

A Regional Energy Hub for Achieving a Low-Carbon Energy Transition

Presented by: Dr. Burak Guler
Turkey Energy Summit
9-10 October 2018
Antalya, Turkey

2018 October 10

Outline

- Historical Background
- REH Concept
- REH Framework
- Case Studies
- Conclusion & Summary.

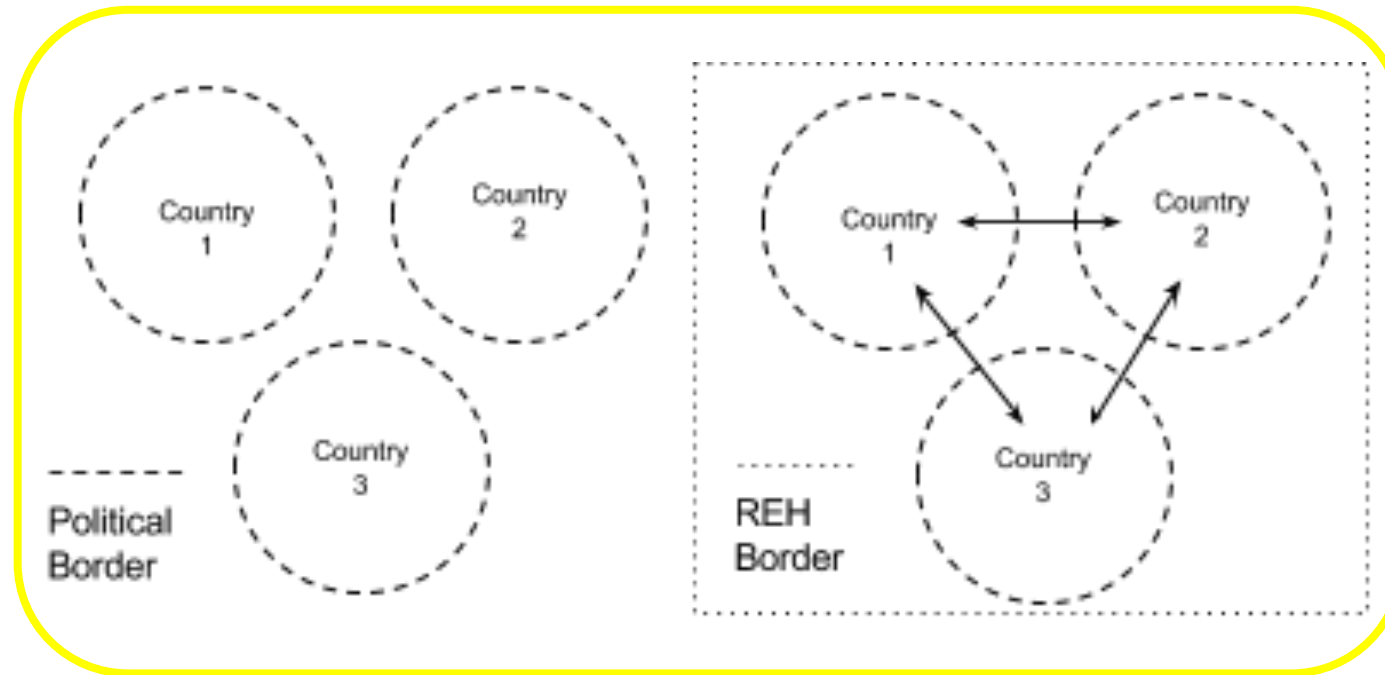
Strategic Energy Policy View for a Global Decarbonization

Tomorrow's Requirements:
Low-Carbon Energy Economy
Energy Policy & Electricity Market Requirements

Long Term View
Strategic Energy Policy Options

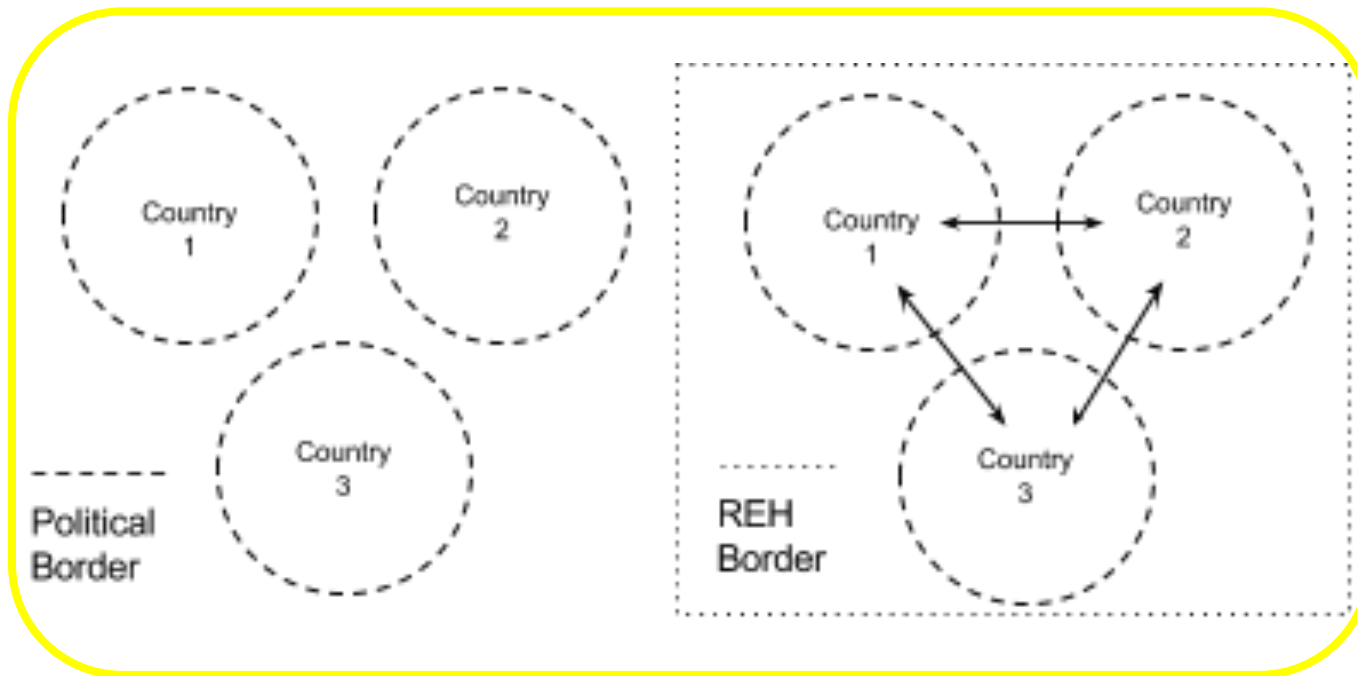
Regional Energy Hub Concept
(Optimize regional generation resources via more investment into transmission capacity and help investment in climate-resilient assets)

Regional Energy Hub - Concept



**Markets (countries) to rely more on:
trading through operating in integrated markets**

Regional Energy Hub - Approach



Country 1: clean fuel mix with no GHG emissions within its political boundary.

Country 2: dirty fuel mix within its political boundary.

Country 3: semi clean and semi dirt fuel mix within its political boundary.

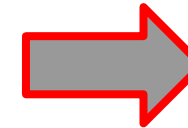
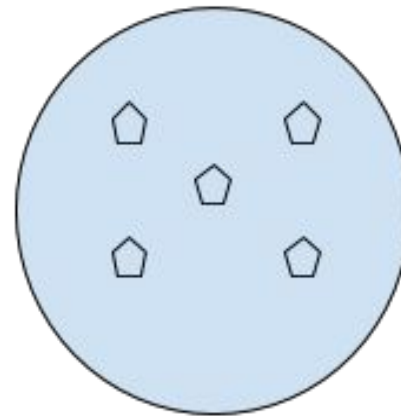
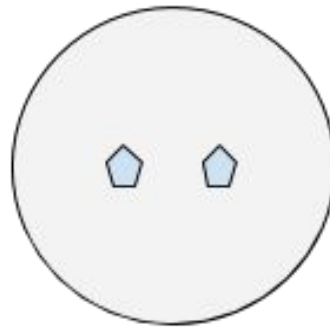
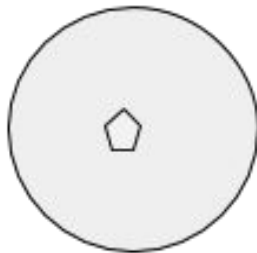
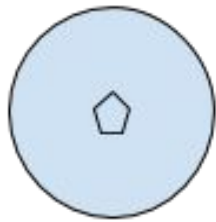
Also assume that all countries have unique seasonal and fluctuating demands.

Countries are not connected or fully connected could transit to Low-Carbon Energy Economy

Strategic Energy Policy Options: Long View

An Energy Policy View of a market (Physical Electricity Markets)

Day ahead market and capacity markets developing to developed markets (based on market efficiency)



Regional Energy Hub Framework

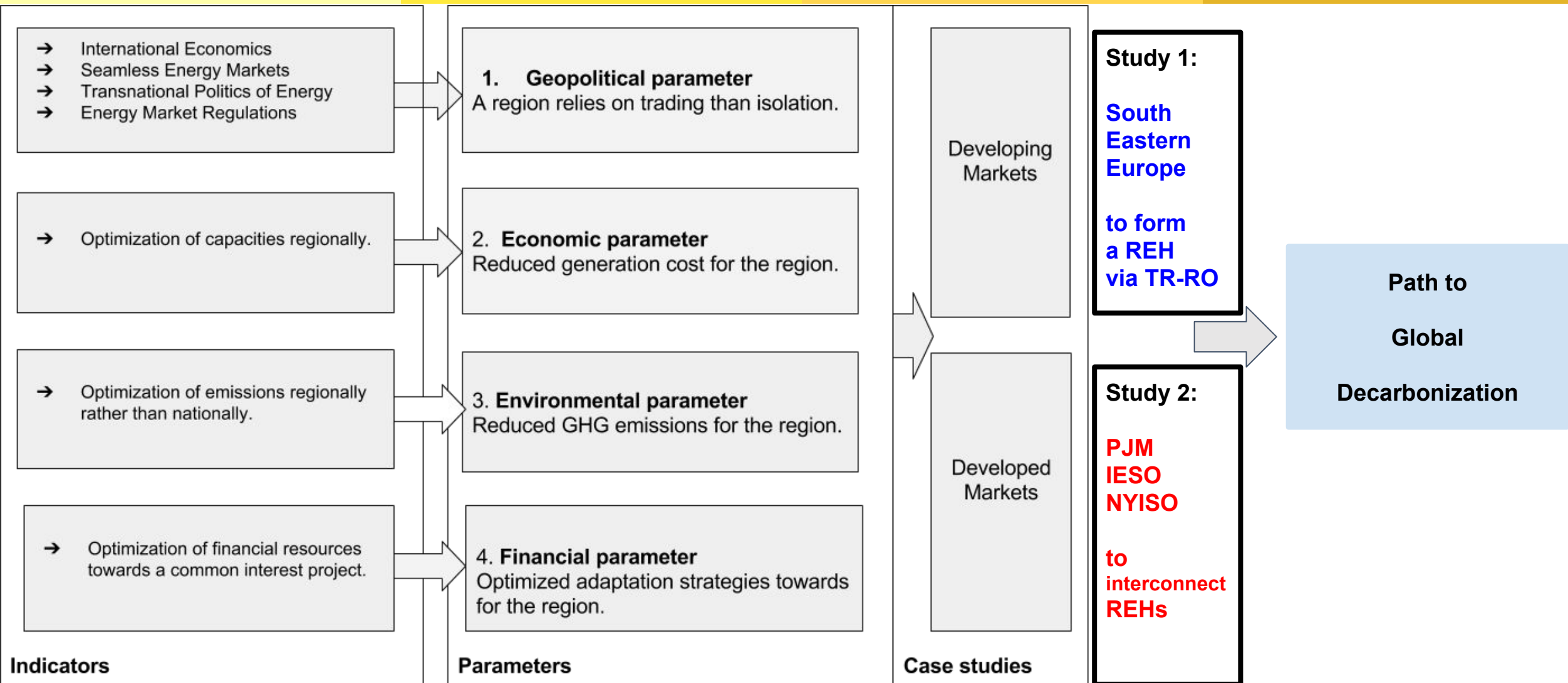
Reliability Standard

Resource Adequacy Standard

Capability

Time (years)

Operate (0-1)	Construct (1-4)	Plan (4-10)	Strategize (>10)
Optimizing of an asset	Constructing of an asset	Expanding, retiring the existing assets	Strategizing real options of assets



Regional Energy Hub - Framework

REH Parameters

Geopolitical (country or market level)

> form alliances to capture the institutional knowledge of a region to enable further trading.

Economic (technology level)

> use of mutually beneficial supply mixes and demand characteristics to optimize capacities regionally so that regional cost is reduced.

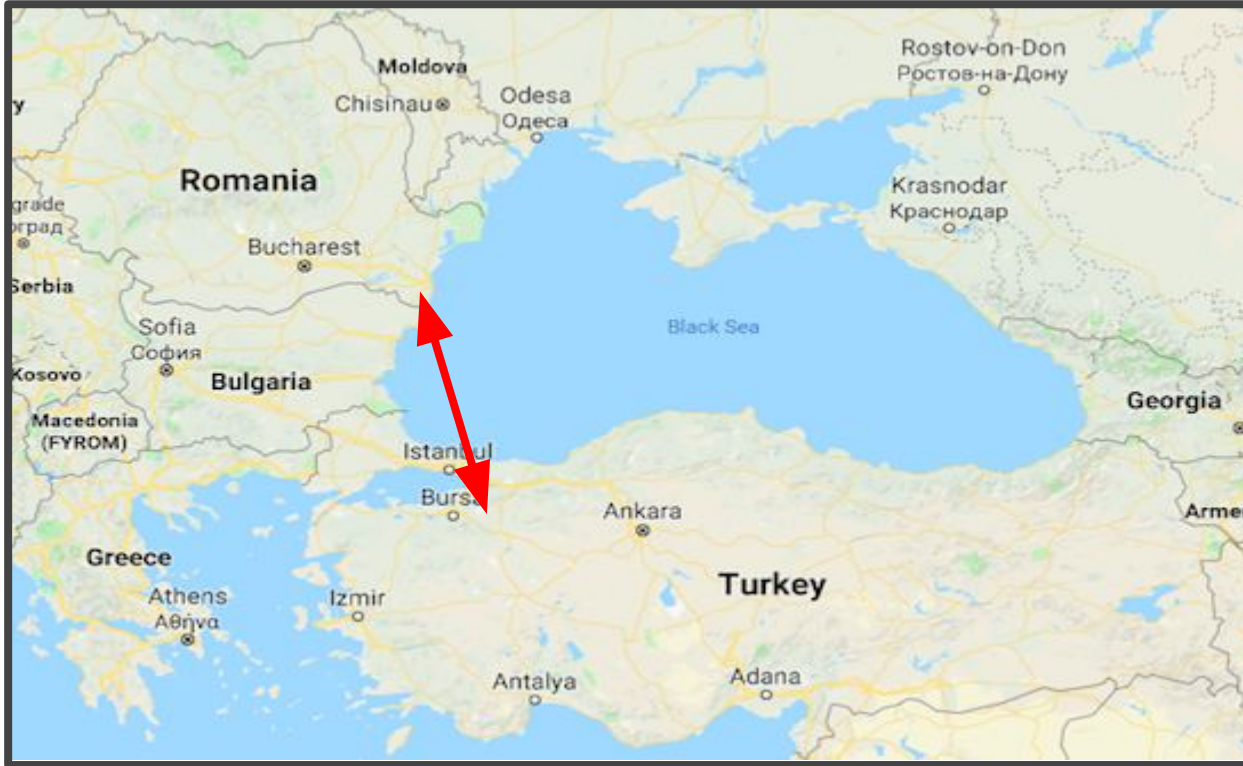
Environmental (technology level)

> use of mutually beneficial supply mixes of countries clean vs dirty to optimize emissions regionally so that regional emission is reduced.

Financial (project level)

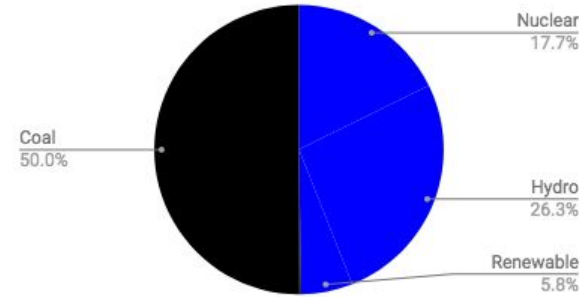
> compare common interest projects with uncommon ones regionally so that financial resources are optimized towards a common interest project.

Case-Study 1: South Eastern Europe to form a REH in Developing Markets RO-TR Interconnector

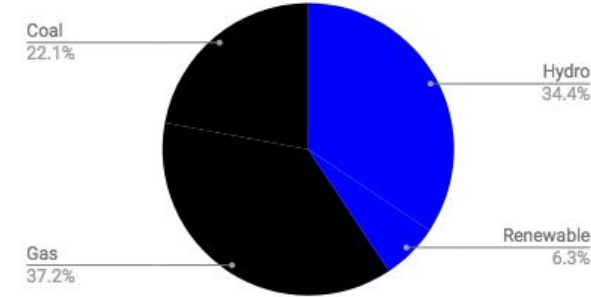


1. Start off with a geopolitical parameter/indicators to form a REH
2. Optimize the resources of the formed REH: reduced costs.
3. Measure emissions before/after for the REH: reduced emissions.
4. Measure dollar savings before/after for the REH:

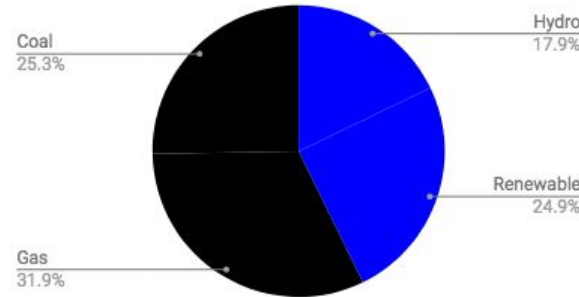
BG



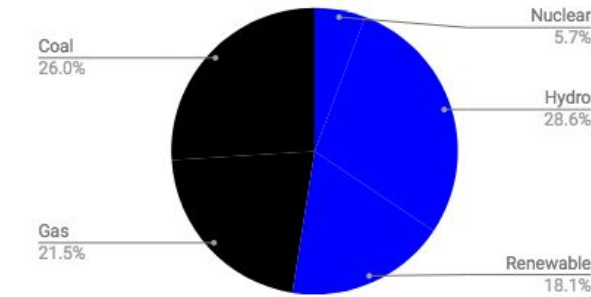
TR



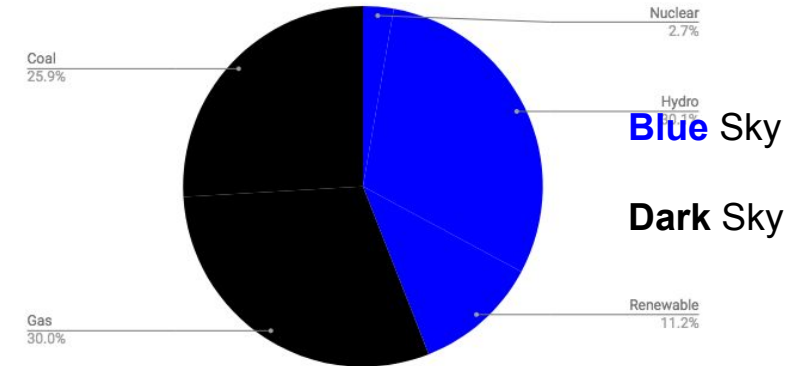
GR



RO



REH



REH Case Study 1:

Select a set of countries to form a REH

1. Geopolitical Parameter: Which countries could benefit from the increasing trading?		Evidence Required	BG	TR	GR	RO
International Economics	1. Is there an indication of increased economic welfare after forming a regional trade agreement?	Existence of a study or negotiations under way. (0 or 1 point)	1	1	1	1
	2. Party to any trade agreement?	Existence of a WTO based or Regional economic integration organization (i.e. EU, NAFTA) agreement in place. (0 or 1 point)	1	1	1	1
Climate Change Policies with respect to Transnational Politics of Energy	3. Party to UNFCCC?	Annex I. 1 Non-Annex I. 0 (0 or 1 point)	1	1	1	1
Seamless Markets	4. Ratified the Paris Agreement?	Yes. 1 No. 0 (0 or 1 point)	1	0	1	1
	5. Is there a liberalization of electricity market act or an operating financial market in place? (any applicable one)	Any, 1; Non, 0.	1	1	1	1
	6. Is there a liberalization of gas market act or an operating financial market in place? (any applicable one)	Any, 1; Non, 0.	1	1	1	1
	7. Electricity- Interconnector?	Any, 1; Non, 0.	1	1	1	0
	8. Gas - Interconnector?	Any, 1; Non, 0.	1	1	1	0
Common Project(s)	9. List any common project being considered but not undertaken yet?	Any, 1; Non, 0.	0	0	0	1
Geopolitical Parameter - Outcome	10. Outcome		8	7	8	7

REH Case Study 1:

Select a set of countries to form a REH

2. Economic Parameter. Do these countries have functioning electricity markets (intra-day, day-ahead markets) that could reflect increase in social welfare or decrease in generation costs?

BG - Independent Bulgarian Energy Exchange, IBEX

GR - Operator of Electricity Market - LAGIE

RO - Romanian Gas and Electricity Market Operator, OPCOM

TR - Energy Exchange Istanbul, EXIST

3. Environmental Parameter. Do these countries have fuel mixes that are beneficial to eliminate emissions environmentally?

Table 4 shows region's clean energy fuel mix vs. dirty one.

53,024 out of 120,378 MW total installed capacity is clean energy. |

4. Financial Parameter. Do these countries have a portfolio of common interests that need to be invested in financially?

TR-RO Transmission Investment.

Case Study 1 - Conclusion - TR-RO Interconnector

1. We have utilized a *geopolitical parameter to select a set of countries to form a regional energy hub*. The results for TR-RO case study indicated that the total cost minimization approach for the region results in a net benefit in favor of the transmission investment, hence enabling further trading.
2. *We have introduced a formal definition of the REH and presented a conceptual framework for the REH development including the underlying mathematical model.*



Energy Policy

Certificate of publication for the article titled:

**"A 'Regional Energy Hub' for Achieving
a Low-Carbon Energy Transition "**

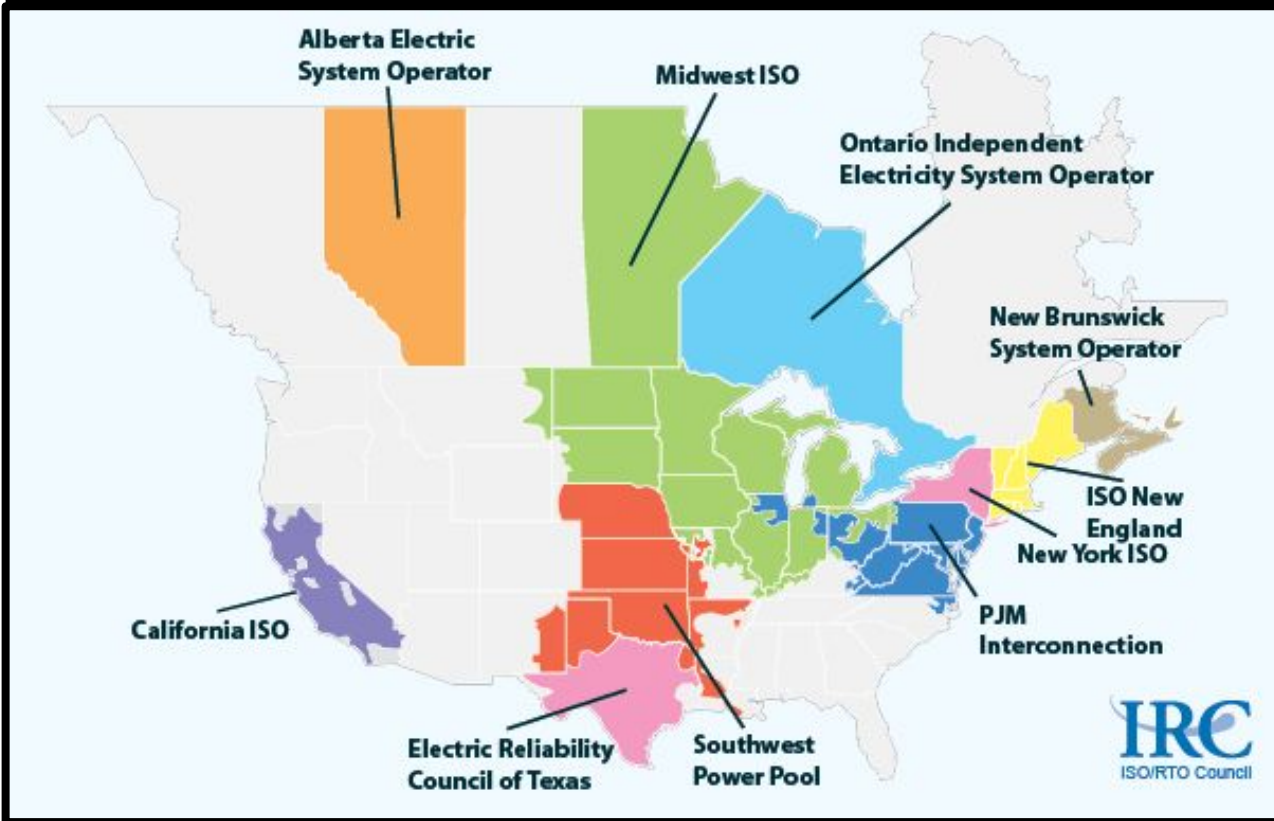
Authored by:

Burak Guler, Emre Çelebi, Jatin Nathwani

Published in:

Volume 113C, 2018, Pages 376-385

Case-Study 2: PJM to interconnect a REH in developed markets



Source: IRC



Source: FERC

Capacity Options in a REH

1. Based on REH Framework: we assume that PJM is a developed “exemplar” REH, started in 1927 between NJ and PA.
2. REH Framework *Financial Parameter* allows us to compare:
Uncommon interest projects (or, local generation) vs. common interest project (regional interconnector) capacities.
3. So from the capacity perspective: two options exist between a generation vs. an interconnector.

Case Study 2 - Conclusion - PJM

1. We have utilized *financial parameter of the REH Framework for an existing REH such as PJM.s*. Our case study showed that by investigating PJM's capacity market from the REH Framework's perspective, PJM intrinsically values transmission capacity within its capacity market. This is validated by HVDC interconnector investments in PJM that are currently operating or proposed.
2. *The REH Framework bridges an important gap between the capacity markets and the RTEP process such that the net cost of new entry figures for transmission could be developed alongside with the net cost of new entry for generation for other REHs around the world.*

Conclusion:

1. The development and definition of a "*regional energy hub*" to support the basis for transmission investments,
2. The **Regional Energy Hub (REH) Framework** and the analytical methods supporting the framework offers an innovative policy for evaluation of the readiness and capability of countries in reaching their targets for a low-carbon energy economy exploiting the full benefits of regional integration.
3. The REH Framework and the supporting tools and method can be applied as a platform in testing the feasibility of a transmission investment strategy to selected regions around the world.
4. Space exists for 15-20 REHs around the world.

**Enabling more transmission capacity (capability) regionally results:
in effective transition to Low-Carbon Energy Economy**

Summary

- Transition to Low-Carbon Energy Economy is underway.
- Many supply & demand side options available: power generation technologies, energy efficiency, demand side, storage to contribute with this transition.
- In our view, markets are also assets where long term-regional view may unlock greater benefits.
- *REH Framework* enables uncovering these benefits for a specific region.
Geopolitical, Economic, Environmental, Financial parameters.
- In long run view: **transmission investment may provide these benefits in more capable way.**
- REH Framework universally applicable around the world

We need to leverage the markets and their evolution as an asset

Regional Energy Hub Definition

“Regional energy hub is an intersection point of all energy (electricity) supply and demand routes geographically originating, transiting, ending (centralizing) in a pre-defined region where there is an ultimate net benefit for that region from the following perspectives: *geopolitical, economic, environmental, and financial.*”

When the net benefit is evaluated (e.g., it is positive), there is a need for *a transmission investment for that region.*”

UNIVERSITY OF WATERLOO

