



ENERGY SERVICE MARKET EVALUATION BY BAYESIAN BELIEF NETWORK: CASE OF TURKEY

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INTERNATIONAL CONFERENCE ON IMPROVING ENERGY EFFICIENCY IN COMMERCIAL
BUILDINGS AND SMART COMMUNITIES

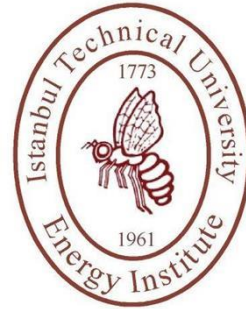
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MOTIVATION AND PURPOSE

- Turkey has a growing energy service market and new regulations and opportunities for the market are emerging. However, there are also obstacles to the development of the market.
- Although there are informative studies on the Turkish energy service market, a study concerning the analysis of the market from the viewpoint of Turkish ESCOs is not available.
- This study aims to update the literature by **presenting and analysing an overview of the current situation from the viewpoints of Turkish ESCOs** on emerging energy efficiency policies in the energy service market of Turkey and **develop recommendations for policymakers**.

CONTENT

- Current information and regulations about the Turkish energy service market
- The methodology of the study: Bayesian Belief Network (BBN)
- ESCO survey study and BBN analysis
- SWOT Analysis of Turkish energy service market
- Recommendations for the development of the market



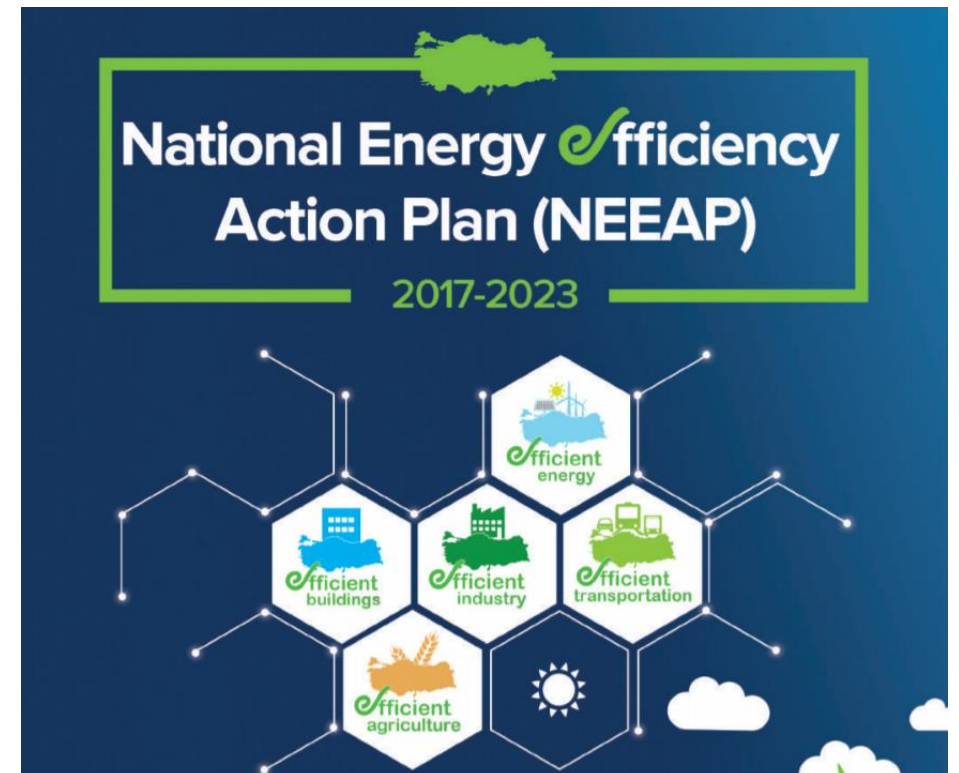
TURKISH ESCO CONCEPT

- In the Energy Efficiency Law of Turkey, “ESCO” was referred to as “EVD companies” in Turkish; a direct translation for **Energy (E) Efficiency (V) Consulting (D)** companies.
- This Turkish acronym sounds as if Turkish ESCOs have been conceived primarily as **state-licensed energy consulting firms**.
- Any company **delivering energy efficiency services/consulting** can become ESCO if and only that company fulfils the requirements stated in the Law and related by-law as “Regulation on Increasing Efficiency in the Use of Energy Resources and Energy” (**ENVER Regulation**).



NATIONAL ENERGY EFFICIENCY ACTION PLAN OF TURKEY

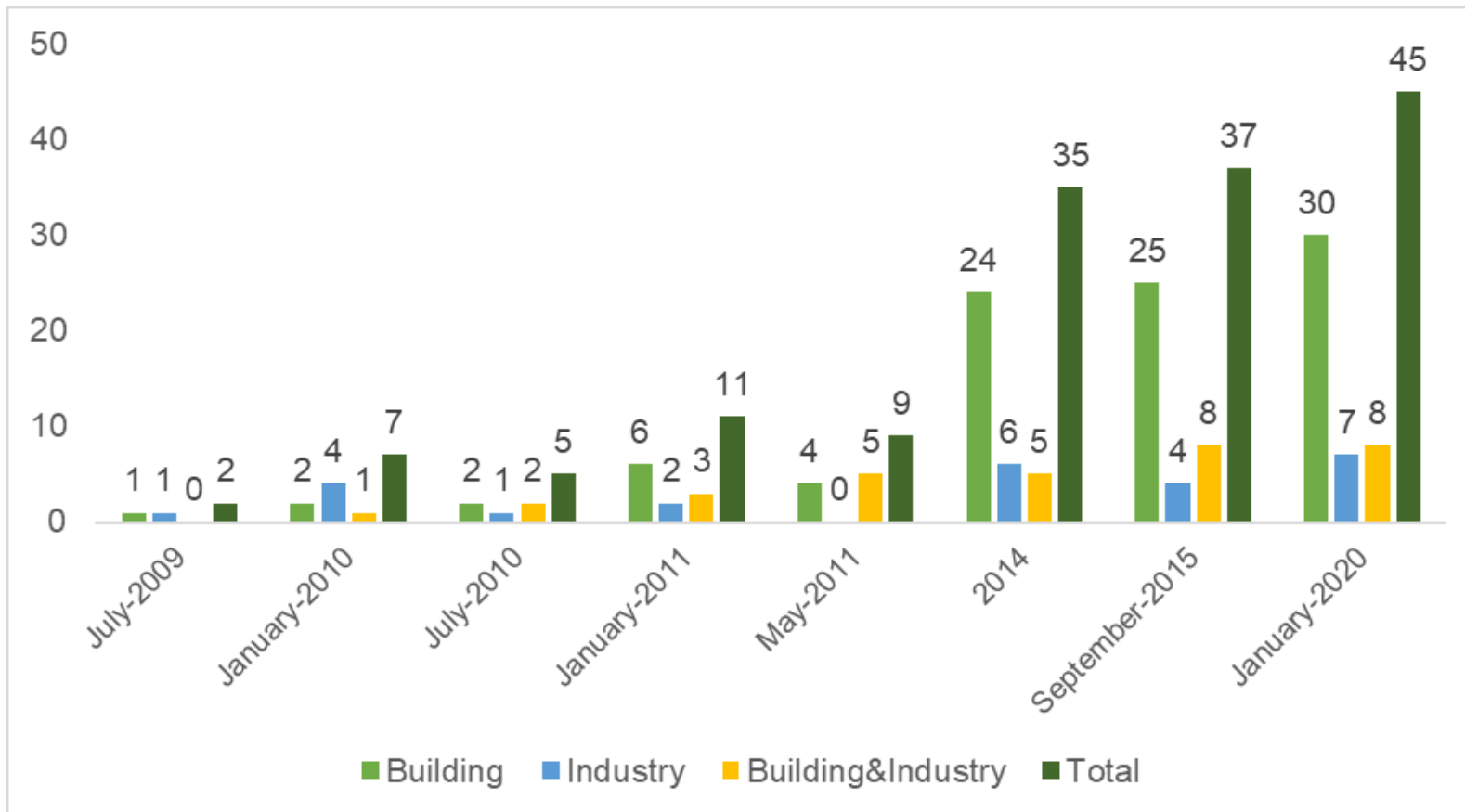
- For the harmonization of the legislation with the EU, the **Turkish National Energy Efficiency Action Plan (NEEAP)** was prepared and published in 2018.
- Under the NEEAP, it is aimed to reduce the primary energy consumption of Turkey by **14%** by 2023 through 55 actions defined in 6 categories namely **buildings and services, energy, transport, industry and technology, agriculture and cross-cutting** (horizontal) areas.
- It is also projected to achieve savings of **23.9 Mtoe** cumulatively by 2023, for which **10.9 billion USD** of investment will be made.



ACTIONS RELATED TO EVD COMPANIES STATED IN NEEAP

Sector	Action
Cross-cutting areas	Establish and increase the efficiency of energy management systems (TS ISO 50001)
	Develop guides, standard contracts, measurement and verification tools and similar bases containing technical, legal and financial aspects for energy efficiency projects
	Perform more energy efficiency audits
Building sector	Improve energy performance of existing public buildings
Industry sector	Mapping energy-saving potential
	Improve voluntary agreements
Energy sector	Improve energy efficiency in public lighting

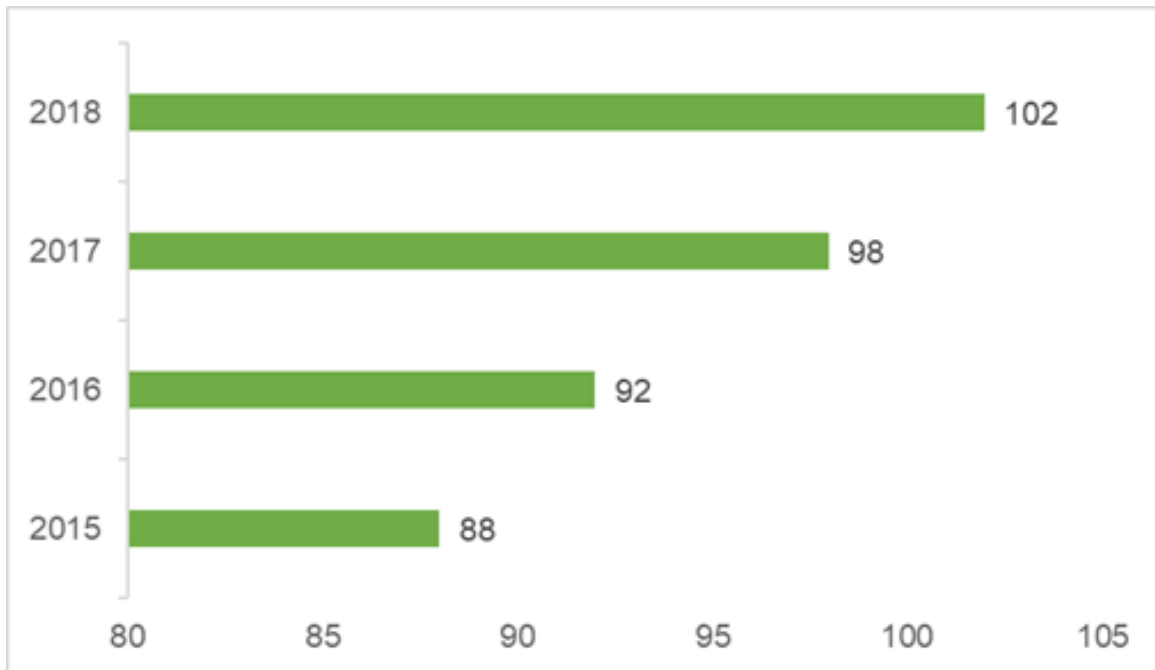
NUMBER OF EVD COMPANIES ACTING IN THE MARKET, 2009-2020



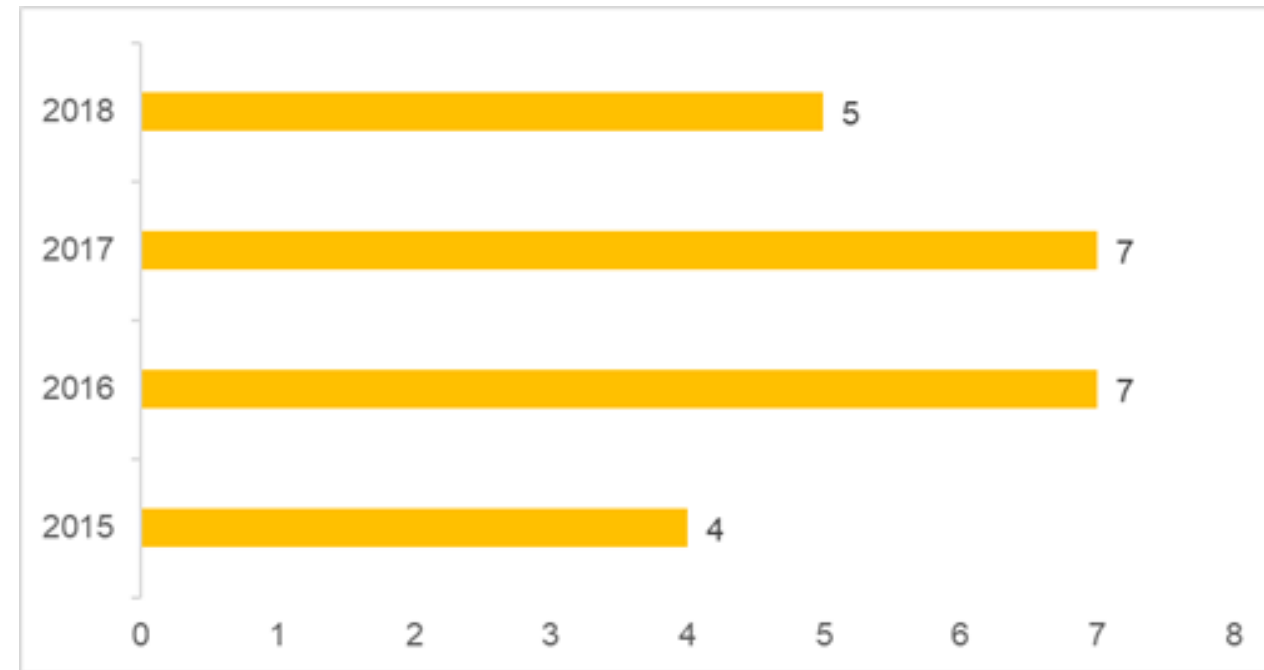
- In 2011, due to changes in the structure of the related general directorate, issuing EVD licenses, under the Ministry of Energy and Natural Resources (MENR), the authorization of companies had been ceased and started after 2012.
- Between 2014 and 2020, there is a sharp increase in the number of EVD companies.

ENERGY EFFICIENCY PROJECTS vs EnPCs

Number of energy efficiency projects conducted by EVD companies



Number of energy performance certificates made by EVD companies



SAVING POTENTIALS AND INVESTMENT REQUIREMENTS

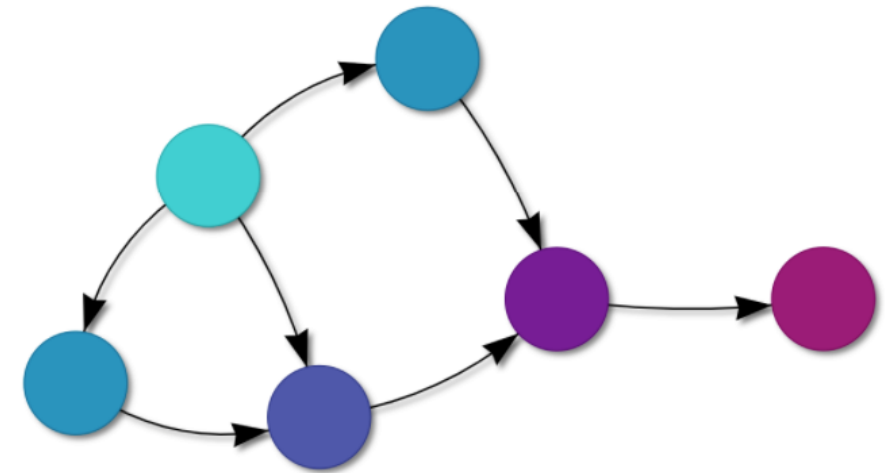
Energy efficiency projects with saving potentials and investment requirements					
	Saving Potential		Investment Requirement		Energy Saving Potential
Years	(Million TRY/year)	(Million EUR/year)	(Million TRY)	(Million EUR)	(ktoe/year)
2015	17.60	5.83	29.84	9.88	9.26
2016	23.06	6.90	47.90	14.34	14.27
2017	28.05	6.81	53.40	12.96	21.62
2018	19.79	3.50	51.81	9.15	10.16

2015: 1 EUR=TRY 3.02; **2016:** 1 EUR=TRY 3.34; **2017:** 1 EUR=TRY 4.12; **2018:** 1 EUR=TRY 5.66

Although energy efficiency investment costs are falling down over the years, due to rising currency exchange rates Turkey can not benefit from this decline.

METHODOLOGY: BAYESIAN BELIEF NETWORK

- The theory of Bayes reveals from the work of Thomas Bayes in 1763. Mainly in the theorem, **conditional probabilities of events of interest have been computed from known probabilities.**
- BBN method integrates **principles from graph and probability theory** as well as computer science, and statistics.
- BBNs are generally used in various fields comprising environment and energy in order **to reflect and explain the complex system, under discussion with expert knowledge and data.**
- BBNs allow **to create scenarios and observe the current structure and basic consequences of any strategic change.**



EVD SURVEY STUDY: PARTICIPANT PROFILES

EVD	Sector	Sub-sectors
EVD -1	Industry and Building	Energy, Metal, and Trade (Sales and Marketing)
EVD -2	Building	Residential
EVD -3	Building	Automotive, Health and Social Services, Community and Personal Services, Tourism, Hospitality, Food and Beverage Services
EVD -4	Building	Construction and Residential
EVD -5	Industry	Energy
EVD -6	Industry	Woodworking, Paper, Glass, Cement and Soil, Energy, Food, Chemical, Petroleum, Rubber and Plastic, Mining, Metal, Automotive, Textiles, ready-made clothing, Leather, Tourism, Hospitality, Food and Beverage Services
EVD -7	Building	Construction
EVD -8	Building	Energy and Residential
EVD -9	Building	Information Technology, Residential
EVD -10	Industry and Building	Woodworking, Paper, Glass, Cement and Soil, Education, Electric - Electronics, Energy, Food, Chemical, Petroleum, Rubber and Plastic, Mining, Metals, Automotive, Health and Social Services, Textiles, ready-made clothing, Leather
EVD -11	Industry	Glass, Cement and Soil, Education, Energy, Metal, Automotive, Textiles, Clothing, Leather
EVD -12	Industry and Building	Woodworking, Paper, Glass, Cement and Soil, Electric - Electronics, Energy, Food, Business and Management, Chemical, Petroleum, Rubber and Plastic, Mining, Metal, Automotive, Textiles, ready-made clothing, Leather
EVD -13	Building	Information Technology, Energy, Residential, Culture & Arts, and Design, Health and Social Services, Tourism, Hospitality, Food, and Beverage Services

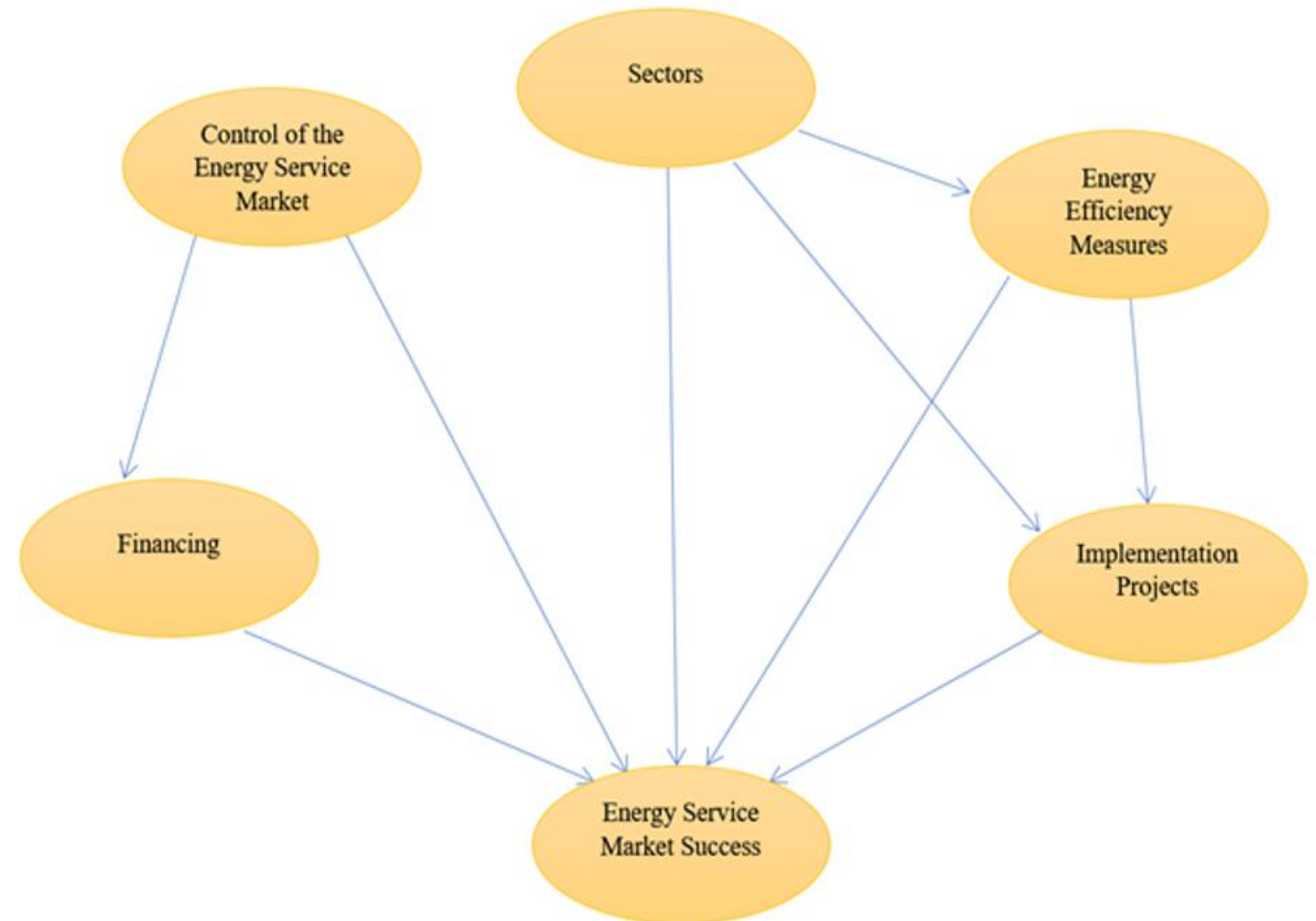
EVD SURVEY STUDY: QUESTIONS

In the survey, to reveal the current situation of the energy service market and to evaluate the Energy Service Market Success, EVD companies were asked about their opinions and/or practices on;

- control authority of the Turkish energy service market,
- sectors and sub-sectors carrying out the audit and implementation projects,
- possible measures and energy-saving potentials determined after audits,
- the main focus of implementation projects, major financing sources in audits and implementation projects.

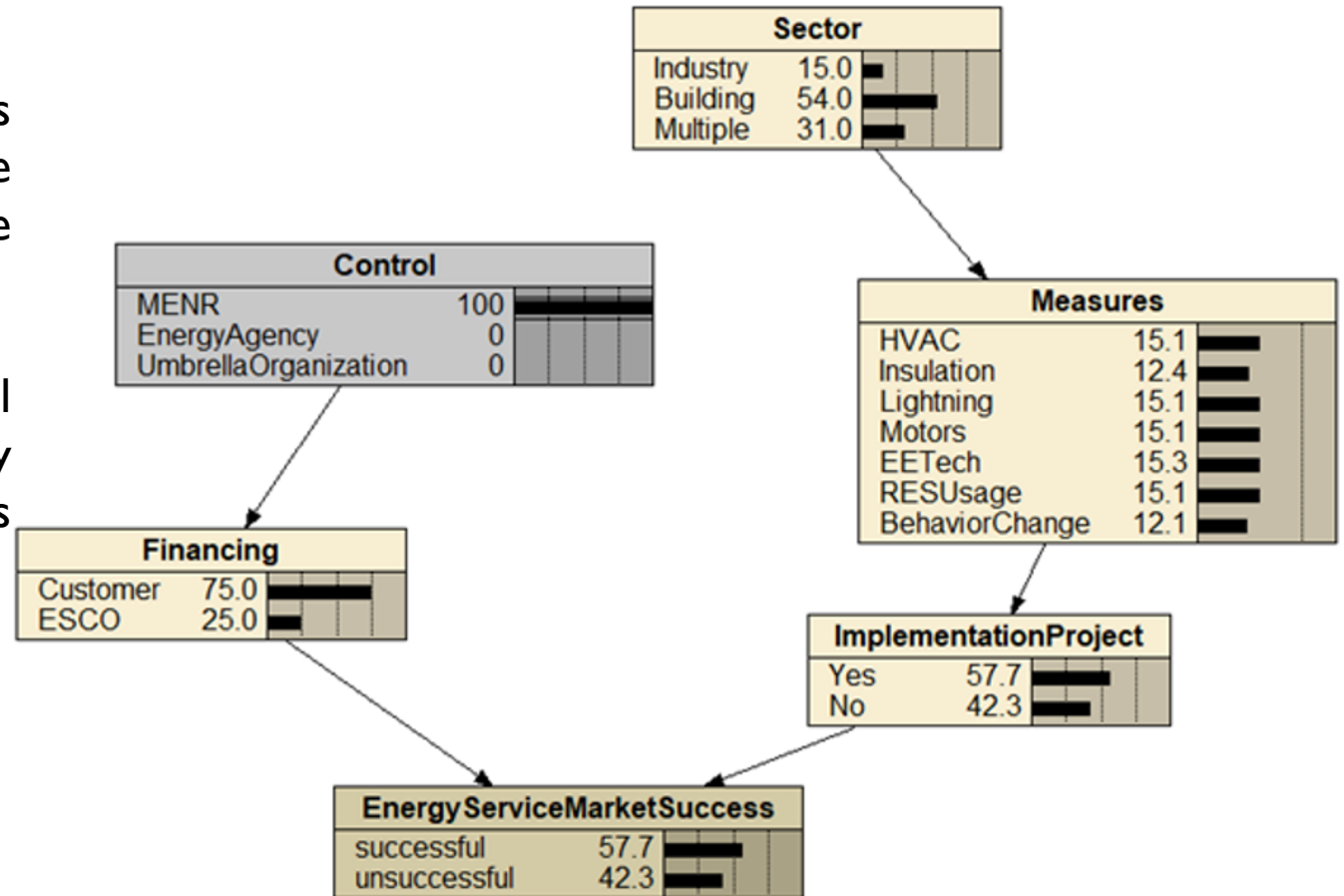
EVD SURVEY STUDY: CAUSAL MAP

- For more practical and understandable analysis the structure of energy service market of Turkey was examined on five factors.
- For the BBN analysis, EVD companies were asked the impact of these factors on the energy service market success and each other.



EVD SURVEY STUDY: BBN ANALYSIS

- “Netica Bayesian Network Modelling Program” was used as a tool for BBN analysis and how these factors affect the success of the energy service market was investigated.
- Energy service market of Turkey, under the control of the MENR, with its main focus sectors, energy efficiency measures, and implementation projects is found as **58% successful**.



EVD SURVEY STUDY: BBN ANALYSIS OUTPUTS

To improve the success of the Turkish energy service market, the following issues can be identified:

- Diversification of implementation projects in the building sector
- The share of the industrial sector (especially small and medium-sized enterprises) implementation projects should be increased
- Implementation projects should be improved both in the number and the quality by diversifying the energy efficiency measures, such as renewable energy integration and behaviour change.

EVD SURVEY STUDY: BBN ANALYSIS and OTHER OUTPUTS

- The main control mechanism of the energy service market should be a possible national energy agency.
- National Energy Efficiency Fund and Third-Party financing-EnPC should be the major financing methods for energy efficiency audits and the implementation projects.
- The difference between energy-saving amounts calculated and realized in audit studies and implementation projects, respectively, should be reduced. For this purpose, EnPC applications should be brought along with measurement & verification and independent control bodies.

SWOT ANALYSIS: WHAT HAVE DONE SO FAR?

Strengths:

- Presence and revision of legislation
- Mandatory energy efficiency audits
- Mandatory ISO 50001 Energy Management System establishment for governmental incentives
- Defined incentives for at least the industry sector
- In the market, about 25 EVD companies continuously acting from 2009 meaning sustainability
- Training of technical staff through EE manager, EE audit-project topics
- Presence of concrete NEEAP targets
- Presence of ENVER Portal which is mean of properly collected, analysed and used as a data bank and reference studies for specific sectors to determine EE measures easily
- The decision on the procedures and principles of energy performance contracts in the public sector
- Learning not only from know-how but also by doing



SWOT ANALYSIS: WHAT SHOULD BE IMPROVED?

Weaknesses:

- Wide scope energy efficiency legislation which is very difficult to implement
- Lack of governmental incentives for building sector
- National energy efficiency fund is desired but not in the scope of new revisions
- Due to economic fluctuation, high investment cost for the initial development (currency issues)
- Not very efficiently utilized EE evaluation tools (i.e. building energy performance)
- Insufficient capacity of financing institutions
- Lack of measurement and verification
- Lack of awareness by the costumers (they usually want to see best practices as real examples of gains)
- Lack of understanding behaviour changes and non-energy benefits towards energy efficiency
- Dependency of imported energy efficient technologies



SWOT ANALYSIS: WHAT CAN BE UTILIZED FOR IMPROVEMENT?



Opportunities:

- Variety of international financial institutions allocating funds for Turkish market improvement
- If best practice projects can be possible for the new EE technology applications, there is a big chance to widespread easily
- Very few examples of the studies including increase in buildings' energy performance hence it is an open area
- Opportunity to have best EnPC practices especially in public buildings with minimum 15% energy saving target in 2023 by Presidency Circular dated 15/08/2019 and No.2019/18
- Presence of national smart cities strategy and action plan by Ministry of Environment and Urbanism towards 2023
- Improvements to reach the NEEAP targets

SWOT ANALYSIS: WHAT SHOULD BE NOTICED?



Threats:

- The economic situation in Turkey
- Due to not effective usage of international funds, the threat of resignation of related institutions for the Turkish market
- Risk of large companies to finish their EVD activities in the market due to economic fluctuations
- Risk of inaccurate evaluation of energy efficiency performance because of inefficient tools
- In NEEAP, for some applications, the duration for the realization is very close and this could bear risks of not performing them
- Lack of independent control bodies for measurement and verification of the implementation projects

IMPLICATIONS FROM SWOT ANALYSIS

- New sufficient policy strategies based on measurement, data analysis, verification and continuous monitoring for sustainable business areas along the value chains
- A clear direction for major technology and infrastructure investments in the market
- The establishment of climate-neutral and circular value chains in the energy service market
- An integrated comparative climate, energy, economic and social policies as a central component of the sustainability.

CONCLUSION

- Considering the progress and the potential of the Turkish energy service market, to be evaluated, it should be noted that criticizing constructively is always better than being destructive. All strengths, weaknesses, opportunities, and threats should be integrated based on planning, doing, controlling, and acting phases of the management for further improvement of the Turkish energy service market.
- Energy efficiency together with current hot topics such as “carbon neutrality”, “circular economy”, “big data”, “digitalization” and “industry 4.0” can be regarded as the central driver of innovation for the energy service market.
- For further improvement of energy service market in Turkey, the outputs of the study can be used to improve the related regulations and the NEEAP actions, especially the establishment National Energy Efficiency Fund as well as National Energy Agency.



THANK YOU FOR LISTENING

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