ATOMEXPO 2012

Global Nuclear Markets after Fukushima

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The Ux Consulting Company, LLC
www.uxc.com

The Ux Consulting Company

- **Founded in March 1994**
- **Provides nuclear power and fuel cycle consulting and market information to suppliers, utilities, investors, and government agencies internationally**
- **Publishes:**
  - *Ux Weekly* (publication started in 1987)
    - UxC News Headlines
  - Quarterly *Market Outlook* reports with price forecasts
    - Uranium, Conversion, Enrichment, and Fabrication
  - *Nuclear Power Outlook* and *UxC Requirements Model* forecasting
  - *Uranium Suppliers Annual*
  - Key country analysis: China, Russia, India, Japan, Kazakhstan, etc.
  - Special studies on *Nuclear Reactor Technology Assessments, Small Modular Reactor Assessments, Nuclear Power after Fukushima, etc.*
  - UxC *Policy Watch* briefing service
  - *SpentFUEL* and *StoreFUEL*
- **Launched uranium futures contract with CME/NYMEX in May 2007**
- **Offices located in Atlanta, GA, Washington, DC, and other locations**
- **The most complete & accurate consulting service in the nuclear markets, backed by senior industry experience & strong fundamental analysis**

Presentation Outline

- **Global nuclear energy market overview**
- **Fukushima accident aftermath**
  - Specific country-level impacts
  - Ramifications for world nuclear markets
- **UxC's global nuclear power forecasts**
- **Market outlook for the following industries:**
  - Uranium
  - Conversion
  - Enrichment
  - Fuel Fabrication
- **Final observations**

Current Status of Global Nuclear Power

- **432 commercial nuclear reactors operating in 30 countries, with about 368 GWe of total capacity**
- **Nuclear plants continue to supply around 14% of the world's electricity, as baseload power**
- **Currently, roughly 60 units (~50 GWe) under construction in 14 countries around the world**
- **Various drivers for nuclear power expansion**
  - Increased world demand for electricity due to steady economic & population growth
  - Global Warming and Climate Change fears impacting use of fossil fuels (especially coal)
- **However, also a number of challenges…**
  - Safety concerns
  - Public opinion
  - Capital costs
  - Low price of natural gas
  - Waste management

Perspectives on Fukushima

- The second worst nuclear power accident in history
- Instant loss of nuclear capacity in near-term from Japan and Germany
- Large level of new regulatory reviews/safety checks
- Cancellation of new reactor projects in some cases
- Costs for reactors will likely rise and cause various re-evaluations for operating and new units
- Faster shift to Generation III+ advanced designs
- Slowing down of pace of nuclear power growth, but overall net growth remains all but certain
- This is not the end of nuclear power, and a renewed emphasis on safety and public education is positive

Specific Impacts in Japan

- **Near-Term Impacts:**
  - Earthquake/Tsunami impacted total of 15 units (~13,000 MWe)
  - Instant loss of Units 1-4 at TEPCO Fukushima Daiichi (~2,700 MWe)
  - Likely decommissioning of Fukushima Daiichi Units 5 & 6 (~2,150 MWe)
  - Uncertain future for Units 1-4 at TEPCO Fukushima Daini (~4,300 MWe)
  - Since March 2011, no reactor in outage allowed to restart
  - As of May 2011, Japan has no reactors in operation
  - Despite reactor stress tests, restarts uncertain due to local opposition
- **Long-Term Impacts:**
  - New builds delayed or canceled – only 2 units assured (Shimane 3 & Ohma 1)
  - Regulations & policies changing: new energy plan to show nuclear reductions
  - Public opinion and local political support dwindling, but elements of the national government retain strong allegiance to nuclear power
- **As third largest world economy, Japan has few good energy options. Expect nuclear to remain 15-20% of total electricity supply for at least next 20 years (i.e. 25-35 GWe through 2030).**

Specific World Impacts: RED Countries

- **Germany: Complete phase-out by end of 2022 is now law**
  - 8 reactors (~8,500 MWe) shut down instantly in March 2011
  - Remaining 9 reactors (~12,500 MWe) to shut down over period 2014-2022
  - Shifting to coal/gas and renewables
- **Switzerland: Voted to end new build plans and license renewals**
  - First shutdown in 2019, last shutdown in 2034
  - Small chance of being reversed in the future
- **Taiwan: Finishing 2 new reactors at Lungmen, but no more new units or license renewals allowed**
  - First shutdown as early as 2016, last shutdown in 2054
  - Medium chance of being reversed in the future
- **Italy: Referendum in June 2011 makes nuclear power illegal**
- **Various countries no longer expected to build reactors**
  - Philippines, Israel, Morocco, Tunisia, Venezuela, Uruguay, Kuwait

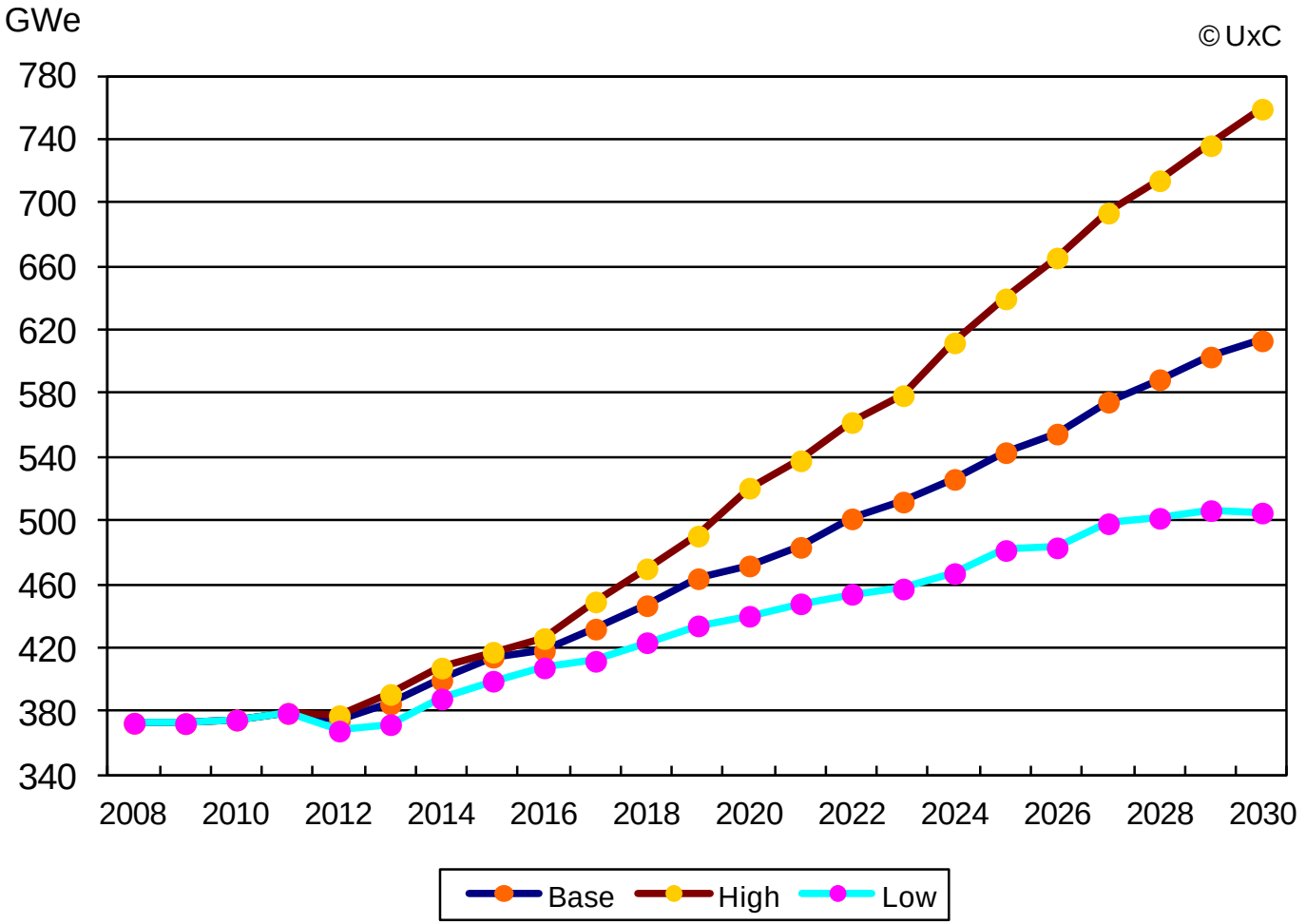
Specific World Impacts: YELLOW Countries

- **U.S.: Despite lots of media attention, no radical changes**
  - Lots of scrutiny on existing reactors likely to cause increased O&M costs
  - Harder to relicense some plants: California & Northeast problem sites
  - Fewer new reactors (4-5 by 2020) and lower growth after that as well
  - What happens after 2035 if not enough replacement reactors are built?
- **China: 18-24 month delay in construction cycle**
  - Operating units underwent safety checks and passed
  - Approvals for new construction stopped for safety checks & new regulations
  - New forecast (compared to 12 GWe from 15 units today):
    - 38 GWe by 2015, 66 GWe by 2020, and 120 GWe by 2030
- **France: Lower public opinion, Increased obstacles for new build**
  - Oldest plant license renewed, but new reactors delayed
  - Socialist/Green parties vowing reductions in nuclear power if elected
- **Belgium: Prior to Fukushima, already had long-term plan to phase-out nuclear power, and new government has confirmed it**

Specific World Impacts: GREEN Countries

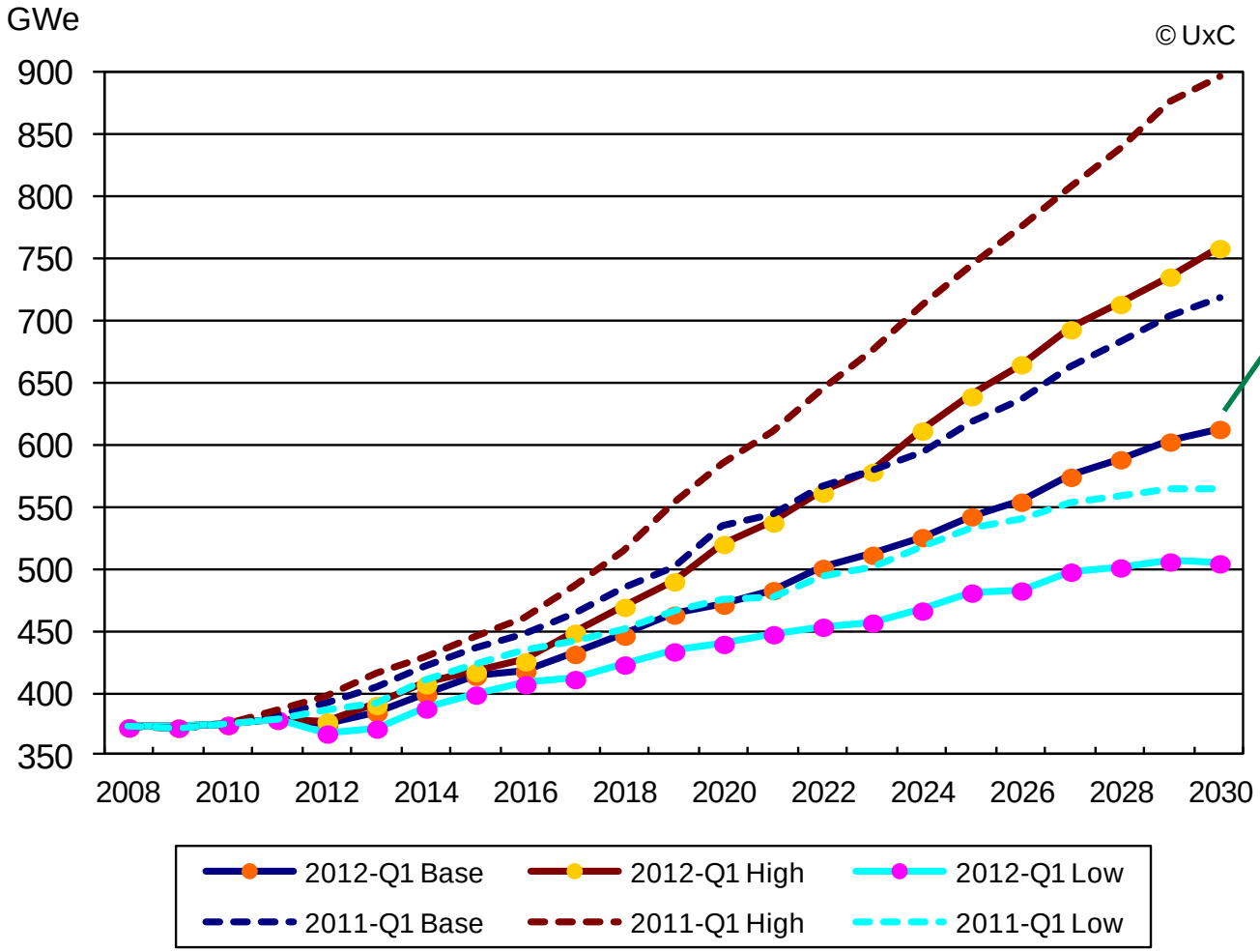
- **Russia: Not deterred from new build expansions**
  - Undertaking new safety reviews (potential for older plants to shut down earlier)
  - Operation of RBMK reactors at lower capacities
- **India: Maintains that nuclear is critical to economic development**
  - Some delays likely due to public acceptance of greenfield sites
- **South Korea: On track to expand new units + license renewals**
  - Spending ~$1 billion in safety upgrades to allay public concerns
- **Many countries remain committed to nuclear power**
  - UK: Proceeding with new plant development (gov't & industry actions)
  - Sweden: Not canceling reversal of nuclear phase-out
  - Finland: No change in TVO or Fennovoima project plans
  - Czech: Finalizing plans for Temelin 3 & 4
  - Canada: CANDU sale and OPG continued plans are positive developments
  - Brazil & Argentina: No major changes to new build plans
- **Various countries still likely to join the "nuclear family"**
  - UAE, Poland, Belarus, Turkey, Saudi Arabia, Vietnam, Jordan, Egypt, etc.

UxC Base, High, and Low Case Nuclear Capacity Forecasts



Source: UxC *Nuclear Power Outlook*, Q1 2012

UxC Reactor Forecasts: Before and After Fukushima



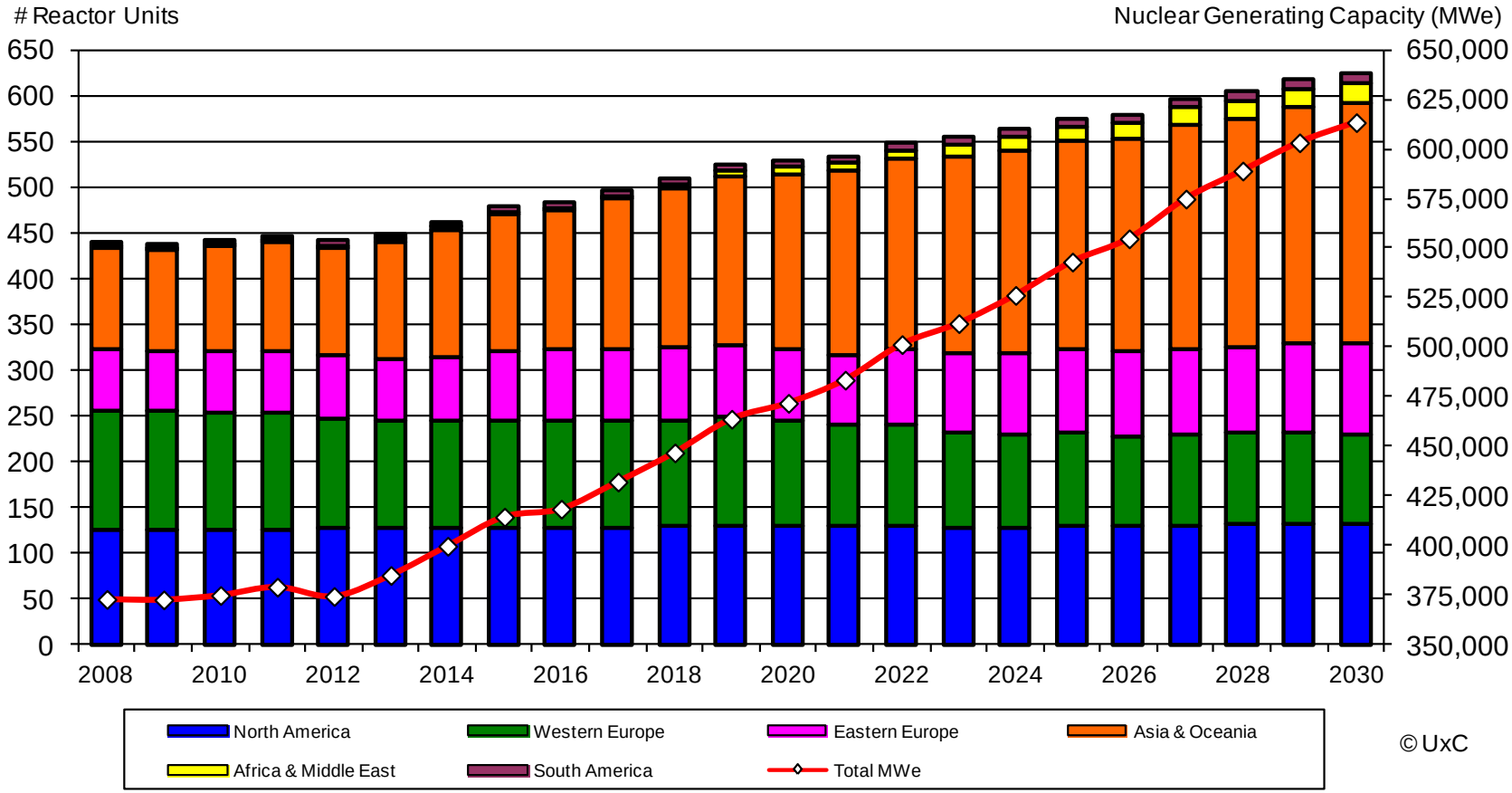
Still show 67% net growth by 2030!

~12% drop for 2020 in base case

~15% drop for 2030 in base case

Source: UxC *Nuclear Power Outlook*, Q1 2012

UxC Base Case Nuclear Forecast Details by Region, 2008-2030



Source: *Nuclear Power Outlook* Q1 2012

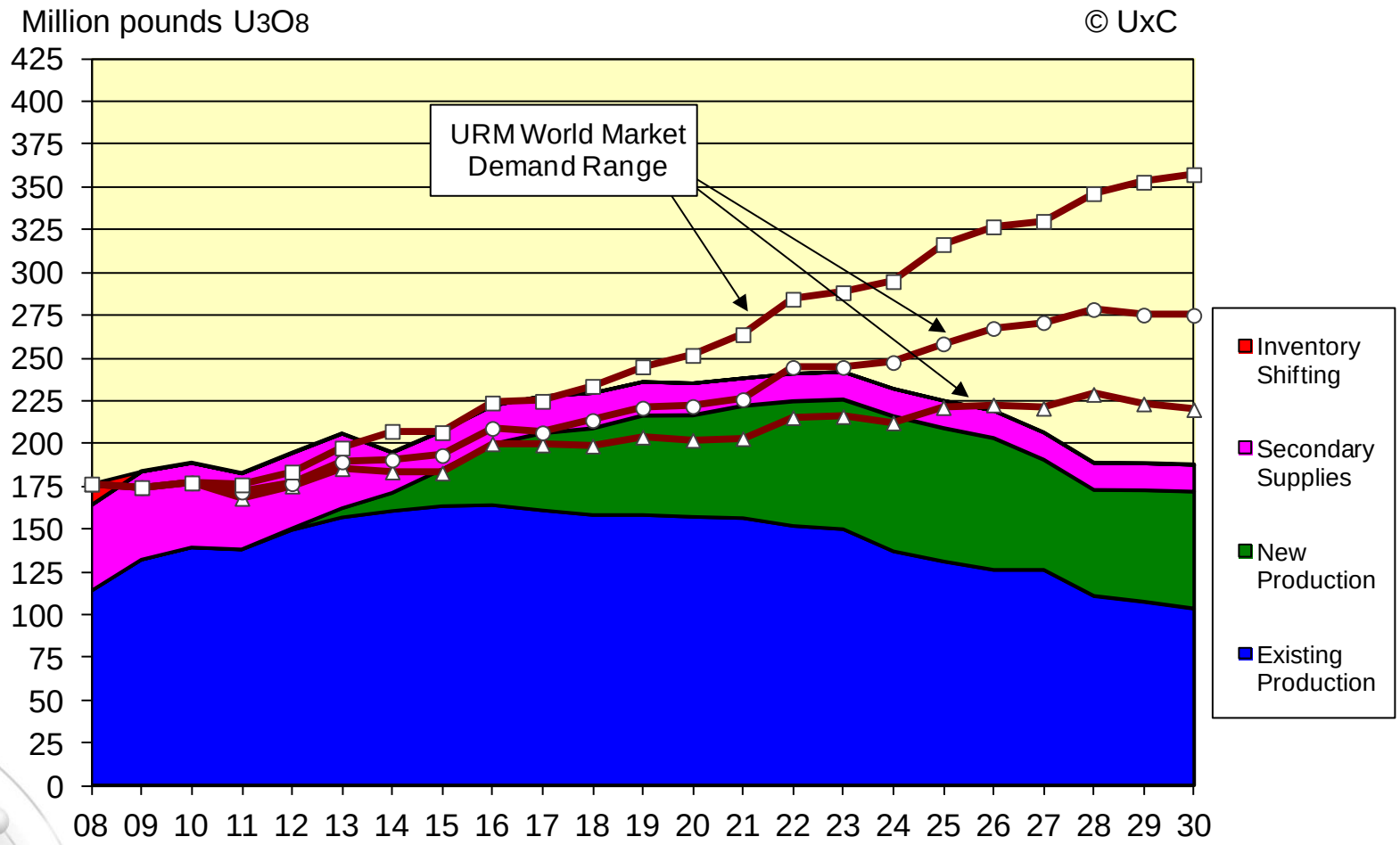
Global Uranium Supply Overview

- **Era of large inventories and secondary supplies is ending**
- **Relative market price increases since 2001 have helped push forward investments in exploration and new mines**
- **However, vast majority of global growth in world production has been coming from Kazakhstan and Africa**
  - Kazakhstan has accounted for nearly 80% of world uranium expansion increase since 2003
- **New higher-cost projects require higher prices to start up**
- **New round of producer consolidation to meet the challenges of the future; polarization towards larger, well-diversified producers.**

Fukushima Impacts on Uranium

- **Fukushima has mainly had impact on fuel demand**
  - Declining near-term demand and inventory overhang
    - Limited spot demand due to heavy buying over the past few years
    - Slight oversupply situation, mainly due to ramp-up in Kazakh production and shutdown of Japanese and German reactors. Balanced out by production problems.
    - Disposal of excess inventory: Japan, DOE
    - Flat price situation
  - Long-term reduction in demand
    - Demand growth improves, driven by China, Russia, India, and South Korea
    - Less new production needed to meet post-Fukushima demand
- **Supply response is starting to be seen**
  - New mine delays – ex. AREVA's Trekkopje
  - Impact on exploration companies an uranium juniors
  - Marginal projects
  - Potential exists for price spike to re-occur, if supply growth is muted

World Uranium Supply vs. Demand 2008-2030 – Mid Production Case

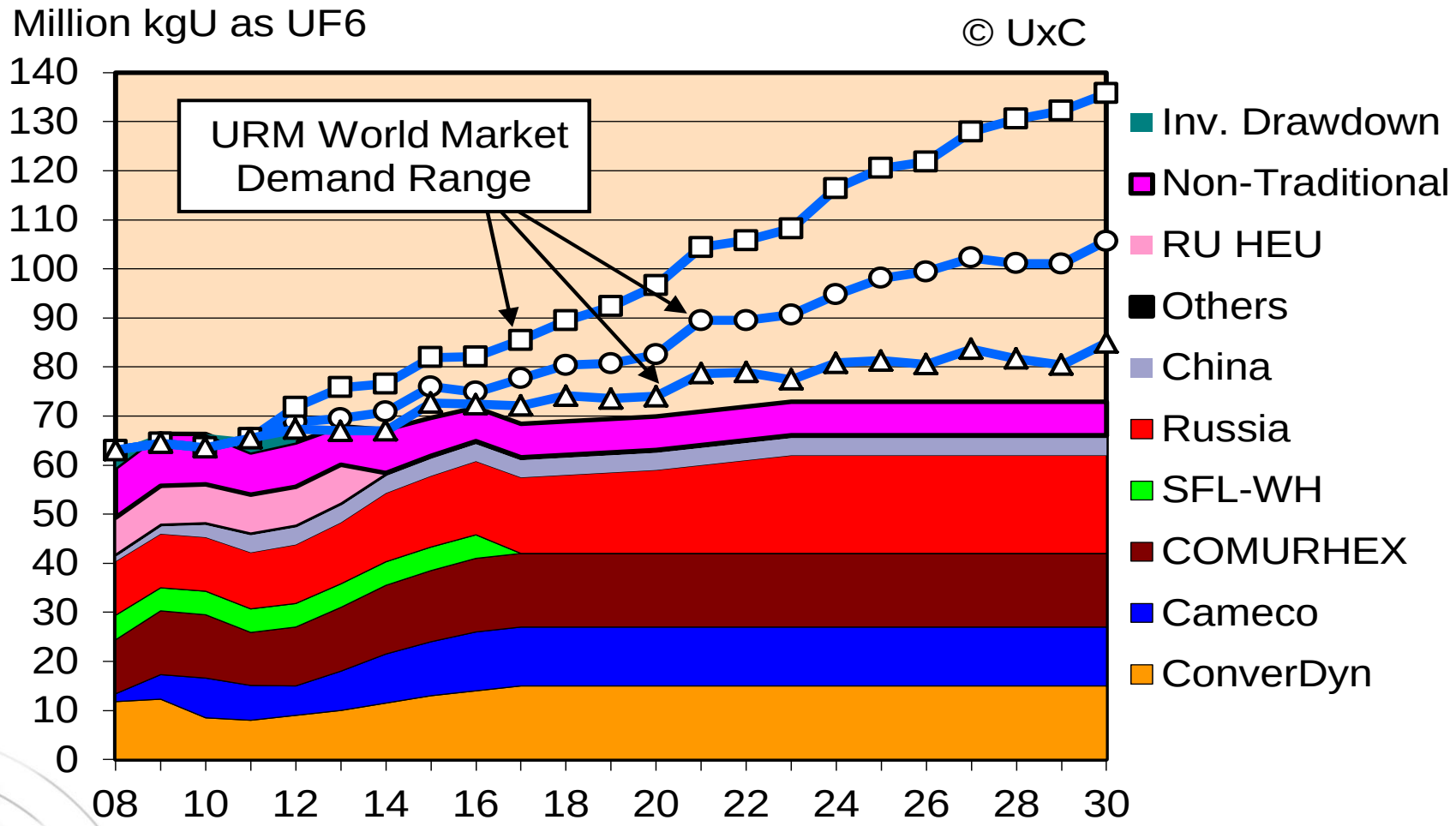


Source: *Uranium Market Outlook*, Q1 2012

Fukushima Impacts on Conversion

- **Reduced Demand Forecasts:**
  - Near-term demand and inventory overhang
  - Long-term demand
- **Fukushima provides a little breathing room, but conversion continues to be the "weakest link"**
- **New primary conversion capacity is desperately needed after 2013 loss of Russian HEU**
- **Until recently, only new project is AREVA's COMURHEX II, which is basically a replacement of the old plant**
- **Now new conversion capacity in Russia (SCC), also replacement of the old plant**
- **China remains a wild card, but expect new market demand for UF6 from China going forward**
- **Conversion spot prices have been under downward pressure**
- **Conversion LT prices remained elevated after Fukushima and has flattened out.**
  - Still questionable whether sufficient to entice new capacity outside of China and Russia

Status Quo Conversion Supply Case vs. Post-Fukushima Demand

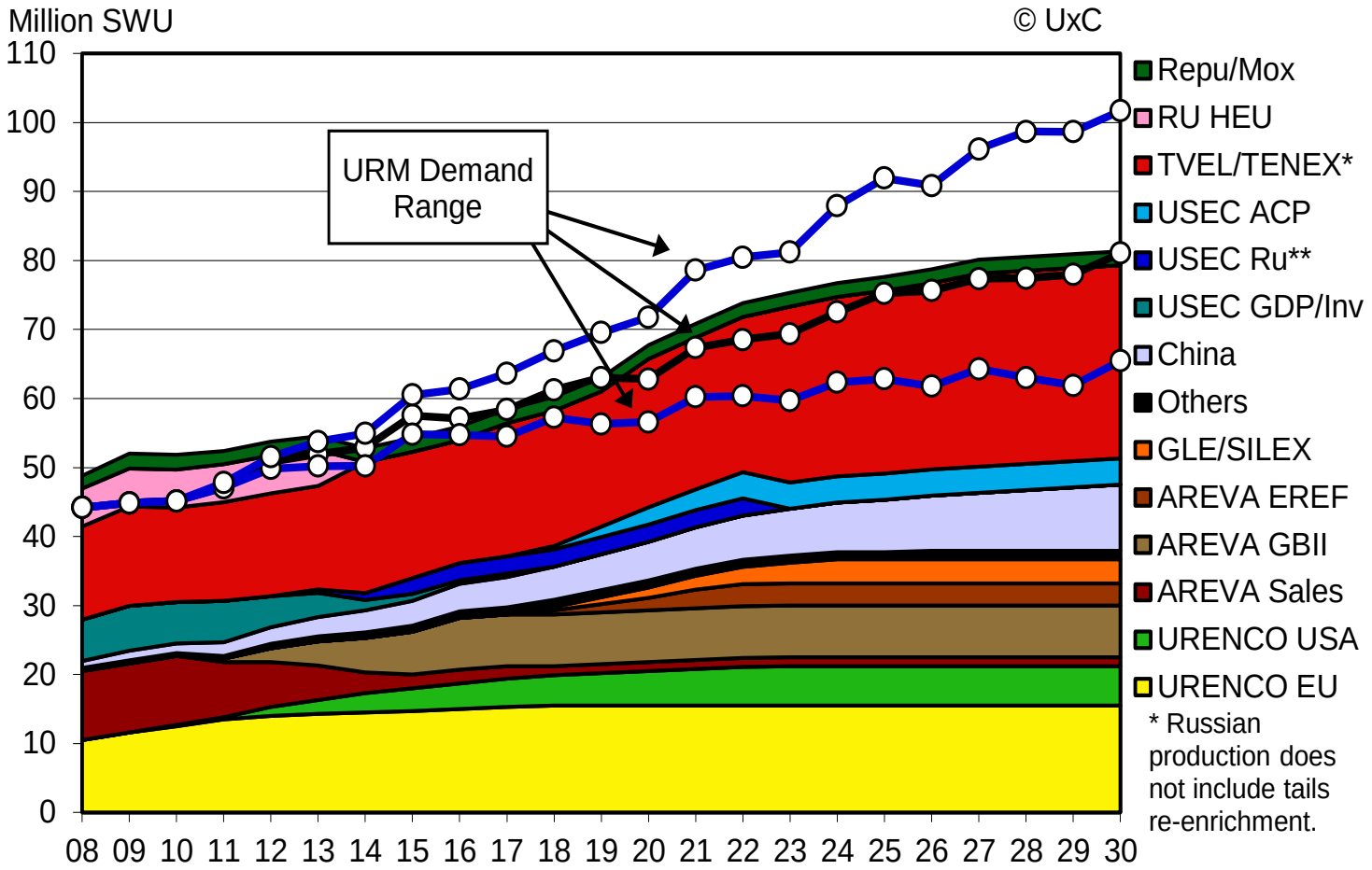


Source: *Conversion Market Outlook*, April 2012

Fukushima Impacts on Enrichment

- **Reduced Demand Forecasts**
  - Realization that this lower demand may create a "glut of SWU" if all new enrichment plants that were planned would get built
- **Multiple new projects were being planned around the world, and the suppliers revisited their plans:**
    - AREVA's suspension of Eagle Rock
    - URENCO's reduction of expansion plans
    - Russia's enrichment industry restructuring expected to be accompanied with lower capacity growth
    - Uncertain future of USEC
- **China's domestic SWU program remains wild card**
- **Either way, shift to new technologies - centrifuge and potentially laser – is almost complete**
- **SWU prices initially held firm after Fukushima, but have since seen drop in base contract prices**
- **Increased competition over low uncovered requirements (following increased activity in 2005-2009)**
- **The enrichers found themselves with more excess capacity than originally anticipated. Prices are expected to begin firming up once the market finds its balance**

Base Case Enrichment Supply Case vs. Post-Fukushima Demand



Source: *Enrichment Market Outlook*, Q1 2012

Fukushima Impacts on Fabrication

- No major changes overall, but reduced demand will be felt, especially for BWR fuel
- Western Europe and North America will continue to have large over-capacity
- Some slowing of expansions, but most new capacity is planned in Asia anyway
- LWR fabrication prices are still expected to rise due to other pressures (e.g. labor, regulations, services, non-uranium input costs like zirconium)
- Entrance of TVEL into the PWR fuel fabrication market with TVS-Kvadrat

Final Observations

- **Globally, nuclear energy is still on a growth path**
  - Largest growth expected in Asia (esp. China, Russia, S. Korea & India)
- **Fukushima caused several countries to reconsider nuclear, but most were never big growth prospects**
- **Uranium market still tight with upwards price trend likely in the mid-term (2-5 years out)**
- **Conversion market remains the "weakest link" though LT prices have been more favorable towards the industry than in the past**
- **Enrichment market is seeking its balance and the downward pressure in the near future is expected to be replaced by an upwards price trend**
- **The fuel fabrication industry remains stable and oversupplied**

Преумножая ценность информации

Локализованный продукт

- Котировки спотовых и долгосрочных цен
- Переводная аналитическая информация UxC
- Эксклюзивные материалы Nuclear.Ru
- Обзор событий ЯТЦ за неделю
- Обзор мирового фондового рынка

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Цены Ux U_3O_8

Обзор уранового рынка UxC

- *Умеренная активность на спотовом рынке U3O8 не привела к изменению цены.*
- *Активность на долгосрочном рынке свидетельствует об увеличении цен предложений на средне- и долгосрочную поставки.*
- *Несмотря на рост активности, спотовые и долгосрочные цены на услуги конверсии остаются на прежнем уровне.*
- *Незначительная активность на рынке обогащения, цены неизменны в течение месяца.*

(См. стр. 11-16)

Ядерные дороги Каролины

Ядерно-энергетическая ассамблея-2012 (Nuclear Energy Assembley – ежегодная конференция и выставка поставщиков атомной отрасли, организуемая Институтом атомной энергии (NEI)) США. - Прим. UxN) прошла в «стране NASCAR» в Шарлотт, Северная Каролина, с 21 по 23 мая. Место проведения оказалось под стать настрою, царившему на конференции…

(См. стр. 4)

Обзор фондового рынка

За период с 21 по 28 мая глобальные фондовые индексы сильно не изменились, а акции урановых компаний несколько восстановились после падения двух предыдущих недель. Так, индекс «MSCI World» снизился за этот период на 0,06%, «S&P Global Nuclear Energy» – на 0,16%, а «Merrill Lynch Uranium…

(См. стр. 7)

МНТК: Первые контуры ЗЯТЦ

В рамках 8-й Международной научно-технической конференции «Безопасность, эффективность и экономика атомной энергетики» (МНТК), проходившей 23–25 мая в Москве, были представлены долгосрочные перспективы развития атомной энергетики России, в том числе создания к 2030 году первого этапа замкнутого ядерного топливного цикла. Как отметил заместитель генерального директора – управляющий проектом ОАО «Концерн Росэнергоатом» Олег Сараев, замыкание ЯТЦ – приоритетная задача ГК «Росатом», «не имеющая прецедентов решения».

О. Сараев обрисовал контуры нового топливного цикла в докладе «Перспективы развития и внедрения замкнутого топливного цикла» (ЗЯТЦ). Он отметил, что задачи по переводу атомной энергетики на ЗЯТЦ упоминаются «едва ли не во всех программах» развития отрасли, однако эта тема «обезличена и уже четверть века не имеет сколько-нибудь конкретного плана реализации». По словам О. Сараева, в сегодняшних условиях заказчиком внедрения ЗЯТЦ может и должен стать «Росэнергоатом», так как он «через 10–15 лет встретится с угрозой потери конкурентоспособности на рынке электроэнергии».

Эта угроза связана во многом с опережающим ростом затрат концерна на услуги по обращению с ОЯТ, которые в период с 2015 по 2030 гг. могут возрасти в 7 раз, до 46,7 млрд. руб., при прогнозируемом росте установленной мощности АЭС в два раза, до 54 ГВт. Как отметил О. Сараев, начиная с 2027 года все ОЯТ будет находиться в собственности «Росэнергоатома» со «всеми обременениями» по обращению с ОЯТ. Более того, в период с 2016 по 2027 гг. будут остановлены энергоблоки АЭС старого поколения мощностью более 12 ГВт для последующего вывода из эксплуатации.

В этой связи «опасный рост топливной составляющей в…

(Продолжение на стр. 2)

Новый уровень в консалтинге

Nuclear.Ru

- Ведущее специализированное СМИ в России по ядерной тематике
- Экспертиза Nuclear.Ru позволяет адаптировать консалтинговые проекты для российских компаний

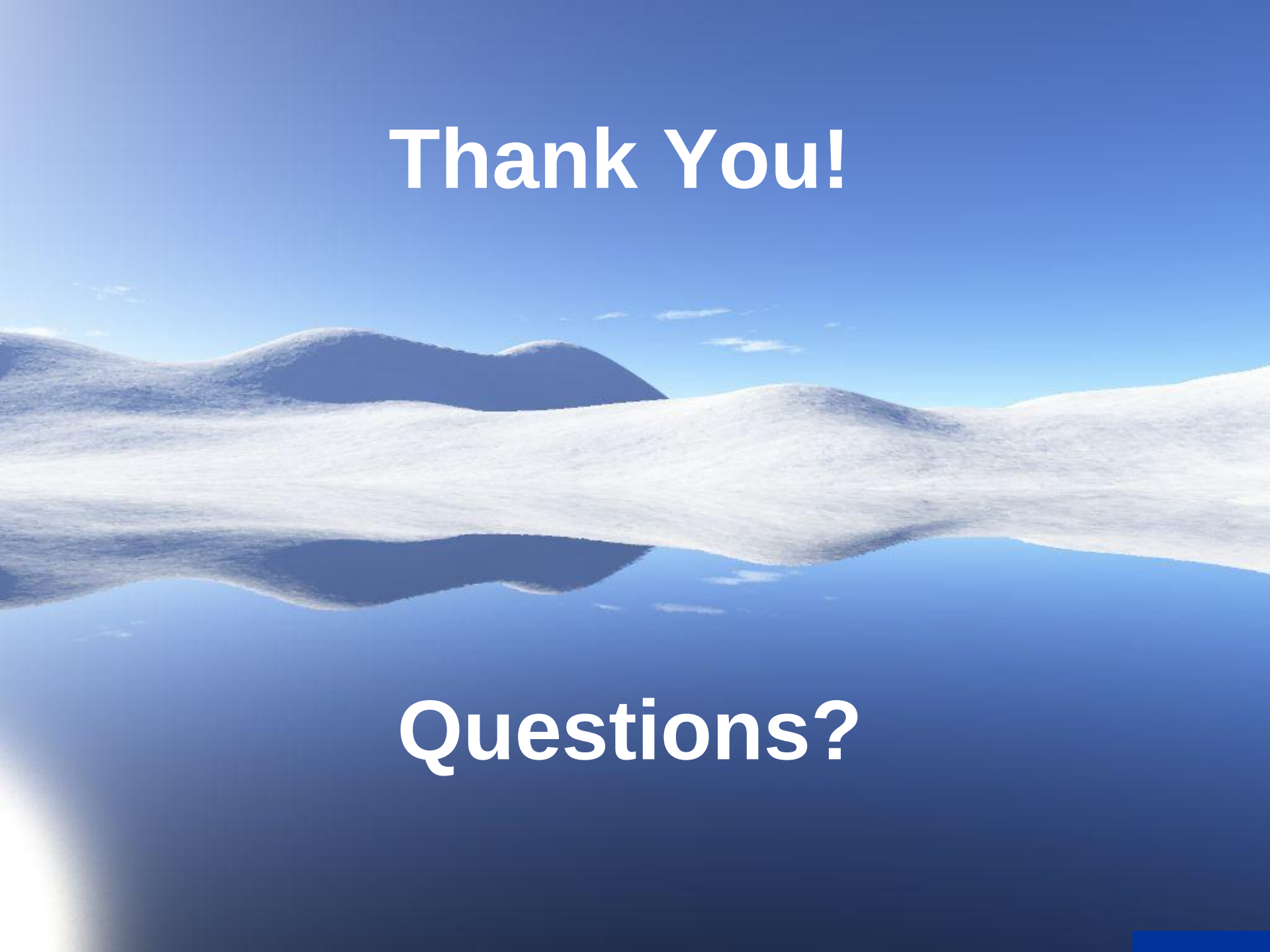
UxC

- Мировой лидер в области консалтинга в атомной отрасли, включая все стадии ЯТЦ
- Авторитетный источник рыночной информации

UxC Nuclear

- **Объединение усилий UxC и Nuclear.Ru создает сильного игрока на рынке консалтинговых услуг в России и других странах СНГ**

UxC


Thank You!
Questions?