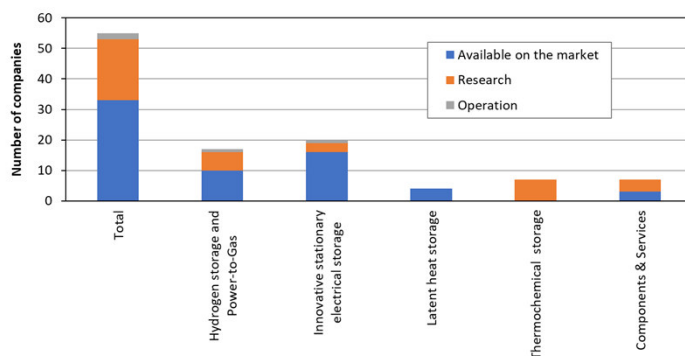
- Hydrogen storage & Power-to-gas (fuel cell, electrolysis)
- Innovative stationary electric storages (brine battery, Redox-flow battery)
- Latent heat storage (Phase Change Material – PCM, ice storage)
- Thermochemical storage (absorption- and adsorption storage)

Local limitation

- Austrian producers respectively Austrian market
- Austrian research activities
- Sold units or realised pilot- and demonstration projects

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Innovative Energy Storage: Market Participants 2023



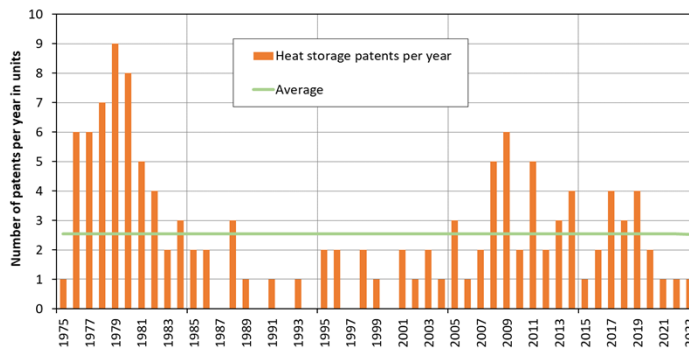
Source: BEST

Companies and research institutions innovative storage technologies in Austria

Number of companies and research institutions that research innovative storage technologies or offer those on the Austrian market

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Innovative Energy Storage: Patents for Heat Storages



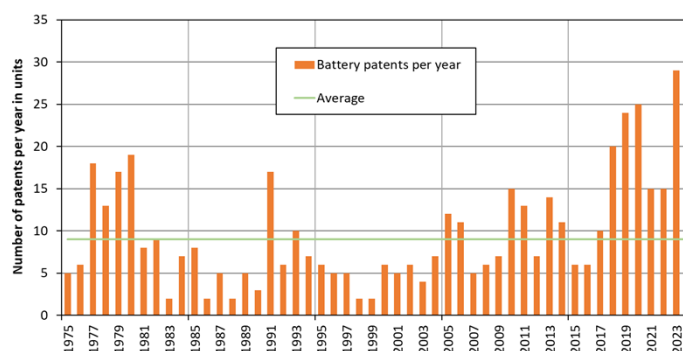
Source: Austrian patent database, evaluation BEST

Amount of annually submitted heat storage patents in Austria:

Ø 1974 to 2023: 2.6

Ø 2000 to 2023: 2.4

Innovative Energy Storage: Patents for Battery Storages



Source: Austrian patent database, evaluation BEST

Amount of annually submitted battery patents in Austria:

Ø 1974 to 2023: 9.4

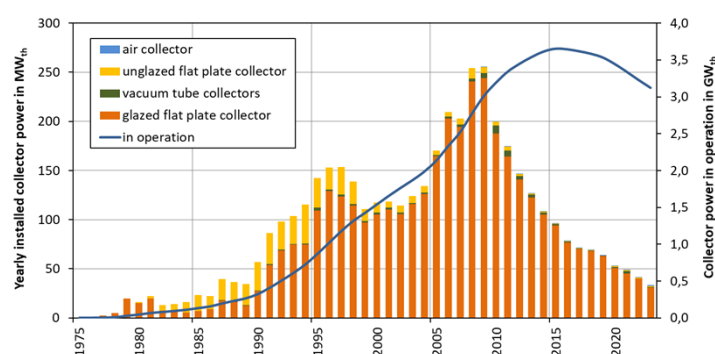
Ø 2000 to 2023: 11.6

Innovative Energy Storage: Conclusions

- The number of identified companies and research institutions has increased from 47 in 2022 to 53 in 2023
- The number of patent applications in the area batteries, hydrogen and fuel cells has clearly increased over the last 5 years
- The field is still rather limited
- An expansion of research and development will be necessary in order to persist in the international competition

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Solarthermics: Market Development 2023



Source: AEE INTEC

Standard collectors

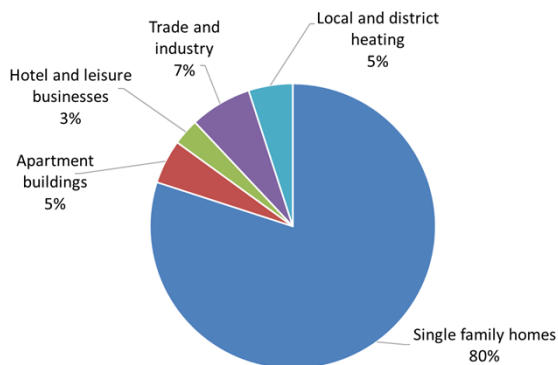
- New installations: 33.2 MW_{th}
2022 → 2023: -20 %
- Stock: 3.1 GW_{th}
2022 → 2023: -3.3 %
- Export: 375 MW_{th}.
2022 → 2023: -26 %

Solar hybrid collectors (PVT)

- New installations: 671 m²
2022 → 2023: -33 %

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Solarthermics: Areas of Application

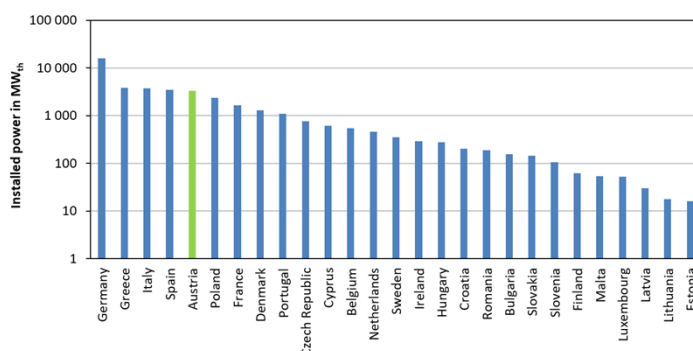


Source: AEE INTEC

- Applications in the single-family home sector (80 %) dominated the market in 2023
- The technology was unable to benefit from "Get out of oil" in 2023 due to the comparatively unfavorable funding system
- Industry launches testbed campaign in Styria
- Large-scale systems were unable to compensate for the decline in the residential sector in 2023

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Solarthermics: Total Performance in Comparison with the EU



Source: AEE INTEC

- Austria is in 5th place with 3.1 GW_{th} of installed capacity, and in 1st place per capita
- Twice as high solar thermal density as in DE, for example
- Worldwide: AT is No. 4 in terms of collector area per inhabitant
- Strong market growth in the UK (66 %) and GR (10 %)

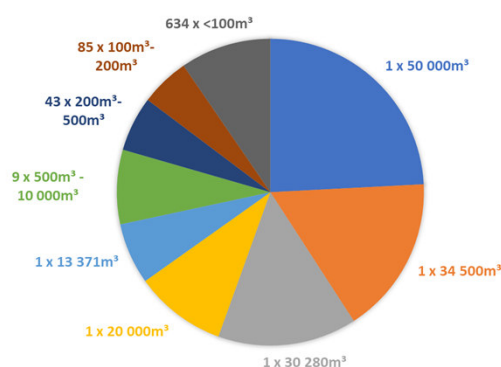
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Solarthermics: Total Performance in Comparison with the EU

- Without new impulses in funding policy (federal and state), the traditional core market "housing sector" will disappear
- 5 large-scale projects (10 MW_{th} - 30 MW_{th}) before implementation decision, one large-scale project (190 MW_{th}) is fighting for funding commitments
- The funding program for large-scale solar thermal systems ended in December 2023, which led to an immediate halt to activities
- 95% export share → important global market supplier, 70% value added share
- High technological sovereignty that can be maintained with targeted RTI (hybrid collectors, solar reactors, heat storage, large-scale systems, etc.)

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Large Heat Storages: Usage in Heat Grids 2023

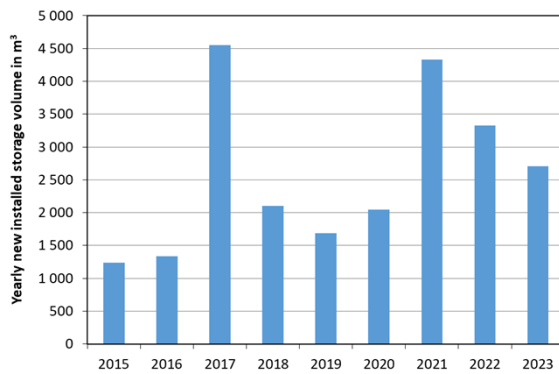


Source: AEE INTEC

- **1,081 heating networks** with a total heat sales of 19.8 TWh form the data basis (>90% of district heating sold in Austria)
- Multiple conversion plants and sources → **high demand for flexibility**
- **End of 2023:** 1,023 tank storage systems with 206,820 m³ (8.4 GWh) installed in 776 heating networks; 2022→2023: +1.3%
- **New installations** in 2023 in the segment between 100 m³ and 500 m³

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Large Heat Storage: Market Development 2015 to 2023



Source: AEE INTEC

- Representation in time series with current data basis possible from 2015
- Installed in 2023: 2,707 m³ (0.11 GWh storage capacity)
- 33 water storage tanks
- The largest tank water storage tank installed in 2023 comprises 400 m³ (2x200 m³)

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Large Heat Storage: Largest Storage Installed in 2023



Source: © AEE INTEC

- Biomass heating plant Wollsdorf, Styria
- Supply of an industrial and commercial park
- 2 x 200 m³
- Pressure storage tank
- Use of the storage tank: load management in conjunction with 2 x 4 MW biomass boilers

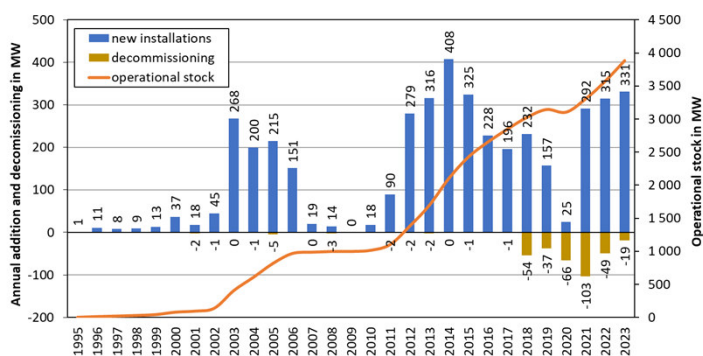
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Large Heat Storage (LHS): Conclusions

- Demand for LHS is increasing enormously in the course of the transformation
- Technologies: Up to approximately <1 GWh of above-ground LHS made of steel and above that an underground container or basin storage, aquifers, caverns, former quarries, geothermal probes, etc.
- Projects are currently being developed (40,000 m³ - 1.5m m³)
- Innovative LHS requires targeted funding models → e.g. adjustment of the "LHS system" funding program in terms of percentage and upper limit!
- Targeted RTI activities are needed in the area of GWh storage (development, implementation and operational support) as well as for scaling (up to 1m m³)

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Wind Power: Market Development 2023

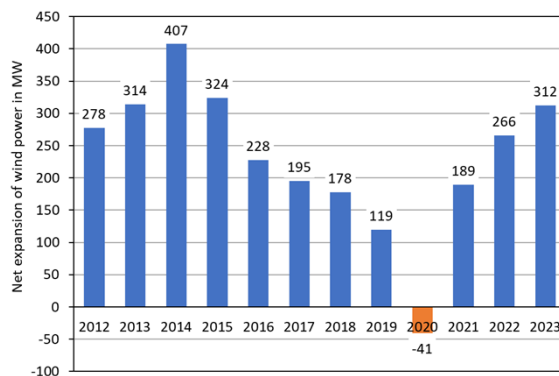


Source: IG Windkraft

- New installations: 331 MW
- Stock: 3,885 MW
- 2022→2023: +5.0 %
- Wind power 2023: ca. 8.0 TWh

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Wind Power: Net Expansion on the Level of 2013



Source: IG Windkraft

- **Expansion 2/3 too low** (in order to achieve climate targets: 150 wind turbines with 1000 MW)
- All plants built in 2023 are still subsidized by the **old Green Electricity Act**
- EAG: **Only around 43% of the 2023 quantities were awarded!**
- **Increase in expansion is not sustainable!** (2024: only 124 MW)

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Wind Power: Current Usage in the Federal States

Austria in total

1,426 plants
3,885 MW
8.0 TWh

Lower Austria

797 plants
2,081 MW

Upper Austria

31 plants
50 MW

Vienna

9 plants
8 MW

Burgenland

461 plants
1,411 MW

Styria

118 plants
307 MW

Carinthia

10 plants
28 MW



Source: IG Windkraft

- Wind power production concentrated in eastern Austria
- Wind also blows in western Austria
- **Framework conditions for the expansion of wind power are missing!**
- Federal states must take action: areas, personnel, permits

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Wind Power: Subcontractor Branch with World Market Leaders



Copyright: Pletterbauer

- No wind power producer in Austria
BUT:
- More than **180 companies** in
subcontractor and service areas of
the wind branch in Austria
- Several **world market leaders** in
various sectors

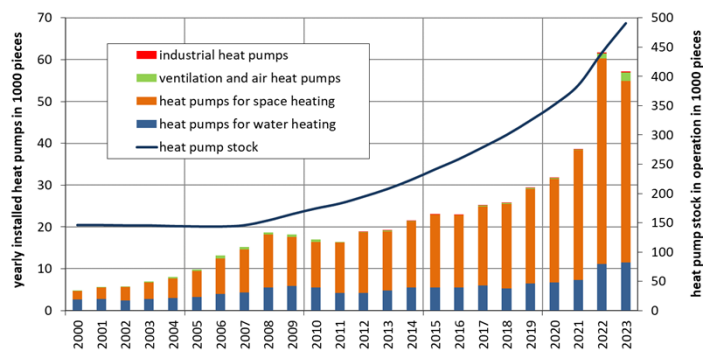
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Wind Power: Conclusions

- **Expansion of wind power installations not sustainable** due to missing
framework conditions
- The **biggest obstacle** is the lack of framework conditions at the Federal
state level (except for Burgenland). **Federal states are delaying the
energy transition!**
- **Interconnection between the federal and state governments urgently
needed:** Renewable Energy Expansion Acceleration Act, Climate
Protection Act (Electricity Industry Act)

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Heat Pumps: Market Development 2023

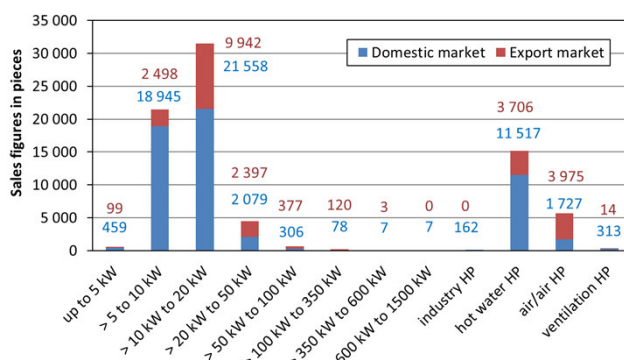


Source: ENFOS

- New installations:
57,158 pieces
2022→2023: -7,3 %
- Stock: 491,291 pieces
2022→2023: +14.5 %

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Heat Pumps: Sales by Type and Market 2023

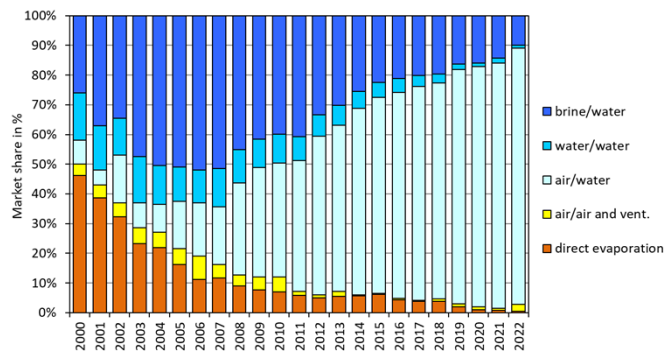


Source: ENFOS

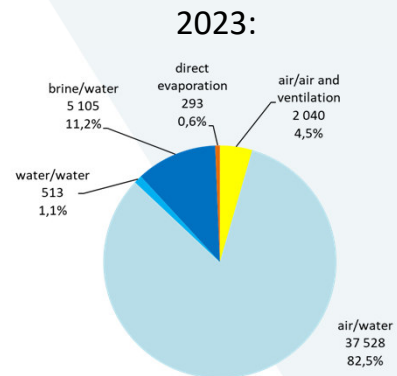
- Export quota heat pumps for space heating : 26.2 %
- Export quota domestic water heat pumps: 24.3 %
- Export quota total: 28.8 %

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Heat Pumps: Sales by Type and Market 2023



Source: ENFOS



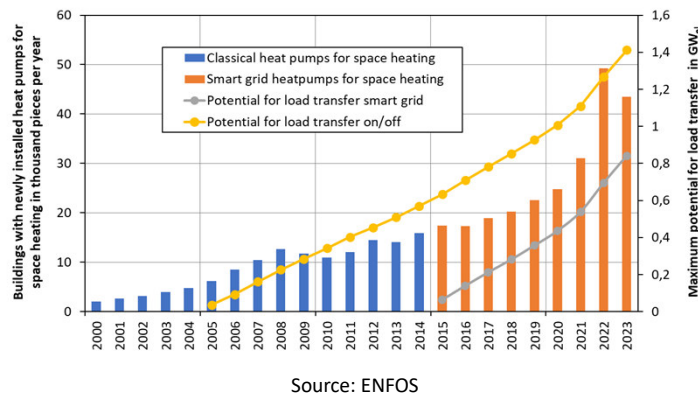
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Heat Pumps: Conclusions

- Market volume 2022/23 demonstrates the industry's performance under difficult conditions (supply chain problems, shortage of skilled workers)
- The heat pump has a key role in the heat transition
- Long-term developments of building energy efficiency and cooling demand promote the further market diffusion
- Challenge: Maintaining 2022/23 diffusion rates under the current general conditions

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Activation of Buildings: Market Development 2023

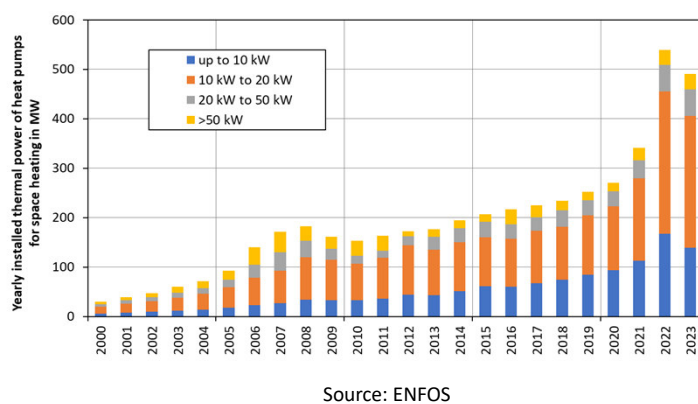


Load shifting potential:

- On/off ripple control:
max. 1.4 GW_{el}
2022→2023: +11.6 %
- Smart Grid HP:
max. 0.8 GW_{el}
2022→2023: +21.1 %

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Activation of Buildings: Distribution of Power Classes



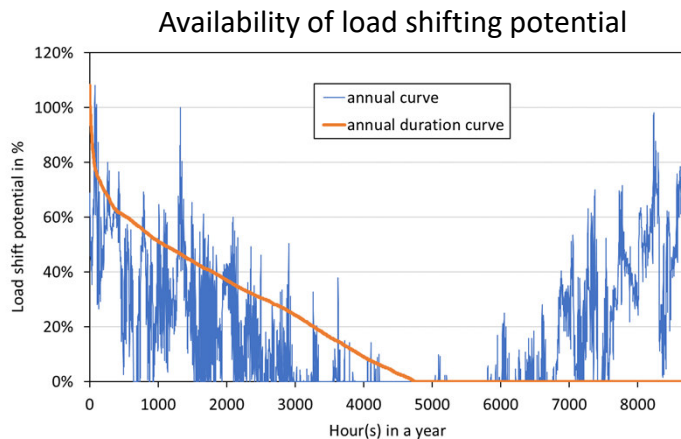
Power classes:

- up to 10 kW: -17.2 %
- >10 kW – 20 kW: -7.0 %
- >20 kW – 50 kW: -1.8 %
- >50 kW: +6.4 %

→ Swarm solution is necessary

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Activation of Buildings: Success Factors



Success factors:

- Critical mass of smart grid heat pumps
- Comprehensive availability of smart meters
- High control energy prices
- Business models for network operators

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Activation of Buildings: Conclusions

- The load shifting potential will continue to grow rapidly
- The rollout of smart meters is almost completed
- The potential can be used to benefit the grid and/or the system
- A high degree of digitization among the grid operators is a prerequisite, software solutions are available
- The price development for control energy and power is essential
- Profitable business models depend on the above factors

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Summary: Key figures 2023

(Sums of biomass, photovoltaics, solarthermics, heat pumps and wind power)

- **Renewable energy:** 272 PJ (\cong 75.5 TWh)
- **CO₂^{equ}-savings:** 15.1 million tons
- **Turnover** (primary, gross): 13.4 billion €
- **Employees:** 46,700 full-time equivalents

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Summary: Trends

Trend	20/21	21/22	22/23
Biomass boilers and stoves	↗	↗	↘
Photovoltaics	↗	↗	↗
Solar thermal	↘	↘	↘
Heat pumps	↗	↗	↘
Wind power	↗	↗	↗
PV battery storage	↗	↗	↗
Large heat storage	↗	↗	↗
Activation of buildings	↗	↗	↗
Innovative energy storage	↗	↗	↗

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General Conclusions (1)

- **After the exceptional year of 2022**, numerous inhibiting factors had an impact on the market activity. The 2023 market figures are partly the result of orders from 2022.
- In 2022 and 2023, **diffusion rates were achieved for the first time** in some areas that make it possible to achieve the 2030/2040 climate and energy targets.
- **The key energy policy challenge** is to safeguard these high diffusion rates in times of worsening framework conditions.
- In addition, there must be a massive **increase in energy efficiency** to achieve the targets.

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General Conclusions (2)

- To achieve the 2030/2040 targets, **proven technologies** for the use of renewables must be implemented immediately and problem areas must be addressed through **accelerated R&D**.
- **The incentive-oriented energy policy instruments** recently used have effectively supported the market development.
- **Recession, inflation, a shortage of skilled workers and falling prices for fossil energy** are becoming new, effective barriers to diffusion.

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General Conclusions (3)

- **Coordination between the federal and state governments as well as a binding legal framework** are essential for achieving the national climate and energy targets for 2030/2040.

The final report is on the Internet:

<https://nachhaltigwirtschaften.at/de/publikationen/markterhebungen.php>



Acknowledgement

We are thankful for the productive cooperation of:

- The Austrian companies
- The associations
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- The energy departments of the federal states
- The employees of the R&D-institutions

Thank you for your attention!